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Fertility and Prosperity: Links Between Demography and Economic Growth

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Foreword

The present study reports on results emerging from the research project «Fertility and Prosperity: Links between Demography and Growth» that was commissioned to the Ifo Institute by *Deutscher Arbeitskreis für Familienhilfe e.V.*, Kirchzarten, in December 2003. The study adopts a two-stage research strategy, comprising (a) a broad-based econometric investigation regarding potential long-term consequences of demographic change for the economic performance in developed as well as developing countries and (b) a survey of fertility outcomes and family policies in a limited number of developed countries. The results indicate that the decline in fertility observed in the past, through its impact on the size and age-composition of the labour force, may have a substantial negative impact on the growth of aggregate output, output per capita and productivity in countries that are strongly affected by this trend. At the same time, our econometric results confirm that increasing fertility rates in countries where they are currently low is mainly a matter of the existing institutional framework and of related policy decisions. This is further demonstrated through an in-depth discussion of a wide range of policy measures applying to families and children in Germany, France, the UK, and Sweden.

Vorwort

Die vorliegende Studie dokumentiert die Resultate des Forschungsprojekts »Fertility and Prosperity: Links between Demography and Growth«, mit dem der Deutsche Arbeitskreis für Familienhilfe e.V., Kirchzarten, das ifo Institut im Dezember 2003 beauftragt hat. Die Studie verfolgt eine zweistufige Forschungsstrategie, (a) mit einer breit angelegten ökonometrischen Analyse möglicher Zusammenhänge zwischen demographischem Wandel und ökonomischer Entwicklung in zahlreichen Industrie- und Entwicklungsländern sowie (b) mit einem Überblick über Geburtenentwicklung und familienpolitische Rahmenbedingungen in einer begrenzten Zahl hochentwickelter Länder. Die Ergebnisse zeigen an, dass der in der Vergangenheit eingetretene Geburtenrückgang durch seine Auswirkungen auf Größe und Altersaufbau der Erwerbsbevölkerung einen nennenswerten negativen Effekt für das Wachstum von Bruttoinlandsprodukt, Pro-Kopf-Einkommen und die Produktivität der verbleibenden Erwerbstätigen haben kann wo immer dieser Trend besonders ausgeprägt war. Zugleich deuten die ökonometrischen Befunde darauf hin, dass eine Steigerung der Geburtenrate in Ländern mit niedriger Fertilität vor allem eine Frage institutioneller Rahmenbedingungen und darauf bezogener politischer Entscheidungen ist. Durch die vertiefte Diskussion eines breiten Spektrums familienpolitischer Maßnahmen in Deutschland, Frankreich, dem Vereinigten Königreich und Schweden wird diese Einsicht weiter konkretisiert.

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Zusammenfassung

Während der letzten 150 bis 200 Jahre hat sich in fast allen entwickelten Volkswirtschaften ein bemerkenswerter Wandel im Reproduktionsverhalten vollzogen, mit einem anhaltenden Rückgang der Geburtenraten. Während der letzten drei Jahrzehnte sind diese teilweise sogar deutlich unter ein bestandserhaltendes Niveau gefallen. Die Frage ob und gegebenenfalls welche Auswirkungen dieser beispiellose Wandel auf die ökonomische Entwicklung der Industriestaaten hat, ist nicht nur für die wirtschaftswissenschaftliche Forschung von Interesse. Sie ist auch im Hinblick auf ihre politischen Implikationen von erstrangiger Bedeutung. Die Perspektive eines stark verlangsamten Bevölkerungswachstums, das in vielen Ländern mit einem zahlenmäßigen Schrumpfen der Bevölkerung im Erwerbsalter, in einigen Ländern sogar mit einem Schrumpfen der Gesamtbevölkerung einher geht, macht es sehr wahrscheinlich, dass die gesamtwirtschaftlichen Wachstumsraten in Zukunft deutlich geringer ausfallen als in der Vergangenheit, vor dem Hintergrund einer ständig wachsenden Erwerbsbevölkerung.

Eine solche Entwicklung ist aus der Sicht der betroffenen Gesellschaften für sich genommen noch nicht unbedingt als problematisch anzusehen. Wegen steigender demographischer Lastquotienten ist es jedoch ebenfalls wahrscheinlich, dass auch die Wachstumsraten des Pro-Kopf-Einkommens zurückgehen, das häufig als ein einfacher Wohlstandsindikator angesehen wird. Beide Effekte – ein rückläufiges aggregiertes Wirtschaftswachstum und ein rückläufiges Wachstum pro Kopf der Bevölkerung – ergeben sich im Kern allerdings rein aus der Arithmetik ökonomischer Wachstumsprozesse. Sie werden allein von der zukünftigen Entwicklung der Erwerbspersonenzahl und der Altersstruktur der Gesamtbevölkerung getrieben und ergeben sich unmittelbar, wenn man die derzeit mit relativ hoher Verlässlichkeit voraussehbaren demographischen Verschiebungen als gegeben nimmt und außerdem zunächst unterstellt, dass die Entwicklung der Produktivität der verbleibenden Erwerbstätigen davon weitgehend unberührt bleibt. Die Schlüsselfrage, die sich in diesem Zusammenhang stellt, ist daher, ob der demographische Wandel über diese Effekte hinaus auch Auswirkungen auf die Produktivitätsentwicklung selbst hat. Zentrales Ziel der vorliegenden Studie ist es, nach systematischen Zusammenhängen zwischen Änderungen des Geburtenverhaltens und ihren Konsequenzen für die demographische Struktur einer Volkswirtschaft einerseits und der dort realisierten Produktivität bzw. Produktivitätsentwicklung andererseits zu suchen.

Obwohl der demographische Wandel in den meisten entwickelten Volkswirtschaften mittlerweile ein fortgeschrittenes Stadium erreicht, ist Fragen dieser Art in der wirt-

schaftswissenschaftlichen Forschung bislang überraschend wenig Aufmerksamkeit geschenkt worden. Einer der wichtigsten Gründe für diese Wissenslücke dürfte darin liegen, dass Daten, die für einschlägige Forschungszwecke erforderlich sind, in der Vergangenheit nur sehr eingeschränkt verfügbar waren. Verfügbarkeit von und Zugangsmöglichkeiten zu Daten, die makroökonometrische, international vergleichende Panel-Analysen für möglichst viele Länder und auf der Basis möglichst langer Zeitreihen erlauben, verbessern sich auch in der Gegenwart erst allmählich. Gewissen prinzipiellen Beschränkungen unterliegt außerdem die Aussagekraft von Untersuchungen mit einer solchen Methodik, da zahlreiche Bestimmungsfaktoren und Mechanismen, die die gesamtwirtschaftliche Entwicklung auf der Mikro-Ebene beeinflussen, dabei nicht genau genug ins Auge gefasst werden können. Aus heutiger Sicht stellt die Analyse makroökonomisch orientierter Mehr-Länder-Datenpanels für die hier ins Auge gefasste Fragestellung gleichwohl die Methode der Wahl dar.

Aufgrund dieser mehrfachen Beschränkungen wird hier effektiv eine zweistufige Forschungsstrategie verfolgt. Der erste Teil der Studie ist einer zwangsläufig eher groben, aber breit angelegten empirischen Analyse möglicher Zusammenhänge zwischen dem demographischen Wandel, insbesondere dem Geburtenrückgang, und der langfristigen wirtschaftlichen Entwicklung gewidmet. Einbezogen werden dabei nicht nur die vergleichsweise hoch entwickelten OECD-Staaten, sondern darüber hinaus auch zahlreiche Schwellen- und Entwicklungsländer. Dies geschieht zum einen, weil die behandelten Fragen potentiell auch dort von Bedeutung sind, und zum anderen, um verzerrte Schlussfolgerungen aufgrund eines zu kleinen und zu stark selektierten Kreises der erfassten Länder zu vermeiden. Im zweiten Teil der Studie werden, vor dem Hintergrund der besser abgesicherten empirischen Resultate des ersten Teils, für eine kleinere Auswahl europäischer Länder die dortige Geburtenentwicklung und wesentliche Elemente der jeweiligen nationalen Familienpolitik genauer beschrieben. Letztere stellt einen wichtigen Teil der institutionellen Rahmenbedingungen dar, unter denen potentielle Eltern ihre Entscheidungen über Kinder treffen, und soll in ihren Strukturen und Effekten hier detailliert verglichen werden. Die Studie konzentriert sich dabei auf die Gegebenheiten in Deutschland, Frankreich, Schweden und dem Vereinigten Königreich. Hinsichtlich der Belegbarkeit der Schlussfolgerungen einerseits und der Gewinnung eines reicheren Anschauungsmaterials für konkrete Handlungsoptionen andererseits können sich die beiden Teile des gesamten Forschungsprojekts somit wechselseitig ergänzen.

Teil I:
Geburtenentwicklung und Wirtschaftswachstum – Empirische Evidenz

1. Der demographische Wandel: Stilisierte Fakten

In den Ländern, die heute als wirtschaftlich hoch entwickelt einzustufen sind, zeigt sich ein langfristiger Rückgang der Geburtenziffern, der bis in das 19. Jahrhundert zurückverfolgt werden kann. So lag die „rohe Geburtenziffer“, d. h. die jährliche Zahl der Geburten je 1.000 Einwohner, im Durchschnitt der heutigen OECD-Staaten im Jahre 1900 noch bei gut 30 und ist im Laufe des 20. Jahrhunderts auf zuletzt rund 11 geschrumpft (vgl. Mitchell 2003). In der ersten Hälfte des Jahrhunderts wurde diese Entwicklung dabei sichtbar von äußeren politischen und wirtschaftlichen „Schocks“, z. B. dem Ersten Weltkrieg, den nachfolgenden Phasen von Hyperinflation und Weltwirtschaftskrise und dem Zweiten Weltkrieg, beeinflusst und zeigte starke Fluktuationen und nationale Unterschiede. Anschließend, nach einem verbreiteten „Baby-Boom“ um die Jahrhundertmitte, ergibt sich hingegen ein klarer, allgemeiner Abwärtstrend, im Zuge dessen die Geburtenzahlen in vielen OECD-Ländern rasch und nachhaltig unter ein bestandserhaltendes Niveau gefallen sind.

Ab etwa 1980 divergieren die nationalen Entwicklungen der jährlichen Geburtenziffern wieder stärker, wobei sie jedoch nur in wenigen Ländern wieder leicht zugenommen haben (insbesondere in den USA), in anderen Ländern auf niedrigem Niveau stagnieren (etwa in Frankreich, dem Vereinigten Königreich und – auf deutlich niedrigerem Niveau – in Deutschland) und in manchen Ländern kontinuierlich weiter gesunken sind (z. B. in Italien, Spanien und in Japan; vgl. dazu Billari und Kohler 2002). Gleichzeitig hat die durchschnittliche rohe Geburtenziffer während der letzten vierzig Jahre auch in den Schwellen- und Entwicklungsländern zu schrumpfen begonnen, von knapp 42 im Jahre 1960 auf gut 26 im Jahre 2000 (vgl. erneut Mitchell 2003).

Der in den Industriestaaten zwischenzeitlich eingetretene Baby-Boom hat dort ab den 1970-er Jahren zunächst zu einem bemerkenswerten Anstieg des Anteils Erwerbstätiger an der Gesamtbevölkerung geführt. Trotz anderweitiger Trends, wie einer wohl weiterhin steigenden Frauenerwerbsbeteiligung, wird sich diese Entwicklung mit dem Eintritt der „Baby-Boomer“ ins Rentenalter, etwa ab 2010, aber tendenziell wieder umkehren. Damit ergeben sich, allein aus der Dynamik der Geburtenentwicklung, in diesen Ländern im Zeitablauf nicht nur massive Änderungen in der Gesamtzahl der Bevölkerung und der Bevölkerung im erwerbsfähigen Alter, sondern auch charakteristische Verschiebungen im Altersaufbau beider Bevölkerungsaggregate. Dieses Phänomen, das zusammenfassend als demographischer Wandel bezeichnet wird, und in den heutigen Entwicklungs- und Schwellenländern möglicherweise lediglich um einige Jahrzehnte Verzögert abläuft, wirft aus ökonomischer Sicht gravierende Fragen auf. Eine der zentralen Fragen ist dabei, ob die absehbare Alterung von Bevölkerung und Erwerbspersonen, zumindest in den davon in besonderer Weise betroffenen Volkswirtschaften, negative Konsequenzen für die Entwicklung der Produktivität haben wird.

Aus aktuellen Bevölkerungsprojektionen für die entwickelten Volkswirtschaften ergibt sich im Übrigen, dass die parallel zum Geburtenrückgang eingetretenen massiven Erhöhungen der Lebenserwartung zwar starke Effekte für die Altersstruktur der Gesamtbevölkerung haben. Für die Frage nach unmittelbaren Effekten für die Produktivität der Personen im Erwerbsalter dürfte dies jedoch eher bedeutungslos sein, da sich der Anstieg seit geraumer Zeit vor allem auf Lebensalter jenseits der Erwerbsphase bezieht.

Einfache Korrelationen von Geburtenziffern und realem Pro-Kopf-Einkommen jeweils desselben Jahres legen nahe, dass zwischen Fertilität und wirtschaftlichem Wohlstand kurzfristig – solange die Kinder inaktiv sind und Zeit und andere Ressourcen der Eltern in Anspruch nehmen – plausiblerweise ein Spannungsverhältnis besteht. Kinder aufzuziehen bedeutet jedoch auch eine Investition in zukünftige Produktionsmöglichkeiten. Entscheidend sind letztlich die langfristigen Effekte von Fertilitätsentscheidungen für den zukünftigen Bevölkerungsaufbau und ihre möglichen Auswirkungen auf Produktivität und Wohlstand. Stellt man beispielsweise jährliche Produktivitätsniveaus der relativen Besetzung der Altersklasse 30- bis 39-jähriger Erwerbstätiger gegenüber, die im Rahmen des demographischen Wandels enorm schwankt, so verschwindet jede negative Korrelation. Vielmehr zeichnet sich die Möglichkeit einer positiven Beziehung zwischen vergangenen Geburtenraten und laufender wirtschaftlicher Entwicklung ab.

2. Fertilität, Bevölkerungsentwicklung und wirtschaftliches Wachstum: Theorie und Evidenz

Angestrebt wird mit dem hier dokumentierten Forschungsprojekt eine Analyse möglicher Auswirkungen des Geburtenrückgangs und seiner Konsequenzen für die Bevölkerungsentwicklung auf die wirtschaftliche Entwicklung eines Landes. Dazu soll hier zunächst präzisiert werden, welche Wirkungen sich dabei rein rechnerisch – noch ohne Zuhilfenahme irgendwelcher ökonomischer Überlegungen im eigentlichen Sinn – ergeben und warum etwaigen Effekten des demographischen Wandels für die Produktivitätsentwicklung letztlich eine Schlüsselrolle für die weitere Analyse zukommt.

Bezeichnet man den aggegrierten Output einer Volkswirtschaft in einer Periode, z. B. ihr jährliches Bruttoinlandsprodukt (BIP), als Y, so errechnet sich die Produktivität, d. h. das BIP pro Erwerbstätigem als $q = Y/L$ (mit L als Zahl der Erwerbstätigen) und das BIP pro Kopf der Bevölkerung als $y = Y/N = (L/N)\,q$ (mit N als Bevölkerungszahl). Nimmt man vereinfachend zunächst an, dass die Produktivität von Jahr zu Jahr mit einer konstanten Rate g wächst, so beläuft sich die jährliche Wachstumsrate des aggregierten BIP auf $(1+g)(1+\lambda) - 1$ (mit λ als Wachstumsrate der Erwerbstätigenzahl) und die des Pro-Kopf-BIP auf $(1+g)(1+\lambda)/(1+n) - 1$ (mit n als Wachstumsrate der Bevölkerungszahl).

Wenn λ im Zuge des demographischen Wandels nahezu unausweichlich sinkt, während g unverändert bleibt,[1] sinkt die aggregierte Wachstumsrate. Dahinter steht ein reiner Mengeneffekt, der für die Versorgung der Bevölkerung mit Gütern und Dienstleistungen aller Art, messbar am BIP pro Kopf, allein noch nicht entscheidend ist. Das Wachstum des Pro-Kopf-BIP wird außerdem noch vom Faktor $1+n$ beeinflusst, der im Zuge des demographischen Wandels typischerweise ebenfalls sinkt. Aufgrund der steigenden Lebenserwartung und einer insgesamt steigenden demographischen (Jugend- und Alters-)Last geht das Bevölkerungswachstum jedoch in der Regel nicht so stark zurück wie das Wachstum der Erwerbstätigenzahl. Infolgedessen sinkt auch die Wachstumsrate des BIP pro Kopf, das als grober Wohlstandsindikator angesehen werden kann. Allerdings sinkt es wiederum nicht so stark wie die Wachstumsrate des BIP. Die Perspektive rückläufigen Wohlstandswachstums, erneut allein aufgrund relativ klar vorhersehbarer Änderungen von Zahl und Altersaufbau der Bevölkerung, ist gleichwohl eine schlechte Nachricht. Entscheidend ist aus ökonomischer Sicht aber, dass diese Aussicht abgemildert oder aber noch verschärft werden kann, wenn der demographische Wandel auch das Produktivitätswachstum g systematisch beeinflusst.

Gedanklicher Ausgangspunkt für die Analyse dieser zentralen Frage ist die neoklassische Wachstumstheorie, die in wegweisenden Arbeiten von Solow (1956) und Swan (1956) entwickelt wurde und seither zum ökonomischen Standardinstrumentarium gehört. Praktisch alle mittlerweile entwickelten Neuansätze lassen sich letztlich als Vertiefungen und Erweiterungen dieses Grundmodells interpretieren. Im Mittelpunkt dieser Theorie steht eine einfache gesamtwirtschaftliche Produktionsfunktion,

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[1] Für diese Überlegung ist es egal, ob die Erwerbstätigenzahl lediglich langsamer wächst ($\lambda > 0$) oder absolut gesehen zu schrumpfen beginnt ($\lambda < 0$). Zu beachten ist in diesem Zusammenhang jedoch, dass für das Produktivitätswachstum g üblicherweise erwartet wird, dass es größer oder gleich Null ist, während λ und n im Allgemeinen nur größer oder gleich -1 sein müssen: Bevölkerungs- oder Erwerbstätigenzahl einer Gesellschaft können im Extremfall verschwinden, aber nicht negativ werden.

$$Y = AF(K, L). \quad (1)$$

Sie besagt, dass sich das jährliche BIP einer Volkswirtschaft aus der Kombination zweier Arten von Produktionsfaktoren (Kapital K und Arbeit L) mit Hilfe der Technologie $AF(\cdot)$ ergibt. Der Parameter A misst dabei den gegenwärtigen technologischen Entwicklungsstand, der sich im Zeitablauf durch technischen Fortschritt stärker ändern kann als die grundlegende Form des Funktionals $F(\cdot)$. Kennzeichnend sind für die neoklassische Wachstumstheorie, neben einigen Annahmen bezüglich mathematisch-formaler Eigenschaften von $F(\cdot)$, dass die zeitliche Entwicklung von A als solche nicht genauer erklärt wird und dass für die zeitliche Entwicklung des Kapitalstocks K vereinfachend unterstellt wird, dass sie sich aus einer vorgegebenen Sparquote bezüglich des Bruttoinlandsprodukts und einer vorgegebenen Abschreibungsquote für das vorhandene Kapital ergibt. Auch die zeitliche Entwicklung des gesamtwirtschaftlichen Arbeitsvolumens wird grundsätzlich als gegeben genommen, bestimmt durch die Demographie und die Erwerbsbeteiligungsquote der Personen im erwerbsfähigen Alter.

Mit Hilfe des einfachen Formelapparates dieser Theorie lassen sich grundlegende Zusammenhänge und Effekte weiter systematisieren, die für die genauere Untersuchung der Fragestellung des Projekts von Bedeutung sind. Neben den bereits angesprochenen Wirkungen der Entwicklung von Erwerbstätigenzahl („Partizipationseffekt“) und Bevölkerungszahl („demographischer Lasteffekt“) für das Wachstum von BIP und BIP pro Kopf tritt dabei zunächst ein möglicher positiver Effekt für die Produktivitätsentwicklung hervor: Bei unveränderter Sparquote und rückläufiger Entwicklung der Erwerbstätigenzahl erhöht sich der Kapitaleinsatz je Erwerbstätigem und macht die eingesetzte Arbeit produktiver („Kapitalintensivierungseffekt“). Durch Änderungen des Sparverhaltens, von denen im Grundmodell der neoklassischen Wachstumstheorie abgesehen wird, kann dieser Effekt allerdings erneut sowohl verstärkt als auch abgeschwächt werden. Erkennbar wird in diesem Modellrahmen außerdem, dass stets zwischen kurz- und langfristigen Effekten des demographischen Wandels unterschieden werden muss: Soweit die Geburt und Erziehung von zukünftigen Erwerbstätigen Auswirkungen auf die Erwerbsbeteiligung der Eltern – namentlich der Mütter – hat, können rückläufige Kinderzahlen vorübergehend zu Effekten für das Wachstum von BIP und Produktivität führen, die ihrer theoretischen Struktur ganz nach den bisherigen Überlegungen entsprechen, aber ein umgekehrtes Vorzeichens aufweisen.

Eine Erweiterung des Grundmodells um „endogene“ Sparentscheidungen nutzenmaximierender Haushalte – anknüpfend an Ramsey (1928), jedoch eingebettet in Modelle mit überlappenden Generationen à la Samuelson (1958) und Diamond (1965) – klärt die

Frage nach Effekten des demographischen Wandels für die Sparquote nur teilweise. Wenn die zukünftige Erwerbstätigenzahl zurückgeht, verringert dies den Zins und damit den Anreiz zu sparen. Soweit diese Entwicklung auf verringerte Kinderzahlen in der Gegenwart zurückzuführen ist, sinken jedoch die laufenden Ausgaben des Elternhaushaltes für Kinder, und dies wirkt sich positiv auf die Sparneigung aus, um einen Teil des zusätzlichen Güterkonsums in die Nach-Erwerbsphase zu transferieren. Dabei dürfte der erste dieser Effekte dominieren, so dass die Sparquote insgesamt sinkt und der Kapitalintensivierungseffekt abgeschwächt oder sogar überkompensiert werden könnte. Nimmt man auch noch die kurzfristigen Effekte sinkender Kinderzahlen auf Produktivität und Einkommen des Elternhaushalts hinzu, werden die Auswirkungen auf Ersparnis und langfristige Produktivitätsentwicklung aus theoretischer Sicht vollkommen unbestimmt.

Andere, nahe liegende Modellerweiterungen, die für die hier analysierte Fragestellung von Interesse sind, beziehen sich auf mögliche Änderungen des durchschnittlichen Qualifikationsniveaus der Erwerbstätigen, auf mögliche altersspezifische Unterschiede in der Produktivität Erwerbstätiger oder auf mögliche Änderungen des technologischen Entwicklungsstandes, die ihrerseits von der Zahl und der Altersstruktur der Erwerbstätigen beeinflusst sein können. Durch variierende Qualifikationen kann sich das in einer Volkswirtschaft insgesamt vorhandene „Humanvermögen“[2] unabhängig von der schieren Zahl der Erwerbstätigen entwickeln, so dass der erwartete Rückgang letzterer tendenziell kompensiert oder im Extremfall sogar überkompensiert werden kann. Ob und inwieweit dies geschieht, hängt jedoch von den Anreizen, vor allem der Eltern, ab, Humanvermögen in Gestalt höherer durchschnittlicher Qualifikationen der Kindergeneration zu bilden. Resultate dazu variieren stark nach dem jeweils unterstellten Modell und erlauben klare Schlussfolgerungen. In Ländern, die vom Geburtenrückgang stark betroffen sind, erscheint eine Kompensation oder Überkompensation der Effekte sinkender Erwerbstätigenzahlen für das effektive Arbeitsangebot durch höhere Qualifikationen jüngerer Arbeitnehmer in jedem Fall als kaum wahrscheinlich.

Beginnt man, das in einer Volkswirtschaft verfügbare Arbeitsangebot nach Qualifikationen und Produktivitäten zu differenzieren, ist im Zusammenhang mit dem demogra-

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[2] In der ökonomischen Fachsprache ist dafür, angelehnt an den angelsächsischen Sprachgebrauch (vgl. Becker 1962), der Begriff „Humankapital“ gängig. In der breiteren Öffentlichkeit ist dieser Begriff jedoch – nicht zuletzt wegen einer verzerrenden Verwendung im Kontext betriebswirtschaftlicher Fragen – anhaltend unpopulär. So gelangte er im Jahre 1998 auf Platz 3 der Liste der „Unwörter des Jahres“, die regelmäßig von einer Jury von Sprachwissenschaftlern aufgestellt wird, und wurde 2004 sogar auf Platz 1 dieser Liste gewählt. Der hier verwendete, breiter angelegte Begriff „Humanvermögen“ (vgl. Krüsselberg 1997) vermeidet möglicherweise einen Teil der ungünstigen Konnotationen.

phischen Wandel mit der Möglichkeit zu rechnen, dass die individuelle Produktivität jedes Erwerbstätigen ein charakteristisches Altersprofil aufweist. Dies legen z. B. gängige ökonometrische Schätzungen altersspezifischer Lohnverläufe (nach dem von Mincer 1974 entwickelten Standardverfahren) nahe: Individuelle Lohnsätze steigen in der ersten Hälfte des Erwerbslebens typischerweise stark an, anschließend flachen die Profile ab und beginnen – zumindest im Vergleich zum jeweiligen Durchschnittslohn – sogar zu sinken. Fraglich ist allerdings, inwieweit aus solchen Lohnverläufen überhaupt auf gleichförmige Änderungen individueller Produktivitäten geschlossen werden kann. Außerdem lässt sich zeigen, dass die möglichen, altersspezifischen Produktivitätsunterschiede, die daran ablesbar sein könnten, im Zuge der absehbaren Änderungen der Altersstruktur der Erwerbstätigen nur einen vergleichsweise schwachen, negativen Gesamteffekt auf deren durchschnittliche Produktivität haben (Börsch-Supan 2003).

Besondere Bedeutung kommt der Einführung möglicher Qualifikationsunterschiede und einer expliziten Messung des Humanvermögens anstelle einer undifferenzierten Erfassung des aggregierten Arbeitsangebots schließlich im Kontext von Modellen „endogenen“ Wachstums zu. Mit Hilfe solcher Modelle soll, eine grundlegende Beschränkung des neoklassischen Grundmodells überschreitend, auch die zeitliche Entwicklung des in der gesamtwirtschaftlichen Produktionsfunktion enthaltenen Technologieparameters A erklärt werden. Ferner werden dabei aus dem Modell selbst heraus, d. h. „endogen“, Wachstumsprozesse erzeugt, die mit einer ständigen Zunahme der Produktivität einhergehen.[3] Einen möglichen Mechanismus zur Endogenisierung des (Produktivitäts-) Wachstums arbeitet Lucas (1988), anknüpfend an Arbeiten von Uzawa (1965), in einem Modell „humankapitalgebundenen“ endogenen Wachstums heraus. Formal ergibt sich ein solches Modell etwa, indem man das durchschnittliche Qualifikationsniveau der Erwerbstätigen als $\bar{h}$ bezeichnet, das gesamtwirtschaftliche Arbeitsangebot in der Produktionsfunktion durch den aggregierten Humanvermögensbestand der Volkswirtschaft $H = \bar{h}\,L$ ersetzt und außerdem den Einfluss von (oder $\bar{h}$) auf A berücksichtigt:

$$Y = A(H)\,F(K, H) \tag{2}$$

Diese modifizierte Produktionsfunktion impliziert die Möglichkeit, dass das Humanvermögen einer Volkswirtschaft, einschließlich der darin eingehenden Zahl und Struktur der Erwerbstätigen, die Produktivitätsentwicklung unmittelbar beeinflusst. Diese Möglichkeit wird im nächsten Abschnitt weiterverfolgt.

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[3] In einfachen neoklassischen Wachstumsmodellen ist dies nur möglich, wenn der „exogene“ Parameter A ständig zunimmt – aus Gründen, die nicht näher betrachtet werden –, weil der Kapitalstock je Erwerbstätigem langfristig stets gegen einen festen Gleichgewichtswert der Kapitalintensität tendiert.

Aus theoretischer Sicht ergeben sich eine Reihe möglicher Einzeleffekte der Geburten- und Bevölkerungsentwicklung für das Wachstum einer Volkswirtschaft. Teilweise ist ihre Richtung jedoch unklar, und auf jeden Fall bleibt ihr Nettoeffekt unbestimmt. Einer empirischen Klärung der damit angerissenen Fragen sind insgesamt bisher nur relativ wenige empirische Arbeiten gewidmet. Ein Teil dieser Arbeiten (Brandner and Dowrick 1994, Ahituv 2001) beschränkt sich darauf, vor allem die kurzfristigen Effekte demographischer Variabler wie Bevölkerungswachstum oder Geburtenziffern für Investitionen, Produktion und Wachstum zu untersuchen, die erwartungsgemäß tendenziell negativ ausfallen. Andere Arbeiten (v. a. Lindh und Malmberg 1999 sowie Feyrer 2002) fassen hingegen Effekte der gesamten Altersstruktur der (aktiven) Bevölkerung und damit die langfristigen Effekte vergangener Fertilitätsentscheidungen für die wirtschaftliche Entwicklung ins Auge. Dabei ergeben sich relativ stabile Muster, denen zufolge der Anteil der 40- und 50-Jährigen an der (Erwerbs-)Bevölkerung von besonderer Bedeutung für die Entwicklung Produktivität und Wachstum einer Volkswirtschaft ist.

3. Die Rolle der totalen Faktorproduktivität

Die neuere empirische Wachstumsforschung kommt auf breiter Basis zu dem Schluss, dass die technologische Entwicklung eine entscheidende Rolle für das beobachtbare Wachstum von Output und Produktivität einer Volkswirtschaft hat (vgl. Easterly und Levine 2000 und den dortigen Literaturüberblick). Sie erweist sich häufig als wichtiger als die der quantifizierbaren Ausstattung mit Produktionsfaktoren wie Kapital und Arbeit (oder Humanvermögen) und deren zeitlicher Veränderung. Da sich der einschlägige Technologieparameter A im Rahmen einer neoklassischen Standard-Produktionsfunktion nicht eigens erklären, sondern nur als Restgröße bestimmen lässt, wird er auch als „Solow-Residual“ bezeichnet. Noch gängiger ist mittlerweile die Bezeichnung als „totale Faktorproduktivität“ (TFP).[4]

Zur Bestimmung der totalen Faktorproduktivität in einer Volkswirtschaft sind, anknüpfend an eine frühe Arbeit von Solow (1957), in der Literatur im Kern vergleichsweise einfache Ansätze erarbeitet worden, die unter dem Namen „*Growth accounting*“ zusammengefasst werden. Gegenstand dieser Literatur sind unter anderem Beiträge zu zahlreichen konzeptionellen und Messproblemen, die für empirische Analysen von Wachstumsprozessen generell von Belang sind. So wurden sogenannte „*Perpetual-*

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4 Gemeint ist damit eine Determinante von Output und Wachstum, die sich nicht unmittelbar aus der Akkumulation einzelner Produktionsfaktoren ergibt und deren Änderungen die Produktivität aller Faktoren zugleich betreffen.

inventory"-Methoden entwickelt, mit deren Hilfe der aggregierte Kapitalstock einer Volkswirtschaft abgeschätzt werden kann, der als solcher kaum direkt messbar ist. Der aktuelle Gegenwert des physischen Kapitalstocks wird dabei mit Hilfe verketteter Daten zu den jährlichen Investitionen ermittelt, d. h. zu den laufenden Änderungen des Kapitalbestandes (Jorgenson und Griliches 1967). Durch laufende Abschreibungen des jeweils vorhandenen Kapitalstocks werden etwaige Fehler durch eine Fehlbewertung des Anfangsbestandes, für den mangels Daten ebenfalls nur ein grober Schätzwert angesetzt werden kann, im Zeitablauf immer unbedeutender.

Schwierigkeiten bereitet auch die empirische Messung des durchschnittlichen Qualifikationsniveaus und damit des aggregierten Humanvermögens einer Volkswirtschaft. Lange Zeit wurden dazu nur sehr grobe Maße – z. B. Alphabetisierungsraten der erwachsenen Bevölkerung oder Bildungspartizipationsquoten der jungen Bevölkerung – verwendet. Anknüpfend an Arbeiten von Psacharopoulos und Arriagada (1986) entwickelten Barro und Lee (1993; 1996) eine Methode, um aus Zeitreihen von Bildungsbeteiligungs- und -abschlussquoten kumulierte Maße der durchschnittlichen Bildungsdauer in der erwachsenen Bevölkerung eines Landes zu gewinnen. In Kombination mit empirischen Resultaten zur Rendite von Bildungsinvestitionen, die schwerpunktmäßig auf verschiedenen Ebenen des Bildungssystems (primär, sekundär und tertiär) getätigt wurden (Psacharopoulos 1994), können daraus Maße für das jeweils verfügbare Humanvermögen ermittelt werden, die – neben dem durchschnittlichen Qualifikationsniveau – auch die Idee abnehmender Grenzerträge höherer Bildung reflektieren (Hall und Jones 1999).

Die zuletzt genannten Arbeiten führen dazu, dass sich die fortschreitende Faktorakkumulation im Kontext international vergleichender, empirischer Analysen ihrer Effekte für die wirtschaftliche Entwicklung eines Landes mittlerweile hinreichend genau abbilden lässt. Erfasst werden dabei auch wichtige qualitative Änderungen, etwa steigende durchschnittliche Qualifikationen des verfügbaren Arbeitsangebots. Unter dieser Voraussetzung lässt sich in einem weiteren Schritt auch die Rolle der totalen Faktorproduktivität genauer ins Auge fassen. Zu diesem Zweck wird der gemessene Output, z. B. das jeweilige BIP, zunächst in seine Komponenten zerlegt. Diejenigen Anteile des jeweiligen Niveaus des BIP (*Level accounting*) bzw. seines Wachstums (*Growth accounting* im eigentlichen Sinn), die durch die (Entwicklung der) Bestände an physischem Kapital und an Humanvermögen erklärbar sind, werden dabei herausgerechnet. Auf diesem Wege bestimmte Maße der TFP und ihrer Änderungen können dann ihrerseits genauer auf ihre Determinanten hin untersucht werden.

Grundlage der Zerlegung des beobachteten BIP sind in der Regel einfache Spezifikationen der gesamtwirtschaftlichen Produktionsfunktion auf der Basis einer sogenannten Cobb–Douglas-Technologie, mit

$$Y = K^{\alpha} (AH)^{1-\alpha} = K^{\alpha} (AhL)^{1-\alpha} \tag{3}$$

(vgl. etwa Hall and Jones 1999; Feyrer 2002).[5] Für das Produktivitätsmaß $q = Y/L$ folgt daraus, dass

$$q = k^{\alpha} (Ah)^{1-\alpha} = \kappa^{\alpha/(1-\alpha)} Ah\,, \tag{4}$$

mit der Kapitalintensität $k = K/L$ bzw. dem Kapitalkoeffizienten $\kappa = K/Y = k/q$. Schreibt man Gleichung (4) in logarithmierter Form, so ergibt sich eine einfache lineare Zerlegung,

$$\ln q = \ln A + \frac{\alpha}{1-\alpha} \ln \kappa + \ln h\,, \tag{5}$$

durch die das TFP-Maß $\ln A$ bei gegebenen Werten für q, k und h isoliert und errechnet werden kann. Die Eigenschaft des Logarithmus', dass $\ln(x_t/x_{t-1}) = \ln x_t - \ln x_{t-1} \equiv \Delta \ln x_t$, impliziert ferner, dass das Wachstum aller in Gleichung (5) enthaltenen Größen auf der Basis von („ersten") Differenzen der Werte aus aufeinander folgenden Perioden t–1 und t analysiert werden kann. Generell gilt, dass

$$\Delta \ln q = \Delta \ln A + \frac{\alpha}{1-\alpha} \Delta \ln \kappa + \Delta \ln h\,. \tag{6}$$

Die Gleichungen (5) und (6) liefern somit einfache Anleitungen zur empirischen Bestimmung der TFP und ihrer Variation in der Zeit in einer gegebenen Volkswirtschaft. Entscheidend ist schließlich, auf dieser Grundlage nach empirisch überprüfbaren Erklä-

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5 Durch die Verwendung der Exponenten α und $1-\alpha$ für die ansonsten multiplikativ verknüpften Produktionsfaktoren physisches Kapital (K) und um das Humanvermögen je Erwerbstätigem erweiterte Arbeit ($H = hL$) ist sichergestellt, dass die Produktionsfunktion die formalen Eigenschaften einer neoklassischen Produktionsfunktion aufweist, zumindest solange „endogene" Wachstumseffekte unberücksichtigt bleiben, die sich aus den Determinanten des Technologieparameters A ergeben können.

Der durch A gemessene technische Fortschritt ist in dieser Spezifikation sowohl „Hicks-neutral" (nach Hicks 1932) als auch „Harrod-neutral" (oder „arbeitssparend", nach Harrod 1942). Die erste dieser Annahmen stellt sicher, dass sich die Produktionsfunktion im Sinne des *Growth accounting* auf einfache Weise zerlegen lässt, weil die Relation der Grenzproduktivitäten von K und H bzw. L bei variablem A unverändert bleibt. Die zweite Annahme sorgt dafür, dass die K und H bzw. L zurechenbaren Anteile des BIP bei gegebenem Kapitalkoeffizienten $\kappa = K/Y$ unabhängig von A sind und ist erforderlich, damit das Wachstumsmodell ein langfristiges Gleichgewicht mit konstanter Kapitalintensität $k = K/L$ aufweist. Man beachte, dass die simultane Erfüllung beider Neutralitätsannahmen ist nur bei Verwendung einer Cobb–Douglas-Produktionsfunktion gewährleistet ist (Uzawa 1961).

rungen für Unterschiede in den Niveaus und Änderungsraten der TFP-Maße möglichst vieler verschiedener Länder zu forschen.

In der empirischen Literatur gibt es zahlreiche Belege für Zusammenhänge zwischen dem Humanvermögen einer Volkswirtschaft und dem Wachstum der dortigen totalen Faktorproduktivität (vgl. etwa Benhabib und Spiegel 1994; Bils und Klenow 2000; oder Aiyar und Feyrer 2002). Verstärktes Interesse gilt, seit einer wegweisenden Arbeit von Mankiw et al. (1992), in der Forschung außerdem internationalen Unterschieden im Niveau der Produktivität im Allgemeinen und der TFP im Besonderen (vgl. Barro und Sala-i-Martin 1995, Kap. 12; Jones 1995; Hall und Jones 1999; oder Easterly und Levine 2000). Eine neue Idee, die beide Forschungsrichtungen verbindet, liefert die bereits im letzten Abschnitt erwähnte Arbeit von Feyrer (2002). Dieser untersucht insbesondere den Einfluss der demographischen Struktur der Erwerbstätigen auf die TFP und ihre zeitliche Entwicklung. Da dieser Aspekt für die Analyse von möglichen Auswirkungen des demographischen Wandels auf die wirtschaftliche Entwicklung der davon in besonderer Weise betroffener Volkswirtschaften potentiell sehr bedeutsam ist, wird er im Rahmen des hier dokumentierten Forschungsprojekts zur Grundlage der eigenen empirischen Arbeiten gemacht (vgl. Abschnitt 5). Dabei wird analysiert, ob und inwieweit Niveau und Wachstum der wirtschaftlichen Leistungsfähigkeit eines Landes – unter Berücksichtigung aller Pfade der Faktorakkumulation, inklusive der Humanvermögensbildung, die in die Ermittlung der TFP-Maße $\ln A$ und $\Delta \ln A$ ebenfalls eingehen – letztlich durch die Altersstruktur der aktiven Bevölkerung bestimmt werden und damit im Kern eine Funktion der vergangenen Geburtenentwicklung sind.

4. Wirtschaftliche Entwicklung und Fertilität: Theorie und Evidenz

Zusammenhänge zwischen Demographie und Wirtschaftswachstum ergeben sich einerseits, wenn demographische Variablen, namentlich die Geburtenentwicklung eines Landes, einen Einfluss auf dessen langfristige wirtschaftliche Entwicklung haben. Andererseits kann es umgekehrt auch Auswirkungen ökonomischer Gegebenheiten und Trends auf die demographische Entwicklung und nicht zuletzt auf die Fertilität geben. Unter der Sammelbezeichnung „ökonomische Theorie der Fertilität“[6] ist dazu im Anschluss an eine wegweisende Arbeit des späteren Nobelpreisträgers Becker (1960) in den vergangenen Jahrzehnten ein mittlerweile recht umfangreiches Schrifttum entstanden.

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[6] Geläufig ist auch die Bezeichnung als „Theorie endogener Fertilität“, die aus ökonomischen Modellen heraus erklärbar sein soll und nicht als anderweitig, d. h. „exogen“, vorgegeben angesehen wird.

Entscheidungen über Kinder werden in dieser Literatur grundsätzlich als Resultate rationaler Abwägungen potentieller Eltern verstanden, die dadurch ihren individuellen Nutzen zu maximieren suchen. Durch theoretische und im wachsenden Umfang auch empirische Arbeiten innerhalb dieses Forschungsfeldes (vgl. Hotz et al. 1997) wurden im Zeitablauf insbesondere drei Erklärungsmuster herausgearbeitet, die ökonomisch schlüssige Gründe für den anhaltenden Geburtenrückgang liefern, der sich in den letzten rund fünfzig Jahren in den entwickelten Volkswirtschaften beobachten lässt:[7] Erstens eine sogenannte „Quantitäts-Qualitäts-Interaktion" bei simultanen elterlichen Entscheidungen über Kinderzahl und Ausgaben je Kind, zweitens steigende „Opportunitätskosten" der Kindererziehung und drittens „fiskalische Externalitäten" von Kindern, die sich aus staatlichen Eingriffen in die Sphäre elterlicher Entscheidungen ergeben. Diese Erklärungsmuster schließen sich hinsichtlich ihrer Geltung dabei nicht wechselseitig aus. Vielmehr können sie sich in ihren die Geburtenzahl reduzierenden Effekten sogar noch gegenseitig verstärken.

Die Quantitäts-Qualitäts-Interaktion zu Lasten der jeweiligen Kinderzahl (Becker 1960; Becker und Lewis 1974) kann sich einstellen, wenn in die Nutzenfunktion von Eltern üblicherweise sowohl die Zahl ihrer Kinder (quantitative Dimension) als auch die „Qualität" jedes Kindes, gemessen an den elterlichen Ausgaben je Kind, eingeht. Falls bei steigendem Einkommen der Eltern deren Wunsch nach erhöhten Ausgaben pro Kind ausgeprägter ist als der Wunsch nach einer höheren Kinderzahl, kann die Kinderzahl trotz zunehmenden Wohlstands stagnieren oder sogar zurückgehen, da einzelne Kinder im Zuge der wirtschaftlichen Entwicklung immer „teurer" werden. Aus ökonomischer Sicht ist hier zum einen ein tendenziell positiver Einkommenseffekt am Werk,[8] der durch einen negativen Substitutionseffekt jedoch aufgehoben oder sogar überkompensiert wird. Ein empirischer Nachweis für diese aus theoretischer Sicht elegant differenzierten Einzeleffekte lässt sich allerdings kaum geben. Der Grund dafür ist, dass sich die sogenannte „Qualität" von Kindern und speziell der Preis einer „Qualitätseinheit" eines Kindes nicht direkt beobachten lassen (Hotz et al. 1997).

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[7] Für die Geburtenentwicklung in historische früheren Phasen und/oder unter anderen wirtschaftlichen und gesellschaftlichen Rahmenbedingungen können dieselben Muster unter Umständen ebenfalls einen nennenswerten Erklärungsbeitrag leisten. Der Anspruch, eine konsistente, allgemeingültige Erklärung des säkularen Geburtenrückgangs zu geben, kann dafür aber wohl nicht erhoben werden. Für zahlreiche Hinweise, die dies belegen, vgl. etwa Birg (1987; 1995).

[8] Ein positiver Einkommenseffekt – steigende Haushaltseinkommen erhöhen die elterliche Nachfrage nach Kindern – definiert für Ökonomen ein „normales" Gut. Ohne ihn müssten Kinder als „inferiores" Gut klassifiziert werden, bei dem die Nachfrage mit steigendem Einkommen zurückgeht. Dies erschiene schon aus theoretischer Sicht als unbefriedigende Alternative.

Objektiv teurer werden Kinder auch durch steigende Opportunitätskosten (Willis 1973), d. h. durch steigende Einkommensverluste im Falle einer vorübergehenden Einschränkung oder Aufgabe der Erwerbstätigkeit mindestens eines Elternteils zum Zwecke der Betreuung und Erziehung von Kindern. Vordergründig steigen die Opportunitätskosten im Zuge der wirtschaftlichen Entwicklung – nicht nur absolut gesehen, sondern auch in Relation zum gesamten Haushaltseinkommen der Eltern – vor allem durch im Durchschnitt immer weiter steigende Erwerbsquoten, Qualifikationsniveaus und Lohnsätze von Frauen. Dahinter muss aus theoretischer Sicht jedoch ein grundlegenderer Wandel der Lebensentwürfe von Frauen stehen, mit einem wachsenden Wunsch nach beruflicher Tätigkeit mit angemessenen Qualifikationen bzw. nach einer Vereinbarung von Familie und Beruf. Wünsche dieser Art beeinflussen dann nämlich ihre Entscheidungen über beobachtbare Phänomene wie den Qualifikationserwerb oder die (fortgesetzte) Erwerbsbeteiligung (Rosenzweig und Schultz 1985). In der empirischen Forschung wird ein negativer Zusammenhang zwischen der Geburtenzahl einerseits und Erwerbstätigkeit, Lohnsätzen oder durchschnittlichen Qualifikationen von Frauen andererseits praktisch durchgängig bestätigt. Analoge Effekte für Männer lassen sich hingegen nicht finden, vor allem wohl, da die Betreuung und Erziehung von Kindern für Väter bis heute üblicherweise weit weniger zeitintensiv ist als für Mütter. Vielmehr sollte sich bezüglich der Lohnsätze oder der durchschnittlichen Qualifikationen von Männern, wie bei jeder Determinante des sonstigen Haushaltseinkommens, ein positiver Einkommenseffekt zeigen. Durch die zuvor skizzierte Quantitäts-Qualitäts-Interaktion kann dieser jedoch erneut überlagert werden.

Schließlich beeinflussen auch staatliche Interventionen, insbesondere staatliche Abgaben und Transfers, die elterlichen Entscheidungen über Kinder in vielfältiger Weise. Per Saldo können sie dabei ebenfalls zum Geburtenrückgang beitragen, und zwar – im Gegensatz zu den beiden anderen Erklärungsmustern – in eindeutig verzerrender Weise. Zwar enthalten die meisten Steuer- und Transfersysteme entwickelter Volkswirtschaften eine Reihe familien- sowie bildungspolitischer Instrumente, die das Haushaltseinkommen der Eltern erhöhen und die elterlichen Kosten von Kindern gezielt senken. Damit werden entgegengesetzte Effekte anderer fiskalischer Instrumente aber möglicherweise bei weitem noch nicht ausgeglichen. Hingewiesen wurde in der Diskussion insbesondere auf die Effekte der Einrichtung und des Ausbaus umlagefinanzierter Alterssicherungssysteme (Cigno 1993; Sinn 1997): Sie verpflichten erwachsene Kinder dazu, anstelle ihrer eigenen Eltern die gesamte Eltern*generation* im Alter zu unterstützen und erzeugen dadurch oft massive fiskalische Externalitäten, d. h. finanzielle Vorteile für Dritte, z. B. kinderlose Rentner und andere Beitragszahler, die allein auf den öffentlichen, „fiskalischen“ Eingriff zurückgehen. Mögliche Erträge der Kindererziehung werden dadurch in quantitativ bedeutsamem Umfang sozialisiert, und der Anreiz Kinder aufzuziehen wird aus der Sicht potentieller Eltern spürbar verringert. Die empirische Forschung bestätigt gemeinhin, dass familienpolitische Instrumente für sich genommen einen positiven Effekt für die Geburtenzahl haben (vgl. den Survey von Meier 2005). Alle Untersuchungen, die sich der entgegengerichteten Wirkungen staatlicher Alterssicherungssysteme annehmen, unterstreichen aber auch deren negativen Effekt (vgl. insbesondere Cigno und Rosati 1996; Cigno et al. 2003; oder Ehrlich und Kim 2005)

Anknüpfend an die zuletzt genannten Arbeiten wird im Rahmen des hier dokumentierten Forschungsprojekts daher auch eine empirische Analyse des durchschnittlichen Geburtenverhaltens angestrebt (vgl. Abschnitt 6). Dabei wird besonderes Augenmerk auf die Effekte staatlicher Instrumente, sowohl im Bereich der Familienpolitik als auch der Alterssicherung, gelegt. Zugleich werden aber auch die wichtigsten sonstigen ökonomischen Bestimmungsfaktoren elterlicher Fertilitätsentscheidungen einbezogen und kontrolliert, nicht zuletzt der jeweilige Stand der wirtschaftlichen Entwicklung. Damit wird hier schließlich auch der Möglichkeit einer komplexen, sehr langfristig angelegten Interaktion zwischen der demographischen Struktur eines Landes, die stark von der Geburtenentwicklung in der Vergangenheit abhängt, seinem aktuellen wirtschaftlichen Entwicklungsstand und der laufenden Geburtenzahl nachgegangen.

5. Fertilität, Produktivitätswachstum und wirtschaftliche Entwicklung: Empirische Ergebnisse

Die empirischen Untersuchungen zu langfristigen Auswirkungen der Geburtenentwicklung auf das wirtschaftliche Wachstum basieren auf den theoretischen Überlegungen und der empirischen Literatur, die schwerpunktmäßig in den Abschnitten 2 und 3 dieser Zusammenfassung dargelegt wurden. Sie bestehen in ökonometrischen Analysen der Daten eines internationalen Makrodaten-Panels, das möglichst viele Länder umfasst und einen möglichst langen Stützzeitraum abdeckt. Im Mittelpunkt stehen dabei Schätzungen, in denen der Einfluss der Altersstruktur der jeweiligen Erwerbstätigen auf die totale Faktorproduktivität (TFP) und deren Wachstum untersucht wird. Die Maße für TFP (genauer: $\ln TFP$ bzw., in den bisherigen Formeln, $\ln A$) und TFP-Wachstum ($\Delta \ln TFP$ bzw. $\Delta \ln A$) in jeder betrachteten Volkswirtschaft i und für jeden betrachteten Zeitraum t werden dabei mit Hilfe der Gleichungen (5) und (6) bestimmt. Die zentrale Schätzgleichung lautet, ergänzt um eine Regressionskonstante b_0, zeit-invariante, länderspezifische Effekte λ_i, einen reinen Zeittrend μ_t und einen Störterm ε_{it},

$$\ln TFP_{it} = \beta_0 + \sum_s \beta_s L_{sit} + \lambda_i + \mu_t + \varepsilon_{it}. \qquad (7)$$

In der Differenzen-Schreibweise für das Wachstum der TFP wird daraus

$$\Delta \ln TFP_{it} = \sum_s \beta_s \Delta L_{sit} + \mu_t + \varepsilon_{it}. \qquad (8)$$

Die Altersstruktur-Variablen L_{sit} messen dabei den Anteil der Altersgruppe *s* an der gesamten Erwerbstätigenzahl (in Land *i* und Periode *t*). Konkret werden die Erwerbstätigen in den Altersstufen 10–19, 20–29, … 50–59 und 60 und darüber betrachtet. Feyrer (2002) weist darauf hin, dass die Altersstruktur der Erwerbstätigen primär Auswirkungen auf das *Niveau* der TFP haben sollte, so dass sich aus Änderungen dieser Altersstruktur Effekte für das TFP-*Wachstum* ergeben könnten. Im Hintergrund steht dabei die Vorstellung, dass das Produktivitätsniveau und dessen Trend-Wachstumsrate fundamental (und sehr langfristig) für alle Länder dieselben sind, weil sie von der globalen Technologie-Grenze und ihren Verschiebungen durch wirkliche Inventionen bestimmt werden. Durch Auswirkungen auf den Innovationsprozess, im Sinne der Diffusion und Adaption existierender Technologien, kann die demographische Struktur in einzelnen Volkswirtschaften die Konvergenz zu dieser Grenze jedoch temporär beschleunigen oder verlangsamen. Diese Effekte können gegebenenfalls mit den β_s-Koeffizienten beider Schätzgleichungen gemessen werden, während in Gleichung (7) die aktuelle Technologie-Lücke an den Länder-Dummies (λ_i) ablesbar wird und in Gleichung (8) vor demselben gedanklichen Hintergrund gerade keine sonstigen, länderspezifischen Effekte mehr enthalten sein sollten.[9]

Aus methodischer Perspektive hat die Altersstruktur der Erwerbstätigen in entwickelten Volkswirtschaften zwei Merkmale, die für die hier angestrebte empirische Wachstumsanalyse von Vorteil sind. Zum einen wird sie im Wesentlichen durch weit in der Vergangenheit liegende Entscheidungen geprägt. Anders als bei zahlreichen anderen, in der Literatur vorgeschlagenen Bestimmungsfaktoren des Produktivitätswachstums (z. B. Handel, Investitionen, Ausbildung etc.) ergibt sich in der Analyse daher kein „Endoge-

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[9] Die Spezifikation ergibt sich in diesem Punkt also nicht nur aus den Mechanismen der Differenzenbildung, sondern auch aus materiellen Überlegungen. Hingegen kann in Gleichung (8) durchaus noch mit zeit-spezifischen Effekten gerechnet werden, die vereinfachend mit demselben Symbol (μ_t) belegt werden wie in der Niveau-Gleichung (7). – Alternativ zu Gleichung (8) wurden im Rahmen der ökonometrischen Arbeit auch Spezifikationen *mit* Länder-Dummies geschätzt, die dauerhaft unterschiedliche Wachstumsraten der TFP zulassen und der demographischen Struktur somit eine zusätzliche Rolle als treibende Kraft hinter dem technischen Fortschritt selbst geben würden. Die Ergebnisse erweisen sich in dieser Hinsicht jedoch als wenig aussagekräftig.

nitätsproblem“ aufgrund möglicher Wechselwirkungen mit der abhängigen Variable. Wo solche Probleme bestehen, wird die Richtung eventueller Kausalitäten hinter den gemessenen Effekten gemeinhin fraglich. Zum anderen weisen die Altersstruktur der Erwerbstätigen und ihre Verschiebungen während der letzten Jahrzehnte eine erhebliche Variation auf – sowohl über die Zeit als auch zwischen verschiedenen Ländern, selbst innerhalb des relativ homogenen Kreises entwickelter Volkswirtschaften. Dies zeichnet sie vor anderen möglichen Determinanten des Produktivitätswachstums aus (z. B. geographische Lage, Klima), von denen mit ähnlicher Klarheit gesagt werden kann, dass sie in einem gegebenen Land und zu einem gegebenen Zeitpunkt „exogen“ vorgegeben sind und nicht ihrerseits vom wirtschaftlichen Entwicklungsstand beeinflusst werden.

Die Datenbasis, die für die Bearbeitung des Projekts zusammengestellt wurde, speist sich in erster Linie aus Daten amtlicher Statistiken, die von internationalen Organisationen zusammengestellt wurden (z. B. die „*World Development Indicators*“ der Weltbank, die „LABORSTA“-Datenbank der ILO oder Bevölkerungsdaten der UN Population Division), und weiteren Datenbasen und Indikatoren, die von führenden Forschern erarbeitet wurden (etwa die „Penn World Tables“ von Summers und Heston 1988 bzw. Heston et al. 2002; die Humanvermögens-Indikatoren von Barro und Lee 1993, 1996; oder Berechnungen zum physischen Kapitalstock von Easterly und Levine 2000). Die daraus zusammengestellte Datenbasis enthält derzeit Daten für bis zu 213 Länder und für einen maximalen Zeitraum von 1950 bis 2002. Die effektive Verfügbarkeit von Daten begrenzt den Stützzeitraum der nachfolgenden Schätzungen jedoch im Wesentlichen auf 1960–1995 und die Zahl der berücksichtigten Länder auf rund 100. Alle Schätzungen werden parallel auch für das Sub-Sample der ca. 30 OECD-Länder durchgeführt. Einerseits soll dadurch möglichen Besonderheiten der hochentwickelten Länder Rechnung getragen werden. Andererseits sollen die für sie gewonnenen Ergebnisse breiter abgesichert werden, um einen „*Small-sample bias*“ der Schätzungen zu vermeiden.

Bei der Berechnung der Variablen $\ln TFP$ und $\Delta \ln TFP$ wird dem Berechnungsansatz von Easterly und Levine (2000) zur Bestimmung der Kapitalintensität auf der Basis der „*Perpetual-inventory method*“ gefolgt, und es werden der Ansatz von Hall und Jones (1999) zur Berechnung des durchschnittlichen Humanvermögens je Erwerbstätigem und ihre Kalibration auf der Basis von Psacharopoulos (1994) übernommen (vgl. zu allem Abschnitt 3). Die partielle Produktionselastizität des Faktors Kapital wird, angelehnt an Gollin (2002), auf 1/3 gesetzt. Die Daten zur Altersstruktur der Erwerbstätigen stammen von der ILO, wo sie in 10-Jahres-Intervallen verfügbar sind. Mit Hilfe von Bevölkerungsdaten der UN werden sie, wie in Feyrer (2002), für 5-Jahres-Intervalle interpoliert.

Tab. 1: Die Altersstruktur der Erwerbstätigen und die totale Faktorproduktivität (TFP)

Abhängige Variable:	ln *TFP*	ln *TFP*		Δ ln *TFP*	Δ ln *TFP*
Sample Schätzmethode	Alle Länder *Robust* OLS [a)]	OECD *Robust* OLS [a)]		Alle Länder *Robust* OLS [a)]	OECD *Robust* OLS [a)]
*L*10–19	–4,620*** (*1,266*)	–4,520*** (*1,292*)	Δ *L*10–19	–2,784*** (*0,747*)	–2,231** (*0,958*)
*L*20–29	–2,380** (*1,067*)	–1,853* (*0,913*)	Δ *L*20–29	–2,221** (*0,920*)	–1,586** (*0,576*)
*L*30–39	–3,214*** (*1,138*)	–3,427*** (*1,108*)	Δ *L*30–39	–2,385** (*1,002*)	–1,115 (*0,957*)
*L*40–49 (Referenzgruppe)			Δ *L*40–49 (Ref.-gruppe)		
*L*50–59	–1,570 (*1,250*)	–1,501 (*1,040*)	Δ *L*50–59	–1,791* (*0,986*)	–1,404 (*0,908*)
*L*60+	–4,279** (*1,701*)	–0,830 (*1,497*)	Δ *L*60+	–0,532 (*1,080*)	–1,253 (*0,842*)
Perioden-Dummies Länder-Dummies	Ja Ja	Ja Ja		Ja Nein	Ja Nein
Konstante	9,916*** (*0,832*)	8,795*** (*0,699*)			
Beobachtungen Länder R^2	638 104 92,0%	183 27 92,7%		534 101 18,0%	156 27 44,9%

a) Residuen nach Ländern geclustert, um Verzerrungen der Standardfehler durch serielle Korrelation zu vermeiden.

***, ** und * zeigen Signifikanz auf dem 1%-, 5%- bzw. 10%-Niveau an. (Standardfehler in Klammern.)

Die Ergebnisse der ökonometrischen Schätzungen auf der Basis der Gleichungen (7) und (8) fasst Tabelle 1 zusammen. Die Angaben konzentrieren sich dabei auf diejenigen Modelle, die unter einer größeren Auswahl verwendeter Spezifikationen und Schätzmethoden als die definitive Version erscheinen. Die Koeffizienten der *L*-Variablen sind sowohl in der ln *TFP*-Schätzung als auch in der Δ ln *TFP*-Schätzung überwiegend hoch signifikant. Auch gemeinsam sind sie signifikant auf dem 1%-Niveau (für alle Länder) oder nahe daran (in der OECD-Version), wie ein zusätzlicher *F*-Test anzeigt. Das auffallendste Resultat der Schätzungen ist jedoch wohl das folgende: Die altersspezifischen Beiträge zur totalen Faktorproduktivität und dessen Wachstum weisen ein ausgeprägtes Profil auf, das in seinem Verlauf sehr dem einer typischen Mincer-Lohnkurve gleicht (vgl Abschnitt 2). Den größten Einzelbeitrag leistet die Referenzgruppe der 40–49-Jährigen;[10] alle anderen Beiträge sind niedriger, da sie im Vergleich zur Referenzgruppe negative Vorzeichen aufweisen. Allerdings variieren die altersspezifischen TFP-Beiträge um ein Vielfaches stärker als übliche, altersbezogene Lohnunterschiede. Diese Beobachtung deutet darauf hin, dass von der Altersstruktur der Erwerbstätigen eines Landes quantitativ gewichtige Wachstumsexternalitäten ausgehen, die in individuellen Löhnen nicht internalisiert werden. Sie erweisen sich, mindestens vorübergehend, als wichtiger Wachstumsmotor, z. B. weil die altersmäßige Zusammensetzung einzelner Arbeitsteams, ganzer Firmenbelegschaften oder eben des gesamtwirtschaftlichen Arbeitsangebots die Technologiediffusion und -adaption in einer Volkswirtschaft stark beeinflusst.

In ergänzenden Schätzungen, deren Ergebnisse hier nicht im Einzelnen wiedergegeben werden, werden außerdem alle Komponenten der Gleichungen (5) und (6) einzeln auf den Vektor der L-Variablen regressiert. Der Konstruktion dieser Schätzungen nach sind die Koeffizienten für $\ln q$ und $\Delta \ln q$ dabei gleich der Summe der Koeffizienten für alle ihre Komponenten; gegenüber Tabelle 1 bleiben die Resultate für $\ln TFP$ und $\Delta \ln TFP$ dabei unverändert. Diese zusätzlichen Schätzungen verdeutlichen, dass die Altersstruktur der Erwerbstätigen zwar auch einen ausgeprägten Effekt auf das Produktivitätsmaß q und sein Wachstum hat. Dieser läuft aber fast exklusiv über den TFP-Kanal und praktisch nicht über die Akkumulation der Produktionsfaktoren physisches Kapital und Humanvermögen. Ablesbar ist dies daran, dass die L-Koeffizienten bei diesen beiden Faktoren mindestens um eine Größenordnung kleiner ausfallen als beim TFP-Maß und jeweils kaum signifikant sind. Schätzungen von gewisser Signifikanz ergeben sich eigentlich nur bezüglich der Effekte der jüngeren Erwerbstätigengruppen für den Kapitalkoeffizienten κ. Die negativen Vorzeichen dieser Effekte könnten dabei den in Abschnitt 2 eingeführten Kapitalintensivierungs- (bzw. hier: -verdünnungs-)effekt eines durch junge Erwerbstätige stark wachsenden Arbeitsangebots anzeigen. Auch dieser ist allerdings nicht sehr ausgeprägt.

Über die genaueren Gründe für den hier gefundenen Zusammenhang zwischen der Altersstruktur der Erwerbstätigen und Niveau und Wachstum der TFP kann man nur spekulieren. Ihrer ganzen Art nach lassen Datenbasis und Schätzansatz der Analyse die ökonomischen Mechanismen nicht erkennen, die dieses Resultat auf der Mikro-Ebene treiben könnten. Die Gleichförmigkeit mit dem üblichen Verlauf von Mincer-Lohnkurven, die mikroökonomisch besser fundiert sind, legen jedoch nahe, dass es unter ande-

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[10] Da sich die Anteile aller Altersgruppen zu Eins summieren, muss eine aus der Regression ausgeschlossen werden.

rem Effekte der Berufserfahrung sind, die – bei gegebenem Qualifikationsniveau – den Anstieg des Beitrags Erwerbstätiger zur aggregierten Produktivität bis zur Mitte des Erwerbslebens steigen lassen. Konsequenterweise könnte auch die altersmäßige Mischung von Arbeitsteams und die in ihnen insgesamt repräsentierte Mischung aus frisch erworbenem Fachwissen und langjähriger Erfahrung die Entwicklung der TFP beeinflussen. Feyrer (2002) verweist zur Interpretation seiner materiell ganz übereinstimmenden Resultate außerdem auf gewisse empirische Evidenz, dass unternehmerische Aktivitäten, die Bereitschaft Risiken zu übernehmen sowie die Fähigkeit, Innovationen zu machen und, vielleicht noch mehr, sie zur Marktreife zu bringen und zu verwerten, ebenfalls altersspezifisch sind und den hier beobachteten Zusammenhang zwischen demographischer Struktur der Erwerbstätigen und TFP bzw. TFP-Wachstum erzeugen könnten.

Die Stärke und potentielle Bedeutung der hier aufgezeigten Zusammenhänge zwischen Altersstruktur der Erwerbstätigen und Produktivität bzw. Produktivitätswachstum soll abschließend noch mit Hilfe einiger illustrativer Simulationen für ausgewählte Industrieländer verdeutlicht werden. So wie die gegenwärtige Altersstruktur der Erwerbstätigen durch die vergangene Geburtenentwicklung weitgehend vorbestimmt ist, lässt sich auch ihre zukünftige Struktur vergleichsweise verlässlich vorausschätzen. Gestützt auf Langfrist-Projektionen der UN Population Division werden die in Tabelle 1 zusammengefassten ökonometrischen Schätzungen hier daher am Beispiel der Länder Deutschland, Frankreich, USA und Japan – d. h. der vier größten OECD-Volkswirtschaften – in Langfrist-Szenarien zur wirtschaftlichen Entwicklung in diesen Ländern übersetzt.[11] Die empirischen Schätzungen lassen dabei zuallererst Rückschlüsse über nationale Abweichungen vom langfristigen Trend-Wachstum der Produktivität zu, die sich aufgrund der aus heutiger Sicht absehbaren Altersstruktur der Erwerbstätigen in Zukunft ergeben. Mit Hilfe dazu passender Angaben zur zukünftigen Erwerbstätigenzahl und zur zukünftigen Bevölkerungszahl der betrachteten Länder lassen sich daraus Abweichungen vom langfristigen Trendwachstum des BIP und des BIP pro Kopf ermitteln. Die Ergebnisse dieser Berechnungen zeigt Abbildung 1.

Die Abbildung deutet an, dass die vier betrachteten Länder vom demographischen Wandel im Zeitraum bis 2050 auf sehr verschiedene Weise betroffen sein werden. Was den bereits vergangenen Zeitraum bis 2005 betrifft, erklären die Schätzungen offenbar –

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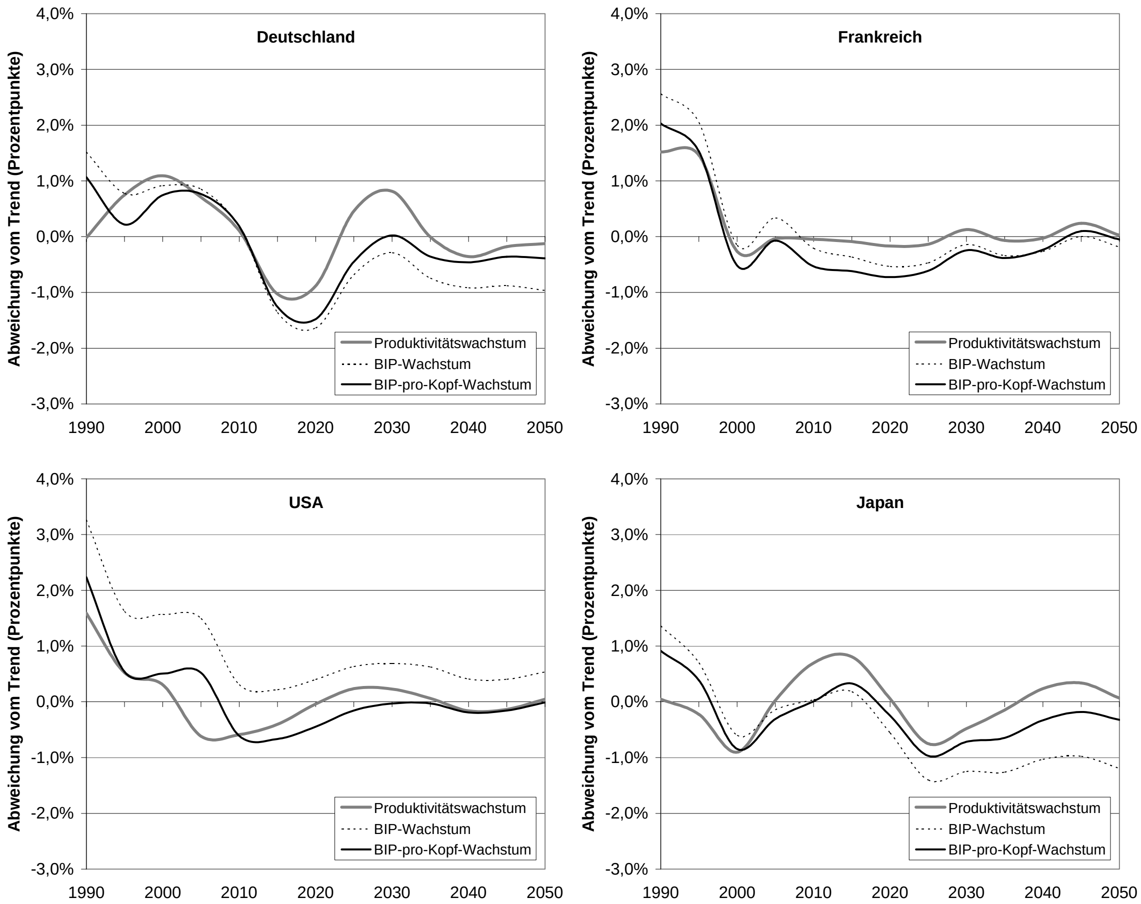
[11] Die altersspezifischen Erwerbsquoten werden dabei gegenüber dem aktuellen Stand der Dinge (nach Angaben in der ILO „LABORSTA“-Datenbank) vereinfachend unverändert festgehalten. Auch auf explizite Annahmen bezüglich der Investitionen und der Humanvermögensbildung, die die resultierenden Wachstumspfade modifizieren könnten, wird verzichtet.

Abb. 1: Der Effekt des projizierten demographischen Wandels für das Wirtschaftswachstum (1990–2050) – OECD-Regression

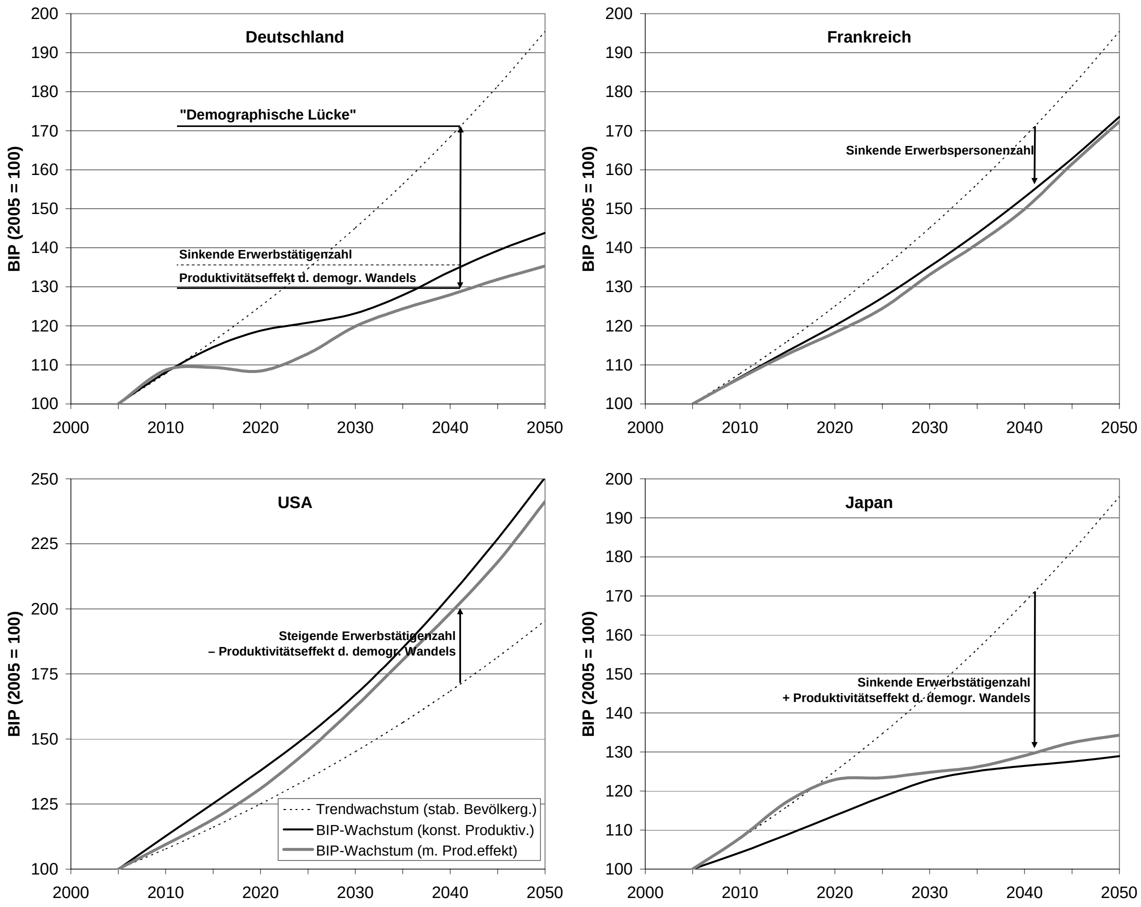


Quellen: UN Population Division; ILO LABORSTA-Database; ifo-Schätzungen.

bis zu einem gewissen Punkt – sowohl das überdurchschnittliche Wachstum der USA in den 1990-er Jahren (durch die große Zahl der dortigen „Baby-Boomer“ in ihrer produktivsten Lebensphase) als auch die Wachstumsschwäche Japans im gleichen Zeitraum. Für Deutschland scheint das Modell dagegen weniger gut zu passen, da dieses Land sich gemäß der vorliegenden Simulation aktuell in einer Phase ausgeprägten Wachstums befinden müsste. Eine mögliche Interpretation ist, dass die derzeitigen strukturellen Probleme Deutschlands das Land um die in der demographischen Struktur angelegte Chance auf überdurchschnittliche Wachstumsraten von Produktivität und BIP bringen.

Für die nächsten vierzig Jahre sagen die ökonometrischen Schätzungen im Übrigen starke Fluktuationen der Wachstumsraten in Deutschland und Japan voraus. Für Frankreich und die USA, die nach dem Ausscheiden starker Geburtsjahrgänge aus den 1950-er Jahren aller Voraussicht nach jeweils eine vergleichsweise stabile Altersstruktur der

Abb. 2: Der Effekt des projizierten demographischen Wandels für das BIP (1990–2050) – OECD-Regression

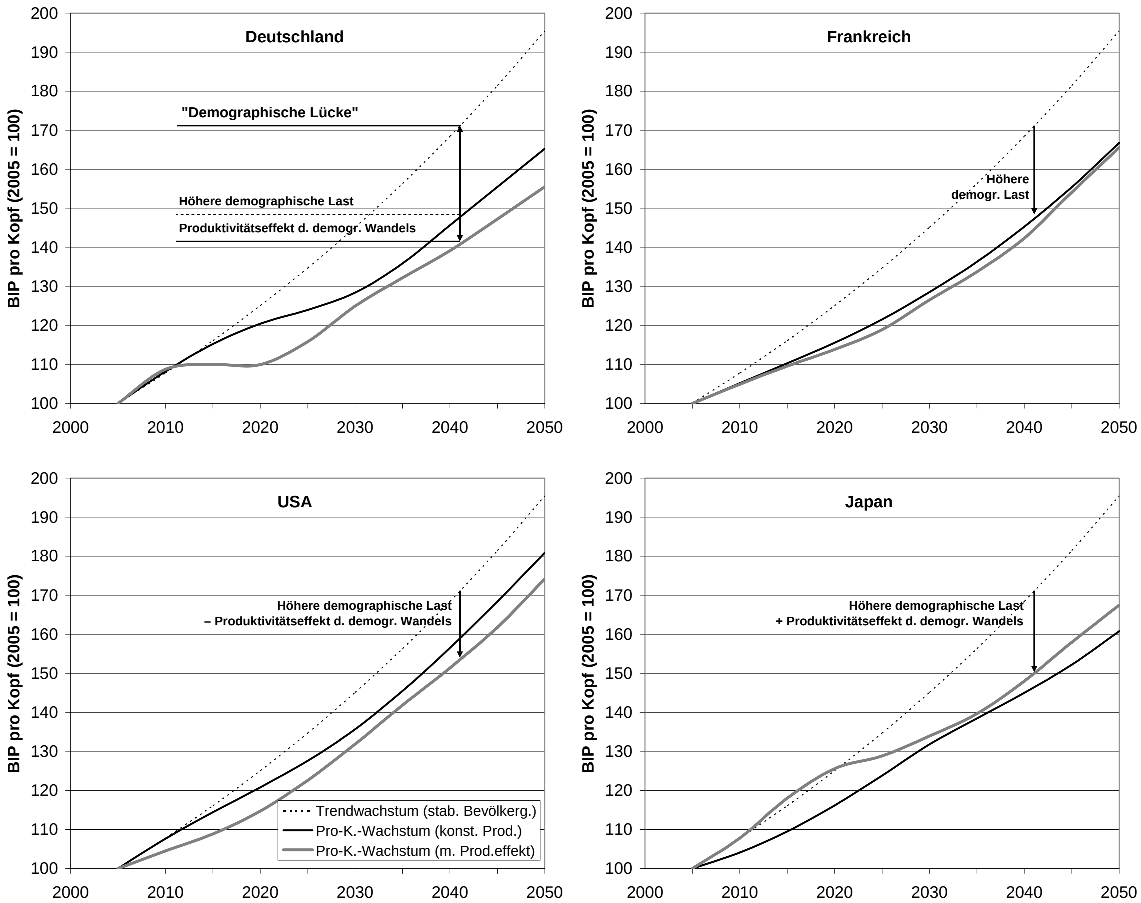


Quellen: UN Population Division; ILO LABORSTA-Database; ifo-Schätzungen.

Erwerbstätigen aufweisen werden, ergeben sich deutlich geringere Schwankungen. Die Wachstumsrate des aggregierten BIP in den USA dürfte, vor allem wegen eines ungebrochenen Bevölkerungswachstums durch hohe Geburtenzahlen und Zuwanderung, sogar durchgängig positiv beeinflusst werden.

In Abbildung 2 werden die für die laufenden Wachstumsraten berechneten Effekte in Simulationen zukünftiger Niveaus des BIP übertragen. Dabei wird das aktuelle Niveau des BIP auf 100 gesetzt und ein einheitliches, reales Trendwachstum der Produktivität in Höhe von 1,5% pro Jahr unterstellt (dies ist annähernd der Durchschnittswert des realen Produktivitätswachstum in entwickelten Volkswirtschaften seit 1990). Unterschieden wird außerdem zwischen der Entwicklung des BIP-Wachstum, die sich unter dieser Annahme im Falle einer „stabilen Bevölkerung“ (mit konstanter Bevölkerungszahl und unveränderter Altersstruktur) ergeben würde, und denjenigen Entwicklungen,

Abb. 3: Der Effekt des projizierten demographischen Wandels für das BIP pro Kopf (1990–2050) – OECD-Regression



Quellen: UN Population Division; ILO LABORSTA-Database; ifo-Schätzungen.

die sich unter Berücksichtigung der tatsächlich projizierten Entwicklung der Erwerbstätigenzahl (bei konstanter Produktivität) und unter zusätzlicher Berücksichtigung der hier ermittelten Produktivitätseffekte des demographischen Wandels ergeben könnten. Abbildung 3 ergänzt das Bild um eine analog konstruierte Simulation zukünftiger Niveaus des BIP pro Kopf der Wohnbevölkerung. Anstelle sich ändernder Erwerbstätigenzahlen spielen nun allerdings projizierte Änderungen des demographischen (Jugend- und Alters-)Lastquotienten die entscheidende Rolle. Zu erinnern ist hier daran, dass die Entwicklung des Pro-Kopf-BIP als Wachstum eines einfachen Wohlstands-Maßes aus ökonomischer Sicht weit bedeutsamer ist als die des aggregierten BIP (vgl. Abschnitt 2).

Hinsichtlich des simulierten Wachstums des BIP pro Kopf ergeben sich in den vier betrachteten Ländern vier durchaus unterschiedliche Szenarien. In Frankreich und in den USA sind die Gesamteffekte von zunehmender demographischer Dependenz und altersstruktur-bedingten Produktivitätswirkungen – d. h., die „demographische Lücke" beim Wachstum des BIP pro Kopf – kleiner als in den beiden anderen Ländern. In Frankreich ist der Produktivitätseffekt aufgrund einer offenbar relativ gut ausbalancierten, stabilen Altersstruktur der Bevölkerung im erwerbsfähigen Alter im Zeitablauf sogar weitgehend vernachlässigbar. In den USA macht sich die derzeit laufende Alterung der „Baby-Boomer" hingegen stärker bemerkbar, mit kumulierten Wachstumseffekten, die auch langfristig nicht ganz ausgeglichen werden können.

Die Effekte steigender demographischer Lastquotienten fallen in Deutschland und Japan im Vergleich dazu hingegen deutlich stärker aus. In Japan wird der Effekt allerdings konterkariert durch einen für sich genommen positiven Produktivitätseffekt der absehbaren Änderungen der dortigen Altersstruktur der Erwerbstätigen. Im Grunde „erholt" sich der Altersaufbau der japanischen Erwerbsbevölkerung in den nächsten Jahren von den Effekten exzessiver Geburtenraten, die in diesem Land bis nach der Mitte des 20. Jahrhunderts weitgehend ungebrochen anhielten und gegenwärtig, wegen des fortgeschrittenen Erwerbsalters der letzten dazu gehörigen Alterskohorten, die durchschnittliche Produktivität eher reduzieren.

Den mit Abstand stärksten Gesamteffekt für das Wachstum des Pro-Kopf-BIP hat der absehbare demographische Wandel nach den hier angestellten Schätzungen und Simulationen in Deutschland. Der negative Effekt der steigenden Dependenzquote wird durch ungünstige Produktivitätseffekte noch erkennbar gesteigert. Im Zeitraum zwischen 2010 und 2020 könnte das BIP pro Kopf aufgrund des Zusammenwirkens beider Effekte real gesehen sogar stagnieren. Auch die anschließend mögliche Beschleunigung des Produktivitätswachstums (vgl. Abbildung 1) kann die „demographische Lücke" bis zum Ende des Zeithorizonts der Simulationen bei Weitem nicht schließen.

6. Wirtschaftliche Entwicklung und endogene Fertilität: Empirische Ergebnisse

Nach den Erkenntnissen der ökonomischen Theorie endogener Fertilität (vgl. Abschnitt 4) könnten langfristigen Effekten der vergangenen Geburtenentwicklung auf die gegenwärtige und zukünftige wirtschaftliche Entwicklung umgekehrt Auswirkungen der aktuellen wirtschaftlichen Rahmenbedingungen auf die laufenden Geburtenzahlen gegenüberstehen. Ob und inwieweit dies der Fall ist, wird im Rahmen des hier dokumentierten Forschungsprojekts durch einen zweiten Komplex empirischer Untersuchungen analysiert. Die Untersuchungen beziehen sich im Wesentlichen auf denselben Länderkreis und denselben Zeitraum wie die im vorangegangenen Abschnitt zusammengefassten Schätzungen. Anders als zuvor werden nun allerdings nicht Daten verwendet, die in 5-Jahres-Intervallen gemessen werden, sondern Zeitreihen jährlicher Daten.

Als abhängige Variable der Schätzungen wird die zusammengefasste Geburtenziffer (*Total fertility rate*, TFR) jedes betrachteten Landes *i* in jedem betrachteten Zeitraum *t* verwendet. Soweit möglich werden in der Schätzgleichung simultan alle drei zuvor erläuterten Erklärungsmuster der Theorie endogener Fertilität für den anhaltenden Geburtenrückgang berücksichtigt, der sich vor allem in entwickelten Volkswirtschaften seit der Mitte des letzten Jahrhunderts beobachten lässt. Wie in zahlreichen anderen Arbeiten, die auf internationalen Makrodaten-Panels basieren, ist dies im Falle der Opportunitätskosten der Mütter allerdings nur eingeschränkt, im Falle der Quantitäts-Qualitäts-Interaktion bei elterlichen Entscheidungen über die Kinderzahl bestenfalls ansatzweise möglich.[12] Die verwendete Schätzgleichung lautet:

$$\ln TFR_{it} = \gamma_0 + \gamma_1 p_{it} + \gamma_2 fa_{it} + \gamma_3 g_{it} + \gamma_4 le_{it} + \gamma_5 \ln y_{it} + \gamma_6 h_{it}^{m} + \gamma_7 h_{it}^{f} \qquad (9)$$

(länderspezifische *Fixed effects* λ_i und der Störterm ε_{it} werden bei der Wiedergabe vereinfachend unterdrückt). Die erklärenden Variablen sind wie folgt definiert:

- *p* bezeichnet die Rentenausgaben je Erwachsenem im Alter ab 65, gemessen in Prozent des laufenden BIP pro Kopf;
- *fa* bezeichnet den Gegenwert familienpolitischer Leistungen pro Kind im Alter unter 16, ebenfalls in Prozent des laufenden BIP pro Kopf;
- *g* bezeichnet die (sonstigen) staatlichen Konsumausgaben in Prozent des BIP;
- *le* misst prozentuale Änderungen der laufenden Lebenserwartung bei Geburt;
- $\ln y$ bezeichnet das BIP pro Kopf (in realen Größen nationaler Währungseinheiten und in logarithmierter Form);
- h^m und h^f bezeichnen die durchschnittliche Zahl von Schul- und Ausbildungsjahren der Männer bzw. Frauen im Alter ab 15.

Die Variablen *p* und *fa* messen gegebenenfalls die Effekte direkter staatlicher Eingriffe in elterliche Fertilitätsentscheidungen mit fiskalischen Instrumenten; mit Hilfe von *g*

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[12] Der Grund für die erste Einschränkung liegt darin, dass Haushaltsentscheidungen, die simultan die Kinderzahl und das Arbeitsangebot von Frauen betreffen, mangels geeigneter Mikro-Daten hier nicht betrachtet werden können. Trotzdem kann der Effekt steigender Opportunitätskosten in die Analyse des Fertilitätsverhaltens durch geeignete erklärende Variable, die als „exogen“ angesehen werden müssen, einbezogen werden. Der Effekt der Qualitäts-Quantitäts-Interaktion, auf den sich die zweite Einschränkung bezieht, ließe sich selbst dann nicht beobachten, wenn Mikro-Daten verwendet würden (vgl. Abschnitt 4). Hilfsweise muss daher versucht werden, seine Wirkung an den Ergebnissen indirekt abzulesen, wie es hier im Folgenden tentativ getan wird.

kann überprüft werde, ob darüber hinaus auch die sonstigen öffentlichen Finanzen per Saldo eine (geburtenmindernde) fiskalische Externalität zu Lasten von Kindern erzeugen (z. B: durch umlagefinanzierte Gesundheitskosten oder durch die explizite Staatsverschuldung). Die Variable *le* misst, wie in ähnlichen Schätzungen üblich, vor allem den Effekt sinkender Kindersterblichkeit, der in weniger entwickelten Ländern nach wie vor einen gewissen Beitrag zum Geburtenrückgang leisten könnte.

Das (logarithmierte) Pro-Kopf-BIP $\ln y$ ist ein grobes Maß für das durchschnittliche Haushaltseinkommen der Eltern, von dem Einkommenseffekte, aber auch negative Substitutionseffekte (etwa im Sinne der Quantitäts-Qualitäts-Interaktion) bezüglich der Kinderzahl ausgehen können. Im Zusammenspiel mit den beiden Humanvermögens-Variablen misst $\ln y$ insbesondere die Effekte von Nicht-Arbeitseinkommen. Die Zahl von Schul- und Ausbildungsjahren ist ein international gängiges Maß für das erreichte Qualifikationsniveau Erwachsener. In empirischen Studien erweist sie sich regelmäßig als eng korreliert mit den individuellen Lohnsätzen. Speziell h^f, das Qualifikationsmaß für Frauen, kann daher als Proxy für die Opportunitätskosten der Betreuung und Erziehung von Kindern dienen. Je nach der typischen Arbeitsteilung im Haushalt hat h^m demgegenüber unter Umständen eher den Charakter sonstigen Einkommens und kann dann ganz ähnliche Effekte auslösen wie $\ln y$.

Tabelle 2 fasst die Ergebnisse der ökonometrischen Schätzungen auf der Basis der Gleichung (9) zusammen. Wiederum konzentrieren sich die Angaben dabei auf die definitive Version unter einer größeren Auswahl verwendeter Spezifikationen und Schätzmethoden. Wiederum erweisen sich die verwendeten erklärenden Variablen weit überwiegend als hochsignifikant und die Schätzgüte des gesamten Modells, vor allem hinsichtlich der Erklärung der zeitlichen Variation innerhalb („*within*“) jedes Landes, als befriedigend. Vorzeichen und Stärke der einzelnen Effekte sind plausibel interpretierbar und stimmen mit den Ergebnissen anderer Schätzungen (insbesondere Cigno und Rosati 1996; Ahituv 2001; oder Ehrlich und Kim 2005) überein, soweit sie der Definition der Variablen und der Struktur des Schätzmodells nach vergleichbar sind.

Die Fertilitätseffekte der Rentenvariablen *p* und der Variablen für familienpolitische Leistungen *fa* sind erwartungsgemäß negativ bzw. positiv. Das negative Vorzeichen für *g* zeigt an, dass auch die sonstigen Staatsausgaben einen nicht unerheblichen, geburtenmindernden Effekt haben. Steigerungen der Lebenserwartung, gemessen durch *le*, wirken sich ebenfalls negativ auf die endgültige Kinderzahl aus. Die Interpretation der Einkommens- und Qualifikationsvariablen erweist sich hingegen als komplizierter.

Tab. 2: Ökonomische Determinanten der Geburtenziffer

Abhängige Variable:	ln *TFR*	ln *TFR*
Sample Schätzmethode	Alle Länder OLS (*fixed effects*)	OECD OLS (*fixed effects*)
p	–0,001*** (*0,000*)	–0,001* (*0,001*)
fa	0,0137*** (*0,0019*)	0,0139*** (*0,002*)
g	–0,0159*** (*0,0016*)	–0,026** (*0,003*)
le	–0,052*** (*0,014*)	–0,089*** (*0,018*)
ln *y*	–0,275** (*0,023*)	–0,228** (*0,033*)
h^m	0,009 (*0,011*)	0,031** (*0,016*)
h^f	–0,098*** (*0,0126*)	–0,113** (*0,017*)
Länder-*fixed effects*	Ja	Ja
Konstante	4,573** (*0,202*)	4,147*** (*0,289*)
Beobachtungen	1.033	635
Länder	88	25
R² *overall*	21,9%	12,5%
within	71,5%	77,3%
between	11,4%	4,3%

***, ** und * zeigen Signifikanz auf dem 1%-, 5%- bzw. 10%-Niveau an.
(Standardfehler in Klammern.)

Wie unter dem Gesichtspunkt steigender Opportunitätskosten erwartet, wirkt sich ein steigendes durchschnittliches Qualifikationsniveau von Frauen, h^f, signifikant negativ auf die zusammengefasste Geburtenziffer eines Landes aus. Der Effekt steigender Qualifikationen von Männern, h^m, trägt demgegenüber ein positives Vorzeichen. Gleichzeitig fällt er aber absolut gesehen deutlich schwächer aus als der parallele Effekt bei den Frauen, und er ist im Falle der Schätzung für alle Länder nicht einmal signifikant. Ferner fällt auf, dass das Pro-Kop-BIP, gemessen durch $\ln y$, einen robusten und ausgeprägten negativen Effekt für die Geburtenziffer hat. Diese Beobachtung entspricht für sich genommen durchaus den möglichen Wirkungen der Beckerschen Quantitäts-Qualitäts-Interaktion, die auf direktem Wege nicht kontrolliert werden kann. Vermuten – jedoch prinzipiell nicht näher belegen – lässt sich demnach, dass der dadurch ausgelöste Substitutionseffekt zu Lasten einer größeren Kinderzahl durch den negativen Koeffizienten von $\ln y$ gemessen wird, während h^m den aus theoretischer Sicht plausiblerweise positiven Einkommenseffekt für die Kinderzahl aufnimmt. Wenn diese Interpretation zutrifft, kann der Koeffizient von h^m durch die Präsenz des Substitutionseffekts aber immer noch nach unten verzerrt und in seiner Signifikanz beeinträchtigt sein. Ein genaueres Bild von Art und Richtung ökonomischer Effekte für die Fertilitätsentscheidungen durchschnittlicher Eltern lässt sich auf der Basis des hier verwendeten empirischen Designs, mit einer Makrodaten-Panelanalyse für eine größere Zahl von Ländern, nicht gewinnen.

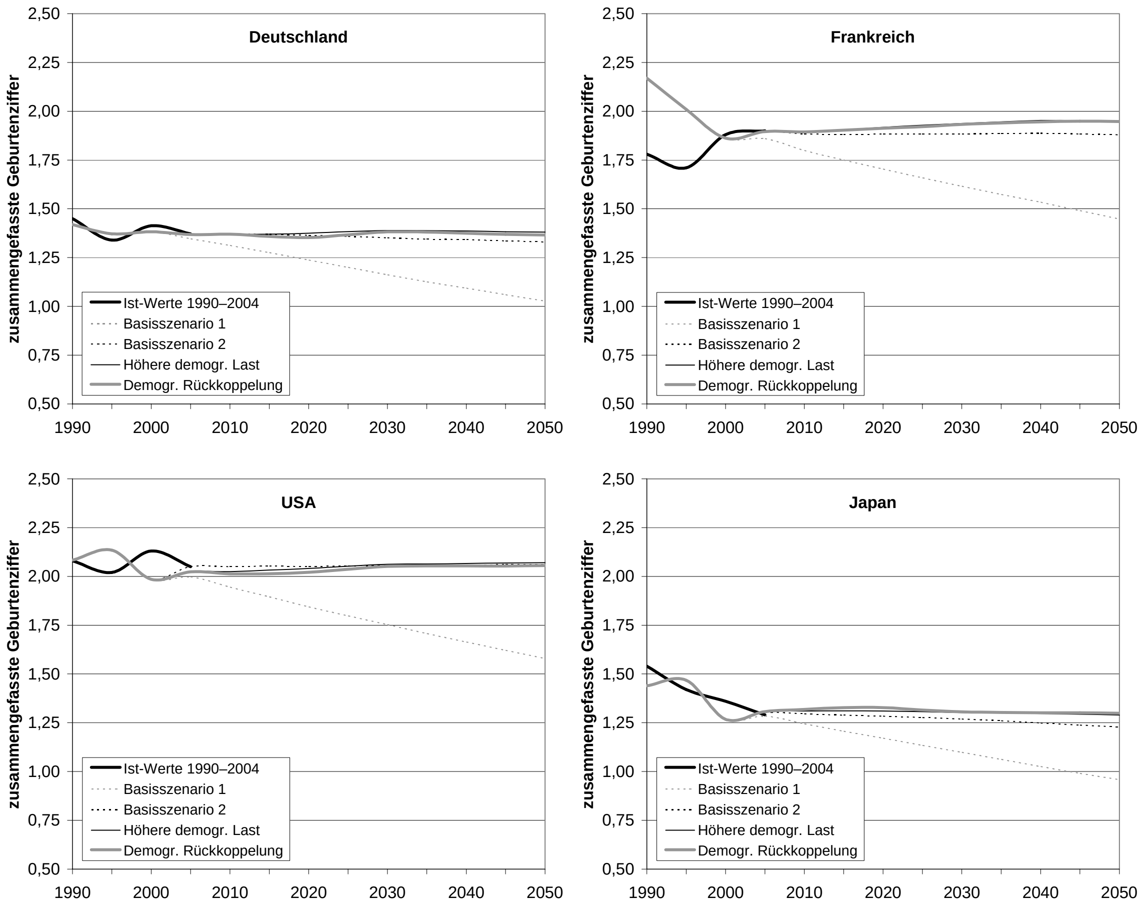
Wie am Ende der empirischen Untersuchung der Auswirkungen der Altersstruktur der Erwerbstätigen auf Produktivität und Produktivitätswachstum, sollen die Implikationen der ökonometrischen Analyse der laufenden Geburtenentwicklung hier abschließend mit Hilfe einiger illustrativer Simulationen für ausgewählte Industrieländer verdeutlicht werden. Wiederum beziehen sich die Simulationen auf Deutschland, Frankreich, die USA und Japan. Sie stützen sich erneut auf die OECD-Variante der in Tabelle 2 zusammengefassten Schätzungen. Effektiv werden die Resultate beider Komplexe empirischer Analysen, die im Rahmen des hier dokumentierten Forschungsprojekts durchgeführt wurden, dabei sogar miteinander verknüpft. In stark tentativer Weise kann somit ein Blick auf die mögliche Stabilität oder Instabilität des Gesamtprozesses des demographischen Wandels und seiner ökonomischen Konsequenzen geworfen werden.

Die Resultate dieser neuerlichen Langfrist-Simulationen zeigt Abbildung 4. Aufgrund der zuvor angesprochenen Unklarheiten bezüglich der Interpretation der empirischen Resultate zu ökonomischen Determinanten der Geburtenentwicklung werden dabei zunächst zwei Basisszenarien konstruiert. Anschließend werden zusätzlich die Änderungen der zukünftigen wirtschaftlichen Entwicklung eingefügt, die aus den im vorangegangen Abschnitt dargelegten empirischen Ergebnissen folgen könnten.

Für das Basisszenario Nr. 1 werden einige Variable (y, h^m, le) für alle Länder einheitlich mit konstanten Wachstumsraten fortgeschrieben, die sich aus ihrer vergangenen Entwicklung in der OECD-Welt ergeben. Für andere Variable (fa, g) wird vereinfachend angenommen, dass sie im Zeitablauf konstant bleiben. Spezielle Annahmen werden hingegen für die durchschnittlichen Qualifikationen von Frauen und für die Entwicklung der Rentenausgaben je Erwachsenem im Alter ab 65 getroffen. Für die Variable h^f wird eine kontinuierliche Angleichung an h^m bis 2050 unterstellt, und zwar unabhängig davon, wie sie sich in der Vergangenheit in jedem Land relativ zu h^m entwickelt hat.[13]

[13] Mögliche idiosynkratische Entwicklungen in einzelnen Ländern, die gegebenenfalls eher Ergebnis größerer Differenzen in der Vergangenheit wären als dass sie auch zukünftige Entwicklungen berühren müssten, werden auf diese Weise weitgehend ausgeblendet.

Abb. 4: Der Effekt projizierter Änderungen in ökonomischen Determinanten für die zusammengefasste Geburtenziffer (1990–2050) – OECD-Regression



Quellen: ifo Annahmen und Schätzungen.

Hinsichtlich der langfristigen Entwicklung der Variable *p* wird von den Resultaten international vergleichbarer Projektionen zukünftiger Rentenausgaben auf der Basis des gegenwärtigen Rechts ausgegangen, die in der Regie der OECD (2001, Kap. 4) entstanden sind.[14] Konsequenz all dieser Annahmen wäre nach Maßgabe der hier erarbeiteten ökonometrischen Schätzung ein allseitiger, fortgesetzter Rückgang der laufenden Geburtenziffern, auf rund 1,0 in Deutschland und Japan, auf rund 1,5 in Frankreich und den USA (vgl. Abbildung 4).

[14] Da das zukünftige Wachstum der Rentenausgaben in praktisch allen entwickelten Volkswirtschaften einerseits durch eine demnächst beginnende neue Phase des demographischen Wandel verstärkt, andererseits aber durch politische Reaktionen darauf gedämpft wird, kann weder einfach von einer Konstanz von *p* noch von einer konstanten Wachstumsrate aus der Vergangenheit ausgegangen werden.

Wenn die zuvor gegebene Interpretation der empirischen Schätzungen zutrifft, ist diese Tendenz als solche kaum verwunderlich. Die Simulationen zum Basisszenario 1 reflektieren dann im Wesentlichen den negativen Effekt steigender Opportunitätskosten bei steigendem Qualifikationsniveau von Frauen und den negativen Effekt der Qualitäts-Quantitäts-Interaktion bei steigendem BIP pro Kopf. Der positive Effekt eines weiter leicht zunehmenden durchschnittlichen Qualifikationsniveaus ist viel zu schwach, um die entgegengesetzten Effekte auch nur annähernd auszugleichen. Möglicherweise wird damit aber der positive Einkommenseffekt vernachlässigt, der auch von einem steigenden Pro-Kopf-BIP ausgehen sollte. In der hier angenommenen Verbesserung der Qualifikationen von Männern wird er möglicherweise nur sehr unvollkommen reflektiert.

Ausgehend von dieser Überlegung wird bei der Konstruktion des Basisszenarios Nr. 2 genau eine Änderung vorgenommen: Die h^m-Variable wird künstlich so erhöht, als müsste sie allein den Anstieg der Produktivität erklären, der zum hier unterstellten Wachstum des Pro-Kopf-BIP führt. Grundlage dieser Berechnungen sind die Zerlegung der Produktivität $\ln q$ in Gleichung (5) und die Kalibration, die bei der Ermittlung des TFP-Maßes im Kontext des ersten Komplexes empirischer Untersuchungen in dieser Arbeit verwendet wurde (vgl. Abschnitt 4). Umgekehrt wird unterstellt, dass h^m unter dieser Annahme nun den vollen Einkommenseffekt zunehmenden wirtschaftlichen Wohlstandes für die Geburtenentwicklung reflektiert, während $\ln y$ weiterhin den negativen Substitutionseffekt aus der Quantitäts-Qualitäts-Interaktion ins Spiel bringt. Der Effekt für die Entwicklung der zusammengefassten Geburtenziffer ist verblüffend: Sie verharrt in allen vier betrachteten Ländern über den gesamten Zeithorizont der Simulationen praktisch unverändert auf ihrem gegenwärtigen Niveau (vgl. Abbildung 4). Nimmt man dieses Resultat ernst, bedeutet es, dass sich die Einkommens- und Substitutionseffekte steigender Pro-Kopf-Einkommen und steigender Opportunitätskosten im Regelfall exakt ausgleichen. Zu beachten ist dabei, dass sich dieses Ergebnis zwar unmittelbar aus einer in sich schlüssigen Modellierung ergibt. Es hängt zugleich aber ganz an einer nicht näher belegbaren Interpretation der hier vorgelegten empirischen Schätzungen. In jedem Fall erscheint es plausibler als das vom Basisszenario 1 ableitbare Resultat, dass steigende Einkommen die Geburtenzahlen unzweideutig verringern.

In Ermangelung einer verlässlicheren Grundlage werden die Annahmen des Basisszenarios daher weiter modifiziert, um mögliche Langfrist-Effekte des demographischen Wandels und seiner Effekte für die laufende wirtschaftliche Entwicklung einzubeziehen. Wie in den Simulationen in Abschnitt 4 wird dabei unterschieden zwischen den Auswirkungen der im Zeitablauf allerorten tendenziell zunehmenden demographischen

Lastquotienten auf das BIP pro Kopf und den zusätzlichen Auswirkungen der Produktivitätseffekte der absehbaren Verschiebung der Altersstruktur der Erwerbstätigen (vgl. dazu auch Abbildung 3). Die Annahmen bezüglich $\ln y$ und – soweit erforderlich – h^m werden dabei jeweils entsprechend angepasst. Abbildung 4 zeigt an, dass die Effekte der jeweiligen „demographischen Lücke“ für die zukünftige Geburtenentwicklung in keinem Land besonders ausgeprägt sind, selbst wo und wenn die Effekte für das Wachstum von Pro-Kopf-BIP und Produktivität vergleichsweise groß ausfallen: Das sinkende Pro-Kopf-Einkommen durch steigende Dependenzquoten führt jeweils sogar zu einer leichten Erhöhung der simulierten Geburtenziffern, während die Produktivitätseffekte die Geburtenziffern in derselben Richtung modifizieren wie zuvor das Pro-Kopf-BIP.

Alles in allem kann in keinem der hier betrachteten Länder von einer erkennbaren „demographischen Rückkoppelung“ gesprochen werden, in deren Verlauf sich die Geburtenentwicklung durch ihre langfristigen Auswirkungen auf die wirtschaftliche Entwicklung auf Dauer wieder stabilisieren oder – im Gegenteil – vollkommen destabilisieren könnte. Vielmehr sieht es so aus, als ob sich die Geburtenziffern bei einem gewissen Maß an weiterem Wirtschaftswachstum und selbst bei einer anhaltenden Erhöhung von Qualifikationen und Erwerbsbeteiligung von Frauen jeweils auf ihrem aktuellen Niveau einpendeln. Eine weitere Voraussetzung für solche Entwicklungen ist, dass keine Änderungen der staatlichen Politikparameter – in den vorliegenden Schätzungen: der Ausgaben für Familienpolitik und für Renten – eintreten. Umgekehrt folgt daraus jedoch, dass die politischen Rahmenbedingungen elterlicher Entscheidungen über Kinder die wesentlichen Stellschrauben darstellen, um die Geburtenziffer eines Landes wieder nachhaltig zu erhöhen, wenn diese gegenwärtig sehr niedrig geworden ist.

Vorsichtshalber sei abschließend darauf hingewiesen, dass keine der hier vorgestellten Simulationen als ernsthafte Prognose zukünftiger Geburtenzahlen verstanden werden sollte. Mit ihrer Hilfe können jedoch einige grundlegende Tendenzen hervorgehoben werden, die die zukünftige Entwicklung dieser Zahlen mitbestimmen werden. Ob und inwieweit sie sich materialisieren, wird dabei unter anderem auch eine Frage zahlloser offener Entscheidungen auf individueller und kollektiver Ebene sein. In den Bereich wichtiger kollektiver Entscheidungen fällt z. B. die hier zuletzt angesprochene Möglichkeit, die Politik in Ländern mit niedriger Fertilität wie Deutschland und Japan in den Bereichen Familienförderung und Alterssicherung oder – allgemeiner ausgedrückt – im Bereich der intergenerationellen Umverteilung anders auszurichten als bisher. Konkrete Optionen dafür und ihre Auswirkungen auf Geburtenzahlen und Familienstrukturen in ausgewählten EU-Ländern werden im zweiten Teil dieser Arbeit näher betrachtet.

Teil II:
Zur Wirksamkeit staatlicher Familienpolitik – Fallstudien zu Deutschland, Frankreich, dem Vereinigten Königreich und Schweden

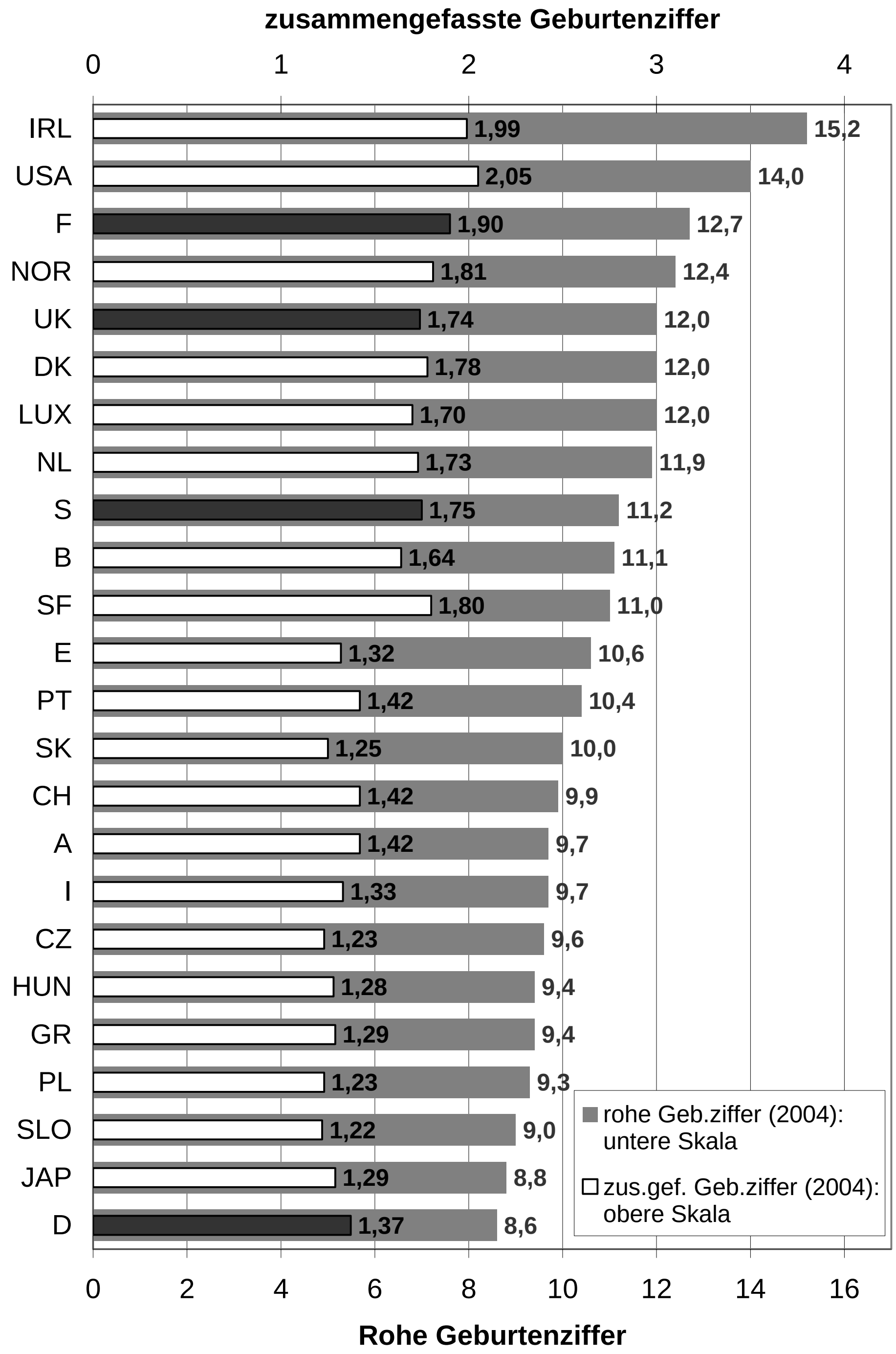
7. Geburtenentwicklung in ausgewählten europäischen Ländern

Der zweite Teil der Studie ist einem detaillierteren Vergleich der Auswirkungen familienpolitischer Maßnahmen auf grundlegende Trends und wichtige Strukturen der Geburtenentwicklung in entwickelten Volkswirtschaften gewidmet. Vor dem Hintergrund einschlägiger Angaben für eine größere Auswahl europäischer und sonstiger OECD-Länder werden dabei schwerpunktmäßig insbesondere vier EU-Länder betrachtet, nämlich Deutschland, Frankreich, das Vereinigte Königreich und Schweden. Die Auswahl impliziert zum einen, dass hier Länder mit gewissen grundlegenden Übereinstimmungen hinsichtlich kultureller Traditionen und aktueller wirtschaftlicher und sozialer Gegebenheiten in den Mittelpunkt der Analyse gestellt werden. Zum anderen weisen diese vier Länder jedoch überraschend große Unterschiede in der jeweiligen Geburtenentwicklung auf, und sie repräsentieren zugleich die drei wesentlichen, zeitgenössischen Typen sozialstaatlicher Arrangements, die in der einschlägigen sozialwissenschaftlichen Literatur gemeinhin unterschieden werden, nämlich das „kontinentaleuropäische“, das „angelsächsische“ und das „nordische“ Modell.

Abbildung 5 verdeutlicht zunächst, auf der Basis eines OECD-weiten Vergleichs, dass Deutschland unter den hier genauer betrachteten Ländern derzeit die mit Abstand geringste zusammengefasste Geburtenziffer aufweist: im Jahre 2004 beläuft sie sich auf der Basis des durchschnittlichen Geburtenverhaltens aller Frauen im gebärfähigen Alter auf lediglich 1,37 Geburten je Frau, während Frankreich (mit 1,90), das Vereinigte Königreich (mit 1,74) und Schweden (mit 1,75) Werte aufweisen, die deutlich näher am Wert von gut 2,0 liegen, der für eine stabile, bestandserhaltende Bevölkerungsentwicklung erforderlich wäre. Nach der einfacheren Maßzahl der rohen Geburtenziffer, d.h. der jährlichen Geburtenzahl je 1.000 Einwohner, nimmt Deutschland sogar den letzten Platz unter allen hier erfassten Ländern ein.

Diese Diskrepanz erklärt sich daraus, dass die jährliche zusammengefasste Geburtenziffer in (West-)Deutschland bereits in der ersten Hälfte der 1970-er Jahre, wesentlich schneller als in allen anderen OECD-Staaten, auf ihre heutiges, niedriges Niveau gefallen ist. Daher ist bereits der Anteil der Frauen im gebärfähigen Alter an der Gesamtbevölkerung in Deutschland nun niedriger als anderenorts, mit nachhaltigen Auswirkungen auf die zukünftige Altersstruktur des Landes. Für zahlreiche weitere Länder, spe-

Abb. 5: Rohe und zusammengefasste Geburtenziffer in OECD-Staaten (2004)



Quelle: Eurostat (2005).

ziell in Osteuropa, die gegenwärtig noch niedrigere Geburtenziffern aufweisen, lässt sich hingegen noch nicht abschließend beurteilen, ob sich der verschärfte Geburtenrückgang dort zumindest teilweise nur als temporäres Phänomen erweisen wird.

Die langfristigen Auswirkungen, die diese Entwicklung – trotz einer erwarteten, anhaltenden Nettozuwanderung – für den Altersaufbau der deutschen Wohnbevölkerung haben wird, wurden bereits in Teil I der Studie angesprochen. Gegenwärtig ähnelt die Alterstruktur der erwachsenen Bevölkerung Deutschlands noch annähernd der in anderen EU-Staaten: der Anteil der 70-Jährigen und Älteren an der Gesamtbevölkerung liegt bei 11,5%, in Frankreich bei 11,7%, im Vereinigten Königreich bei 11,4%, und nur in Schweden ist er deutlich höher, bei derzeit 13%. Ferner ist in allen vier Ländern die zahlenmäßig stärkste Altersgruppe, trotz eines leicht unterschiedlichen Timing und unterschiedlicher Stärke des „Baby-Booms" der Nachkriegszeit, derzeit noch die der 30–39-Jährigen. Nach aktuellen Bevölkerungsprojektionen der Vereinten Nationen (United Nations Population Division 2005) wird sich bei konstanter Geburtenziffer und „mittleren" Annahmen zur Entwicklung der Lebenserwartung und Zuwanderung der Anteil der 70-Jährigen und Älteren in Deutschland bis 2050 jedoch auf 24,5% erhöhen, in Frankreich auf 21,4%, im Vereinigten Königreich nur auf 18,6% und in Schweden auf 20,8%. Für die wirtschaftliche Entwicklung dieser Länder noch bedeutsamer ist nach den im ersten Teil dieser Studie vorgestellten Schätzungen, dass die am stärksten besetzte Altersgruppe der Wohnbevölkerung in Deutschland im Jahre 2050 voraussichtlich die der 60–69-Jährigen sein wird, im Vereinigten Königreich und in Schweden die der 50–59-Jährigen, in Frankreich hingegen die der 40–49-Jährigen.

Neben der Tatsache, dass sich der Geburtenrückgang in Deutschland in den letzten drei Jahrzehnten wesentlich rascher und nachhaltiger vollzogen hat als etwa in Frankreich, im Vereinigten Königreich oder in Schweden, lassen sich anhand verfügbarer, international vergleichbarer Daten weitere Aspekte der Geburtenentwicklung herausarbeiten, hinsichtlich derer sich Deutschland signifikant von den hier zum Vergleich herangezogenen EU-Partnerländern unterscheidet. Gerade diese Feinstrukturen des nationalen Fertilitätsverhaltens können dabei zugleich Aufschluss über Eigenarten und mögliche Defizite der nationalen Familienpolitik dieser Länder geben.

Erstens ergibt sich unter (west-)deutschen Frauen, die ihre gebärfähige Phase ganz oder zumindest annähernd vollendet haben, ein deutlich höherer Anteil, der lebenslang kinderlos bleibt bzw. aller Voraussicht nach bleiben wird (14,8 % bei den Geburtsjahrgängen um 1950; 21,3 % bei den Geburtsjahrgängen um 1960), als in Frankreich (7,7% bzw. 11,3%), im Vereinigten Königreich (bzw. in England und Wales: 13% bzw. 18%) und in Schweden (11,5% in beiden Fällen). Tendenziell dasselbe gilt auch für den Anteil von Frauen mit nur einem Kind. Deutlich niedriger als in den anderen Ländern fallen in (West-)Deutschland hingegen die Anteile von Frauen mit zwei sowie mit drei und mehr Kindern aus.[15] Soweit vergleichbare Angaben dazu vorliegen, scheint die Kinderlosigkeit deutscher Frauen ferner besonders ausgeprägt zu sein unter Frauen mit höheren Qualifikationen sowie unter Frauen, die in Haushalten mit überdurchschnittlichem Einkommen leben.[16] Diese Beobachtungen deuten darauf hin, dass hohe Opportunitätskosten der Geburt und Betreuung von Kindern in Deutschland in geringerem Maße durch finanzpolitische Instrumente ausgeglichen und/oder durch ausreichende institutionelle Betreuungsangebote vermindert werden als anderenorts. Zu prüfen ist außerdem, ob sich familienpolitische Leistungen, z. B. durch niedrige Einkommensgrenzen und rasches Abschmelzen wichtiger Elemente, tendenziell auf Haushalte mit geringem Einkommen konzentrieren.

Zweitens weist Deutschland, trotz der niedrigen Geburtenziffer, im internationalen Vergleich zugleich eine relativ niedrige Erwerbsquote von Frauen auf. Interessant ist in diesem Zusammenhang, dass ein breiter angelegter internationaler Vergleich mit einer einfachen Gegenüberstellung von Frauenerwerbsquoten und Geburtenziffern auf den ersten Blick überhaupt keinen Konflikt zwischen den beiden damit bezeichneten Aktivitätsbereichen von Eltern, namentlich von Müttern, erkennen lässt. Dies veranschaulicht Abbildung 6: Während die Erwerbsbeteiligung aller Frauen im Alter von 15 bis 64 Jahren in Frankreich ungefähr so hoch ist wie in Deutschland, ist die zusammengefasste Geburtenziffer dort wesentlich höher. Ganz ähnlich weist Schweden annähernd dieselbe Geburtenziffer auf wie das Vereinigte Königreich, jedoch eine deutlich höhere Frauenerwerbsbeteiligung. Sowohl das Vereinigte Königreich als auch Schweden haben in beiden Bereichen außerdem höhere Werte als Deutschland. Letztlich suggeriert die Graphik unter Berücksichtigung weiterer Länder insgesamt eher eine positive Korrelation der beiden hier betrachteten Größen (mit Italien und Norwegen als den beiden extremen Ausprägungen, während die USA eher als *Outlier* erscheinen) denn eine negative.

Eine differenziertere Deutung des in der Abbildung gezeigten Bildes schlagen Apps und Rees (2004) sowie Kögel (2004) vor. Sie argumentieren, dass innerhalb jedes Landes

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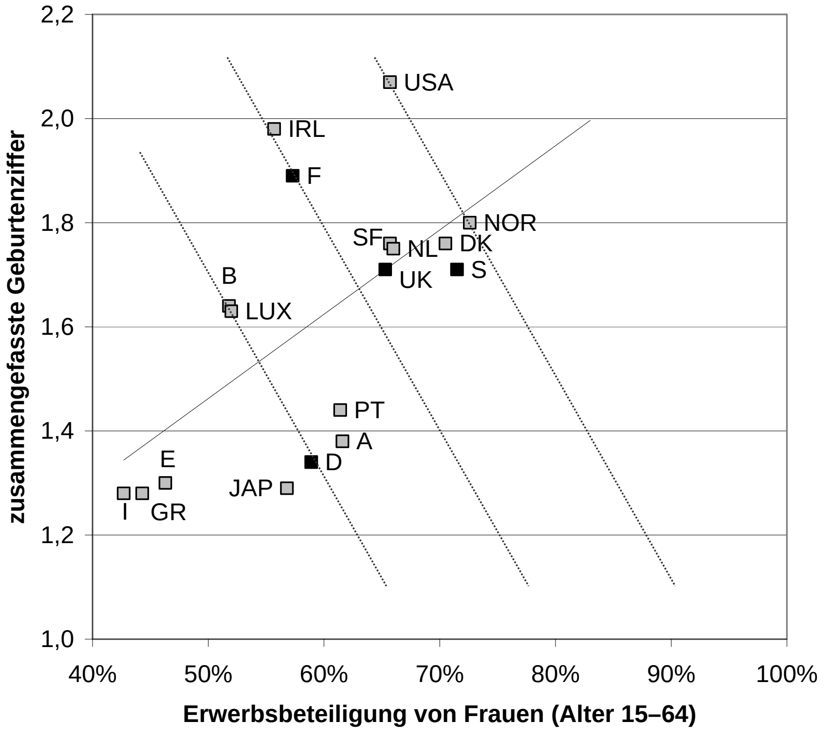
[15] Quelle dieser Angaben ist United Nations Economic Commission for Europe (2005), ergänzt mit Informationen des Bundesinstituts für Bevölkerungsforschung (2004) und des britischen Office of National Statistics (2004). – Man beachte dabei, dass sich das Timing der Geburten, die gleichwohl stattfinden, gemessen am Durchschnittsalter Erstgebärender, zwischen diesen vier Ländern kaum unterscheidet. Diese Beobachtung legt nahe, dass die allseitige Erhöhung des Durchschnittsalters von Müttern kein wesentlicher Bestimmungsfaktor der beobachteten Unterschiede in den nationalen Geburtenziffern ist und dass deutsche Frauen letztlich nicht überproportional ungeplant kinderlos bleiben.

[16] Vgl. dazu erneut United Nations Economic Commission for Europe (2005) sowie D'Addio und d'Ercole (2005).

und für jede betroffene Frau unweigerlich ein Zielkonflikt zwischen der Beteiligung am Erwerbsleben und der Geburt und Betreuung eines (weiteren) Kindes besteht, der in verschiedenen Ländern aber durch unterschiedliche institutionelle Rahmenbedingungen – z. B. durch ein ausreichendes Kinderbetreuungsangebot, aber auch durch steuerliche Rahmenbedingungen, familienpolitische Transfers, Unterstützung durch private Netzwerke, im Arbeitsumfeld und durch Arbeitgeber, etc. – verschieden gut entschärft werden kann. Insofern finden sich Frauen in verschiedenen Ländern auf unterschiedlichen „Budgetgeraden" (wie diejenigen, die in der Graphik tentativ eingezeichnet sind). Die Lage dieser Geraden zeigt dann an, wie gut betroffene Frauen unter den jeweiligen Rahmenbedingungen mit dem genannten Zielkonflikt im Durchschnitt umgehen können. Frauen in Frankreich, im Vereinigten Königreich und in Schweden wären so gesehen durchgängig besser gestellt als in Deutschland.

Abb. 6: Geburtenziffer und Frauenerwerbsbeteiligung in OECD-Ländern (2003)



Quellen: Eurostat (2005); OECD (2005a); nationale statistische Ämter.

Interessant sind darüber hinaus wiederum einige Feinstrukturen des Verhältnisses zwischen Frauenerwerbsbeteiligung und Mutterschaft. So ist die Erwerbsquote von Frauen, die tatsächlich Kinder haben, in Deutschland im Vergleich zu Frankreich, dem Vereinigten Königreich oder Schweden klar die niedrigste. Dies gilt in besonderem Maße für die Erwerbsquote von Müttern mit zwei oder mehr Kindern, wo vor allem Schweden einen absoluten Spitzenwert erreicht; für die Erwerbsquote von Müttern kleiner Kinder im Alter unter 3 Jahren, wo Frankreich und Schweden deutlich höhere Werte aufweisen; sowie auch für die Erwerbsquote von Müttern mit Kindern im Pflichtschulalter von 6–14 Jahren, wo alle drei Vergleichsländer, wiederum vor allem Schweden, erkennbar höhere Werte realisieren (vgl. OECD 2002, 2005b). Auch diese Befunde deuten auf besondere Schwierigkeiten für deutsche Frauen hin, Familie und Erwerbstätigkeit zu vereinbaren. Solche Schwierigkeiten können natürlich zurückwirken auf die Entscheidung, überhaupt Kinder zu haben, oder zumindest auf die Bereitschaft, die entsprechenden Konflikte wiederholt einzugehen und größere Kinderzahlen anzustreben.

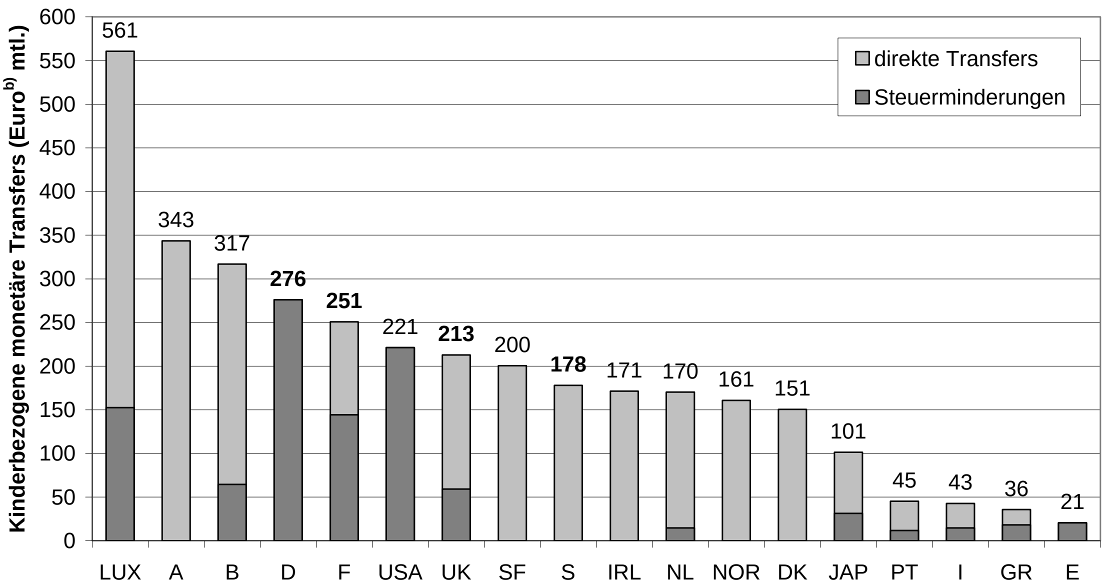
Von besonderem Interesse ist im nächsten Untersuchungsschritt schließlich, ob und inwieweit die genannten Besonderheiten hinsichtlich Niveau und Strukturen der Geburtenentwicklung in den hier genauer betrachteten Länder – mindestens teilweise – mit Charakteristika der dort jeweils betriebenen Systeme familienpolitischer Maßnahmen erklärt werden können.

8. Familienpolitische Maßnahmen in ausgewählten europäischen Ländern

Das Feld familienpolitischer Maßnahmen wird in der vorliegenden Studie einerseits klar eingegrenzt, mit einer Beschränkung auf fiskalische Instrumente, welche die Einnahmen- oder Ausgabenseite des Staatsbudgets berühren. Andererseits wird es, abgesehen von dieser Vorgabe, bewusst breit ausgelegt und umfasst daher auch Bereiche, die in anderen Arbeiten oft vernachlässigt werden. Neben direkten Transfers und speziellen steuerlichen Regelungen für Familien mit wirtschaftlich abhängigen Kindern werden hier auch eine ganze Reihe von Sachleistungen erfasst, die in die Bereiche Kinderbetreuung, schulische Bildung und Gesundheitskosten von Kindern fallen. Außerdem werden, anknüpfend daran, weitere staatliche Maßnahmen im Bereich der intergenerationellen Umverteilung einbezogen, die, namentlich in Gestalt der staatlichen Altersvorsorge, de facto eher den Charakter einer „Familienpolitik mit negativem Vorzeichen“ annehmen können, selbst wenn zugleich auch der wachsende Umfang kinderbezogener Leistungen im Rahmen der gesetzlichen Alterssicherung berücksichtigt wird.

Vergleicht man zunächst die Niveaus monetärer staatlicher Leistungen an Familien mit wirtschaftlich abhängigen Kindern für eine größere Auswahl an OECD-Ländern, so fällt auf, dass Deutschland in dieser Hinsicht mittlerweile eine Position in der „oberen“ Hälfte, d. h. unter den Ländern mit relativ hohen Leistungen, einnimmt. Zwar ist dies in erster Linie getrieben durch eine Reihe einschlägiger Beschlüsse des Bundesverfassungsgerichts und weniger durch originäre politische Entscheidungen. Den Befund als solchen belegt jedoch Abbildung 7, die auf Erhebungen im Rahmen eines breit angelegten, internationalen Vergleichs basiert (vgl. Bradshaw und Finch 2002) und sich auf den Fall eines Ehepaar-Haushalts mit zwei Kindern und einem bestimmten, insgesamt eher mittleren bis leicht überdurchschnittlichen Einkommensniveau konzentriert. Deutschland wird allerdings, mindestens für die in der Abbildung betrachtete, spezifische Fallkonstellation, dicht gefolgt von Frankreich, und auch das Vereinigte Königreich und Schweden nehmen Plätze oberhalb und in der Mitte der Verteilung der Länder nach Leistungsniveaus ein.

Abb. 7: Kinderbezogene monetäre Leistungen[a)] in OECD-Ländern (2001)
– Zwei-Verdiener-Paar mit zwei Kindern



Anmerkungen:

a) Die Berechnungen beziehen sich auf ein Ehepaar mit zwei Kindern im Alter von 7 und 14 und einem Einkommen in Höhe des nationalen Durchschnittslohns für Männer zuzüglich des halben nationalen Durchschnittlohns für Frauen. Betrachtet wird die Differenz des verfügbaren Nettoeinkommens (nach Steuern und monetären, kinderbezogenen Sozialleistungen) zu dem eines kinderlosen Paares mit gleichem Bruttoeinkommen.

b) Ursprüngliche Angaben in nationalen Währungseinheiten; umgerechnet in € anhand offizieller Umstellungskurse der EZB für Länder der Eurozone, ansonsten mit Hilfe der OECD-Kaufkraftparitäten.

Quelle: Bradshaw und Finch (2002), kombiniert mit Information aus den zugehörigen „Ländermatrizen".

Weitere Differenzierungen des Vergleichs der hier erfassten direkten Transfers und steuerlichen Regelungen ergeben außerdem, dass ihre Effekte in Deutschland mit der Zahl der Kinder im Wesentlichen proportional zunehmen – dasselbe gilt nach einer mittlerweile erfolgten Rechtsänderung auch im Vereinigten Königreich –, während sie in Schweden leicht, in Frankreich sogar sehr prononciert mit höheren Kinderzahlen ansteigen. Ferner gewähren zwar alle vier Staaten tendenziell höhere Leistungen an Familien mit niedrigem Einkommen, oberhalb durchschnittlicher Einkommen variieren diese in Deutschland, im Vereinigten Königreich und in Schweden aber kaum oder gar nicht mehr mit dem jeweiligen Haushaltseinkommen, während sie in Frankreich tendenziell zunehmen. Dies ist insbesondere ein Effekt des in Frankreich praktizierten „Familiensplittings" bei der Einkommensteuer, während ähnliche, aber weit schwächere Effekte der deutschen Kinderfreibetrags-Lösung durch das alternativ gewährte, einheitliche Kindergeld weitgehend überlagert werden.[17] Im Vereinigten Königreich erhalten Familien mit geringem Erwerbseinkommen die höchsten Leistungen – höhere als völlig einkommenslose Familienhaushalte –, was integraler Bestandteil der dort verfolgten Politik einer aktivierenden Politik der Armutsvermeidung durch kinderbezogen differenzierte Kombilöhne, d. h. durch aufstockende Sozialleistungen für Geringverdiener, ist.[18]

Unterschiede zwischen diesen vier Ländern ergeben sich auch im Bereich besonderer monetärer Transfers an Familien mit kleinen Kindern. Während in Deutschland in Gestalt des Erziehungsgeldes bisher vergleichsweise niedrige (und stark negativ einkommensabhängige) Leistungen für eine mittlere Laufzeit von 2 Jahren gewährt werden, gibt es in Frankreich nochmals niedrigere Leistungen für eine längere Zeit (bis zu 3 Jahre), in Schweden hingegen deutlich höhere, überdies positiv einkommensabhängige „Lohnersatzleistungen" für eine wesentlich kürzere Zeit (13 Monate). Im Vereinigten Königreich existieren solche Leistungen vor allem für Alleinerziehende mit geringem Erwerbseinkommen, da dieser Personenkreis dort – anders als andere Personengruppen – kaum zur Aufnahme einer Erwerbstätigkeit verpflichtet wird, um eine anderenfalls drohende Sozialleistungsbedürftigkeit abzuwenden.[19]

Ein erkennbarer Rückstand Deutschlands gegenüber den anderen, hier betrachteten Ländern ergibt sich im Bereich des Angebots an Kinderbetreuungseinrichtungen, speziell für Unter-3-Jährige. Auch bei den 3–4-Jährigen, d. h. im unteren Kindergartenalter, nimmt Deutschland unter einer größeren Zahl von OECD-Staaten lediglich einen Platz

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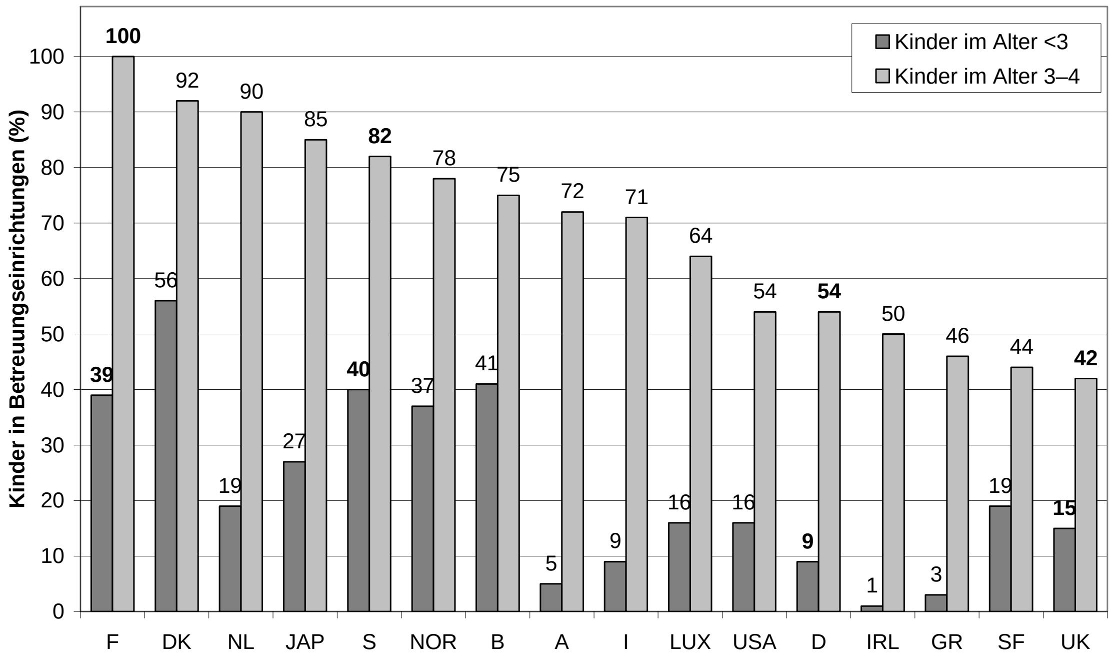
[17] Da das Kindergeld seit 1996 für Normalfälle ebenfalls im Rahmen des deutschen Einkommsteuergesetzes geregelt ist, werden die in Abbildung 7 für Deutschland erfassten Leistungen in vollem Umfang als Steuerminderungen klassifiziert.

[18] Auch diese zusätzlichen Informationen lassen sich den sehr differenzierten Erhebungen von Bradshaw und Finch (2002) entnehmen.

[19] Vgl. erneut Bradshaw und Finch (2002) sowie Angaben aus den dazu gehörigen „Ländermatrizen".

im unteren Mittelfeld ein, es rangiert in diesem Fall aber immerhin noch deutlich vor dem Vereinigten Königreich. Frankreich und Schweden hingegen weisen für beide Altersgruppen einen wesentlich höheren Versorgungsgrad mit Betreuungseinrichtungen auf. Schweden, das als einziges der hier genauer betrachteten Länder für Kinder im Alter unter 3 eine Garantie auf Zugang zu einer öffentlichen Betreuungseinrichtung gibt, erreicht für diese Altersstufe einen Versorgungsgrad von 40%. In Frankreich ergibt sich für Kinder ab dem vollendeten 3. Lebensjahr durch die Pflicht zum Eintritt in eine *École maternelle* sogar einen Versorgungsgrad von 100%. Einen Überblick über entsprechende Daten gibt Abbildung 8.

Abb. 8: Anteil der Kinder im Alter <3[a] und 3–4[b] in Kinderbetreuungseinrichtungen in OECD-Ländern (2000)[c]



Anmerkungen:

a) Belgien: 3 Monate bis 2,5-Jährige; Irland: Unter-4-Jährige; Norwegen: 1–2-Jährige.

b) Belgien: 2,5–6-Jährige; Griechenland: 3–5,5-Jährige; Irland: 4-Jährige; Italien: 3–5-Jährige; Niederlande 3-Jährige; Norwegen: 2-Jährige,

c) Finnland und Italien: 1998; Belgien, Deutschland (3–4-Jährige), Japan, Niederlande, Schweden, Vereinigtes Königreich und USA: 1999.

Quelle: Bradshaw und Finch (2002).

Eine geringe Inanspruchnahme von Kinderbetreuungseinrichtungen ist allerdings nicht notwenig nur ein Ausdruck eines geringen Angebots, das schon aufgrund weit verbreiteter staatlicher Regulierungen fast unweigerlich zumindest in eine öffentliche Mitverantwortung fällt. Sie kann vielmehr auch mit einer geringen Nachfrage aufgrund hoher Gebühren und sonstiger Kosten zu tun haben. In der Erhebung von Bradshaw und Finch (2002, Kap. 5) werden daher auch üblicherweise zu entrichtende Kosten für die jeweils vorherrschende Form von Kinderbetreuung (im Falle Unter-3-Jähriger in Deutschland und Schweden: öffentlich betriebene Kinderkrippen; in Frankreich und im Vereinigten Königreich: Tagesmütter) erfasst. Diese Kosten liegen im Vereinigten Königreich (mit rund € 530 pro Monat im Jahre 2001, umgerechnet zu Kaufkraftparitäten) deutlich höher als in den anderen, hier genauer betrachteten Staaten, weil private Arrangements zur Betreuung kleiner Kinder dort nicht staatlich subventioniert werden. In Deutschland sind die Gebührensätze (in Höhe von durchschnittlich rund € 330 pro Monat, die bei niedrigerem Einkommen der Eltern häufig auch bis auf Null reduziert werden) hingegen in nennenswertem Maße öffentlich subventioniert. Durchschnittliche Gebühren und sonstige Nettokosten der außerhäuslichen Kinderbetreuung fallen in Frankreich (€ 200 bis € 270) und Schweden (€ 140 bis € 210) nochmals niedriger aus. Allerdings erklären diese Gebühren- und Kostenunterschiede – vielleicht mit Ausnahme des Vereinigten Königreichs – kaum die massiven internationalen Differenzen bei Angebot und Nutzung von Betreuungseinrichtungen.

Ein für Deutschland wenig günstiges Bild ergibt sich im Übrigen auch bei einem Vergleich aller öffentlichen und privaten Kosten, die in den OECD-Ländern zur Finanzierung von Bildungseinrichtungen aller Art anfallen. In der Verteilung der Länder nach dem Anteil entsprechender Ausgaben am BIP liegt Deutschland (mit einem Anteil von 3,7%) klar in der unteren Hälfte, während Frankreich, das Vereinigte Königreich und Schweden (mit um 0,5 bis 1,0 Prozentpunkten höheren Anteilen) in der oberen Hälfte rangieren (vgl. OECD 2005c). Korrigiert man diese Kennziffer noch um die gleichfalls variierenden Anteil von Schülern an der Gesamtbevölkerung, so zeigt sich, dass Deutschland möglicherweise zumindest eine suboptimale Struktur der Bildungsausgaben nach Stufen des Bildungssystems realisiert: Bei den Bildungsausgaben je Schüler, gewichtet mit dem BIP pro Kopf, liegt Deutschland im Bereich der Primarstufe und der unteren Sekundarstufe weiterhin am unteren Ende der Verteilung der OECD-Länder; lediglich im Bereich der oberen Sekundarstufe rückt es auf einen vorderen Platz vor (vgl. wiederum OECD 2005c). International vergleichende Evaluationsstudien zeigen zwar, dass es generell bestenfalls eine schwache Korrelation zwischen dem Niveau nationaler Bildungsausgaben und den Leistungen von Schülern gibt (vgl. Wößmann 2002, 2005), dass ein positiver Zusammenhang aber, wenn überhaupt, gerade auf den unteren Stufen des Bildungssystems besteht.

Während diese Überlegungen eher zu einer vergleichenden Diskussion bildungspolitischer Maßnahmen verschiedener Länder überleiten, erfüllt die in praktisch allen entwickelten Ländern geltende Schulpflicht für Kinder im Alter zwischen 4–6 Jahren und 14–18 Jahren jedoch noch eine weitere Funktion, auch wenn diese hinter den Bildungsauftrag der Schulen in der Regel zurücktritt: Die Dauer von Schuljahr, Schulwoche und Schultag beeinflusst, inwieweit insbesondere die Eltern jüngerer Schulkinder von Betreuungsaufgaben entlastet werden und etwa ungehinderter einer Erwerbstätigkeit nachgehen können. Bei einem Vergleich einschlägiger Daten (vgl. nochmals OECD 2005c) fällt auf, dass die Zahl der jährlichen Unterrichtsstunden für Schüler zwischen 7 und 11 Jahren in Deutschland im OECD-Vergleich klar unterdurchschnittlich ist – lediglich in Schweden ergeben sich ähnlich niedrige Werte, während im Vereinigten Königreich rund 50% Unterrichtsstunden mehr anfallen. Ferner erweist sich Deutschland im Vergleich mit Frankreich, dem Vereinigten Königreich und Schweden als das einzige Land, in dem der Unterricht üblicherweise Mittags endet und die Kinder ohne Schulspeisung nach Hause gehen, sofern sie nicht einen Platz in separaten Betreuungseinrichtungen („Horten“) haben.

Ein weiterer wichtiger Typ von Sachleistungen, die Kinder in entwickelten Volkswirtschaften üblicherweise unentgeltlich oder gegen geringe Gebühren erhalten, sind Leistungen der nationalen Gesundheitssysteme. In staatlichen Krankenversicherungen sind Kinder zumeist betragsfrei mitversichert, und in vielen Ländern sind sie auch ganz oder teilweise von Zuzahlungen zu diversen Gesundheitsleistungen entbunden, die dort ansonsten als zusätzliche Einnahmequelle und zur Steuerung des Patientenverhaltens eingeführt worden sind. Ein standardisiertes Paket von Gesundheitsdienstleistungen für Kinder wird daher in Deutschland, im Vereinigten Königreich und in Schweden im Regelfall effektiv unentgeltlich angeboten; lediglich in Frankreich ergeben sich geringe Zuzahlungen (von monatlich € 4 bis 11; vgl. Bradshaw und Finch 2002, Kap. 6).[20] Zu beachten ist dabei allerdings, dass die weitgehend unentgeltliche Inanspruchnahme von Gesundheitsleistungen durch Kinder im Rahmen staatlicher Krankenversicherungssysteme oder staatlicher Gesundheitsdienste nicht bedeutet, dass die Kinder auf diese Weise einen lebenslangen Nettotransfer erhalten. Vielmehr entrichten sie normalerweise ab Eintritt ins Erwerbsleben eigene Beiträge, mit denen sie den Gegenwert der zuvor empfangenen Leistungen in der Regel rasch abgezahlt haben. Anschließend werden sie in-

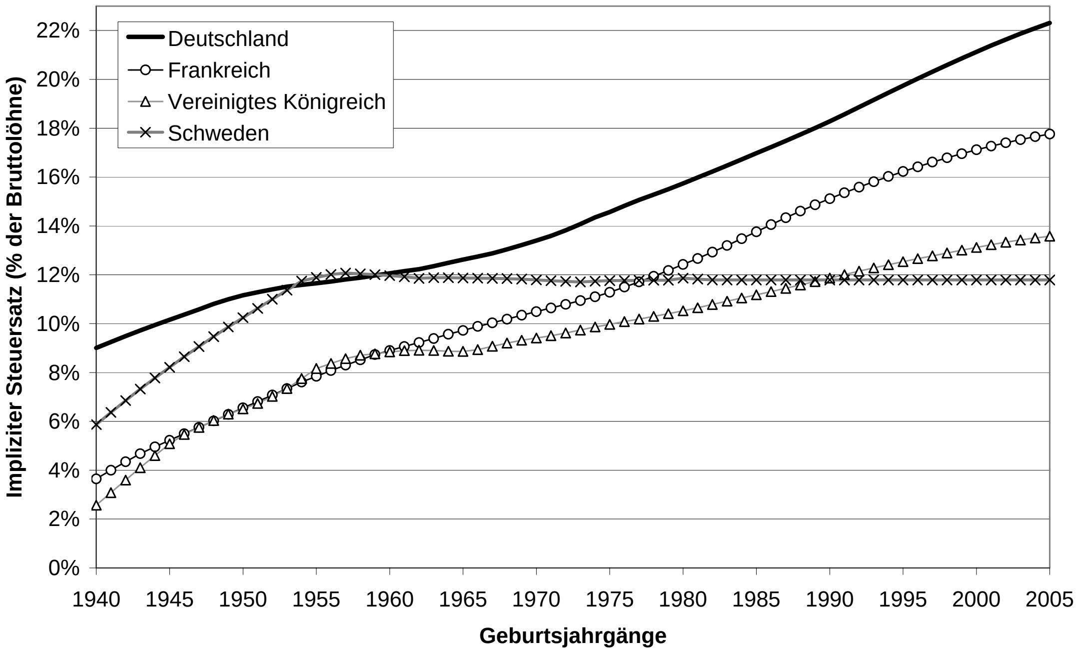
[20] Nennenswerte Abweichungen von dieser Norm finden sich unter den OECD-Ländern im Übrigen nur in den Niederlanden und in den USA. In den Niederlanden ergeben sich bei Familien mit überdurchschnittlichem Einkommen unter Umständen spürbare Zuzahlungen zu Gesundheitsleistungen für Kinder, in den USA werden sie nur gegen volle, risikoadäquate Prämien versichert.

nerhalb der weit verbreiteten Umlagefinanzierung solcher Systeme zu Nettozahlern, die über ihren gesamten Lebenszyklus per saldo in nennenswertem Maße belastet werden, und zwar jeweils zu Gunsten älterer Versicherter bzw. Leistungsempfänger.

Am deutlichsten und quantitativ wohl auch am gewichtigsten ist diese intergenerationelle Umverteilung, die unweigerlich zu Lasten von Kindern (gegenüber Angehörigen der nächst-älteren Generation) und – ohne gezielte Korrekturen – auch von Eltern (gegenüber Kinderlosen) geht, im Bereich umlagefinanzierter staatlicher Alterssicherungssysteme. Die bereits in Teil I der vorliegenden Arbeit angesprochene „fiskalische Externalität" von Kindern, die im Rahmen solcher Systeme entsteht und die Fertilitätsentscheidungen potentieller Eltern verzerrt, kann dabei auch als eine implizite Steuer auf das Lebensarbeitseinkommen der Kinder interpretiert werden, die sich aus der barwertmäßigen Differenz zwischen den von ihnen geleisteten Beiträgen und den von ihnen in Anspruch genommenen Leistungen ergibt (vgl. Thum und Weizsäcker 2000, Fenge und Werding 2003, 2004).

Auf der Basis international vergleichender Modellrechnungen für ausgewählte OECD-Länder haben Fenge und Werding (2004) gezeigt, dass diese implizite Steuer in Deutschland für alle Geburtsjahrgänge ab etwa 1960 deutlich höher ausfällt als etwa in Frankreich, im Vereinigten Königreich oder in Schweden (vgl. Abbildung 9). Während ihr allgemeiner Aufwärtstrend, der vor allem durch den demographischen Wandel bedingt ist, im Vereinigten Königreich durch fast zwei Jahrzehnte mit Rentenanpassungen auf der Basis eines reinen Inflationsausgleichs stark gedämpft und in Schweden durch einen konsequenten Umbau des Rentensystems mit Fixierung der Beitragssätze aller Voraussicht nach sogar gestoppt wurde, ergibt sich in Deutschland – zumindest noch unter den Rahmenbedingungen der Rentenreform von 2001 – ein ungebrochener Anstieg. Grund dafür ist die jahrzehntelang verfolgte Politik, nach der das Rentenniveau trotz der absehbaren, immer weiter wachsenden Anspannung der Rentenfinanzen jeweils möglichst konstant gehalten werden sollte, um den Preis enorm steigender Beitragssätze. Die Resultate für Deutschland dürften sich erst durch die hier noch nicht erfasste Rentenreform von 2004 merklich geändert haben. In dem Maße, wie die darin liegende Abkehr von einer langjährigen Politik für alle davon Betroffenen unerwartet kam, dürfte aber eher der in Abbildung 9 zugrunde gelegte, ältere Rechtsstand bei elterlichen Fertilitätsentscheidungen in den letzten drei Jahrzehnten verhaltensbestimmend gewesen sein. Ein ähnlicher Trend wie in Deutschland zeigt sich lediglich für das französische staatliche Rentensystem. Allerdings fällt das Niveau der impliziten Steuern dort niedriger aus, weil das Niveau der Rentenleistungen (ohne die gleichfalls obligatorische betriebliche Altersvorsorge) dort geringer ist. Außerdem bewirkt die günstigere demographische Entwicklung, dass der anhaltende Anstieg für die jüngsten, hier berücksichtigten Geburtsjahrgänge sich, anders als in Deutschland, abschwächt.

Abb. 9: Implizite Steuer in den staatlichen Rentensystemen in Deutschland, Frankreich, dem Vereinigten Königreich und Schweden (Rechtsstand 2003)



Anmerkung:

Der “implizite Steuersatz” jedes Geburtsjahrgangs ist definiert als Differenz zwischen den Barwerten aller während des gesamten Lebenszyklus entrichteten Rentenbeiträge und aller in Anspruch genommenen Leistungen (Erwerbsminderungsrenten, Altersrenten und Hinterbliebenenrenten), bezogen auf den Barwert aller lebenslang erzielten Bruttolöhne. Die Berechnungen basieren auf der stilisierten Biographie eines „durchschnittlichen Versicherten“ und auf langfristigen Simulationen zur finanziellen Entwicklung der betrachteten Rentensysteme, die mit Hilfe des CESifo-Rentenmodells erstellt wurden.

Quelle: Fenge und Werding (2004).

Neben der Belastung von Kindern, die im Umlageverfahren finanzierten, staatlichen Rentensystemen fast automatisch innewohnt, bietet eine wachsende Zahl solcher Systeme jedoch auch spezielle, kinder- oder erziehungszeitenbezogene Rentenansprüche, die ihre negativen Effekte für die Geburtenentwicklung zumindest reduzieren können. Entsprechende Regelungen, die allerdings sehr verschieden ausgestaltet sind, existieren mittlerweile etwa in Deutschland, Frankreich, dem Vereinigten Königreich wie in Schweden. Motiviert wurde ihre Einführung häufig mit der Tatsache, dass Zeiten der häuslichen Kinderbetreuung, gemessen an den Rentenansprüchen von Versicherten mit ununterbrochener Erwerbsbiographie, vor allem für Mütter in der Regel mit Verlusten an regulären, erwerbs- oder lohnbezogenen Anwartschaften einhergehen. Zwar ist dieses Argument etwas vordergründig – die implizite Steuer der Rentensysteme begrenzt die insgesamt anfallenden Opportunitätskosten sogar eher, nämlich auf die jeweils entgangenen Nettolöhne –, gleichwohl sind kinderbezogene Renten geeignet, die Kosten der Erziehung von Kindern weiter zu vermindern und damit Anreize für eine insgesamt wieder zunehmende Fertilität zu setzen. Ihrer genauen Ausgestaltung nach können die einschlägigen Regelungen in Deutschland, Frankreich und Schweden außerdem bewirken, dass Mütter mit relativ kurzer Erziehungspause insgesamt sogar höhere Renten erhalten als kinderlose Frauen mit vergleichbaren Qualifikationen und Löhnen bei durchgängiger Erwerbstätigkeit (vgl. Cigno und Werding 2006, Kap. 4). Die Regelungen gehen damit über den Ausgleich eines vordergründig bestehenden Verlustes hinaus und prämiieren explizit die Geburt und Betreuung von Kindern. Allerdings ist der Effekt dieser Regelungen, die in Deutschland, wiederum nicht zuletzt durch einschlägige Urteile des Bundesverfassungsgerichts und nicht durch unabhängige, politische Entscheidungen, tendenziell am weitesten ausgebaut sind, insgesamt bei Weitem zu gering, um die negativen Fertilitätsanreize des Rentensystems als solchen auch nur annähernd zu kompensieren.

Durch umfassende Berechnungen zur „fiskalischen Bilanz“ eines Kindes, das seinen gesamten Lebenszyklus unter den Rahmenbedingungen des gegenwärtigen deutschen Steuer- und Sozialsystems durchläuft, haben Werding und Hofmann (2005) gezeigt, dass dasselbe auch für die Gegenüberstellung aller Beiträge und Leistungen der Sozialsysteme sowie der quantitativ gewichtigsten Steuerzahlungen und steuerfinanzierter Leistungen gilt. Selbst unter detaillierter Berücksichtigung der insgesamt durchaus nennenswerten familienpolitischen Leistungen des Staates, einschließlich der staatlichen Bildungsfinanzierung fällt die Bilanz aus der Sicht des betrachteten Kindes negativ aus. Im Rahmen der intergenerationellen Umverteilung durch die in Deutschland stark ausgebauten, umlagefinanzierten Sozialversicherungen (und wegen der hohen, laufenden Staatsverschuldung) belastet das deutsche Fiskalsystem Kinder per saldo weit stärker als es sie durch einzelne Instrumente der Familien- und Bildungspolitik begünstigt. Vergleichbare Berechnungen für andere Länder fehlen leider.

Empirische Untersuchungen, die die Auswirkungen familienpolitischer Maßnahmen auf die Geburtenentwicklung in einzelnen Ländern oder sogar vergleichend für mehrere Länder analysieren, sind selten. Studien, die auch nur annähernd einen so umfangreichen Satz an Maßnahmen einbeziehen wie der hier erarbeitete Überblick, existieren in der Literatur gar nicht. Dies liegt in erster Linie am Mangel hinreichend detaillierter, im

Idealfall überdies international voll vergleichbarer Mikro-Datensätze. Untersuchungen der Effekte familienpolitischer Maßnahmen auf der Mikro-Ebene konzentrieren sich daher in der Regel auf einzelne Länder und einzelne Instrumente, bei denen eine gewisse Variation über die Zeit oder zwischen verschiedenen Regionen eine quasi-experimentelle Situation schaffen, in der solche Effekte ökonometrisch messbar werden. Daneben gibt es einige Studien, darunter auch international vergleichende, die die Auswirkungen familienpolitischer Maßnahmen auf der Basis von aggregierten oder Durchschnittswerten und damit auf der Makro-Ebene abzuschätzen versuchen, wie dies auch im ersten Teil dieser Studie getan wurde. Die Maßnahmen werden dabei in der Regel jedoch nur in relativ grober Form erfasst.

Einen Überblick über existierende empirische Arbeiten, schwerpunktmäßig über Studien für Deutschland, Frankreich, das Vereinigte Königreich und Schweden sowie für Studien auf der Basis von Mikro-Daten, hat jüngst Meier (2005) erarbeitet. Die in diesem Survey erfassten ökonometrischen Untersuchungen bestätigen praktisch ohne Ausnahme, dass monetäre Leistungen für Familien und Kinder das Timing von Geburten und darüber hinaus auch die endgültige Kinderzahl einer Familie beeinflussen können.[21] Dies entspricht auch den Ergebnissen der hier zuvor präsentierten Makrodaten-gestützten Analyse (vgl. Abschnitt 6). Weit unklarer ist nach dem Stand der empirischen Forschung, ob die Verfügbarkeit oder die Nutzung von Kinderbetreuungseinrichtungen einen signifikanten Einfluss auf das Geburtenverhalten haben. Bestätigt wird dies eigentlich nur im Rahmen international vergleichender Studien auf der Basis von Makrodaten (vgl. etwa Castles 2003, Sleebos 2003). Mikrodaten-Studien finden zumeist keinen signifikanten Zusammenhang oder teilweise sogar negative Effekte (vgl. etwa Hank et al. 2004 oder Andersson et al. 2004). Zu berücksichtigen ist dabei allerdings, dass der derzeitige Forschungsstand in diesem Punkt durch Beschränkungen der verfügbaren Daten und, vielleicht mehr noch, durch grundlegende Schwierigkeiten geprägt sein kann, die teils simultanen, teils sequentiellen Entscheidungen potentieller Eltern über die Zahl ihrer Kinder, über ihre Erwerbsbeteiligung und über die Modalitäten der Kinderbetreuung angemessen zu modellieren. Schließlich wurde bereits darauf hingewiesen, dass alle empirischen Studien, die sich der Thematik annehmen, den negativen Effekt umlagefinanzierter Rentensysteme für die Fertilität bestätigen (vgl. erneut Abschnitt 6 und auch die dort präsentierte Analyse), wobei jedoch mangels hinreichend langer Zeitreihen keine dieser Studien auf Mikrodaten basiert.

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[21] Die methodisch und ihren Resultaten nach wohl interessantesten Arbeiten liefern Laroque und Salanié (2004, 2005) auf der Basis französischer Daten. Studien für Deutschland liefern Genosko und Weber (1992) oder Althammer (2000).

Empirische Studien zu den Effekten familienpolitischer Maßnahmen, namentlich für die Geburtenentwicklung des jeweiligen Landes, lassen eine ganze Reihe von Fragen offen, die für die konkrete Ausgestaltung solcher Maßnahmen, also auch für die Umgestaltung existierender Systeme, von hohem Interesse wären. Insbesondere lassen sie bis auf weiteres praktisch keine belastbaren Rückschlüsse hinsichtlich der optimalen Struktur umfassender Leistungspakete zu. Dies gilt erstens für die richtige Mischung von monetären Transfers und Sachleistungen, auch wenn die Wirksamkeit ersterer zumindest besser messbar zu sein scheint; zweitens für die Wahl zwischen Leistungen, die für alle Kinder weitgehend uniform sind, und solchen, die zweite oder dritte und weitere Kinder in besonderer Weise fördern, oder solchen, die für Kinder am unteren oder am oberen Ende der Einkommensverteilung höher ausfallen; drittens für das richtige Timing der Leistungen, sei es im Sinne einer Konzentration auf Familien mit Kleinkindern oder im Sinne einer verstärkten Gewährung von kinderbezogenen Leistungen an im Alter bereits fortgeschrittene Eltern im Rahmen ihrer Renten. Die Frage, was angesichts all dieser Alternativen beim Einsatz gegebener Mittel für familienpolitische Maßnahmen die stärksten Effekte hätte, lässt sich empirisch bislang nicht beantworten.

Angesichts der weit reichenden Effekte von Änderungen des Geburtenverhaltens hätten diese gegebenenfalls Folgewirkungen in zahlreichen weiteren Feldern der Wirtschafts- und Sozialpolitik. Eine besonders interessante Frage, nämlich die nach möglichen Auswirkungen auf den Arbeitsmarkt, lässt sich allerdings ebenfalls nicht abschließend beantworten. Bereits im Kontext der theoretischen Grundlagen der Analyse der Beziehungen zwischen Fertilität und wirtschaftlicher Entwicklung (vgl. Abschnitt 2.2) wurde darauf hingewiesen, dass erhöhte Geburtenzahlen das gesamtwirtschaftliche Arbeitsangebot – v. a. durch verstärkte Aktivitäten von Frauen zur heimischen Kinderbetreuung – zumindest vorübergehend reduzieren könnten. In einer unterbeschäftigten Volkswirtschaft wie Deutschland, in der strukturelle Probleme das Wachstum aktuell stark hemmen (vgl. Abschnitt 5.4), wäre darin nicht unbedingt ein Nachteil zu sehen. Längerfristig, wenn auch der demographische Wandel das Wachstum von Bruttoinlandsprodukt und Pro-Kopf-Einkommen zu dämpfen droht, erscheint eine möglichst umfassende Mobilisierung des Erwerbspersonenpotenzials allerdings mehr als wünschenswert. Hinzuweisen ist dabei jedoch zum einen auf den fundamentalen Unterschied zwischen produktiver Haushaltsarbeit, die im laufenden Bruttoinlandsprodukt lediglich nicht erfasst wird, und sonstigen Formen von Nicht-Erwerbstätigkeit. Zu berücksichtigen ist zum anderen, dass sich die Grenzen zwischen unentgeltlichen, elterlichen Tätigkeiten zur Betreuung und Erziehung von Kindern und ihren marktlich abgewickelten Pendants auch anders ziehen lassen als dies in Deutschland gegenwärtig geschieht. Letztlich kann in diesem Bereich – im Rahmen einer effizienten Arbeitsteilung, die tradierte Rollenmuster nicht zwingend festschreibt, sondern alle vorhandenen Fähigkeiten und Neigungen potenzieller Betreuungspersonen optimal nutzt – bei steigenden Geburtenzahlen sogar mehr formelle Beschäftigung entstehen als derzeit. Erforderlich wären dafür aus heutiger Sicht jedoch sowohl größere Kapazitäten im Bereich der institutionellen Betreuung von Kindern und Jugendlichen als auch Rahmenbedingungen für deren Finanzierung, die eine echte Wahlfreiheit der Eltern hinsichtlich der Nutzung solcher Angebote bzw. einer heimischen Betreuung eröffnen.

Fest steht angesichts der vorliegenden empirischen Arbeiten in jedem Fall, dass potentielle Eltern bei ihren Entscheidungen über die Geburt, Betreuung und Erziehung von Kindern auf ökonomische Anreize reagieren (vgl. Abschnitt 6). Entscheidungen dieser Art sind daher auch mit familienpolitischen Instrumenten beeinflussbar. Länder wie Deutschland, die vom Geburtenrückgang in der Nachkriegszeit in besonderem Maße betroffen sind, sollten demnach in der Lage sein, die zukünftige Geburtenentwicklung durch eine aktivere Familienpolitik zu beeinflussen. Anzustreben sind dabei gezielte Verbesserungen innerhalb des gesamten, hier betrachteten Spektrums familienpolitischer Maßnahmen, das von monetären Transfers an Familien mit Kindern aller Altersstufen, speziell mit Kindern im Kleinkindalter, über Kinderbetreuungseinrichtungen und die Finanzierung und Organisation des Schulwesens bis hin zur Ausgestaltung der gesetzlichen Sozialversicherungen, insbesondere des Rentensystems, reicht.

Das zweite, zentrale Resultat der vorliegenden Studie besteht in der grundlegenden Bedeutung verbesserter Rahmenbedingungen für eine Erhöhung niedriger Geburtenzahlen, die sich aus den im ersten Teil der Arbeit präsentierten empirischen Resultate zum Zusammenhang zwischen Geburtenentwicklung und wirtschaftlichem Wachstum ergibt (vgl. Abschnitt 5). Familienpolitische Maßnahmen sind dabei letztlich als Teil einer langfristig und vorausschauend angelegten Strategie der allgemeinen Wirtschaftspolitik anzusehen. Die hier vorgestellten Schätzungen belegen insbesondere, dass entsprechende Maßnahmen aus ökonomischer Sicht vorteilhaft sein können, wenn sie zu einer Wiederannäherung an ein bestandserhaltendes Geburtenverhalten und damit langfristig zu einer besser ausbalancierten Altersstruktur der Bevölkerung führen.

Introduction

During the last 150 to 200 years, there has been a remarkable change in reproductive behaviour in virtually all the industrialised countries, marked by a secular decline in fertility rates with the number of births falling below a “replacement level” during the last three decades. The question of whether and, if so, how these changes affect the economic development in the industrialised world is of first-order significance not only for economic research but also with respect to the policy implications that may arise. With the prospects of a slow-down in population growth which, in many countries, will be accompanied by a decline in working-age population and in some countries even goes along with a decline in total population, it is highly likely that growth rates of aggregate output will be considerably smaller in the future than they have been in the past. While this is not necessarily harmful for the societies affected, it is also likely that per-capita growth rates will decline.

To illustrate this, let us assume for an instant that the growth rate of output per worker – *i.e.*, productivity growth – were equal to a constant rate g. Aggregate output will then grow at a rate $(1+g)(1+\lambda) - 1$, where $1+g$ is the growth factor associated with productivity growth and $1+\lambda$ is the growth factor of the labour force. Hence, if λ declines, while g remains constant, aggregate output growth will decline. The growth rate of output per capita is influenced by another factor representing population growth, $1+n$. (Note that, while g is usually taken to be larger than zero, the only restrictions applying to λ and n are that they exceed -1, that is, that populations can disappear, but can never become negative.) In our example, the growth rate of per-capita output is $(1+g)(1+\lambda)/(1+n) - 1$. Hence, if n declines not as fast as λ, which is basically what happens when population growth slows down and total (youth plus old-age) dependency increases, the growth rate of per-capita output will also decline, though not as fast as the growth rate of aggregate output. What do these observations really mean? One implication is that, with a fundamental change in the direction of population growth, one should probably not be too much concerned about the prospects of a slow- down in aggregate growth rates. On the other hand, if we take per-capita output to be a rough indicator of individual well-being, the conclusion that, in the course of projected demographic change, its growth rate may go down as well may sound like bad news. Last but not least, it is far from clear that, in spite of all shifts in the demographic structure and the economic environment to be expected for industrialised countries, productivity growth will be entirely unaffected.

Our simple exercise therefore highlights two aspects. First, the link between fundamental changes in fertility and economic growth is partly a matter of calculations that are relatively simple, or predictions that are rather obvious. Second, the consequences for productivity growth are really the key issue that needs to be addressed when studying the impact of demographic change on future economic performance. Investigating whether and, if so, how productivity and productivity growth are systematically related to changes in fertility and the induced changes in the demographic structure is therefore one of our main tasks.

From a theoretical point of view, a number of competing effects of low (or high) birth rates on economic growth in general and productivity growth in particular can be hypothesised to exist, although they are seldom fully worked out in the existing literature. For instance, there are simple quantitative effects of labour-force participation – of women who are, or could be, mothers or, later on, of their potential children; effects that could work via the capital intensity of production or, more fundamentally, via savings and capital accumulation; or effects that are due to age-related differences in individual productivities. Furthermore, next to these effects that, at least in theory, can be traced back to the micro-level, there may be a link between the demographic composition of the labour force of a firm, a larger sector or an entire country and average productivity that is based on features of endogenous growth and, hence, cannot be attributed to individual workers or other factors of production. Again, some of these effects are rather obvious in their direction, while others are unclear or ambiguous. Similarly, some effects may be relatively short-term in their nature, while others are of potentially growing significance in the long run. Ultimately, therefore, the direction of the joint impact of demographic change on economic performance in the countries affected, including the timing by which it will become relevant, is an empirical question.

Surprisingly, up until now there are few attempts to subjecting the relevant theoretical considerations to systematic empirical investigation. One of the main reasons for this gap to exist is that the availability of data which could be used for research on these issues was rather limited in the past. Econometric studies based on (time-series) data for individual countries offer too narrow a picture, as the conclusions can be obscured by unobserved peculiarities of the country under scrutiny. The opportunities to find compatible data for a larger sample of countries, spanning a longer period of time and covering all the aspects that are potentially important, are improving only recently and are still subject to numerous restrictions. Also, there are limitations to what can be concluded from macro-econometric multi-country studies – which, at the current stage of affairs, is nonetheless the methodology best suited for dealing with our overall subject – as they simply cannot reflect all the mechanisms and determinants that may influence the relevant decisions taken at a micro-level.

Considering these limitations, the present study adopts a two-step research strategy to tackle the issue raised for closer inspection. As a first step to take, a rough, but comprehensive, empirical analysis addresses the links between fertility and economic growth using a larger panel of data that covers as many countries and as long an observation period as possible (Part I). By the motivation of our study, the most important candidates for the selection of countries to be included are all the OECD countries. But as the issue raised here may effectively have much broader relevance, while conclusions for the OECD world could still suffer from a small-sample bias, our data collection and analyses do not focus exclusively on industrialised countries, but include quite a number of less-developed countries as well.

In chapter 1, we set the stage by reviewing fertility trends in developed as well as in developing countries from about 1900 onwards. In addition, we also take a look at the impact of lower fertility rates on the economically active population and output per capita in a purely descriptive, and highly preliminary, fashion. We then discuss, in chapter 2, the theoretical background of our main theme and summarise the existing empirical evidence. Starting from a simple, neoclassical growth model in the Solow (1956)–Swan (1956) tradition, we first restate the obvious impacts of demographic change on aggregate output and output per capita, identifying effects related to economic dependency, labour-force participation and "capital dilution" as those that really matter in the context of such models, an then look at potential extensions with endogenous savings, more differentiated measures of human capital and elements of endogenous-growth models à la Lucas (1988) and Uzawa (1965). In chapter 3, we address the role of "total factor productivity" (TFP) that has moved to the fore in recent empirical growth analysis, thus paving the way towards our own empirical work regarding potential links between labour-force demographics that are, in turn, influenced by past fertility trends on the one hand and measures of TFP on the other. Chapter 4 rounds off the discussion of the theoretical framework of the study and the review of related evidence in summarising major results of the theory of "endogenous fertility" initiated by Becker (1960), making clear that fertility must also be expected to respond to changes in the economic environment.

Chapters 5 and 6 cover the main body of our empirical work on the potential links between fertility and economic development, laying out our empirical design and describing the data base we have constructed in order to pursue our tasks as well as summarising and interpreting our results. Building on recent work done by Feyrer (2002), chapter 5 establishes that there is an impact of the age composition of the labour force on the level and growth rate of productivity by which the historical decline in fertility could indeed have a negative impact on the future growth performance in the countries affected. The effect is statistically significant and surprisingly strong as is demonstrated in a series of illustrative simulations for highly developed countries such as Germany, France, the US and Japan. Chapter 6 provides fresh evidence regarding the main economic determinants of current fertility rates, with results that are fully in line with the existing literature. An interesting side-observation is that we find no signs of a strong "demographic repercussion" by which the past fertility decline, through its impact on current income, could either be accelerated or reverted in an endogenous fashion. Increasing fertility rates where they are currently low appears to mainly a matter of the existing institutional framework and of related policy decisions.

As the second step, fertility outcomes and national family policies – as an important part of the institutional framework for individual fertility choices – are then described and discussed in much more detail for a much smaller sample of countries (Part II). Here, candidates of primary interest are a very narrow selection of European countries, as the emphasis rests on providing detailed descriptions as well as on highlighting policy options that are relevant for highly-developed countries, rather than on covering a large number of cases. We therefore mainly focus on France, Germany, Sweden and the UK in this work. Chapter 7 reviews, in some detail, national trends regarding average fertility rates, the timing of births and the distribution of family size as well as the interplay between fertility and female labour-force participation, mothers' educational attainments and parental household income. Chapter 8 discusses, in a comparative fashion, important aspects of national family policies, broadly defined to encompass the entire system of child-related cash benefits and tax allowances, a number of benefits in-kind and relevant features of public pension schemes as the main instrument of intergenerational redistribution, that are all likely to affect parental fertility choices.

The main purpose of these in-depth country studies is to illustrate and flesh out the results emerging from the empirical work in a way that simply cannot be achieved within the context of a broad-based econometric study conducted in a multi-country setting and relying on a longer time-series of data. At the same time, keeping in mind the conclusions drawn from the empirical analysis should help in avoiding biased and premature conclusions which could be too restricted when based on observations made in just a few countries. In this sense, both parts of the overall project should be seen as mutually complementing each other.

We are indebted to the *Deutsche Arbeitskreis für Familienhilfe e.V.* for generously supporting us in our work and giving us ample leeway for developing the research programme and looking into the issues and sub-issues that turned out to be of importance for our overall task. We are also grateful to Hans Heinrich Nachtkamp (University of Mannheim) and Herwig Birg (University of Bielefeld) for helpful suggestions and hints. By the nature of our analyses, preparing the study has involved substantial efforts spent on retrieving and processing data from various sources regarding fertility, economic development and public policies in a large set of both developed and developing countries as well as on collecting detailed information regarding fertility outcomes and family policies in a smaller selection of developed countries. We have to thank Eva Berger, Andreas Leitenstorfer, Ruth Seitz and Kiril Stojanov who supported us in these efforts while working at the Ifo Institute as student research assistants or student interns.

Part I:

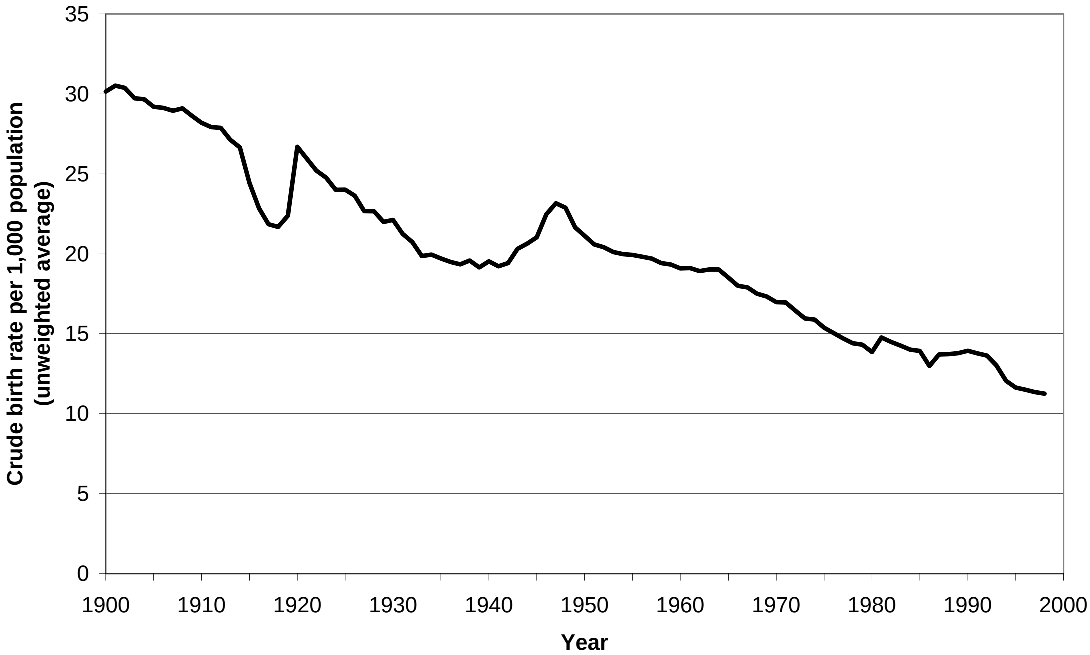
Fertility and Economic Growth
– Empirical Evidence

Chapter 1
Fertility and Economic Growth: Stylised Facts

1.1 Fertility change over the last century

Historical data on fertility are available for quite a long time period. In some countries, complete time series of rough indicators, such as crude birth rates,[1] even go back to the mid-18th century. The existing evidence suggest that, certainly in countries that today are economically developed, there is a secular trend of declining fertility.

Figure 1.1: Average crude birth rates in OECD countries (1900–2000)



Note: The countries covered are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany (1949–91: West), Greece, Hungary, Ireland (Rep. of Ireland: since 1922), Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK (England and Wales), USA, Czech Republic (before 1992: Czechoslovakia)

Source: Mitchell (2003).

Figure 1.1 shows an unweighted average of crude birth rates for a large number of OECD countries during the entire 20th century.[2] The significant decline in crude birth

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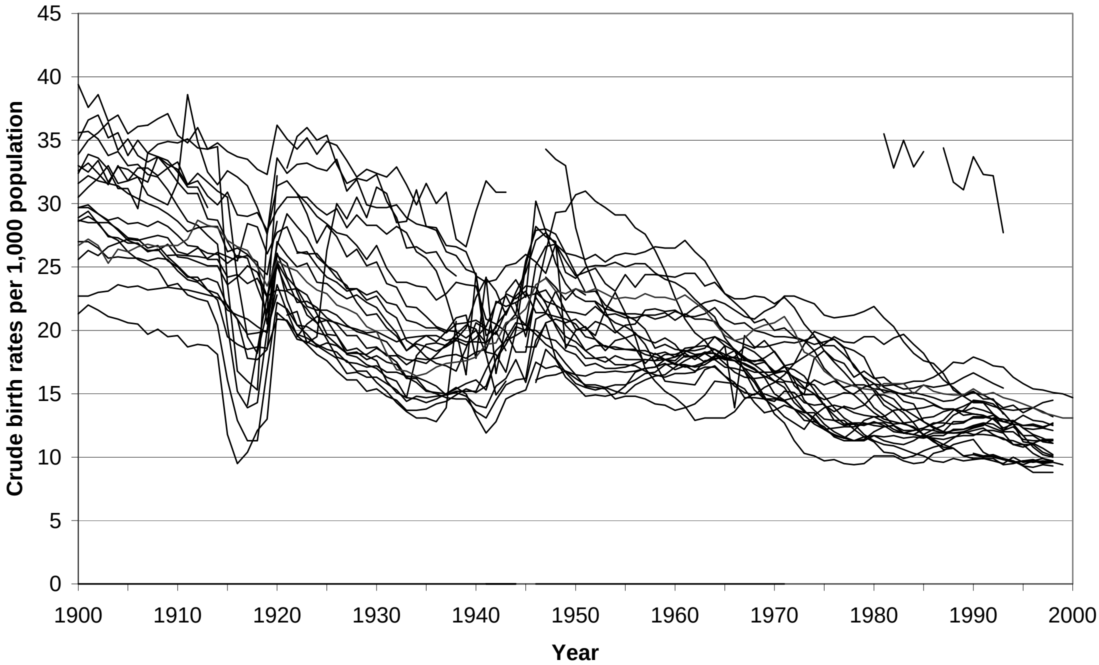
1 For a definition of a number of fertility indicators that are commonly used and a discussion of their differing properties, see appendix A.1 to this chapter.

2 Referring to countries and years for which historical data of this kind is available.

rates (defined as live births per 1,000s of total population) over these 100 years has been interrupted only by a small number of extra-ordinary peaks and drops. First, considerable reductions in birth rates can be observed for the period of World War I and for the period from the "Great Depression" to World War II. Second, during the decade after World War II there is a substantial increase in birth rates. For the average of OECD countries, the peak of this so-called "baby boom" is reached in the year 1947, but the precise timing as well as the overall significance of the baby boom differs a lot from country to country (see figure 1.2[3]). In the United States, for example, the age cohorts born between 1946 and 1964 are generally referred to as the "baby boomers", while in many European countries the boom started not before the mid-1950s and reached its peak in the mid-1960s.

Figure 1.2: Crude birth rates in OECD countries (1900–2000)



Note: The countries covered are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany (1949–91: West), Greece, Hungary, Ireland (Rep. of Ireland: since 1922), Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK (England and Wales), USA, Czech Republic (before 1992: Czechoslovakia)

Source: Mitchell (2003).

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[3] Here, we illustrate the raw data used for constructing figure 1.1 without paying much attention to which graph refers to which country.

Since the end of the baby boom period, birth rates have again started to decline in virtually all OECD countries. But also developing countries have experienced a substantial reduction in fertility between 1960 and 2000 (see figure 1.3).[4] In the heterogeneous group of non-OECD countries, average birth rates declined from 41.9 births per 1000 inhabitants in 1960 to a rate of 26.3 until 2000. For OECD countries, average birth rates amounted to 22.1 births per 1000 inhabitants in 1960 and have declined to 12.3 births by 2000. No matter whether we look at EU-15 countries or at the EU-25, birth rates in Europe were even lower than in the entire OECD world throughout this period (see figure 1.4).[5]

Cross-country differences in the evolution of birth rates are particularly large for the second part of the time period from 1960 to 2000. Among OECD countries, three main groups of countries can be differentiated. There are countries

– with a decrease in birth rates until the beginning of the 1980s, but with slightly increasing birth rates thereafter (examples are, first of all, the US and, with stronger fluctuations, Sweden),
– with a decrease in birth rates until the beginning of the 1980s and with stagnating birth rates thereafter (major examples are France, the UK and, with stagnation at a lower level, Germany),
– with a marked decline in birth rates for the entire time period (examples are Italy and Spain in Southern Europe, Bulgaria and the Czech Republic in Central and Eastern Europe, and Japan).

This latter group of countries has been labelled “lowest-low fertility” countries by Billari and Kohler (2002).

Figures for total fertility rates[6] demonstrate the same developments more harshly (see table 1.1). Total fertility rates (TFRs) differ from crude birth rates in that they focus on the relation between live births and the number of women of fertile age and in that they are normalised with respect to the actual age structure of women alive. They are defined as the total number of children who would be born to a woman during her entire lifetime

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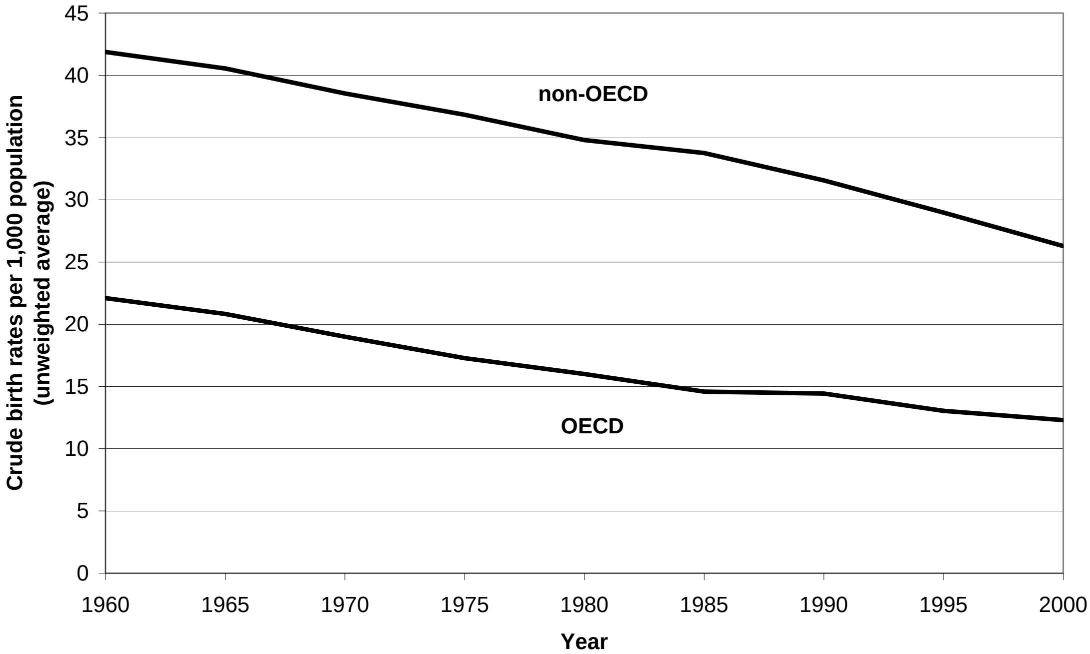
[4] As many of the non-OECD countries do not report internationally comparable data on an annual basis, figure 1.3 uses quinquennial data, thus smoothing some of the short-term fluctuations of birth rates.

[5] For the EU-15, they fall from 18.5 to 11.4, for the EU-25 from 19.0 to 10.7 births per 1000 inhabitants between 1960 and 2000.

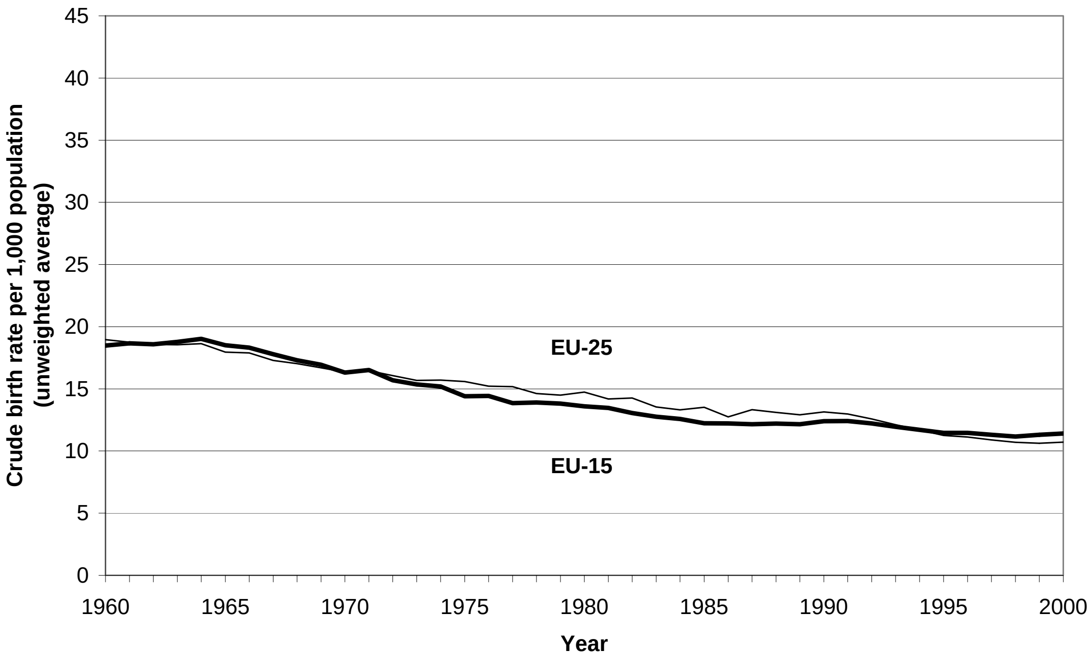
[6] See, again, appendix A.1.

Figure 1.3: Crude birth rates in OECD and non-OECD countries (1960–2000)



Source: Mitchell (2003).

Figure 1.4: Crude birth rates in EU-15 and EU-25 countries (1960–2000)



Source: Mitchell (2003).

Table 1.1: Total Fertility rates in OECD countries (1960–2000)

	1960	1965	1970	1975	1980	1985	1990	1995	2000
Australia	3.45	2.98	2.86	2.24	1.90	1.89	1.91	1.82	1.75
Austria	2.69	2.69	2.29	1.82	1.62	1.46	1.45	1.40	1.34
Belgium	2.58	2.61	2.20	1.74	1.67	1.49	1.62	1.57	1.61
Canada	3.81	3.12	2.26	1.82	1.74	1.67	1.83	1.64	1.55
Czech Republic	2.08	2.17	1.93	2.43	2.07	1.95	1.89	1.28	1.15
Denmark	2.57	2.61	1.95	1.92	1.55	1.45	1.67	1.81	1.77
Finland	2.71	2.40	1.83	1.69	1.63	1.64	1.78	1.81	1.73
France	2.73	2.83	2.48	1.93	1.95	1.82	1.78	1.71	1.88
Germany	2.37	2.50	2.03	1.45	1.44	1.37	1.45	1.25	1.35
Greece	2.28	2.30	2.34	2.37	2.23	1.68	1.40	1.32	1.32
Hungary	2.02	1.82	1.97	2.35	1.91	1.83	1.84	1.57	1.29
Iceland	4.29	3.71	2.79	2.61	2.48	1.93	2.31	2.08	1.98
Ireland	3.76	4.03	3.93	3.40	3.23	2.50	2.12	1.87	1.87
Italy	2.41	2.67	2.43	2.21	1.64	1.39	1.26	1.18	1.23
Japan	2.00	2.14	2.14	1.91	1.75	1.76	1.54	1.42	1.36
Republic of Korea	5.67	4.87	4.27	3.32	2.56	2.04	1.77		1.43
Luxembourg	2.28	2.42	1.98	1.55	1.50	1.38	1.62	1.75	1.78
Mexico	6.88	6.82	6.64	5.79	4.66	3.86	3.31	1.68	2.59
Netherlands	3.12	3.04	2.57	1.66	1.60	1.51	1.62	2.90	1.72
New Zealand	4.04	3.54	3.16	2.33	2.03	1.93	2.18	1.53	2.05
Norway	2.85	2.93	2.50	1.99	1.72	1.68	1.93	2.01	1.85
Poland	2.98	2.52	2.20	2.27	2.28	2.33	2.04	1.87	1.34
Portugal	3.01	3.08	2.76	2.52	2.19	1.74	1.43	1.61	1.51
Slovak Republic	3.05	2.78	2.39	2.56	2.31	2.19	2.09	1.38	1.34
Spain	2.86	2.94	2.84	2.79	2.22	1.63	1.33	1.52	1.24
Sweden	2.17	2.39	1.94	1.78	1.68	1.74	2.13	1.18	1.55
Switzerland	2.09	1.60	1.55	1.51	1.59	1.47	1.46		
Turkey	6.28	5.82	5.27	4.72	4.26	3.79	3.00	1.73	2.36
United Kingdom	2.69	2.86	2.44	1.81	1.89	1.80	1.83		1.68
United States	3.65	2.91	2.48	1.77	1.84	1.84	2.08	2.65	2.13
OECD[a]	3.18	3.04	2.68	2.34	2.11	1.89	1.86	1.70	1.65
Non-OECD[a]	5.96	5.75	5.54	5.21	4.92	4.63	4.24	3.84	3.46

a) Unweighted averages.

Source: World Bank (World Development Indicators).

if, in each year of her fertile period, the number of her children would conform to a set of age-specific fertility rates assessed for a given population in a given year. (I.e., TFRs are an artificial index which converts data taken from an annual cross-section into longitudinal information related to a hypothetical life cycle.) While in 1960 the average TFR was 3.18 in OECD countries and 5.96 in non-OECD, until 2000 these figures declined steadily to 1.65 children and 3.46, respectively. Comparing recent total fertility rates in industrialised countries to the benchmark rate of about 2.1 children per woman that would imply a constant population and a stable population structure, it can be seen that, with the exception of Turkey and the United States, all OECD countries had fertility rates below the "replacement level" by 2000.

1.2 Life expectancy

Around the world, the decline in fertility has been accompanied by an increase in average life expectancy. As can be seen in table 1.2, average life expectancy at birth in OECD countries increased by 8.55 years between 1960 and 2000, from 68.3 to 76.9 years of age. In non-OECD countries, average life expectancy increased by 13.33 years, from 50.1 to 63.4 years. Some countries, such as Algeria, Botswana or Gambia, even experienced increases of life expectancy by about 20 years during this time period. These substantial increases in life expectancy – especially in developing countries – can be explained by improvements in medicine and public health (such as the introduction of antibiotics, treatments for tuberculosis and diarrhoea, the use of DDT to control malaria, as well as improved sanitation, better nutrition and healthier life styles in general; see Bloom et al. 2002).

Table 1.2: Average life expectancy at birth, males and females (1960–2000)

	1960	1965	1970	1975	1980	1985	1990	1995	2000
All countries	53.21	55.26	57.16	59.20	61.24	63.21	64.51	65.09	65.49
non-OECD	50.05	52.33	54.42	56.48	58.83	61.13	62.56	63.08	63.38
OECD	68.31	69.36	70.35	71.52	72.72	73.81	74.76	75.79	76.86
EU-25	69.37	70.30	71.00	71.66	72.52	73.49	74.23	74.83	76.10
EU-15	69.77	70.65	71.49	72.43	73.73	74.84	75.84	76.78	77.68

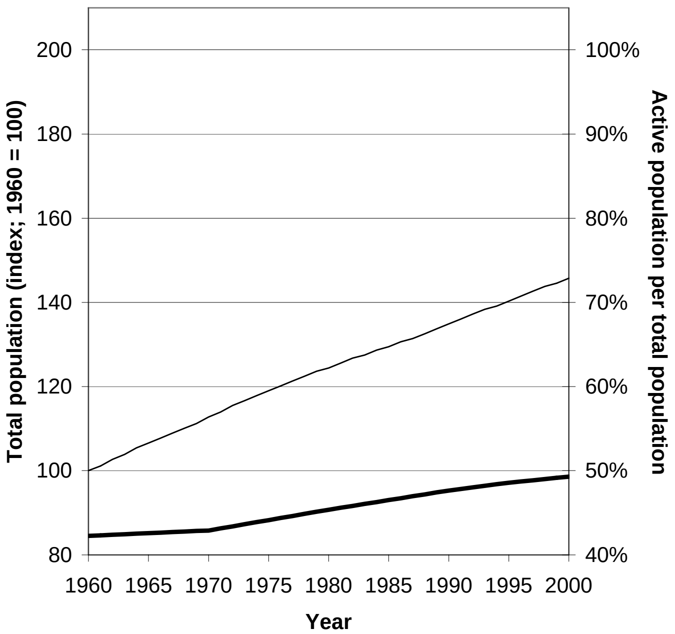
Source: World Bank (World Development Indicators).

What is more important here, for the purpose of our investigation, is that recent improvements in life expectancy in developed countries largely matter for a period of life where individuals are beyond their active life span, implying longer life in retirement, not a potential expansion of the labour force. As a consequence, provided that there is indeed an impact of demographic change on output or output per worker, it should mainly be attributed to changes in fertility and their (long-term) impact on labour force participation and the age structure of the active population.

1.3 Effects for the economically active population

Figure 1.5 illustrates how, against the background of an increasing population, the share of the labour force in total population increased in the OECD world starting from the 1970s, mainly due to the entry of the baby boomers into the pool of economically active cohorts. In spite of growing old-age dependency, this broadly defined participation rate rose from 42.9 percent to close to 50 percent over the last three decades. There have been other trends – for instance, growing labour force participation among females starting with younger cohorts who stick to this behaviour later in their life cycles – which have a similar timing and thus contribute to this development. But with the retirement of the baby boomers that will take place starting around 2010, the ratio of the active population over total population must nonetheless be expected to decline in most of the industrialised countries.

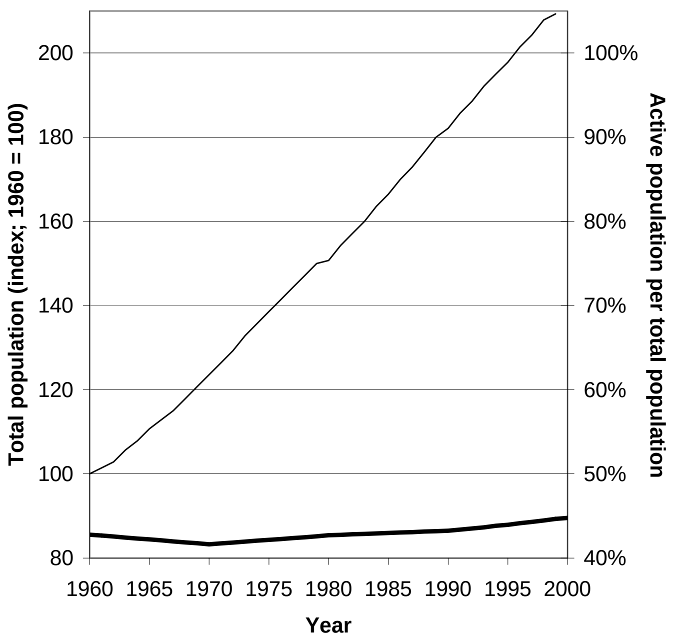
Figure 1.5: Active population and total population in OECD countries (1960–2000)



Source: World Bank (World Development Indicators).

Things are different in non-OECD countries (see figure 1.6). Population growth there has been much more pronounced, due to higher fertility rates and stronger improvements in life expectancy (also relevant for individuals in their active period of life). But the broad participation rate defined here stayed largely constant since 1960. In other words, total population and labour force essentially moved together. It should be noted, however, that in some parts of the world, such as Latin America and the Carribean, something like a late baby boom and a subsequent decline in fertility rates generates a similar pattern (though on a smaller scale) as in industrialised countries. In other regions with higher birth rates, such as North Africa, the Middle East and South and Southeast-Asia, the economically active population continues to consist of large groups of young people (Bloom et al. 2002).

Figure 1.6: Active population and total population in non-OECD countries (1960–2000)



Source: World Bank (World Development Indicators).

1.4 Fertility and output per capita

At the same time, income as measured by real GDP per capita has increased substantially in both OECD and non-OECD countries, rising on average by a factor of 2.6 between 1960 and 2000. Indeed, it is mainly the levels of GDP per capita that were, and remained, different between industrialised and developing countries over time, rather than cumulated growth factors: in the OECD, average GDP per capita, measured in constant 1995 US dollars, increased from 9,389 $ to 24,221 $ between 1960 and 2000; outside the OECD, average GDP per capita rose from 1,185 $ to 3,055 $ over the same period of time.[7] Assuming that this is not a pure time trend, but – as the economic theory suggests – a consequence of investment in physical and human capital and of other activities that may have advanced technological progress, the question is whether and, if so, how this development may be related to demographic change in general and fertility in particular.

Figure 1.7 shows the relationship between real GDP per capita and (contemporaneous) crude birth rates for OECD and non-OECD countries. Here, all data that are available are pooled together for the entire time period from 1960 to the present. As can be seen, there appears to be a non-linear negative relationship between birth rates and levels of output per capita of the same year in the OECD world, while there is virtually no apparent correlation in the heterogeneous set of non-OECD countries.

Neglecting a host of other determinants or possible intermediate factors that are unobserved here, the negative relationship observed in OECD countries could, of course, imply two things. It could mean that rich countries tend to have low fertility rates as the main direction of causality, or that low-fertility countries tend to become richer. In later chapters, we will deal with economic explanations of why individuals with higher income may indeed prefer to have fewer children than individuals on low income. This side of a potential bi-directional causality is mainly a matter of the cost associated with having children, which may rise with income, and of preferences that may be biased towards spending more resources per child, rather than having more children, as income increases. The other side of the inter-linkage should also not be surprising. If raising children consumes time and other resources, it implies income foregone and fewer investments of other kinds. Further, as the children themselves will not contribute to current output for quite some time, they simply increase the number of heads to be counted when calculating per-capita output. Hence, finding a negative relationship between birth rates and current output per-capita is perfectly plausible.

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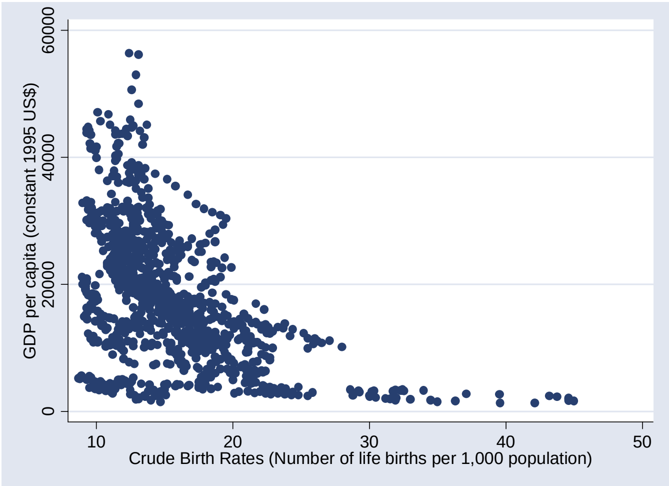
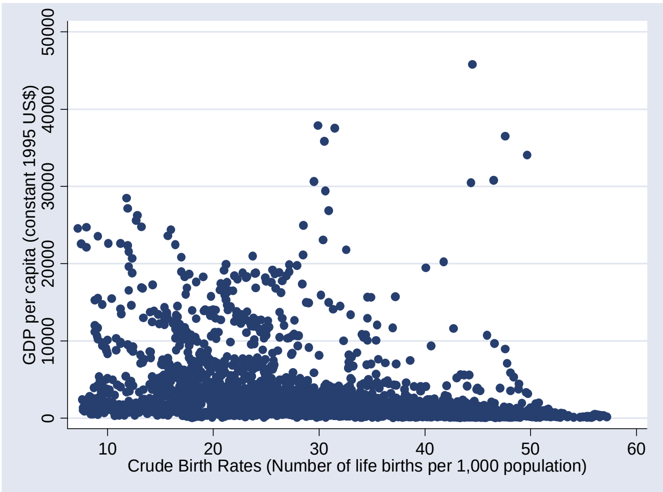
[7] The data used for these calculations are taken from the World Bank's data base of "World development indicators".

Figure 1.7: Real per-capita GDP and birth rates

a) OECD countries (1960–2000)



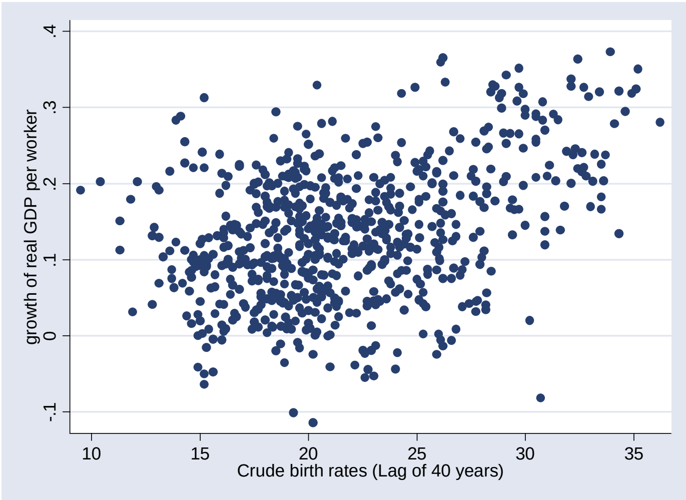
b) non-OECD countries (1960–2000)



Source: World Bank (World Development Indicators), Mitchell (2003).

At the same time, raising children is an investment in itself, contributing to future production capacities. Each cohort of new-borns will inevitably work its way through the age structure of total population and may, whether it is relatively small or relatively large, leave its traces in the long-term development of output per capita and, maybe, also of output per worker. Therefore, a correlation that might be more interesting than the one illustrated in figure 1.7 is that between output per worker and birth rates observed in the past, with a considerable time lag.

Figure 1.8: Growth of real GDP per worker and crude birth rates at t–40 in OECD countries (1960–2000)



Source: Easterly and Levine (2000), Mitchell (2003).

Figure 1.8 gives one example of such a relationship to be observed in industrialised countries, viz. the correlation between productivity growth (i.e., the growth rate of real output per worker) and crude birth rates lagged by 40 years. Against what was illustrated in figure 1.7, we have thus made several changes. First, we now look at output per worker as a measure which, as was pointed out in the introduction, may be more interesting with respect to the economic consequences of fertility change than output per capita. Second, we concentrate on increments in output in order to limit the scope for premature conclusions that would be purely driven by huge cross-country differences and strong time trends in levels of economic activity that have no relation whatsoever to our overall subject. Third, we lag birth rates by an arbitrary number of years until we can expect a given birth cohort to have reached a peak level of their labour force participation and of individual productivities.

In figure 1.8, the negative correlation that may exist between output and current birth rates has certainly disappeared. Instead, the figure suggests that there may even be a positive long-term correlation, which is certainly encouraging to enter the road towards a more rigorous analysis. Yet, fully assessing whether or not a picture such as the present one points to a positive long-term relationship between fertility indicators and economic performance when all other factors that potentially influence output and output growth are taken in is certainly some way to go. In subsequent chapters, we will first survey the economic theory and related evidence that is relevant for our study and then develop an empirical approach of our own that is suited for reaching harder conclusions.

Appendix A.1:
Fertility Indicators

The *crude birth rate* (CBR) is the number of live births per 1,000s of population in a given year. This measure is strongly influenced by the current age structure of the population. It will be higher in a population where more females are in their fertile period of life (roughly ranging from 15 to 44 years of age), lower in a population where more females are too young or too old for childbearing.

$$\text{Crude Birth Rate} = \frac{\text{Number of live births in a calendar year}}{\text{Total mid - year population}} * 1000$$

The denominator used when calculating CBRs is not an appropriate measure of population at risk. Therefore, this indicator is mainly only used for historical data, when some information regarding fertility is needed and the only information available is the number of births and total population.

An alternative measure that is more appropriate for focusing on the population at risk is the *general fertility rate*. The general fertility rate is defined as the number of live births per 1,000 women of child bearing age.

$$\text{General Fertility Rate} = \frac{\text{Number of live births in a calendar year}}{\text{Number of women aged } 15-44} * 1000$$

Still, the general fertility rate is not really suited for comparisons across populations or over time in that it ignores (a) that births are usually not evenly dispersed over the entire fertile period; (b) that the distribution of women over the reproductive life span may not be the same for different populations being compared.

The shortcomings of CBRs and general fertility rates can be avoided by the use of *age-specific fertility rates* (reduced rates, frequencies, incidence rates), separately assessing fertility levels for different age groups. Age-specific fertility rates are defined as the number of live births to women belonging to a given age group, per 1,000 women in the same age group.

$$\text{Age Specific Birth Rate} = f_i = \frac{\text{Number of births to women in age group } i}{\text{Number of women in age group } i} * 1000,$$

where i refers to different age groups, such as women aged 15–19, 20–24, 25–29, 30–34, 35–39, and 40–44. In the limiting case, age-specific fertility rates can be calculated for separately for each year of age. The separation of age groups is helpful in controlling for the age structure of the female population. But it implies that a whole set of indicator values has to be compared across different populations, which could be burdensome. A single fertility index would thus be desirable. This is exactly what the total fertility rate provides.

Age-specific fertility rates can be converted into *total fertility rate*s (TFRs) which approximate the total number of children who would be born to a woman during her entire lifetime if, in each year of her fertile period, the number of her children would conform to the full set of age-specific fertility rates assessed for a given population in a given year. TFRs are calculated as the sum of all current age-specific fertility rates (for instance, multiplying the result by five if age-specific rates have been assessed for 5-year age groups of women).

$$\text{Total Fertility Rate} = k^*(f_1 + f_2 + f_3 + ... + f_a);$$

where f_1, f_2, ... , f_a are age-specific fertility rates for all relevant age groups; k is the number of birth cohorts covered in each age group (with k = 5 if the age groups are 15–19, 20–24, etc. as suggested above; k = 1 if age-specific rates relate to just one birth cohort of women). However, a change in TFRs over time can be induced by two different types of shifts in fertility behaviour: an actual decrease in the number of children per woman and a change in the typical timing of births across different cohorts of women in their fertile age. For instance, since the 1970s, young women in many developed countries tend to postpone the births of their children when compared older women, so that the decline in TFRs measured at an annual level may overstate the actual decline in fertility.

Completed or *cohort fertility rates* (CFRs) provide an equivalent cohort fertility indicator that refers to the fertility behaviour of a given cohort of women at successive ages. Women born in the same calendar year constitute a birth cohort. Cohort fertility is measured based on “central birth rates” which represent the number of births to women of same age in a given year divided by the number of women of that age. (Central birth rates are thus the same as age-specific birth rates with k = 1, but they are combined in a different fashion, not for a given year but for a given birth cohort.) “Cumulative birth rates” are the sums of central birth rates for specific cohorts of women and show the number of children ever born to these women up until a specific age. If a cohort of women completes the fertile period of their life, cumulative birth rates turn into CFRs.

Chapter 2
Fertility, Population Growth and Economic Development: Theory and Evidence

The focus of the present study is on potential links between fertility on the one hand and economic growth on the other. Up until now, there is but a limited number of contributions looking at these issues from both a theoretical and an empirical perspective. Some of the studies that exist effectively look at the relation between population growth and economic development – a somewhat broader issue, that is, where strong conclusions may be even harder to come by, as there are other sources of population dynamics than fertility alone. Nonetheless, a number of effects that may be relevant for our purpose have been identified in the existing body of literature. Let us therefore, first of all, try to shed some light on how changes in population, in particular those driven by changes in fertility, can be expected to affect output and economic growth in a given country from a theoretical point of view.

2.1 A basic neoclassical growth model

A natural point of departure for this discussion is given by a simple standard model of economic growth in the tradition of Solow (1956) and Swan (1956).[1] In its most basic form, such a model would be constituted by a ("neoclassical") production function of the following generic form.

$$Y_t = A_t F(K_t, L_t) \tag{2.1}$$

Here, aggregate output (Y) in a given period of time (a year if time index t refers to annual amounts) is a function of two major types of inputs, viz. capital (K) and labour (L). Parameter A measures the current state of technological progress that has been achieved, while the functional form of $F(\cdot)$, representing the generic type of technology that is currently available, may not change so much over time.[2]

The production function (2.1) is called "neoclassical" if it exhibits decreasing, but non-negative, returns to each factor (i.e., first partial derivatives $F_i > 0$ for $i \in \{K, L\}$; sec-

[1] For an introduction to basic concepts in growth theory and the properties of such models, see Barro and Sala-i-Martin (1995, ch. 1).

[2] Note that, for simplicity, technological progress is assumed to be "Hicks-neutral" (with reference to Hicks 1932) here from the very beginning. Starting from a more general specification of the production function, this implies that changes in A ("innovations") do not affect the ratio of marginal productivities of capital and labour. Hence, $Y_t = G(A_t, K_t, L_t) \equiv A_t F(K_t, L_t)$.

ond derivatives $F_{ii} < 0$); if it exhibits constant returns to scale, such that equiproportional changes in levels of inputs have a linear effect on output (with $F(\lambda K_t, \lambda L_t) = \lambda F(K_t, L_t)$); and if, with respect to extreme levels of inputs, it satisfies the so-called "Inada conditions" ($F_i \to 0$ if $i \to \infty$ and, conversely, $F_i \to \infty$ if $i \to 0$).

An important property of growth models of this kind is that sustained growth of output per worker, Y_t/L_t, can only be achieved through a positive ("exogenous") rate of technological progress, measured by A_{t+1}/A_t or $\hat{A} \equiv \dot{A} / A$ (a dot indicating the derivative of a variable with respect to time, and a hat the corresponding growth rate). This is most evident if, as in the basic Solow–Swan growth model, saving rates that generate financial wealth which is then invested in physical capital are taken to be exogenous, with $I_{t-1} = K_t - K_{t-1} = sY_{t-1} - \delta K_{t-1}$ or $I = \dot{K} = sY - \delta K$. (Here, I denotes net investment, s is the saving rate and δ the depreciation rate). This assumption clearly limits the extent to which changes in the economic environment, other than changes in the saving rate, feed back on the accumulation of physical capital. (Later on, we will turn to the case where saving rates are determined endogenously.) Alternative specifications of the technology that could generate "endogenous" growth necessarily violate one or more of the above conditions defining the neoclassical model. Basically, marginal returns of at least one factor have to be assumed to be non-decreasing, or to converge towards a constant level even if the input level goes to infinity, in order to create persistent per-capita growth through a mechanism "within" the model. (Once we have dealt with the Solow–Swan-type model as a benchmark, models of this kind will move to the centre stage of our interest.)

2.1.1 Aggregate output, output per capita, and productivity

Most of the time, in standard models of economic growth there is no distinction between the number of workers (L) and the total population (N) because all individuals considered are simply assumed to be active in the labour market. For our purposes, we have to be a bit more careful. Dropping time indices from equation (2.1), we may thus define output per worker, or productivity (of labour),

$$q \equiv \frac{Y}{L} = AF(K / L, 1) \equiv Af(k)\,, \tag{2.2}$$

using the constant-returns-to-scale assumption to redefine $F(\cdot)$ in an intensive form, i.e. as a function $f(\cdot)$ of the capital-labour ratio $k = K/L$. Similarly, we can then define output on per-capita terms

$$y \equiv \frac{Y}{N} = \frac{L}{N}\frac{Y}{L} = \frac{L}{N}q \qquad (2.3)$$

The fundamental question we want to tackle here is, then, how aggregate output, per-capita output, and productivity are affected by changes in the size of the population that can be attributed to changes in fertility.

Note, before we go ahead, that it is mainly potential changes in productivity that are of central interest in this context. With respect to aggregate output and output per capita, there are additional effects that are easily predictable and not really surprising. If changes in N affect the size of L, aggregate output Y should change as well, moving in the same direction as the amount of labour inputs. From an economist's point of view, this "extensive" type of growth is of secondary importance. It does not necessarily improve the existing individuals' well-being, nor would a reduction in output growth associated with a slow down in the growth rate of L, or even with a shrinking labour force, clearly imply that the individuals involved in these scenarios are worse off.

Against this background, looking at what happens to output per capita as a rough indicator for consumption possibilities at an individual level is certainly more instructive when it comes to assessing the impact of changes in N. No matter whether L is affected or not, changes in population size have a direct, but inverse, effect on y simply through the inclusion of N in the definition of per-capita output. This effect can be partially offset (or, alternatively, blown up) through parallel (or inverse) changes in L. In the case that L changes as well, however, the most interesting, and least predictable, effect is that on the productivity measure q. If output per worker stays constant, which is unlikely in the context of the basic growth model used so far, the impact of changes in the labour force on aggregate output would be strictly linear. Otherwise, the impact could be more than proportional, a scenario which is even less likely in the present context, or less than proportional, and the main question would be, less than proportional – by how much? At the same time, the references we now had to make to the model employed here indicate that changes in productivity arising from changes in N or L are highly model-specific, while the way they feed through to changes in aggregate output and output per capita is mainly a matter of simple algebra.

2.1.2 Dependency, participation, and "capital dilution"

Let us now look in some more detail at the main effects that arise from variations in fertility in the context of a basic Solow–Swan growth model, concentrating on the effects on q and y. We assume that, through changes in fertility rates, population size deviates from a benchmark scenario – say, one with "steady-state" growth (i.e., $\dot{k}_0 = 0$ or $\hat{K}_0 = sY/K - \delta = sy/k - \delta = \hat{L}_0$) and a "replacement" level of fertility, where both the population and population structure stay constant over time ($\hat{N}_0 = 0$ and $\hat{L}_0 = 0$). Taking time-derivatives of (2.2) and (2.3) and calculating the corresponding growth rates $\hat{q} \equiv \dot{q}/q$ and $\hat{y} \equiv \dot{y}/y$, we obtain:

$$\hat{q} = \hat{A} + \underbrace{\frac{f'k}{f}(\hat{K} - \hat{L})}_{\substack{\text{capital dilution} \\ -}} \tag{2.4}$$

$$\begin{aligned} \hat{y} &= \hat{A} + \underbrace{\frac{f'k}{f}(\hat{K} - \hat{L})}_{\substack{\text{capital dilution} \\ -}} \underbrace{+\hat{L}}_{\substack{\text{participation} \\ +}} \underbrace{-\hat{N}}_{\substack{\text{dependency} \\ -}} = \\ &= \hat{A} + \frac{f'k}{f}\hat{K} + \frac{f - f'k}{f}\hat{L} - \hat{N} \end{aligned} \tag{2.5}$$

If changes in $\hat{N}$ are driven by fertility, the short-term response of employment may be $\hat{L} = 0$ (or, in the more general case where benchmark growth rates of population and labour force can have arbitrary levels: $\Delta\hat{L} = 0$) since children are usually inactive. In this case, productivity *q* is unaffected. In terms of *y*, there is only a "dependency effect" ($\hat{N}$ deviates from zero, while *Y* and $\hat{Y}$ are unchanged) by which per-capita income decreases if $\hat{N}$ increases and vice versa. Taking into account that rearing children may effectively consume time of parents otherwise spent in employment, the immediate effect of higher fertility on employment may even be $\hat{L} < 0$ (or $\Delta\hat{L} < 0$). (The converse holds, here and in what follows, if lower fertility is the relevant scenario.) This implies that per-capita output decreases even more than with constant *L* through a "participation effect", while productivity goes up through an inverse "capital-dilution effect" (inverse because, in the short run, the capital-labour ratio *k* goes up and capital is effectively "condensed").[3] In the long run, however, additional children can be expected to enter employment, such that $\hat{L} > 0$ (or $\Delta\hat{L} > 0$, while nothing new may happen to the dependency ratio). As a consequence, the short-term changes in *q* and *y* through the participation effect and (genuine) capital dilution will be reverted over the long term.

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[3] If (the growth rate of) *L* decreases, the steady-state level of *k* increases and vice versa. During the transition towards the new steady state, the growth rate of the physical capital stock must therefore exceed (in the alternative case, with *L* increasing, it must fall short of) the growth rate of the labour force. In other words, due to $\dot{K} = sY - \delta K$ there must be a change in $\hat{K}$ which runs parallel to the change in $\hat{L}$, but the latter is necessarily stronger than the former.

At each point in time during the process sketched above, the impact of changes in $\hat{N}$ on productivity is unambiguous. It always bears the opposite sign of the change in employment, $\hat{L}$, provided there is one. Things are less clear with respect to the impact on per-capita output. Note, however, that the participation effect always dominates the capital-dilution effect. This can be seen from the second line of equation (2.5) where the two effects of changes in $\hat{L}$ are combined: in a competitive environment, their sum is equal to the share of wages in output, $w/f > 0$. Therefore, $\text{sign}(\hat{L})$ (or $\text{sign}(\Delta\hat{L})$) directly matters for what happens to y as a combined effect of changes in the labour force.[4] Changes in dependency measured through $\hat{N}$ (or $\Delta\hat{N}$) always have an inverse effect on y. In other words, if parents spend time on taking care of additional children, the short-term effect on per-capita output is unambiguously negative. Later on, when the children themselves become active, the net impact on y depends on whether the long-term effect on dependency is stronger than the effect of higher participation (with lower productivity) or not.[5]

These are the main effects of changes in population associated with changes in fertility in the context of the most basic framework provided by standard growth theory. Apart from the obvious impact via dependency, they are all related to amounts of factor inputs and how they affect factor productivities and, through this channel, aggregate output. The main extensions that appear to be worthwhile are the following. First, so far we considered saving rates which govern the time path of the capital stock, K, to be exogenously given. Looking at an augmented model with endogenous savings may thus provide further insights into the role of capital dilution. Second, we could replace raw labour inputs, L, mainly accounted for in terms of the number of active individuals, through human capital, H, in order to take care of a qualitative component, hence another form of investment, by which labour inputs may differ across individuals (or, in an empirical setting with several economies, across countries) and over time. Third, in doing so we can transgress the border-line between standard growth theory, built on production functions which, whatever their precise structure, all exhibit the neoclassical properties defined above, and the theory of endogenous growth that has been developed

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4 Remember that $\hat{K}$ moves in the same direction as $\hat{L}$ (see footnote 3). Taken in itself, the part of the overall capital-dilution effect that runs via $\hat{K}$ and matters during the transition to a new steady state goes therefore the same way as the pure participation effect.

5 This, in turn, depends on how strongly the change in population size feeds through to a change in the size of the labour force. As, during the transition that is triggered by a fertility shock, the relative (long-term) change in L can be stronger than the change in N, it is thus possible that per-capita output increases. However, a negative net effect is possible as well.

more recently. Technically speaking, we will then look at factors that may help explaining the development of total factor productivity, A, or the nature of technological progress, $\hat{A}$.

2.2 Growth models with endogenous savings – an in-depth analysis

In our previous analyses, a major determinant of the development of the capital stock, namely the saving rate, was simply taken as given. A scenario where savings are determined endogenously, potentially affecting the size or even the sign of the capital-dilution effect we observed in the basic model, may thus deserve a second look. This could be done using a Ramsey (1928)–type of growth model, where at each point in time individuals optimise their life-time consumption profile by choosing an appropriate amount of saving, taking into account how their decisions interact with those of firms in a competitive environment. In this setting, individual savings determine investment, hence the time paths of output and labour productivity. On the other hand, as individuals are assumed to be infinitely lived, the time structure involved in the Ramsey model is highly unrealistic,[6] and analysing changes in population that are triggered through changes in fertility would not make much sense in this context.

In addition, being a bit more careful about the timing of all the different effects that we distinguished in the last section may be useful in general. Therefore, we now use a simple overlapping-generations (OLG) model in the tradition of Samuelson (1958) and Diamond (1965) to reconstruct the previous analysis and to look at the implications of consumer optimisation for our earlier results. By and large, this will turn out to be a side-step as there are only some qualifications that arise with respect to the capital-dilution effect. When considered in isolation, this effect is now no longer unambiguously (viz. inversely) related to the direction of population change.

Here, we confine our attention to a 2-period OLG set-up with three generations. There are N_t households belonging to "generation t" who are assumed to be economically active in period t and to retire in period t+1. Children who are still inactive are not entirely neglected as period t expenditure of their parents includes both the direct cost and the time spent on bringing up children to be generation t+1. In order to keep things simple, households are assumed to maximise utility only through their choices regarding con-

[6] With perfect altruism that is „descending“ (such that parents are perfectly altruistic towards their children), the model could be interpreted as reflecting the behaviour of "family dynasties" with an infinite time horizon (Barro 1974). But again, this would be a special case rather than a standard assumption regarding how individuals in subsequent generations interact with each other.

sumption while they are active, c_t, and consumption during retirement, z_{t+1}. In other words, there is no explicit fertility choice, but the number of children, $1+n_{t+1}$ per household in generation t, can vary for exogenous reasons. Also, there is no true choice between labour and leisure, but households in generation t have to divert some of their time that would be available for participation in the labour market, l_t^m, to working at home taking care of their children, l_t^n per child.

As far as decisions made at a household-level are concerned, the model then reads:

$$\max \ u(c_t, z_{t+1}) \tag{2.6}$$

$$\text{s.t.} \quad \text{(i)} \quad c_t = w_t l_t^m - p_t(1+n_{t+1}) - s_t$$

$$\text{(ii)} \quad l_t^m = 1 - l_t^n(1+n_{t+1})$$

$$\text{(iii)} \quad z_{t+1} = (1+r_{t+1})s_t,$$

where budget constraints (i) and (iii) and the time constraint (ii) can be combined to form a single inter-temporal budget constraint

$$\begin{aligned} c_t + \frac{z_{t+1}}{1+r_{t+1}} &= w_t(1 - l_t^n(1+n_{t+1})) - p_t(1+n_{t+1}) \\ &= w_t - (p_t + w_t l_t^n)(1+n_{t+1}). \end{aligned} \tag{2.7}$$

In (2.6) and (2.7), w_t denotes the wage rate, r_{t+1} the interest rate, p_t the monetary cost of raising a child, and s_t the amount of saving that is used as an instrument to transfer resources through time in order to bring about the optimal time-profile of consumption. Maximising utility leads to a familiar first-order condition by which the inter-temporal rate of substitution for current vs future consumption must equal the interest factor:

$$\frac{u_c}{u_z} = 1 + r_{t+1} \tag{2.8}$$

Firms are assumed to utilise a standard neoclassical technology which, in terms of output per worker, is given by

$$q_t = \frac{Y_t}{L_t} = A_t f(k_t) \quad \text{with} \quad k_t = \frac{K_t}{L_t} = \frac{s_{t-1}}{l_t^m(1+n_t)}. \tag{2.9}$$

That is, the aggregate capital stock employed in period t is derived from period t–1 savings, $K_t = s_{t-1}N_{t-1}$, assuming that it will be entirely depreciated over the length of period t. Labour supply in period t is given by $L_t = l_t^m N_t$. (Note that $N_t / N_{t-1} = 1 + n_t$.) With competitive behaviour on all markets, the first-order conditions for profit maximisation conform to a standard solution, with

$$w_t = A_t\big(f(k_t) - f'(k_t)k_t\big) \tag{2.10}$$

$$1 + r_t = A_t f'(k_t). \tag{2.11}$$

With the explicit distinction of different generations, only one of them being economically active, the definition of per-capita output now reads

$$y_t = \frac{Y_t}{N_{t-1} + N_t + N_{t+1}} = \frac{L_t}{N_{t-1} + N_t + N_{t+1}} q_t = \frac{l_t^m (1+n_t)}{1 + (1+n_t)(2+n_{t+1})} q_t . \tag{2.12}$$

Building on this set-up to analyse the consequences of changes in fertility, we can also distinguish more accurately between short-term effects arising in period *t*, when children are still inactive, and long-term effects arising in *t*+1, when children enter their active period of life.

The short-term (i.e., period *t*) impact on productivity is

$$\frac{\partial q_t}{\partial(1+n_{t+1})} = \underbrace{A_t \frac{l_t^n}{l_t^m} f'(k_t)k_t}_{\text{(inverse) capital dilution}} > 0 . \tag{2.13}$$

If fertility increases, the immediate effect is that labour force participation goes down because parents have to devote more of their time to child-rearing activities. Therefore, the capital-labour ratio becomes higher and labour effectively supplied to the market becomes more productive through "capital concentration" – that is, an inverted capital-dilution effect. This is fully in line with what we said about the short-term consequences of higher fertility in the basic Solow–Swan framework. The same is true regarding the short-term impact on output per capita,

$$\frac{\partial y_t}{\partial(1+n_{t+1})} = -A_t \frac{l_t^n (1+n_t)}{3 + n_t + n_{t+1}} \Big(\underbrace{f(k_t)}_{\substack{\text{participation} \\ +}} \underbrace{- f'(k_t)k_t}_{\substack{\text{capital dilution} \\ -}} \Big) - \underbrace{A_t \frac{l_t^m (1+n_t)^2}{\big(1 + (1+n_t)(2+n_{t+1})\big)^2} f(k_t)}_{\substack{\text{dependency} \\ -}} < 0. \tag{2.14}$$

As in the basic model, capital dilution (which tends to increase per-capita output here) is dominated by the (negative) impact of lower participation ($f(k_t) > f'(k_t)k_t$). This, in conjunction with higher dependency, implies that per-capita output y_t will definitely decrease.

However, the long-term (period t+1) effects are slightly modified against the basic model, as there can be adjustments in savings and, hence, in the capital-labour ratio in the present framework. The impact on productivity in t+1 is

$$\frac{\partial q_{t+1}}{\partial(1+n_{t+1})} = A_{t+1} f'(k_{t+1}) \Big(\underbrace{\frac{s_n}{l_{t+1}^m (1+n_{t+1})}}_{\text{effect on saving}} - \underbrace{\frac{k_{t+1}}{1+n_{t+1}}}_{\text{capital dilution}} \Big), \qquad (2.15)$$

s_n measuring the partial derivative of s_t with respect to 1+n_{t+1}. With a growing number of individuals in their active period of life, there is now a conventional capital-dilution effect by which output per worker decreases. In addition, there may be an effect on period t savings that also affects the capital-labour ratio in period t+1. Hence, through adjustments in saving rates and investment, the negative effect of capital dilution could be mitigated or even off-set (if $s_n > 0$) or, as an outcome that appears to be much more plausible, it can as well be aggravated ($s_n < 0$). Before we look into that, let us turn to the long-term impact on per-capita output which is given by

$$\frac{\partial y_{t+1}}{\partial(1+n_{t+1})} = \frac{l_{t+1}^m (1+n_{t+1})}{3+n_{t+1}+n_{t+2}} \underbrace{\frac{\partial q_{t+1}}{\partial(1+n_{t+1})}}_{\text{see (2.15)}} + A_{t+1} \underbrace{\frac{l_{t+1}^m}{(1+(1+n_{t+1})(2+n_{t+2}))^2}}_{\text{participation + dependency}} f(k_{t+1}). \qquad (2.16)$$

Whatever its direction, the impact on output per worker of course feeds through to the impact on output per capita. In addition, there are the effects of labour force participation (which, all other things being equal, increases through the higher number of active individuals) and of the dependency ratio (which tends to go down now). While these latter two effects are unambiguously positive (and, taken in isolation, the participation effect still dominates pure capital dilution), the net effect of changes in q_{t+1} needs further clarification.

What happens as a consequence of 1+n_{t+1} going up that could matter for s_t? Heuristically, the higher number of individuals who will be active in period t+1 implies an upward pressure on the interest rate. This, in turn, could induce higher saving in period t through an intertemporal substitution effect. But at the same time, individuals who are active in period t have less income available for current consumption which induces them to save less through an intertemporal consumption-smoothing effect. A reason for period t income to decline is that, as we have seen, labour force participation in period t decreases because parents have to take care of a higher number of children. As a consequence, wage rates increase per unit of labour effectively supplied, while wage earnings of the household should (but need not[7]) fall due to the time cost of rearing children. In any case, households have to spend more on the direct cost associated with children. In fact, in a partial analysis where we ignore the endogenous adjustments in both w_t and $1+r_{t+1}$, the impact of higher fertility on saving per household is unambiguously negative, if we assume both c_t and z_{t+1} to be "normal" goods (i.e., consumption in both periods increases if household income increases). Since the optimality condition (2.8) must hold under whatever circumstances, we can differentiate it with respect to $1+n_{t+1}$, taking into account how marginal utilities depend on the determinants of consumption in each period and how these are affected by a change in fertility. Solving the result for s_n yields

$$s_n = -(w_t l_t^n + p_t)\frac{u_{cc} - (1+r_{t+1})}{u_{cc} + 2(1+r_{t+1})u_{cz} + (1+r_{t+1})^2 u_{zz}} = \qquad (2.17)$$

$$= -(w_t l_t^n + p_t) s_w < 0 \quad \text{if} \quad s_w > 0.$$

An analytical result for s_w can be obtained by deriving (2.8) with respect to $w_t l_t^m$. Normality of consumption in t and $t+1$ implies that $c_w = 1 - s_w > 0$ and $z_w = (1+r_{t+1}) s_w > 0$, hence $0 < s_w < 1$. In the absence of the intertemporal substitution effect, the time and direct cost of children reduces the amount of period t saving and investment for $t+1$. By equation (2.15), this implies that period $t+1$ productivity definitely decreases. However, if we include general-equilibrium responses in the production sector – and given the length of each period in our model it would be reasonable to assume that individuals foresee, or even feel, these adjustments – the sign of s_n is not clear.[8] Therefore, we cannot say in general whether, in a model with endogenous saving, capital dilution can be

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7 Effectively, this depends on the relevant elasticity of the marginal productivity of labour. But assumptions implying a rise in wage earnings would have to be extreme.

8 For the case with endogenously variable w_t and $1+r_{t+1}$, an expression for s_n that is analogous to equation (2.17) reads as follows:

$$s_n = \frac{\left(A_t\left(f(k_t) - f'(k_t)k_t^2 f''(k_t)\right)l_t^n + p_t\right)\left(A_{t+1}f'(k_{t+1})u_{cz} - u_{cc}\right) - A_{t+1}f''(k_{t+1})\frac{s_t}{l_{t+1}^m(1+n_{t+1})}\left((u_{cz} - A_{t+1}f'(k_{t+1})u_{zz})s_t - u_z\right)}{u_{cc} - 2A_{t+1}f'(k_{t+1})u_{cz} + A_{t+1}^2 f'(k_{t+1})^2 u_{zz} - A_{t+1}f''(k_{t+1})\frac{1}{l_{t+1}^m(1+n_{t+1})}\left((u_{cz} - A_{t+1}f'(k_{t+1})u_{zz})s_t - u_z\right)}$$

Here, we can sign some of the components of the result, but have no clue regarding the overall direction of the effect.

avoided as a long-term consequence of higher fertility because individuals tend to save more or whether, to the contrary, it will be aggravated because they tend to save even less than with a given time path of population and the population structure.

2.3 The role of human capital

So far, we have taken labour to be a homogeneous input, not distinguished by any qualitative aspects as those related to different levels of education or different levels of experience. Refinements of the basic model that take care of the different levels of human capital embodied in each worker are straightforward. For instance, we could take h to be the human capital per worker, such that $H = hL$ measures the effective aggregate labour input in terms of efficiency units and replaces the variable L in any of the production functions considered so far. As long as, at least for each generation, the size of $h_{(t)}$ is assumed to be given, nothing really changes with respect to our results.

Within a purely neoclassical framework, production in intensive form – i.e., productivity – would then read $q = A f(k, h)$, while per-capita output still were $y = (L/N)\, q$. The growth rates associated with this variant of the basic model are given by:

$$\hat{q} = \hat{A} + \frac{f_k k}{f}(\hat{K} - \hat{L}) + \frac{f_h h}{f}\hat{h} \tag{2.18}$$

$$\hat{y} = \hat{A} + \frac{f_k k}{f}\hat{K} + \frac{f - f_k k}{f}\hat{L} + \frac{f_h h}{f}\hat{h} - \hat{N} \tag{2.19}$$

Apart from the additional terms representing potential growth in human capital per worker, the results are identical with equations (2.4) and (2.5). If h stays constant, the effect of population growth through higher fertility is no different from what we observed so far. Any deviation from the basic model is thus contingent on an explanation of how human capital per worker may change over time.

Yet, two extensions that are potentially related to our theme may be of importance here. First, even in a basic neoclassical setting we could take into account that human capital, or efficiency, per worker may systematically differ over the active period of life, hence across different age groups, for reasons such as changes in educational behaviour, differences in experience, depreciation of knowledge, or age-related trends in physical and mental capabilities. In the literature, studying these differences in a systematic fashion is closely related to Mincer's (1974) canonical expression for how wages, which can be taken to represent human capital per worker, develop over a typical working life. What is even more interesting is a second extension by which we may explicitly include the way in which human capital is built up at an individual level and accumulated and exploited at a society-wide level. Here, the seminal contributions go back to Lucas (1988) and Uzawa (1965).

2.3.1 Mincer equations and the age structure of the active population

According to Mincer (1974), the time path of wages of a typical worker are an increasing function of the level of schooling obtained and a non-linear function of experience collected over the length of the working life. Consequently, the standard form of a "Mincerian" wage regression reads

$$\ln wage = a_0 + a_1\, schooling + a_2\, experience + a_3\, experience^2 + \varepsilon, \qquad (2.20)$$

where coefficients a_1 and a_2 are usually positive, while a_3 often turns out to be negative in an empirical context; a_0 is a constant, and ε is an error term reflecting unobserved heterogeneity across individuals. Due to the non-linear effect of the experience variable for any given level of schooling, wages first increase with job experience, but may then reach a maximum at some intermediate age and may even decline towards the end of the active period of life. In any case, there are diminishing returns to experience. If workers are assumed to earn their marginal product, than this age-related pattern of wages should inform us about productivity differentials between workers, including productivity differentials across different age groups.

Without changing the general set-up of the models employed thus far, we could therefore distinguish between different age groups m who are active at a given point in time (for instance, workers aged less than 20, 20–29, etc.), attribute an average level of human capital h_m to each of these groups, and finish by calculating an aggregate measure $H = \sum_m h_m L_m$ for the total amount of human capital that is currently available. This measure, then, has two features which may be relevant for the purpose of our study. First, regardless of whether there are systematic trends in levels of formal schooling across age groups or not, the effective amount of labour inputs utilised for current production becomes a function of the age structure of the active population. Second, this implies that, even without introducing an explicit time structure as rigid as the one behind the overlapping-generations model considered before, we may be able to track how changes in fertility feed through to changes in productivity and per-capita output over time with considerable time lags.

To be sure, in the framework sketched here the productivity of (each efficiency unit of) labour is still fully determined by the current stage of technological progress (A_t), which is taken to be exogenous, and by the current stock of physical capital (K_t), as it is in the basic neoclassical model. Also, all standard properties of the neoclassical model apply – non-negative, but diminishing returns to each factor, constant returns to scale, and output with extreme levels of inputs being governed by the Inada conditions. But the effective amount of labour measured in terms of efficiency units is now influenced not only by the sheer number of workers. Instead it also depends on their age distribution and – in conjunction with that, but as a dimension which can be controlled for independently if the relevant data is available – on the age-specific distribution of their levels of qualification. As a consequence, when measuring productivity or output per worker, one of the core determinants of output per capita, one may now be able to identify sizeable cohort effects. These, in turn, can be attributed to the past history of population growth, including major changes in fertility and their precise timing.

2.3.2 Endogenous growth in the Uzawa–Lucas Model

Still, the discussion in the previous section may not cover all that can be said about the role of changes in population and fertility for the course of economic development. Building on earlier work, but essentially starting from the mid-1980s, a new theory of "endogenous" growth has emerged which, inasmuch as it has proven to be empirically relevant, could substantially modify the way in which population growth, changes in fertility and human capital accumulation may affect economic growth.

In a conventional neoclassical model, persistent per-capita growth can only be achieved through continuous technological progress, $\hat{A}$, which is taken to be exogenous and is not explained within the model. In other words, creating endogenous growth requires a formal model embodying an explanation of how A, sometimes called "total factor productivity", changes over time. This explanation may be related to the accumulation or utilisation of one of the usual factors of production, but the way it works must not be subject to diminishing returns or any other of the neoclassical standard assumptions. Departing from the basic Solow–Swan model, an explanation of this kind essentially comes in two variants: the driving force of endogenous growth could be linked to investment in physical capital (see Romer 1986) or to investment in human capital (see Lucas 1988). Theoretically, endogenous growth can arise either way[9] so that, within the

[9] Besides the introduction of a new role for at least one of the conventional inputs, there are other mechanisms, explicitly representing innovations and their diffusion through imperfect markets, that might drive processes of endogenous growth; see Barro and Sala-i-Martin (1995, chs. 6–8) for further reading. It would be difficult, though not impossible, however, to relate these varieties of endogenous growth models to our overall subject, viz. the link between population and fertility on the one hand

realm of economic theory, there is no way to discriminate between these two competing approaches. But if human capital is assumed to be the (main) engine of growth, there could be a positive (long-term) relationship between fertility and economic prosperity that goes beyond a mere combination of the diverging effects we have dealt with so far. Ultimately, this is an empirical question to which we will turn later on (see chapters 3 and 5). Here, we are still paving the way towards understanding more fully the mechanisms that could be at work behind this relation.

The model suggested by Lucas (1988), who further develops an idea originally brought forth by Uzawa (1965), is built on two amendments of the standard neoclassical growth model that give rise to persistent per-capita growth from "within" the model. First, it introduces a specific formulation for how human capital is generated in a separate sector of "production". By assumption, this sector employs part of a given society's existing human capital, no physical capital,[10] and it exhibits non-decreasing returns to this input. In other words, the production of human capital, $\dot{h}$, is human-capital intensive, and human capital generates new human capital in a "(super-)linear" fashion.[11] Second, the function for aggregate goods production contains an "external effect" of the human capital employed there – i.e., "spillovers" across firms or sectors of industry, or some kinds of "crowding benefits" in areas where production may be concentrated geographically – by which total factor productivity, $A = \Lambda g(\bar{h})$, is an increasing function of the average level of human capital that has been accumulated at a given point in time. (Here, Λ captures aspects of the technological progress other than those reflected in $g(\cdot)$, $\bar{h}$ being average human capital per worker.) It is thus (a) the peculiar way of how human capital is assumed to accumulate and (b) the existence of external economies that constitute mechanisms generating endogenous growth.

In terms of a formal model, aggregate output in an Uzawa–Lucas framework is given by

$$Y = AF(K, \alpha hL) = \Lambda g(\bar{h})F(K, \alpha hL)\,. \tag{2.21}$$

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and economic development on the other. We thus exclude them from our brief survey of what insights existing growth theories may provide for our investigation.

[10] Yet, this is not the decisive feature for an alternative engine of growth other than technology A to arise; see Barro and Sala-i-Martin (1995, ch. 5) for the sketch of a "generalised" Uzawa–Lucas model where the production of human capital also involves some physical capital goods.

[11] In a survey article replying to new developments in "his" field of growth theory, Solow (1994) stresses that constant returns really have a "knife-edge" character for endogenous growth to arise without any implications that are highly unrealistic in terms of the speed of the growth process. In fact, a linear specification of the human-capital production function is what Lucas had used in his 1988 paper.

The state of technological progress, A, is now decomposed into an exogenous component, Λ, and an endogenous one, $g(\bar{h})$, as indicated above. (Note that, with identical workers, average human capital per worker, $\bar{h}$, will equal the individual-level measure of human capital, h.) The functional $F(\cdot)$ represents a neoclassical component of the aggregate production function as it may still exhibit the generic neoclassical properties spelt out before. However, part of the labour force is now engaged in human capital accumulation – or, alternatively, each worker is assumed to spend part of his total working time in this second sector – so that only a fraction α of human capital that is currently available is utilised for goods production. Another fraction, 1–α, serves as an input to the production of (or as an investment in) human capital according to

$$\dot{h} = B(1-\alpha)h\,, \tag{2.22}$$

B, the constant rate of human capital accumulation, being the main technical parameter in this "linear" technology.

Building on equations (2.21) and (2.22), defining output per worker and output per capita is straightforward, only the former being openly affected by the changes in assumptions when compared to the basic neoclassical model:

$$q \equiv \frac{Y}{L} = Af(k,\alpha h) = \Lambda g(\bar{h}) f(k,\alpha h) \tag{2.23}$$

$$y \equiv \frac{Y}{N} = \frac{L}{N} q \tag{2.24}$$

Taking time-derivatives, $\dot{q}$ and $\dot{y}$, and calculating the corresponding growth rates, $\hat{q}$ and $\hat{y}$, now yields:

$$\hat{q} = \hat{\Lambda} + \underbrace{\frac{kf_k}{f}(\hat{K}-\hat{L})}_{\substack{\text{capital dilution} \\ -}} + \underbrace{B(1-\alpha)h}_{\substack{\text{human cap.} \\ \text{accumulation} \\ +}} \Big(\underbrace{\frac{g'}{g}}_{\substack{\text{external} \\ \text{effect}}} + \underbrace{\frac{\alpha f_h}{f}}_{\substack{\text{internal} \\ \text{effect}}} \Big) \tag{2.25}$$

$$\hat{y} = \hat{\Lambda} + \underbrace{\frac{kf_k}{f}(\hat{K}-\hat{L})}_{\substack{\text{capital dilution} \\ -}} + \underbrace{B(1-\alpha)h}_{\substack{\text{human cap.} \\ \text{accumulation} \\ +}} \frac{g'f + \alpha g f_h}{gf} \underbrace{+\hat{L}}_{\substack{\text{participation} \\ +}} \underbrace{-\hat{N}}_{\substack{\text{dependency} \\ -}} = \tag{2.26}$$

$$= \hat{\Lambda} + \frac{kf_k}{f}\hat{K} + \frac{f-kf'}{f}\hat{L} + B(1-\alpha)h\frac{g'f + \alpha g f_h}{gf} - \hat{N}$$

When compared to the basic model (see section 2.1), all of the effects we observed there reappear in the new framework. In addition, the growth rates of both productivity and per-capita output contain a new term now, reflecting the effect of human capital accumulation that is unambiguously positive as soon as it becomes effective. (A direct comparison of the two sets of results is of course obscured by the fact that, in the basic model, nothing was said about the nature of $\hat{A}$.)

If it is changes in $\hat{N}$ that are driven by fertility we want to investigate, we may again have to distinguish between short-term consequences and long-term consequences for q and y. If the short-term response of $\hat{L}$ is zero or negative, nothing much changes against the basic model. In terms of productivity growth, the inverted (i.e., positive) capital-dilution effect of lower labour force participation of parents taking care of their children may now be counteracted by the fact that they are also diverted from producing more human capital embodied in themselves. Also, as this has an impact on total factor productivity and on the entire time path of human capital accumulation, the (positive) effect for $\hat{q}$ may be weaker and the (negative) effect for $\hat{y}$ may be stronger than in the basic model. In terms of per-capita growth, lower participation and higher dependency clearly imply that the total effect is negative over the short-term.

In the long run, however, when children reach their active period of life, in spite of genuine capital dilution, they contribute to higher growth rates of both productivity and output per capita. These latter effects can be much stronger than in the basic model, because now they are not only driven by higher participation (and, everything else being equal, lower dependency) but also by the accumulation of human capital. This is precisely where the special features of the Uzawa–Lucas model move to the fore, implying (a) that there are no shortages whatsoever involved in passing on human capital to a growing number of individuals and (b) that the accumulation of human capital has a double impact on aggregate output, viz. an internal effect on the marginal productivity of workers that is reflected in their wage earnings as well as an external effect on total factor productivity.

Merely as an aside, Lucas explains in his 1988 article that the linearity assumption relating to human capital production, $\dot{h}$, is not at odds with the observation that, over a given individual's life cycle, human capital accumulation is usually slowing down considerably. He attributes this latter observation to the simple fact of life that each individual's lifetime is finite, so that the return to increments in human capital at an individual level falls over time, arguing that it can be entirely consistent with an aggregate-level technology of human capital accumulation represented by (2.22).[12] For our purposes, however, these considerations may nonetheless be of interest. As equation (2.22) does not reveal how precisely new knowledge is created and then disseminated across the active population, the age-structure effects for current productivity that we discussed in the previous section may still be relevant in this amended setting. Furthermore, as the average amount of human capital per worker has an external effect via A, we may even find an impact of the age structure of the labour force on total factor productivity. We will deal with this aspect in some more detail in the following chapter, when we move towards defining the empirical design of the in-depth investigation we have in mind. To illustrate the issues we have covered thus far, let us first turn to briefly surveying the empirical evidence regarding the various channels through which changes in population growth and fertility may affect economic growth in general and the growth of per-capita output and productivity in particular.

2.4 The empirical evidence collected so far

It has already been said that there is only a limited number of contributions which have looked at the themes discussed here from an empirical point of view, using up-to-date techniques of econometric modelling and analysis and exploiting a growing body of data bases that are available for these and similar purposes. Against a different background, with some concern about over-population and the prospects for economic growth in less-developed countries, there has been certain interest in the question for potential links between population growth, in particular inasmuch it is driven by high fertility, and economic development since the 1950s. Yet, from a purely technical point of view, most of the empirical work prior to the contribution by Brandner and Dowrick (1994) is now clearly outdated.

There are certainly several ways to approach the questions raised here, but the most prominent way is one where longer time series of data, mainly consisting of aggregate level (i.e., macroeconomic) indicators, for a larger sample of countries are being analysed controlling for country-specific effects and pure time trends. Building on methodological improvements as well as new data sets that had become available starting from the early 1990s, Brandner and Dowrick are thus the first to investigate the role of population growth and fertility for economic development using a true, modern "panel" analysis (in a multi-country time-series setting, that is). Their data covers 107 countries (both industrialised and developing) and spans the period from 1960 to 1985 in 5-year

[12] This is shown, inter alia, by Rosen (1976).

intervals. Their econometric model is built on the basic Solow–Swan approach introduced earlier in this chapter. Specifically, they run a series of ordinary least-squares (OLS), fixed effects (FE) and random effects (RE) regressions using real per-capita output (y) or real per-capita growth ($\hat{y}$) as dependent variables. As regressors, they include changes in the share of population of working age, population growth, the share of investment in GDP, and a measure of relative labour productivity (relative to maximum levels observed in the same period of time) reflecting the current stage of technological progress in each country. In ancillary regressions, they also look at demographic determinants of the share of investment in GDP and of the growth of the working-age share in total population. Here, the regressors are birth rates, a "relative price of investment" indicator and per-capita output in the former case, and birth rates alone in the latter.

Building on their theoretical model, Brandner and Dowrick expect to find – but are unable to fully isolate against each other empirically – a capital-dilution effect (including a related net effect of resource dilution and economies of scale), a participation effect and an inversely defined dependency effect (lumping together these two latter effects in their ex-ante considerations) of higher population growth. Taking into account that the time dimension of the panel is still relatively short and that they mainly use contemporaneous (non-lagged) values of variables in their estimates, they effectively concentrate on short-term effects of changes in fertility to the extent that these are captured by their set-up at all.

As far as per-capita output and per-capita growth are concerned the coefficient of population growth, which is mainly taken to reflect capital dilution (and dilution of other resources), is weakly negative and insignificant throughout. Among the socio-demographic variables, the working-age share of population (i.e., the "potential" for labour force participation) appears to play a much stronger role, its coefficient being always significant and positive. The role of investment for output and growth is positive and significant (as should be expected), but the most important source of variation, both across countries and over time, is the relative productivity indicator. Regressing the working-age share in population on birth rates reveals that there is a negative effect of current birth rates, but a positive effect of birth rates lagged by 15 years. These results are neither surprising, nor are they very relevant for the questions ultimately addressed here, as the dependent variable is poorly specified if actual labour force participation is what really matters. By contrast, the results regarding determinants of the investment share are interesting in that they suggest that birth rates have an indirect effect on growth via capital accumulation. Furthermore, in less developed countries higher birth rates appear to have a negative impact on investment, while in more developed countries they have a significant, non-monotonic effect that is positive for (crude) birth rates smaller than 30 ‰ and turns to being negative for higher birth rates. All in all, the results shed some light on single issues covered in this chapter. On the other hand, they are far away from fully exploring the relationship between population growth, fertility and economic development both in terms of a proper definition of variables included and in terms of the long-term nature of many important aspects.

In a subsequent paper, Ahituv (2001) presents a number of refinements, both methodological and substantial, to the work of Brandner and Dowrick (1994). His data cover 114 countries, and he shifts the time period spanned to 1965–1989, arguing that growth performance in the early 1960s may be biased upwards for historical reasons. Further, Ahituv (2001) shows fertility rates to have a more significant impact on per-capita output than total population growth, and he explicitly includes variables reflecting human capital accumulation in his estimates.[13] Also, he takes in a larger number of country characteristics, such as geographical situation, degree of civil liberties, being an oil-exporting country, or the role of agricultural land use.

Ahituv (2001) differentiates between physical capital dilution and dependency effects (effectively lumping together the latter with the effect on parental labour-force participation, as he is unable to distinguish between these two aspects empirically[14]) as the main channels for how fertility may affect output per capita. His estimates, augmented by simulations regarding the impact of demographic variables on physical capital investment, suggest that the latter channel is far more important than the former in explaining a negative effect of fertility on output.[15] As Ahituv again looks at contemporaneous relationships only – i.e., effects of current fertility rates on current economic performance – he also tests for a reverse causality, concluding that the negative relation between fertility and output per capita is the result of bi-directional dependence. Like Brandner and Dowrick (1994), however, Ahituv (2001) does not look at the long-term consequences of changes in fertility for economic growth, again potentially neglecting another important dimension of his story.

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[13] In Ahituv and Moav (2003), the interplay of demographics, education and growth is looked at in some more detail, essentially using the same empirical approach and the same data set as in Ahituv (2001).

[14] He calls a "wedge effect" what was introduced as a (child) "dependency effect" before and adds a pure "time consumption effect" related to the parents' time constraint.

[15] Hence the provocative title of his paper, "Be fruitful *or* multiply".

An important step in this direction is taken by Lindh and Malmberg (1999) who build on a neoclassical framework with human capital (as adapted by Mankiw et al. 1992), augment it with the age structure of total population and allow for gradual technical adjustment (transition growth model) in order to study potential effects of the demographic composition of the labour force on the economic performance of industrialised countries. Here, the data base is constituted by 5-year averages for a number of macroeconomic indicators for OECD countries spanning the time from 1950 to 1990. The central equation to be estimated is

$$\frac{\hat{q}_{tj}}{\Theta_{tj}} = a_0 + a_1 \ln i_{tj} + a_2 \ln(\delta + w_{tj}) + a_3 \ln y_{tj} + a_4 \sum_m b_m \ln n_{mtj} + a_5 \frac{1}{\Theta_{tj}} + \varepsilon_{tj} \quad (2.27)$$

where $\hat{q}_{tj}$ is the average annual growth rate of real GDP per worker, Θ_{tj} is a country and time-specific term of convergence, i_{tj} is the average investment rate for country j over each 5-year period, w_{tj} is the average growth rate of the labour force over each 5-year period, δ is the depreciation rate of both physical and human capital (set to 0.03), y_{tj} is initial real GDP per worker and n_{mtj} is the relative size of the age group m at the start of each 5-year period. The age groups distinguished among total population are aged 15–29 years, 30–49 years, 50–64 years, 65 years and above. In a given time period, changes in the age structure are assumed to be exogenous as they largely go back to decisions that have been taken long time ago. (This is certainly plausible with respect to fertility, perhaps a bit less so with respect to migration.)

The results of Lindh and Malmberg (1999) indicate that there is a significant positive effect of the share in population of those who are currently “upper-middle aged” (50–64 years old). With constant total population, an increase in the share of this age group leads to an increase of annual “transitional” growth per capita of 0.25 to 0.5 percentage points. At the same time, the share of the age group of elderly people (65 and over) has a significant negative effect on per-capita growth. Younger age groups have ambiguous effects. The findings are affirmed by a number of robustness tests, but the authors emphasise that the mechanisms behind these age effects are not yet identified. Perhaps, one of the main shortcomings that needs to be resolved in subsequent work is that the demographic variables used by Lindh and Malmberg relate to total population, not to the active population, and therefore do not allow for stronger conclusions regarding the precise mechanisms at work.

A more recent study dealing with effects of the age structure on productivity – using data relating to both population and labour force – is provided by Feyrer (2002). In a setting that is methodologically different from the studies presented so far, he largely confirms the effects found by Lindh and Malmberg, though with a “timing” over different age groups that is slightly different. We will return to this contribution at the end of the following chapter where, first of all, we have to work ourselves through recent developments in empirical growth analysis.

Chapter 3
The Role of Total Factor Productivity

In the empirical growth literature, there is strong empirical evidence for the importance of total factor productivity in explaining actual growth performance both over time and across countries (for an extensive survey, see Easterly and Levine 2000). Therefore, next to explanations based on changes in the sheer amount of factor inputs, such as the stock of physical capital and the number of workers, or the stock of human capital as a broader concept for measuring effective labour inputs, explanations of the determinants of total factor productivity are called for. Potential explanations that have been stressed in the literature are a given country's invariable characteristics (based on geography and climate), its institutional setting (economic freedom, openness to international trade), with a particular focus on government activities (public finances, provision of public services, strictness of government regulation), and, as we have seen in the last chapter, mechanisms that give rise to endogenous growth processes linked to the accumulation and utilisation of physical capital or human capital. In fact, a recent contribution by Feyrer (2002) suggests that there may even be a direct impact of long-term changes in the age structure of the population, hence fertility, on total factor productivity.

To test for the validity of this hypothesis, measures of total factor productivity and its growth first need to be isolated empirically from total output and total (per-capita or per-unit-of-labour) growth through procedures that are usually termed "growth accounting". Since these procedures are highly relevant for the empirical design we are going to adopt ourselves in this study, the current chapter summarises the basic concept of growth accounting and surveys some of the different applications developed in the literature. In chapter 4, we will develop the approach we are following in our own empirical work and present and discuss the results that emerge.

3.1 Growth Accounting: the basic approach

Building on the pioneering contribution by Solow (1957), the main objective of growth accounting is to measure the relative role of the different fundamental determinants of economic growth. In order to do so, observed output growth is first broken down into components that are associated with pure changes in factor inputs, basically capital and labour. The residual of these calculations is then taken to reflect technological progress and other determinants of growth that are not explained by factor accumulation alone. This term, also known as the "Solow residual", is often called "total factor productivity" (TFP). Furthermore, as long as a genuine explanation for its role as a driving force of economic growth is lacking, it is essentially a measure of ignorance (Abramovitz 1956). According to Barro (1998), growth accounting is nonetheless useful if the fundamental determinants that matter for technological change are significantly independent from those that matter for factor accumulation.

In the context of the present study, discussing in some detail the methods and procedures that have been developed in the growth accounting literature serves two tasks. First, as far as the empirical analysis concentrates on analysing levels or changes in the TFP residual – among other things, through linking these to demographic variables – we need to understand how the Solow residual is calculated from existing aggregate data. Second, as far as it is levels or changes in *total* output that will be looked at,[1] growth accounting still provides quite a number of lessons regarding measurement issues and empirical specifications that are important for how to include the effects of pure factor accumulation.

To illustrate the basic approach to growth accounting, consider, again, the neoclassical production function

$$Y = AF(K, L)\,, \tag{3.1}$$

where A is the level of technology, K is the physical capital stock, and L is the quantity of labour employed.[2]

Differentiating with respect to time and rearranging yields:

$$\hat{Y} = \hat{A} + \left(\frac{F_K K}{Y}\right)\hat{K} + \left(\frac{F_L L}{Y}\right)\hat{L}\,, \tag{3.2}$$

where F_K and F_L are (social) marginal products of the two types of inputs and $\hat{A}$ is growth due to technological change (or some other determinants of growth). The rate of technological progress, $\hat{A}$, can thus be calculated as a residual,

$$\hat{A} = \hat{Y} - \left(\frac{F_K K}{Y}\right)\hat{K} - \left(\frac{F_L L}{Y}\right)\hat{L}\,. \tag{3.3}$$

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1 Note that, in chapter 4, we will effectively do both things.

2 As in chapter 2, we assume the aggregate production function to be "Hicks-neutral" in the sense that changes in A do not affect the ratio of marginal productivities of capital and labour. (See footnote 2 in chapter 2 for further details.)

If the input factors are paid their social marginal products, i.e., $F_K = 1 + r$ (the rental price of capital) and $F_L = w$ (the wage rate), then

$$\hat{A} = \hat{Y} - s_K \hat{K} - s_L \hat{L} , \tag{3.4}$$

where s_K and s_L are the respective shares of each factor in total output. If all the income associated with aggregate domestic output, *Y*, can be attributed to the factors capital or labour, then the condition $s_K + s_L = 1$ or, equivalently, $Y = (1+r)K + wL$ holds. In an international context, some net factor income can flow to foreign-owned inputs which then would be also included in the term $(1+r)K + wL$. If the production function $F(\cdot)$ exhibits constant returns to scale in *K* and *L*, then the equality of output to total factor income is consistent with an equality between factor shares (s_K and s_L) and the respective (partial) output elasticities ($F_K K / Y$ and $F_L L / Y$).

If, for instance, the production function is assumed to be of the Cobb–Douglas type,

$$Y = AK^{\alpha} L^{\beta} = AK^{\alpha} L^{1-\alpha} , \tag{3.5}$$

with constant returns to scale ($\beta = 1 - \alpha$), calculating the residual growth rate measuring changes in TFP boils down to

$$\hat{A} = \hat{Y} - \alpha \hat{K} - (1-\alpha)\hat{L} , \tag{3.6}$$

where $\alpha \hat{K}$ and $(1-\alpha)\hat{L}$ are the weighted contributions of observable changes in inputs to observed aggregate output growth $\hat{Y}$, the weights being simply given by the constant technology parameter α that can be inferred from capital's share in total output.

In an intensive form, the decomposition of output reads

$$\hat{A} = \hat{q} - s_K \hat{k} , \tag{3.7}$$

where $q \equiv Y / L$ and $k \equiv K / L$ are quantities per units of labour. Here, the Cobb–Douglas specification of output per worker, $q = Ak^{\alpha}$, yields

$$\hat{A} = \hat{q} - \alpha \hat{k} = \hat{q} - \alpha(\hat{K} - \hat{L}) . \tag{3.9}$$

I.e., the rate of technological progress, γ, can be simply determined based on changes in labour productivity, $\hat{q}$, taking into account changes in capital intensity, $\hat{k}$, and, again, the technology parameter α.

3.2 Measurement issues and refinements

Early applications of growth accounting with physical capital and labour such as those by Solow (1957) and Denison (1962, 1967) found that a substantial part of the growth rate of aggregate output was not explained by the growth rates of measured quantities of inputs. Accordingly, a large part of the output growth was accounted for by the residual term representing technological progress. Up to a point, this preliminary result is not entirely satisfactory and, in itself, calls for further clarification. Jorgensen and Griliches (1967) were the first to give attention to the quality, not only the quantity, of inputs in growth accounting to avoid biases in how the residual is calculated.

In line with the basic approach, Jorgensen and Griliches (1967) as well as Jorgenson, Gollop and Fraumeni (1987) define total factor productivity as the difference between the growth rate of real output and the growth rate of real factor inputs. In turn, the growth rates of real output and real factor inputs are defined as weighted averages of the growth rates of individual categories, or groups, of output and input factors. Relevant weights are the relative shares of each product in the value of total output and the relevant shares of each input factor in the value of total inputs. Building on these refinements, Jorgensen and Griliches (1967) showed that an important source of potential measurement error in total factor productivity analyses is the limited number of separate inputs that can be differentiated empirically. Such errors in aggregation are also labelled “quality change” and occur whenever the growth rates of quantities within each heterogeneous group of inputs are not identical. For example, if high quality inputs included in a larger group grow faster than low quality inputs, then the effective growth rate of the group of inputs is biased downwards against the situation where high and low quality products are considered separately.

3.2.1 Heterogeneous labour

In the case of labour inputs, an important application of the quality-of-inputs approach is that simply accounting for the number of workers does not take into account changes in average working time, the role of the self-employed and other categories of employed individuals, or further differences in the quality of labour based on education, experience, gender, etc. Therefore, a quality-adjusted index of labour services could be computed as a weighted average of the number of hours worked by different types of labour broken down by occupation, education, sector, age, sex, and employment status (full-time, part-time). The relative weights of the individual categories are the average wage rates for the various groups of workers (see Jorgenson and Griliches 1967).

As an example, let us assume that higher educated persons earn higher wages. Then, an additional worker with college education may account for a higher rate of output growth than an extra-worker with high school education would. Further, an increase of the proportion of the labour force with college education accompanied by a decrease of the proportion of the labour force with only primary education would lead to an increase of the total labour input even if the total number hours worked remained the same.

3.2.2 Differentiated capital services and measurement of physical capital stocks

Analogously, the quality of capital can be, and should be, accounted for (see, again, Jorgenson and Griliches 1967). As an example, Barro (1998) differentiates between short-lived and long-lived capital. For a given return to capital, the rental price $1+r_i$ related to type-i capital must be higher if the depreciation rate is higher. Hence, a shift from long-lived capital (with low depreciation, e.g. buildings) to short-lived capital (with higher depreciation, e.g. machinery) would account for part of economic growth.

But the problems involved in accounting for the flow of services of physical capital, for example, the aggregate amount of "machine hours" utilised in the production process in a given period of time, are in fact much more fundamental. Usually, measures of this kind simply do not exist. It is therefore typically assumed that the relevant flows are proportional to the existing stock of capital. But usually, there are not even reliable, direct measures of the value of the capital stock for a given country and a given time period. In general, measurement of the physical capital stock has to start from cumulated figures on gross physical investment as well as from estimates for depreciation of the existing stock of capital in order to extrapolate the capital stock over successive periods of time. These traditional, so-called "perpetual-inventory" methods thus use the following relationship (Jorgenson and Griliches 1967, Statistical Appendix):

$$K_{t+1} = (1-\delta)K_t + I_t, \tag{3.10}$$

where K_t is the capital stock at time t, δ is the depreciation rate, and I_t is the flow of gross investment during period t. The rate δ is assumed to be constant over time, and adjustment costs for investment are neglected. An initial estimate K_0 (using a benchmark year) or a simple guess regarding the size of K_0 is necessary to start the "chain" of capital accumulation. Estimates regarding K_t's for the early years are not very reliable as they strongly depend on the initial capital stock K_0. Due to depreciation, however, the estimate, or guess, regarding the initial capital stock becomes relatively unimportant over time, thereby leading to more accurate estimates of K_t.

3.2.3 Integration of human capital in growth accounting

A distinctive feature of more recent contributions to growth theory and growth accounting is the incorporation of human capital into the production function. Important examples are given by Lucas (1988), Azariadis and Drazen (1990), Mankiw et al. (1992), or Jones (1996).[3] Beyond merely attaching a new label to what was formerly known as the quality of labour, this literature pays particular attention to the accumulation of human capital and productive knowledge and to the interaction between these two aspects.[4]

Current research on human capital and growth implies that increasing the average level of skills and knowledge embodied in the labour force of a given country increases productivity directly and may also increase the economy's ability to develop and adopt new technologies, thereby increasing the productivity of subsequent generations as well. Depending on precisely how human capital enters the production function, there are thus two types of potential effects of changes in human capital for aggregate growth and productivity growth, viz. so-called "level effects" (or "static effects"), with a direct impact on the level of output only, and "rate effects" ("dynamic effects", or genuine "growth effects"), with a lasting impact on the growth rate of output via the growth of TFP (see De la Fuente and Ciccone 2002, or Aiyar and Feyrer 2002).

As an example that potentially combines the two effects, consider the following variant of a Cobb–Douglas production function where human capital per worker, h, is introduced as an additional input factor, such that the aggregate stock of human capital is given by $H = hL$:

$$Y = AK^{\alpha} H^{1-\alpha} = AK^{\alpha} (hL)^{1-\alpha} \tag{3.11}$$

The corresponding growth equation is

$$\hat{Y} = \hat{A} + \alpha\hat{K} + (1-\alpha)(\hat{h} + \hat{L}) \tag{3.12}$$

or, in an intensive form per effective unit of labour L,

$$\hat{q} = \hat{A} + \alpha(\hat{K} - \hat{L}) + (1-\alpha)\hat{h}\,. \tag{3.13}$$

The production function (3.11) exhibits constant returns to scale in capital, labour and total human capital. If the time path of A is taken to be exogenous, an increase in h, with a temporarily higher $\hat{h}$, has a one-shot effect on $\hat{q}$ and $\hat{Y}$. If, later on, h remains high

3 Important predecessors are Uzawa (1965) and Nelson and Phelps (1966).

4 In section 2.3 we presented the Uzawa–Lucas model based on Lucas (1988) in a little more detail.

and $\hat{h}$ returns to its normal value, there will be a permanent effect on the level of *Y*. This is the *level effect*. In addition, $\hat{A}$ may, in itself, be a function of *h* such that, e.g.,

$$\hat{A} = \lambda + \gamma(h)\,. \tag{3.14}$$

In this case, an increase in *h* has a permanent effect on the growth rates of total factor productivity and of total output, not just on their levels. If *h* remains at its new level, this *rate effect* may eventually level off over a long transitional period, until the economy has fully converged to a new, higher growth path that could be defined by the exogenously shifting world technology frontier.[5] Still, if human capital is not just seen as an accumulable factor among others but as an important technology enabler, the rate effect could be present for many decades, at least.

Note that a representation of TFP growth like $\hat{A} = \lambda + \gamma(h)$ is effectively a more sophisticated way of replacing *A* by $Ag(h)$ in an otherwise "neoclassical" production function like (2.21), with the possibility of endogenous growth linked to human capital. This indicates that the level effect of higher *h* also affects wages of employed individuals with better skills – for instance, in such a way as would be predicted by a standard Mincerian wage regression (see equation (2.20)). The rate effect, on the other hand, implies a growth externality of human capital that only arises at the level of firms, regional agglomerations or entire nations and is not rewarded individually if wages are determined in a competitive fashion. As a consequence, it would necessarily be missed in any purely microeconometric work. Given the availability of appropriate macro-level data, however, the link between TFP growth and human capital is a hypothesis that can be, and has been, subjected to empirical testing (see Benhabib and Spiegel 1994, Bils and Klenow 2000, or Aiyar and Feyrer 2002). The bottom-line is that the existence and sizeability of rate effects has been largely confirmed but that, due to data limitations and econometric problems, it is sometimes difficult to separate these from level effects, even though their distinction is conceptually clear (De la Fuente and Ciccone 2002).

3.2.4 Measurement of human capital stocks[6]

Besides simple education-augmented specifications of labour inputs (Denison 1967, Jorgenson 1995), the first proxies for human capital used in the empirical literature were

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5 Based on Nelson and Phelps (1966), the potential impact of *h* on $\hat{A}$ is indeed sometimes modelled as a mechanism interacting with the gap between actual TFP in a given country and its world-wide peak level taken to reflect best practices in all important respects (see, e.g., Benhabib and Spiegel 1994)

6 For a survey, see Wößmann (2003).

adult literacy rates and school enrolment rates. Adult literacy rates are defined by $l = M_A / P_A$, where M_A is the number of literates in the adult population, P_A is the total adult population and l is the adult literacy rate (see, e.g., Azariadis and Drazen 1990, or Romer 1990).[7] School enrolment rates are defined by $e_g = E_g / P_g$, where E_g is the number of students enrolled in grade g, P_g is the total population at an age at which individuals would be enrolled in grade g and e_g is the actual enrolment ratio for grade g. As emphasised by Wößmann (2003), enrolment rates are current “flows” and relate to persons who are children now. Neither do they represent the “stock” of effective labour services that are currently available nor are they a good indicator for the education of new entrants into the labour force. Enrolment rates merely reflect the education of persons who, at some point in time in the future, may enter the labour force. Therefore, school enrolment rates are poor proxies for human capital.

As a consequence, average years of schooling have increasingly become a measure for the stock of human capital that is used in current production. Unfortunately, direct evidence regarding the average years of schooling of the active population is often lacking. Three main methods have been developed in order to exploit data on school enrolment rates for estimating average years of schooling: the perpetual-inventory method by Nehru et al. (1995), the projection method by Kyriacou (1991), and the attainment-census method by Psacharopoulus and Arriagada (1986) and Barro and Lee (1993, 1996). Today, the method suggested by Barro–Lee as well as the rich, comparative data they have provided for a very large number of countries are probably the most widely used.[8]

Using an unweighted average of years of schooling as an indicator of existing human capital would not take into account differences in the rate of return to education over the maximum number of years of schooling. For instance, it would imply that raising schooling by one year in primary, secondary or tertiary education always leads to the same increase in the (private and social) rate of return. Also, such a simple approach would not take into account improvements in the quality of the education system. The first, and major, point is linked to the microeconometric evidence regarding decreasing marginal returns to schooling in Mincerian wage regressions.

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7 Literacy means “the ability to read and write, with understanding, a simple statement related to one’s daily life” (Wößmann 2003, p. 243).

8 This latter method has been criticised and further improved by De la Fuente and Doménech (2000, 2001). For an in-depth analysis of all these methods, see Wößmann (2003).

As emphasised by Hall and Jones (1999) and Bils and Klenow (2000), the evidence regarding decreasing marginal returns to schooling can be incorporated in empirical measures of the human capital stock by assuming that

$$H_t = \mathrm{e}^{\phi(s_t)} L_t \quad \text{or} \quad h_t = \mathrm{e}^{\phi(s_t)} , \tag{3.15}$$

where s_t is average years of schooling in a given country at time t and $\phi'(s)$ represents returns to schooling with $\phi'(s) > 0$ and $\phi''(s) < 0$. Building on this basic idea, two approaches have actually been used in the literature that take into account the non-linear relation between the human capital stock and years of schooling. On the one hand, Hall and Jones (1999) suggest a piecewise linear specification that is based on Psacharopoulos (1994) and has been further used by Feyrer (2002). On the other hand, Bils and Klenow (2000) derive a genuinely non-linear human-capital accumulation equation in less pragmatic way.

For the piecewise linear specification, it is assumed that rates of return to education are linear over particular "intervals" of total years of schooling and that schooling-related wage increments are equal to the rate of return to education (where wages are basically seen as compensating for interest payments foregone). Specifically,

$$\phi(s_t) = \sum_a r_a s_{at} , \tag{3.16}$$

where s_a corresponds to the average number of years at education level a (say, primary, secondary and tertiary education) at time t and r_a is the rate of return to education at level a, respectively. In an empirical context, a typical application is given by

$$\phi(s_t) = r_0 + r_1 s_{\text{year 1–4},t} + r_2 s_{\text{year 5–8},t} + r_3 s_{\text{years 9+},t} . \tag{3.17}$$

Building on estimates of returns to education provided by Psacharopoulos (1994), based on a Mincerian wage equation and data for a very broad set of countries, Hall and Jones (1999) and a number of successors use rates of return of 13.4 % for the first four years of ("primary") schooling (corresponding to rate-of-return estimates for Sub-Saharan Africa), 10.1 % for the next four years of ("secondary") schooling (corresponding to average rate of returns for the world) and 6.8 % for years of schooling beyond 8 years (corresponding to rates of return estimated for OECD countries).

The alternative specification of the human capital stock suggested by Bils and Klenow (2000) uses a generalised Mincerian model of human capital accumulation, taking into account an impact from human capital of the previous generation. Specifically, for the human capital of an individual aged *a* at time *t*, they assume that

$$\ln h_{a,t} = \phi \ln h_{a,t-25} + \frac{\theta s^{1-\theta}}{1-\psi} + \gamma_1 (a - s_{a,t} - 6) + \gamma_2 (a - s_{a,t} - 6)^2 . \tag{3.18}$$

Bils and Klenow set θ to the average return to schooling in their sample (9.9 %), while ψ is assumed to be 0.58, reflecting decreasing marginal returns to education as those found by Psacharopoulus (1994); γ_1 and γ_2 are determined based on the average experience-earnings profile for their sample (0.0512 and –0.00071, respectively); s is the educational attainment of the individual, and the term $(a - s_{a,t} - 6)$ reflects experience. Finally, there is an additional term accounting for the human capital of the previous generation that is assumed to be 25 years older than individuals of age *a* at time *t*.

Ideally, in measuring human capital stocks based on average years of schooling, quality changes and differences in education systems should be accounted for as well, e.g., through specifications such as

$$h_{it}^{r} = e^{\sum_a r_{ai} s_{ait}} , \tag{3.19}$$

where r_{ai} is the rate of return to education in education system *i* and s_{ait} is the educational attainment in education system *i* at time *t*. However, fully accounting for the quality of educational systems is difficult. It has been attempted partly by Psacharopoulus (1994) and, based on direct tests of cognitive skills, by Hanushek and Kimko (2000).

3.3 Growth accounting vs level accounting

3.3.1 Accounting for TFP growth

Estimates for the growth rate of TFP, $\hat{A}$, can be obtained directly based on equation (3.4) using time series data on $\hat{Y}$, $\hat{K}$, $\hat{L}$, s_K and s_L. It should be noted that continuous-time approaches are not really useful for empirical purposes, as most of the empirical information available is measured at an annual level. An analogous discrete-time formulation for TFP growth has already been derived by Thörnqvist (1936) who simply takes log-differences between the respective levels of *Y*, *K*, and *L* observed at dates *t* and *t*–1. Factor shares are derived from arithmetic averages for dates *t* and *t*–1.

Alternatively, dropping the assumption that factor prices, 1+*r* and *w*, are equal to (social) marginal productivities, F_K and F_L, one could attempt to estimate the intercept $\hat{A}$ and the coefficients $F_K K / Y$ and $F_L L / Y$ based on equation (3.3). However, this approach has a number of shortcomings. First, variables $\hat{K}$ and $\hat{L}$ may not be exogenous with respect to variations in $\hat{A}$. Second, if $\hat{K}$ and $\hat{L}$ are measured with an error, then standard estimation delivers inconsistent estimates for $F_K K / Y$ and $F_L L / Y$. Third, time variations in both factor shares and TFP growth would necessitate extensions of the regression framework. Due to these difficulties, most of the existing applications take the assumptions for (3.4) to be a reliable approximation of (3.3) as being basically valid, at least as a point of departure for closer inspection into the nature of $\hat{A}$.

3.3.2 Level accounting

While most contributions to the TFP literature concentrate on analysing *growth rates* of output and factor inputs, during the last decade several authors have emphasised the relevance of *levels* of inputs and output.[9] The renewed interest in level accounting was inspired by the seminal contribution of Mankiw et al. (1992) who demonstrated that the traditional Solow model augmented with human capital does a good job in explaining cross-country differences in the level of income per capita (respectively, per head of the working-age population). In their empirical design however, Mankiw et al. assume that TFP levels are the same across all countries, which is clearly at odds with reality and may explain some ambiguities in their findings relating to the case of developed vs less developed countries. Once this assumption is dropped, the augmented Solow model loses much of its explanatory power, and differences in both levels and growth rates of TFP move to the fore (see Easterly and Levine 2000).

Conversely, influential growth-accounting studies, like the one by Barro and Sala-i-Martin (1995, ch. 12), are based on models that, conditional on a number of other country characteristics, imply convergence to a common level in income per capita and a common growth rate for all countries in the long run. Accordingly, they are mainly looking at explanations for transitional differences in growth rates across countries. They are thus missing the point that persistent differences, or even divergence, in income levels might be the real issue to look at on a global level (see, gain, Easterly and Levine 2000). Up to a point, this is already confirmed by Easterly et al. (1993) who find a relatively low correlation of growth rates in a given country across decades, indicating that any acceleration or slow-down of growth may be purely transitory, whereas aspects that are more fundamental and long-term in their nature might show up in output levels.

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9 This idea can in fact be traced back to Denison (1962, 1967) who addressed the question what part of cross-country differences in income per capita can be explained by differences in physical capital per capita (see Easterly and Levine 2000).

At the same time, level accounting has meanwhile produced a number of new, potentially interesting results. For instance, the model by Jones (1995) points to a relation between government activities and differences in levels, not growth rates, of output. Similarly, Hall and Jones (1999) present a level-framework that explains productivity differences across countries based on "social infrastructure". Feyrer (2002), who is one of the few authors addressing the role of demographics for productivity and productivity growth, argues convincingly that demographic variables, in particular the age structure of the active population, should have an effect on productivity levels, rather than on growth rates. In turn, *changes* in demographic variables, such as shifts in the age structure of the active population, should then affect productivity growth.[10]

To understand the basic setup for level accounting, consider another variant of a Cobb–Douglas production function with human capital as an additional factor of production and with "labour-augmenting" technological progress,[11]

$$Y = K^{\alpha}(AH)^{1-\alpha} = K^{\alpha}(AhL)^{1-\alpha} \tag{3.20}$$

(see, e.g., Hall and Jones 1999), where K denotes the stock of physical capital, $H = hL$ is the amount of human capital-augmented labour used for production, and A is a labour-augmenting measure of productivity. Rewriting the production function (3.20) in terms of output per worker, or productivity, $q = Y/L$, then multiplying both sides by $q^{-\alpha}$ and solving for q yields

$$q = k^{\alpha}(Ah)^{1-\alpha} = \kappa^{\alpha/(1-\alpha)} Ah\,, \tag{3.21}$$

[10] In other words, two countries with stable, but different labour-force demographics should, other things being equal, have different levels of productivity, but may share a common growth rate, while two countries with identical labour-force demographics could have similar levels of productivity, but may experience differing growth rates – for instance, if one country is ageing faster than the other.

[11] Technological progress is called labour-augmenting, or "Harrod-neutral" (with reference to Harrod 1942), if it does not affect the output shares of capital and labour for a given capital-output ratio, $\kappa = K/Y$. Uzawa (1961) has shown that this definition implies that technological progress raises output in the same way as an increase in labour inputs, such that $Y = G(A, K, L) \equiv F(K, AL)$. He also demonstrated that, among the various definitions of "neutral" technological progress (cf. Barro and Sala-i-Martin 1995, sec. 1.2.10), Harrod-neutrality is the only one that is consistent with the existence of a "steady state", i.e., with a balanced long-run growth scenario in which the ratio $k = K/L$ is a constant.

Note that the definitions of Hicks-neutrality (see footnote 2 in chapter 2) – a concept that is of high importance for standard growth accounting – and Harrod-neutrality are not mutually exclusive. However, both definitions can only be met simultaneously with a production function that exhibits a constant unit elasticity of substitution. Furthermore, a constant-returns-to-scale Cobb-Douglas function (where the sum of all partial output elasticities is unity and the output shares of all factors of production are simply constant) is the only functional form that fulfils this condition.

with the capital coefficient $\kappa = K/Y = (K/L)(L/Y) = k/q$.

In a level-framework, taking natural logarithms leads to a linear decomposition by which A can be isolated. The results read

$$\ln A = \frac{1}{1-\alpha}\ln q - \frac{\alpha}{1-\alpha}\ln k - \ln h \tag{3.22}$$

or

$$\ln A = \ln q - \frac{\alpha}{1-\alpha}\ln \kappa - \ln h\,, \tag{3.23}$$

depending on which of the two versions encompassed in equation (3.21) is used.

Calculating first differences of these log-equations to obtain (exponential) growth rates, based on $\ln(x_t/x_{t-1}) = \ln x_t - \ln x_{t-1} \equiv \Delta \ln x_t$ and $\ln 1 = 0$, whereby

$$\Delta \ln A = \frac{1}{1-\alpha}\Delta \ln q - \frac{\alpha}{1-\alpha}\Delta \ln k - \Delta \ln h \tag{3.24}$$

or

$$\Delta \ln A = \Delta \ln q - \frac{\alpha}{1-\alpha}\Delta \ln \kappa - \Delta \ln h\,, \tag{3.25}$$

makes apparent the enormous similarities between level accounting and the growth-accounting framework introduced in section 3.1. Equation (3.24) is basically isomorphic (and, ultimately, equivalent) with (3.9) and its human capital-augmented version (3.13) if one takes into account the slightly differing assumptions regarding the nature of technical progress. (However, using the equivalence of the two neutrality assumptions for the case of a Cobb–Douglas production function, see footnote 10, we simply have to assume that our new TFP measure A included in equations (3.20) etc. is related to the old one, which we may now call T, by the monotonic transformation $A = T^{1/(1-\alpha)}$.)

With respect to applied work, equations (3.22) through (3.25) can be seen as prescriptions of how to calculate TFP in levels (and TFP growth rates, if these are also of interest) based on data an Y, K, L and h, taking into account many of the different aspects regarding the measurement of K and the inclusion and measurement of h discussed in this chapter. Having controlled for the role of pure factor accumulation for levels (and growth rates) of output and productivity, one can then go ahead and subject the measures obtained for $\ln A$ (and $\Delta \ln A$) to further examination in a comprehensive empirical approach, looking for determinants that could (a) explain why A appears to be so important for economic growth both over time and across countries (Easterly and Levine 2000) and (b) help us in understanding more fully how it is shaped, and how it can potentially be influenced, as a major driving force of economic development.

3.4 The role of demographics for TFP: Empirical results

Keeping in mind all the features and details of empirical growth analysis summarised in this chapter, we can now return to the survey of existing empirical evidence regarding the role of demographics for economic growth (see section 2.4). Overall, there is only a small body of literature looking at potential links between demographic variables and economic performance, at all. In fact, as of now, there is only one recent study, viz. the one by Feyrer (2002), that is based on a fully-fledged growth accounting approach in both levels *and* growth rates and investigates the role of demographics for TFP and TFP growth based on a large panel of countries and a relatively long time series of data. In doing so, Feyrer extends the work by Lindh and Malmberg (1999) and specifically looks at the age structure of the labour force (not of the total population) as a potential determinant of output and total factor productivity.

As a motivation for his study, Feyrer (2002) first points to the existing microeconometric evidence that the age structure of the labour force may have an impact on productivity and output. As was already mentioned, these effects should mainly affect productivity and output *in levels*, while shifts in the age structure should then have an impact on productivity and output *growth*. In addition, Feyrer argues that, not unlike the potential externalities of education, or human capital (see section 2.3), part of the effects of the demographic structure may not show up in individual-level outcomes, such as wages, but could affect total factor productivity measured at an aggregate level. He then subjects any of these hypotheses to empirical testing.

Apart from the fact that he is seeking quite different explanations of variation and changes in TFP and output per capita, the empirical setup used by Feyrer (2002) is rather close to the one developed by Hall and Jones (1999). For his TFP estimations in levels, Feyrer (2002) calculates, in the first stage, the TFP residual $\ln A_{it}$ based on an equation that is basically the same as (3.22). In the second stage, the TFP residual is estimated, in levels as well as in first differences (see equation (3.24)), as a function of demographic variables describing the relative size of age groups of the active population (or the respective changes over time). The central equation reads:

$$\ln A_{it} = \beta_1 W10_{it} + \beta_2 W20_{it} + \beta_3 W30_{it} + \beta_5 W50_{it} + \beta_6 W60_{it} + \qquad (3.26)$$
$$+ \textit{ year dummies} + \mu_i + \varepsilon_{it},$$

where *year dummies* reflect a pure time trend common to all countries, μ_i is a time-invariant, country fixed effect, and ε_{it} is the error term. The main regressors are constituted by measures of the relative size of age groups in the active population (*W10, W20*, etc., representing the shares of those aged 10–19, 20–29, etc. in the active population).

In order to determine effects of the age distribution in the active population on productivity, Feyrer (2002) goes through a number of different econometric specifications for different groups of countries (all non-oil countries, OECD countries). Taking *W40* as the reference group in equation (3.26), the coefficients of *W10*, *W20* and *W30* are significant at a 5-percent level in all specifications; in only two estimations for the full non-oil sample, *W50* and *W60* are also significant. At the same time, the demographic variables *W10* through *W60* are jointly significant at a 1-percent level in all the regressions reported. Furthermore, the coefficients for the demographic variables exhibit a particular pattern that is largely stable across all of the different specifications used: they peak at *W40* and become increasingly smaller for younger and older age groups. For instance, Feyrer's results imply that a 5 percentage point shift from the *W30* to the *W40* age group results in an increase in productivity by no less than 17 percent. If this shift occurs over a period of ten years, as would be a natural implication of a large age cohort becoming older, productivity growth would increase by about 1.7 percentage points in each year of the decade. Over the following decade, however, this effect might eventually be reverted.

In other words, countries with a large proportion of workers in their teens, twenties or thirties are, at least while this lasts, significantly less productive than countries with large cohorts in their fourties. The same is true for countries with large proportions of workers in their fifties and sixties. Feyrer demonstrates that these results can not only explain the large productivity slowdown observed in the US in the 1970s and the subsequent boom in the 1990s but also the (different) movements in demographics and economic performance in Japan as well as in developing countries.

Besides examining the relationship between labour-force demographics and total factor productivity measured through the Solow residual (where the effects of factor accumulation are already controlled for), Feyrer (2002) also regresses total output and each of its components on the demographic variables. The results indicate that there is an overwhelming importance of the total-factor productivity channel. The coefficients in TFP estimates are uniformly higher by an order of magnitude than the coefficients in factor regressions. Nonetheless, the results support predictions of conventional life-cycle models of saving as well: large cohorts younger than 40 and older than 60 years of age are correlated with lower stocks of physical capital. At the same time, the findings indicate that the presence of a large cohort of workers in their forties impedes human capital accumulation, while large cohorts in their twenties (and fifties) go along with increasing stocks of human capital. Interestingly, in its response to demographic change human capital will therefore move in the opposite direction of productivity.

All in all, the work done by Feyrer (2002) gives a flavour of how one could proceed, and what one could expect to find, when addressing the question for potential links between demographic change and economic performance. Running parallel estimates of total productivity and TFP measures as dependent variables can help in distinguishing effects that are reflected in theories of endogenous growth (tied to human capital) from those captured in standard neoclassical growth theory. The same can also be achieved by augmenting a TFP-approach with auxiliary regressions regarding factor accumulation – checking, for instance, for the existence of demographic effects on saving and investment. Otherwise, some of the differing effects that might arise with respect to total productivity – capital dilution, effects on saving, and human capital accumulation – might be empirically indistinguishable, but their joint impact could be estimated. Provided that there are significant effects showing up in terms of productivity, i.e., output per worker, determining the effects of changes in demographic variables on output per capita, or the impact on aggregate growth, is a matter of simple calculations, as was discussed at length in chapter 2.

Chapter 4
Economic Development and Fertility: Theory and Evidence

So far, we have been looking at potential effects of demographic variables, fertility ranging very prominently among them, on output, output growth and other aspects of economic development. Economic theory suggests, and existing evidence largely confirms, that large-scale demographic change – with changes in fertility that occurred at some point in time in the past and have an impact on the current population structure – does have an effect for productivity and productivity growth of the countries affected. There is thus a long-term relationship between economic performance and fertility that goes beyond the simple link between population size, or the size of the labour force, on the on hand and aggregate growth on the other.

At the same time, there may also be effects in the reverse direction by which the economic performance of a given country affects current fertility – and may eventually give rise to new, long-term repercussions on future levels and growth rates of economic activity. Theory and evidence related to this second part of the potentially two-sided relationship between demographic variables and economic performance will be discussed in the present chapter.

4.1 The theory of endogenous fertility – an overview

Up until Becker (1960) economists tended to believe that the determinants of fertility are largely non-economic and that the analysis of fertility is essentially outside the scope of economic theory.[1] However, Becker argued conclusively that fertility could be analyzed within an economic framework. Subsequent work that was spawned by the attempt to explain household fertility behaviour by utility maximization of potential parents achieved important theoretical progress and introduced new model features. It basically resulted in three patterns that may explain the secular trend of declining fertility over the last fifty years in economically developed countries.

– *"Quantity-quality interaction"* (Becker 1960, Becker and Lewis 1973): Parents have preferences both for the number of children (quantitative dimension) and the "quality" per child, a notion which is associated with the choice of expenditures per child. Therefore if the demand for child quality increases faster with higher income than

1 Earlier work done by, e.g., Leibenstein (1957) who argued in a similar vein turned out to be much less influential.

the demand for the number of children, declining fertility can be explained within this framework.

- *Rising opportunity costs* (Willis 1973): Higher household income is often associated with a higher cost of female time, either because of increased female wage rates or because higher income raises the value of female time in non-market activities. Under the assumption that childrearing is a relatively time-intensive activity, especially for mothers, increasing opportunity costs of children lead to a substitution effect away from having children.
- *Fiscal externalities* (Cigno 1993, Sinn 1997): Compulsory social security systems, especially public pension schemes, create distortions of parental fertility choices as they give rise to a fiscal externality of child-rearing which contributes to declining fertility rates. The large positive external effect for the rest of the society arises from the fact that contributions to the pension fund that a child makes in the future are shared among all members of the parents' generation. The externality may still be sizeable considering that governments subsidize investment in human capital and, hence, the earnings capacity of future contributors.

Along these three distinct patterns of household fertility behaviour, we will now give a brief review of the development in the theory of "endogenous" fertility[2] that will guide us further pursuing the ambitions of the present study.

4.2 The quantity–quality model

Becker (1960) strongly argued in favour of the view that fertility behaviour can be analyzed within the theoretical framework of neoclassical economics. In his pioneering paper Becker attempted to reconcile "the neo-Malthusian proposition that increases in income tend to stimulate fertility… [with] … the facts that income growth has been accompanied by secular decline of fertility and that family income is inversely associated with cross-section differentials in the industrialized countries" (Willis 1973, p. S15). Becker rejects explanations for this relationship which assert that children are inferior goods or that high-income families, who spend more on their children, have lower fertility simply because they face higher prices of children. Instead, he argues that the puzzle could be resolved within a model of stable preferences by which children are a normal or even a superior good and have a constant price per unit of "child services" by recognising that the demand for children effectively involves, in addition to the quantitative dimension represented by the number of children, a qualitative dimension associated

[2] The brief outline of important elements of the economics of endogenous fertility in sections 4.2 and 4.3 follows Hotz et al. (1997).

with the choice of expenditure per child. As a result of this sub-distinction, Becker proposed the so-called quantity-quality model of fertility.

In this model parents have preferences both for the number of children and the quality per child and maximise a utility function

$$U = U(n, q, s), \tag{4.1}$$

where n denotes the number of children, s the parents' standard of living and q the quality per child. The household's lifetime budget is given by

$$I = \pi_c nq + \pi_s s, \tag{4.2}$$

where I denotes total family life-time income, π_c a price index of goods and services devoted to children and π_s a price index of goods and services consumed by adults. Thus, "parents not only balance the satisfactions they receive from their children against those received from all other sources not related to children, but they also must decide whether to augment their satisfaction from children at the 'extensive' margin by having another child or at the 'intensive' margin by adding to the quality of a given number of children" (Willis 1973, p. S26). The most important thing to note is that, under this assumption, the budget constraint becomes non-linear because quantity and quality enter multiplicatively. It is precisely this quality-quantity interaction that leads to certain distinctive features of the demand for children that will be described here shortly.

An immediate implication of the model based on equations (4.1) and (4.2) is that the income elasticities of demand for n, q and s must satisfy the relationship

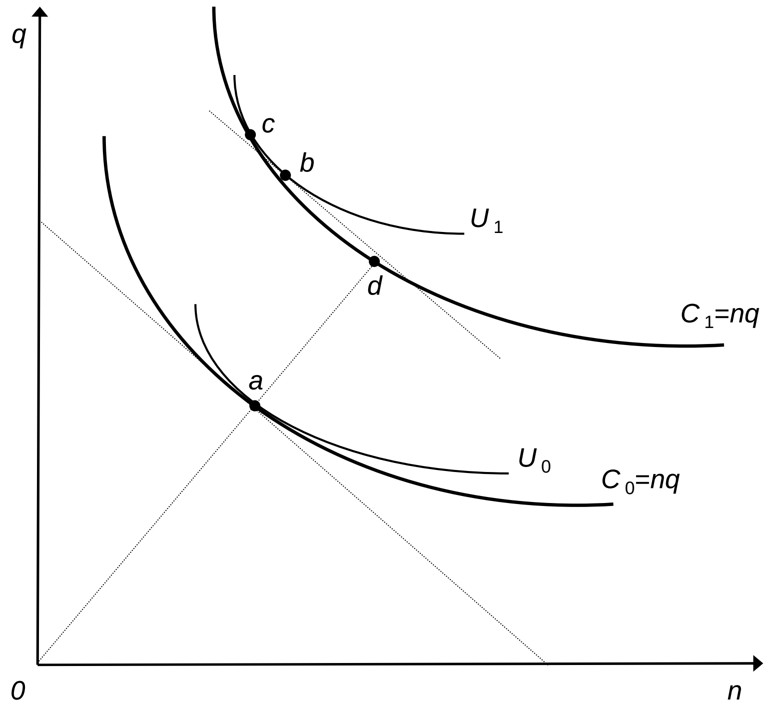
$$\alpha(\varepsilon_n + \varepsilon_q) + (1 - \alpha)\varepsilon_s = 1, \tag{4.3}$$

and

$$\varepsilon_c = \varepsilon_n + \varepsilon_q, \tag{4.4}$$

where α is the share of family income devoted to children, $c = nq$ is total child services demanded by parents, and the ε's denote the relevant income elasticities (Willis 1973, Mathematical Appendix). Assuming that children are normal goods in the sense that total expenditure on children is an increasing function of income, the sum of the income elasticities of the number and quality of children must be positive (i.e., $\varepsilon_n + \varepsilon_q > 0$), but it is still possible that the income elasticity of demand for the number of children is negative (i.e., $\varepsilon_n < 0$) if the income elasticity of quality is large enough. Willis (1973) as well as Becker and Lewis (1973) provide formal analyses in which the implications of the non-linearity in the budget constraint (4.2) are explored.

Figure 4.1: Interaction of the demand for quantity and quality of children



Source: Hotz et al. (1997).

The household's optimal choice regarding the number and quality of children is illustrated by the indifference curve diagram in figure 4.1. An equilibrium is represented by point a. At this point, the indifference curve U_0 is tangent to the budget constraint, $C_0 = nq = (I - \pi_s s(\pi_c, \pi_s, I)/\pi_c$, where C_0 is the household's real expenditure on children and $s(\pi_c, \pi_s, I)$ is demand for the parents' standard living. The assumption that this tangency point corresponds to maximum utility, i.e., is an interior solution, implies that the indifference curve, U_0, must be more concave than the budget constraint, $C_o = nq$, which is given by a rectangular hyperbola. Thus, quality and quantity should not be too closely substitutable in parental preferences if the second-order conditions for utility maximization are to be satisfied. The non-linearity of the budget constraint then causes a quality-quantity interaction as income increases. Specifically, it leads an induced substitution effect against the number of children and in favour of quality per child if the income elasticity of demand for quality exceeds the income elasticity of demand for the number of children. To see this, note that equation (4.3) implies that the marginal rate of substitution between the quantity and quality of children is $MU_n / MU_q = p_n / p_q = q / n$,[3] so that the relative cost of the number of children tends to increase as the ratio of quality to quantity increases, as it will if $\varepsilon_n > \varepsilon_q$.

Assume, for instance, that an increase in income leads the household to increase its demand for children from C_0 to C_1 and that its new choice of n and q is to the left of ray $\overline{Oad}$ at point c. Had the relative costs of n and q remained the same as they were at a, the new equilibrium point, located on the new indifference curve, U_1, would be at b rather than c, with a smaller consumption of q and a larger consumption of n. The total effect of an increase in household income may thus be decomposed into a “pure income effect”, holding p_n / p_q constant, from point a to point b, and an “induced substitution effect” from point b to c. By the way the problem is treated in figure 4.1 , the total effect of an increase in income leaves the number of children unchanged because the pure income effect, which tends to increase desired fertility, is exactly off-set by a substitution effect away from fertility which is induced by increased expenditure per child associated with higher desired quality.

Furthermore, Becker and Lewis (1973) show that the elasticity of demand for the number of children is likely to be more negative with respect to variables which affect π_n (e.g., contraception or maternity costs) than it is with respect to variables which affect π_c in total. On the other hand, a decrease in π_q (through, e.g., parents’ education, quality of neighbourhood, school quality and cultural factors) may have a negative effect on fertility as the direct substitution effect which increases q causes an increase in p_n.

4.3 Time allocation and opportunity costs

A second major reason for a negative relationship between income and fertility can be derived from the hypothesis that higher household income is associated with a higher cost of female time, either because of increased female wage rates or because higher income raises the value of female time in non-market activities. Given the assumption that childrearing is a relatively time-intensive activity, especially for mothers, the opportunity cost of child-rearing tends to increase relative to sources of satisfaction not related to children, again leading to a substitution effect away from having children.

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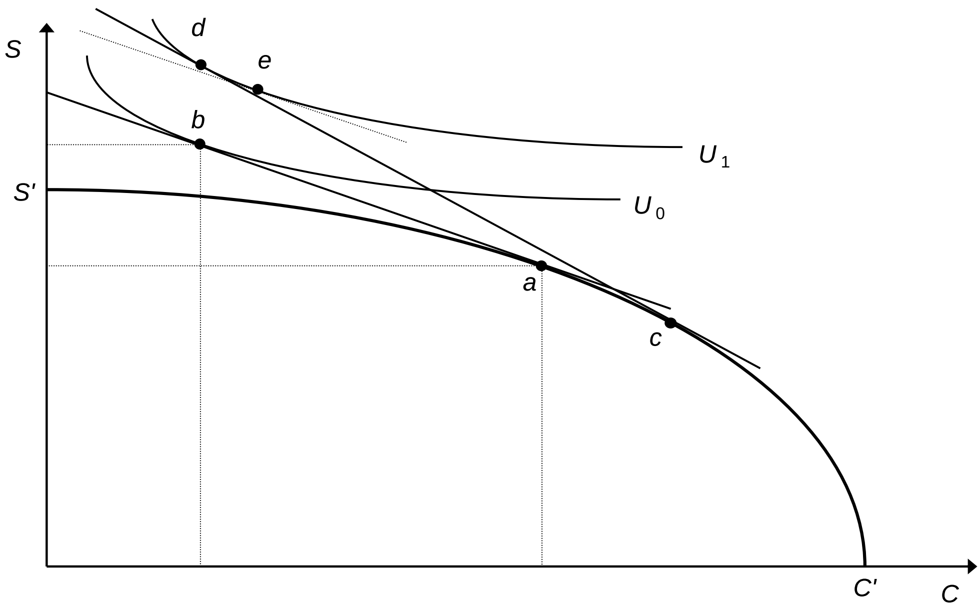
[3] Here, MU_n and MU_q denote marginal utilities, p_n and p_q denote marginal costs or shadow prices of the number of children respectively quality per child. Maximizing the utility function (4.1) subject to the budget constraint (4.2) yields conditions which imply that the shadow price of the number of children is an increasing function of child quality and, similarly, that the shadow price of child quality is an increasing function of the number of children.

A simple, static framework for analysing the interplay between time allocation, labour supply and fertility behaviour was suggested by Willis (1973). He assumes that household decisions are made jointly by a married couple that derives utility from adult standard of living and from the number and quality of children, in line with the utility function (4.1). Following Becker (1965), it is assumed that the basic commodities, satisfaction from children and adult standard of living, cannot be purchased directly in the market. Rather, the household uses non-market time of household members and purchased goods as inputs into household production processes the outputs of which enter the utility function. Furthermore, it is assumed that only the wife is active in the production of household commodities, while the husband is fully specialised in market work and his income, H, can be treated as exogenous. Total household income is $I = H + wL$, where w is the wife's real wage and L is her labour supply outside the household. Satisfaction from having children is again measured by "child services", $c = nq$.

Household production has constant returns, the production functions being $s = g(t_s, x_s)$ and $c = f(t_c, x_c)$, where t_s and t_c are the wife's time inputs and x_s and x_t are purchased goods devoted, respectively, to the production of adult standard of living and child services. A key assumption of the model is that the production of child services is time-intensive relative to the technology for the parents' standard of living. The wife's total time, T, is allocated to home and market work, that is $T = t_c + t_s + L$. Similarly, purchases of market goods are constrained by total household income, so that $I = H + wL = x_c + x_s$. The model implies that fertility decisions are determined by maximising the utility function subject to the production possibility frontier. The relative shadow price of children, π_c / π_s, tends to increase as the output of children rises.

In figure 4.2, the shadow price of the wife's time, $\hat{w}$, is illustrated diagrammatically at point a. The production possibility frontier of the household, illustrated by the curve $S'C'$, indicates the corresponding outputs of c and s. The (absolute value of the) slope of the production possibility frontier is equal to the relative shadow price of children, π_c / π_s, which tends to increase as the output of children rises above the level indicated at point a. Conversely, if the output of s is increased above that at point a, the shadow price of the wife's time falls below the market wage, w (which in this diagram is assumed to be equal the shadow price of time $\hat{w}$ in point a), implying that it is inefficient for her to spend all of her time in household production. As the wife enters the labour market, thereby increasing household money income and decreasing the supply of non-market time, the shadow price of her time can be increased to become equal to her market wage, and household output can be increased beyond the boundaries of the production frontier associated with full-time housework. Point b lies on the tangent to point a which, in turn, is located on the production possibility curve that constrains the household when the wife does not participate in the labour market. The fact that points such as b lie outside this frontier illustrates the efficiency gain accruing to the household through adjustments in the wife's external labour supply.

Figure 4.2: Time allocation and fertility decisions



Source: Hotz et al. (1997).

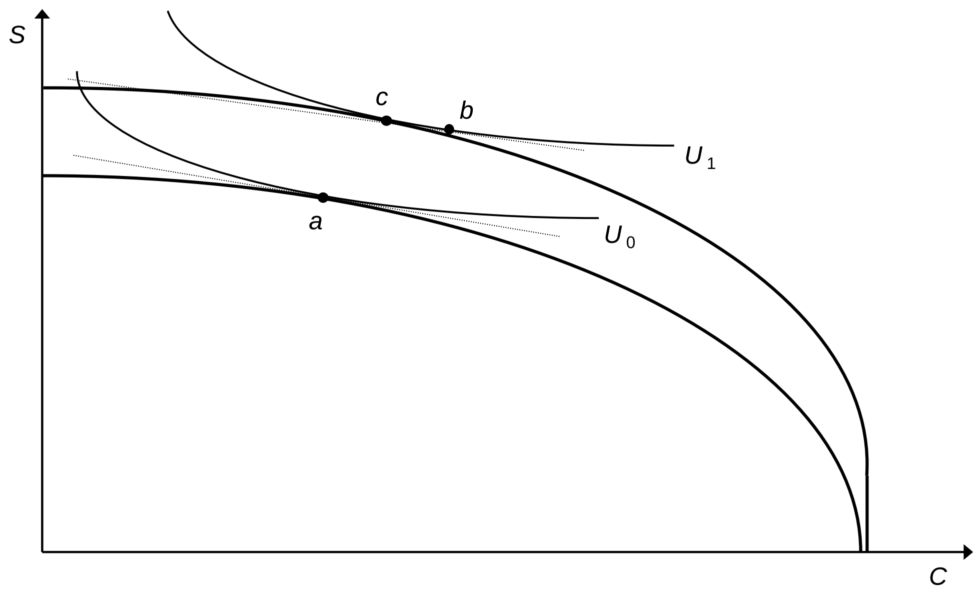
The household fertility decision is then determined by maximising utility subject to the production possibility frontier and the option of working outside the household. The new optimum is shown in figure 4.2 as the tangency point of the household's indifference curve and the linear segment of the augmented production frontier at point b. An increase in w causes the point at which it is efficient for the wife to enter the labour market to shift from point a to point c on the household production frontier, so that the linear portion of the new frontier, with $L > 0$, is both outside of, and steeper than, the linear portion of the old frontier. This implies that the increase in w increases both the household's real income and the opportunity cost of having children.[4] For instance, an

[4] The wife's life-time earnings capacity depends on her initial stock of human capital at the outset of marriage, h, and on the additional human capital she accumulates through post-marital investment, which, in turn, is an increasing function of her life-time labour supply, L. Then, her lifetime earnings are $w(L,h)L$, where w is her average life-time wage and $w(L,h)$ is her earnings (capacity) function. Optimal time allocation requires the wife to adjust her life-time labour supply so as to equate the price of her time, $\hat{w}$, and her marginal wage, $w' = w + w_L L$. This implies that the price of her time will tend

exogenous increase in w could cause the optimal choice to move from point b to point d, leaving $c = nq$ unchanged. More generally, the total effect of the wage increase on the production of child services is ambiguous because the substitution effect away from c could be more than offset by a positive income effect in favour of c. Yet, even if the income effect is dominant, so that $c = nq$ increases, it is possible that fertility decreases while child quality increases. Willis (1973) argues that this is likely to be the outcome because it seems implausible that child quality does not change so much, while the parents' standard of living increases sharply.

Figure 4.3 illustrates the situation for an increase in the husband's income, which causes the optimal choice of the relevant household to move from point a to point c. The total effect consists of a pure income effect which leads to point *b*, and a substitution effect that is due to the curvature of the household production possibility frontier.

Figure 4.3: The effect of an increase in the husband's income



Source: Hotz et al. (1997).

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to exceed the average wage and, more importantly, that it is effectively an endogenous variable, dependent on the choice of L. An increase in the wife's initial stock of human capital, *h*, tends to increase her marginal wage rate, w', and, therefore, the opportunity cost of children, causing a substitution effect against children. Unless her labour supply curve is backward bending, the increase in *h* will tend to increase *L*, w' and π_c. The increase in *h* also increases full wealth by an amount related to the level of the wife's labour supply. In general, it is assumed that the positive wealth effect of *h* does not offset the negative substitution effect, so that the desired number of children will decrease.

4.4 Fiscal externalities

Since the end of the baby-boom period, birth rates have declined substantially in virtually all developed countries. The timing of these changes, in conjunction with the idea that one of the principal motives for having children is old-age support (see already Leibenstein 1957), suggests the possibility that the decline in fertility might be related to the rapid expansion of publicly provided pension schemes that took place over this period. In the literature, this relationship is known as the so-called "social-security hypothesis" (see Nugent 1985 or Sinn 1997).[5] The natural incentive to raise children as an insurance against poverty in old age is removed by compulsory public pension systems.

Cigno (1993) shows that, in a model with purely self-interested individuals who live for three periods and wish to re-allocate consumption from the middle (active) period of life to the first period (youth) and the third period (old age), such transfers can be brought about based on a self-enforcing set of family rules. The rules of this "family constitution" prescribe that those who are old aged in period $t+1$, in return for having incurred the usual cost of raising a child, p, and having transferred an extra-amount of money, z, to each child in period t, will receive a transfer of x from their children in $t+1$ – provided that they have complied with the same rule one period before. The introduction of (wide-spread access to) capital markets or a rise in the market rate of interest can lead to a breakdown of the extended family network. A condition for the family constitution to survive in the presence of capital markets is that the marginal rate of return to investment in children, $\rho = 1 - x/(p+z)$, is sufficiently higher than the interest rate, r, to make up for the transfer of x to the (grand-)parents' generation.

Similarly, the introduction of a compulsory public pension scheme can also make the family transfer system collapse. Since, at date $t+1$, the present middle-aged have no choice but to pay the pension contribution and are promised a pension at $t+2$, irrespective of whether or not they support their parents and have children themselves, they may then refuse to support the present old and have no children. Even if the pension scheme offers a marginal rate of return lower than ρ (and higher, equal to or lower than r), the intra-family arrangement may no longer be attractive because of the transfer of x to the (grand-)parents involved. Choosing not to comply with the family constitution, the active generation will be able to consume their whole disposable income. However, if this applies to all member of the same generation, they will not receive any pension benefits

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[5] Theoretical contributions on the social security hypothesis are given by, e.g., Cigno (1991, 1993) or Werding (1998).

in a pay-as-you-go pension scheme because there will be no contributors left in period $t+2$. (In a fully funded scheme, the generation born in t could receive a pension in old age, even if there were no children born, if the funds are invested outside the economy considered. Yet, there may be second-order effects affecting the return to capital by which the level of that pension would be lower than if generation t had had children.)

The change in individual fertility decisions associated with the existence of a pay-as-you-go pension scheme is distortionary because it arises from a fiscal externality that is created by the introduction of such schemes. The decision to give birth to a child leads to positive external effects for the rest of society because the contributions to the pension scheme that a child would make in the future are shared among all members of the parents' generation. Therefore, unlike with the adjustments in parental decisions discussed in section 4.2 and 4.3, the effect of a compulsory public pension system results in inefficient life-cycle decisions regarding goods consumption and in inefficiently low fertility rates.

Usually, there is a broader class of government interventions and fiscal measures that could affect parental fertility decisions. Most notably, child benefits and publicly subsidised education can be expected to reduce the private cost of having a child and, taken in isolation, should induce a reverse substitution effect in favour of having children. On the other hand, by the relative size of these programmes they may not be sufficient to fully off-set the impact of large-scale public pension schemes.[6] Also, by the way these additional measures are designed and financed, they may create further distortions of different kinds, so that it is more than unlikely that they will compensate for the effect of public pension schemes in a perfect way.

4.5 Empirical evidence

There is a substantial body of empirical work on single aspects of the economic theory of endogenous fertility based on data collected in single countries.[7] Here, we confine our attention to studies that are comparative in that they exploit variation across countries and ideally combine at least two of the theoretical aspects discussed before.

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6 Sinn (1997) shows that, in a simple three-period overlapping-generations model, the net present value of the fiscal externality generated through the birth of a child equals total life-time contributions of this child to the public pension scheme. Even taking into account that governments subsidise investment in human capital, hence the creation of new contributors to the system, there may thus be a substantial fiscal *net* externality.

7 For a survey, see Hotz et al. (1997, section 5).

The study by Ahituv (2001) that was already mentioned in section 2.4 is again of interest in the present context. Based on his empirical model of the interplay between fertility and economic development, the author finds evidence that the negative (contemporaneous) relationship between fertility and growth in GDP per capita is a result of bi-directional causality. In line with the considerations made in chapter 2, a reduction in fertility leads to an increase in per-capita income. At the same time, income growth leads to significant fertility decline, as is suggested by the quantity-quality model as well as the higher opportunity cost associated with higher income. In addition, he argues that because families with low levels of human capital choose to have more children income per capita grows faster in developed countries than in developing countries. However, Ahituv (2001) with his large, multi-country macro-data panel does not employ any direct controls for the opportunity-cost aspect, such as female participation rates, female wages or the gender-specific earnings ratio, nor is he able to produce direct evidence regarding the quality-quantity interaction hypothesised by Becker (1960).[8]

Similar things are true for the studies by Ehrlich and Zhong (1998) and, in an up-dated version, Ehrlich and Kim (2005). They also run a series of multi-country panel regressions based on macro-level data for 57 countries spanning a time period of 32 years. As their main focus, they demonstrate empirically that social security taxes and benefits can create adverse effects on family formation ("marriage") and subsequent household choices regarding fertility and human capital investment which are not fully neutralized by intergenerational transfers within the families. The empirical work is based on a comprehensive endogenous-growth model where human capital is the main engine of growth, while family choices affect human capital investment and family formation itself is a choice variable. Their results conform to the "social-security hypothesis" for explaining the fertility decline, but the effects are not fully distinguishable from those of a quantity-quality interaction or of increased time cost as none of these aspects is directly controlled for.

Further empirical evidence for the social-security hypothesis, with some controls for the opportunity-cost aspect, is given by Cigno and Rosati (1992, 1996, 1997) and Cigno et al. (2003). They use single-country time-series estimates which, by the way their model is specified and by the richer data they can use for their narrow set of countries, are

[8] Note that it is very difficult to directly test for this interaction because the distinction between expenditure per child (as an outcome) and the price of a unit of child quality (as an important parameter) is hard to apply to a real-world context. This deep-rooted identification problem has, inter alia, been subject to criticisms of Becker's approach at a rather early stage (see, for instance, Leibenstein 1974).

closer to micro-economic models of individual behaviour and are better suited to identify long-term relationships and causal effects. In their main study, Cigno and Rosati (1996) find that in Italy, the UK, the US and West Germany "social security coverage" (pension expenditure per population aged 65+) has a negative impact on fertility, rather than on private saving.[9] In line with the standard time-allocation model, female wage rates have a negative impact on fertility, while male wage rates (or other household income) have a positive effect. Furthermore, child benefits in the UK and in Germany are found to have a positive effect on fertility.[10] Cigno et al. (2003) estimate an unrestricted VAR model for West Germany. Again, fertility is found to be negatively affected by "social security coverage" and, in line with their theoretical predictions, appears to be positively influenced by the "social security deficit" (annual benefit expenditure minus annual revenues from contributions). The effects of child benefits, female and male wage rates are as can be expected.[11] The interest rate is also found to have a positive effect on fertility.

All in all, the findings by Cigno and Rosati clearly reject the hypothesis, underlying conventional life-cycle theory and Barro (1974), that fertility is exogenous as well as the hypothesis, underlying Barro (1974) and Barro and Becker (1988), that parents want to have children because of some form of parental altruism. Rather, they are consistent with the hypothesis developed in Cigno (1993) that saving and fertility are jointly determined by self-interested parents and that children are seen by their parents as a form of investment. They also confirm that a self-financing expansion of social security discourages fertility and generally raises household saving.

In a recent paper, Boldrin et al. (2005) also investigate the social-security hypothesis and show that it is supported by the observed impact of changes in the size of public pension schemes on fertility. They also find that observations taken from the U.S. and Europe are more in line with a model of endogenous fertility in which parents have an investment motive for raising children than with a model based on parental altruism like in Barro and Becker (1989). According to their estimates, the negative effect of public pensions accounts for between 40 % and 60 % of the decline in fertility in the US over

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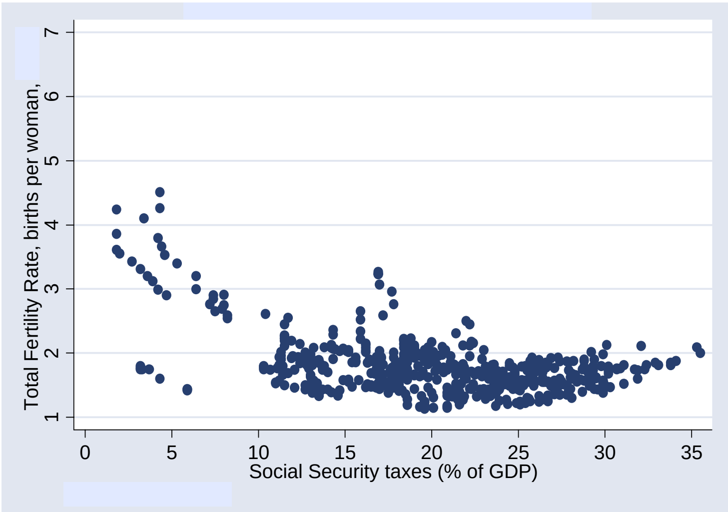
9 A survey undertaken by Cigno (1992) indicates that similar results apply to developing countries.

10 Cigno and Rosati (1992) covers initial work on the same issue fort he case of Italy. Cigno and Rosati (1997) extends the same findings to Japan.

11 The effects of the parents' wages appear to be relatively strong, while the effects of child benefits are rather small. This is hardly surprising in view of the high cost of raising a child, particularly through the opportunity cost of the mother's time (Joshi 1998).

time or of the differences between the US and other developed countries. Boldrin et al. also find that the introduction and expansion of public pension systems has a much stronger effect on fertility incentives at the lower end of the income distribution.

Figure 4.4: Total fertility rate and social security taxes in OECD countries (1977–2001)



Sources: WDI (World Bank), OECD.

Preliminary evidence regarding the social-security hypothesis can also be derived from the data base which we will use for more rigorous tests in chapter 6. Using pooled data from a cross section of 29 OECD countries and the time period from 1977 to 2001, figure 4.4 shows the relationship between a simple measure for the relative size of public pension schemes, viz. contributions or social security taxes as a percentage of current GDP, and total fertility rates. Although one must be careful about causal interpretations, the figure suggests that there is a strong negative relationship between these two variables. Most notably, there are only four observations for which social security taxes amount to at least 6 % of GDP and where the total fertility rate is above 2.0. By contrast, of those countries where total fertility is above 3.0, none has a share of social security taxes in GDP above 4 %.

Chapter 5
Fertility, Productivity Growth and Economic Development: Empirical Results

Building on the theoretical considerations, the empirical literature and the methodological aspects we have surveyed so far, we can now turn to presenting empirical work of our own, explaining our empirical design and reporting on the main results of our approach to investigating the relationship between demographic developments – in particular, observed changes in past fertility behaviour – and economic performance in a multi-country setting with time-series data on important macroeconomic indicators. We will round off the presentation with a number of simulations regarding future trends in productivity growth and aggregate growth for a limited number of industrialised countries, thereby demonstrating that demographic change may indeed have important effects in this area.

5.1 The empirical approach

Similarly as in Feyrer (2002) and Hall and Jones (1999), we start by assuming that, in each country i covered in our study and for each year of observation t, output per worker ("productivity") q_{it} has the following functional form:

$$q_{it} = k_{it}^{\alpha} \left(A_{it} h_{it}\right)^{1-\alpha} = \kappa_{it}^{\alpha/(1-\alpha)} A_{it} h_{it}\,, \tag{5.1}$$

where $\kappa = k/q$; see equation (3.21). Following Feyrer (2002) as well as Lindh and Malmberg (1999), we will further assume that q_{it} is influenced, mainly through the TFP parameter A_{it}, by the age structure of the active population which, in turn, is mainly a function of past fertility rates. We therefore construct an index representing the age composition of the labour force, L_{it}, with

$$L_{it} = \mathrm{e}^{\sum_s \beta_s L_{sit}}\,, \tag{5.2}$$

where L_s is the share of age group s in the total labour force. Including (5.2) in the q-functional (5.1) via $A_{it} = \Lambda_{it}\, L_{it}$ yields

$$q_{it} = k_{it}^{\alpha} \left(\Lambda_{it} L_{it} h_{it}\right)^{1-\alpha} = \kappa_{it}^{\alpha/(1-\alpha)} \Lambda_{it} L_{it} h_{it}\,. \tag{5.3}$$

From equation (5.1), we can then move in two directions.

First, we can use the k^{α}-version of output per worker to calculate, in a standard fashion, the TFP residual $\ln A_{it}$,

$$\ln A_{it} = \frac{1}{1-\alpha}\ln q_{it} - \frac{\alpha}{1-\alpha}\ln k_{it} - \ln h_{it}. \tag{5.4}$$

Alternatively, the residual can then be written as

$$\ln A_{it} = \ln \Lambda_{it} + \ln L_{it} = \ln \Lambda_{it} + \sum_{s} \beta_s L_{sit}, \tag{5.5}$$

or, in terms of first differences, with $\Delta \ln A_{it} = \ln A_{it} - \ln A_{it-1}$ etc., as

$$\Delta \ln A_{it} = \Delta \ln \Lambda_{it} + \sum_{s} \beta_s \Delta L_{sit}, \tag{5.6}$$

which easily lends itself as a testable hypothesis that can be subjected to standard econometric estimations, both in levels and in first differences, splitting $\ln \Lambda_{it}$ into a constant, Λ, a time-invariant country fixed effect, λ_i, and a pure time trend, μ_t, and adding an error term, ε_{it}. As Feyrer (2002) points out, the age structure of the labour force should primarily be expected to have an effect on productivity *levels*, rather than on growth rates. In turn, *changes* in demographic variables, such as shifts in the age structure of the active population, should then affect productivity growth. While testing for the latter aspect may be of interest in itself, switching to first differences is also a means of dealing with potential problems of serial correlation in the pure level framework.

From a methodological point of view, a nice feature of using age-structure variables in such regressions is that they are not at all likely to be endogenously linked to current TFP or TFP growth, as they are essentially determined by decisions taken some 20 to 60 years ago.[1] This avoids problems regarding the direction of causality which are notorious with respect to many other potential determinants of output or output growth, such as trade, investment and education. Also, unlike further variables that are plausibly exogenous, such as geographical characteristics, demographic variables not only exhibit variation across countries but also considerable time-series variation, at least in the industrialised world (see chapter 1). Furthermore, testing for the hypothesized impact of the age structure of the labour force on TFP, not on total productivity, amounts to an

1 This is certainly true with respect to (past) fertility rates and their impact on the current age structure of the labour force, less so with respect to migration. But we may take the role of migration that has taken place *very* recently to be of small significance for the observable age structure of the total active population of a given country, even if migration in terms of labour mobility is usually concentrated among younger individuals.

indirect test of whether or not the effect of L_{it} has the properties of a factor driving endogenous growth (see chapter 2).[2]

Second, we can use the $\kappa^{\alpha/(1-\alpha)}$-version of output per worker to obtain

$$\ln q_{it} = \ln A_{it} + \frac{\alpha}{1-\alpha} \ln \kappa_{it} + \ln h_{it}, \tag{5.7}$$

or, in first differences,

$$\Delta \ln q_{it} = \Delta \ln A_{it} + \frac{\alpha}{1-\alpha} \Delta \ln \kappa_{it} + \Delta \ln h_{it}. \tag{5.7}$$

Equation (5.7), or its counterpart in first differences, can then be used to estimate the influence of (changes in) L_{it} on (growth in) total output per worker, not just on the TFP residual. Furthermore, any variable other than A_{it} on the right-hand side of (5.7) can also be tested for effects of L_{it} in order to check for a potential, hidden endogeneity bias in estimates regarding the constructed variable A_{it} based on (5.5).[3]

In chapter 2 we discussed, as an aside, that changes in fertility potentially affect saving and investment, hence the entire time path of the physical capital stock. Similar things might be true with respect to the stock of human capital. Some of the auxiliary regressions run in Brandner and Dowrick (1994) or Ahituv (2001) confirm that this may actually be the case (cf. section 2.4), implying that estimates regarding the potential role of fertility for economic development would be biased if these alternative channels were not taken into account. At the same time, one should keep in mind that, unlike these authors, we do not intend to look at contemporaneous relationships between fertility on the one hand and variables representing investment, human capital accumulation or economic performance on the other. Instead, following Lindh and Malmberg (1999) as well as Feyrer (2002), we include the age structure of the current (active) population in our estimates which should allow us to concentrate on long-term effects of variations in demographic variables, such as fertility. In his parallel work, Feyrer (2002) finds that effects of the pre-determined age structure for the time paths of κ_{it} and h_{it} are largely

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2 Otherwise, the age structure of the active population could not be found to have an impact on the Solow residual.

3 Note that the potential endogeneity of k_{it} with respect to A_{it} is precisely why the $\kappa^{\alpha/(1-\alpha)}$-variant of the productivity functional (5.1) is needed here. In his paper, Feyrer (2002) demonstrates that, building on a conventional Solow–Swan growth model, the steady-state level of capital per worker, k, must be considered an increasing function of total-factor productivity, A, while the steady-state level of the capital-output ratio, κ, should not be influenced by shocks to, or any other changes in, productivity.

insignificant and, in any case, much smaller than the impact on A_{it}. Against this background, we may expect our regressions relating L_{it} to TFP and TFP growth to convey the story behind the link between demographics and economic development in an essentially unbiased fashion. Nevertheless, additional regressions based on equation (5.6) and its components may be useful for understanding more fully the relative importance of the several channels – factor accumulation among them – by which there could be an influence of L_{it} on output per worker.

In the remainder of the present chapter, we will mainly report on the results of our empirical estimates based on equations (5.5) through (5.8) and illustrate the main findings through a series of simulations. The most interesting aspect about including age-structure variables in regressions regarding TFP and TFP growth, however, is that this enables us to go an important step beyond the existing literature. While output per worker or total factor productivity may be influenced by fertility behaviour observed in the past, the theory of endogenous fertility (see chapter 4) strongly suggests that current fertility rates may, in turn, be a function of current income, hence current output per worker. Actually, there may therefore be an *inter*dependence between demographics and economic performance with long time lags (of ex-ante unknown length), making variables taken from both areas effectively a system that could generate cycles and self-enforcing trends in whatever direction. As, in the present study, we are effectively attempting to have an eye on both sides of this potential interaction, we will return to this issue in the next chapter.

5.2 Data and Variables

In the process of trying various data definitions and alternative specifications, and in looking into other, related issues as well – such as the endogenous-fertility regressions presented in the next chapter – we have effectively established a larger data set that mainly combines and consolidates data from various sources that are publicly accessible. To some extent, we also recorded and included data which, so far, have not been available in electronic form.[4]

The data base now comprises a large number of variables in the following areas: economic output (GDP as an aggregate, on per-capita terms or per worker in various, more

[4] For a list of countries and a list of variables included in the data base, see appendix A.6 at the end of the next chapter. – The "fertility and prosperity" data base will be made available to the research community via free downloads from the Ifo Institute's web site in the near future.

specific definitions; GDP growth), demography (population, age structure, fertility, life expectancy), labour force (total and by age groups), capital (investment in physical capital and imputed capital stock; interest rate), human capital (school enrolment and completion rates, average years of schooling in the adult population, all differentiated by levels of education), and indicators for government activity (with special attention to social security expenditure). In our empirical work, we are particularly interested in looking at industrialised countries. But as the questions we are addressing are potentially of broader relevance and as small, selected samples always entail the risk of giving rise to biased estimates, we did not focus exclusively on this sub-set of countries but included as many developing countries as possible in our sampling and data collection. Therefore, our data base covers a maximum of 213 countries, developed as well as developing ones, and a maximum time frame from 1950 to 2002. However, data availability effectively restricts the time period covered in most of our estimates to 1960 to 1995 and the number of countries included to about 100.

In setting up the data base, we benefited a lot from up-dated editions and continuous growth in coverage of existing data bases and we are greatly indebted to a number of international organisations, in particular, the World Bank, the ILO, and the OECD, and to researchers such as Summers and Heston (1988, 1991),[5] Barro and Lee (1993) or Easterly and Levine (2000) for providing broad sets of comparative data and for doing pioneering work in constructing specific variables and indicators. The list of the data sources we used is as follows.

- World Development Indicators (“WDI”, provided by the World Bank 2003; annual data for 208 countries for the period from 1960–2002).
- Penn World Tables (version 6.1, “PWT 6.1”, provided in Heston et al. 2002; annual data for 214 countries for the period from 1950–2000).[6]
- Data set on output and capital stock based on an earlier version (“5.6”) of the PWT (provided in Easterly and Levine 2000; data for a maximum of 119 countries, partly annual, partly in 5-year intervals, for the period from 1960–1997).
- Data set on educational attainments (provided in Barro and Lee 1993; data for 129 countries at 5-year intervals for the time period 1960–1990).

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[5] The most recent up-date (version 6.1) of the “Penn World Tables” inaugurated by Summers and Heston (1988, 1991) is documented in Heston et al. (2002).

[6] Yet, there are lots of missing values between 1950 and 1960 and towards the end of the sample period.

- International Historical Statistics, with historical data on population and fertility (provided in print form in Mitchell 2003; annual data for 67 countries for the time period 1900–2000).[7]
- ILO-Labour Force Database (“LABORSTA”; data for 200 countries, partly annual, partly at 10-year intervals for the time period 1969–2000).
- ILO-The Cost of Social Security (“ILO-COSS”; until 1989 in print form, since 1990 electronically available; annual data for a maximum of 113 countries for the time period 1950–1996).
- OECD-Historical Compendium (edition 2004/1; annual data for OECD countries for the time period 1980–2000).[8]

As important data are only available at 5-year intervals, this is effectively the time structure of data that we have to use in our empirical work. Against a specification based on annual data, this certainly involves a loss of information. On the other hand, the use of quinquennial data should make our estimates less susceptible to serial correlation – a problem that should not so much affect estimated coefficients but could lead to distortions in standard errors.[9]

In our estimates based on equations (5.5) and (5.6) that are reported in the next section, we are relying to a great deal on measures and procedures that have been developed in the literature reviewed in chapter 3. Wherever possible, we tried to amend existing data and re-constructed all transformations, intermediate estimations etc. involved in data handling from scratch. Specifically, the productivity measure q_{it} that serves as a point of departure for calculating the TFP residual or as a dependent variable on its own is output per worker as defined in Easterly and Levine (2000); the data are taken from PWT 5.6. The capital-stock variable k_{it} is capital per worker as calculated in Easterly and Levine (2000) by a “perpetual-inventory” method (see section 3.2),[10] and κ_{it} is simply defined as k_{it} / q_{it}.

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7 These historical data are included in the data base in terms of lagged (“crude”) birth rates.

8 OECD data were mainly used to augment the database with more detailed information regarding (recent) social security issues in industrialised countries.

9 Section 5.3 reports in more detail on how we are dealing with this and other potential technical problems in our estimations.

10 There, the value of the initial capital stock is estimated to be $I_{60} / (g + \delta)$, where steady-state growth g is calculated as the geometric average of the economy’s aggregate growth rate of real output between 1960 and 1970, and the depreciation rate δ is assumed to be 7 % (see Easterly and Levine 2000, footnote 3).

The stock of human capital is measured as $h_{it} = e^{\phi(s_{it})}$, where s_{it} are average years of schooling in the active population and $\phi(s)$ is a function that is piecewise linear over years of schooling at different levels and is therefore similar as the education-related components a Mincerian wage regression (see section 2.3). In terms of procedures and calibration, we follow Hall and Jones (1999) and use the results provided by Psacharopoulos (1994) implying decreasing returns to higher education (see section 3.2). Based on evidence from a host of international studies, capital's share of output, α, is simply assumed to be 1/3 (see, e.g., Gollin 2002).

Like in Feyrer (2002), we measure the age structure of the labour force by the relative size of 10-year age groups (*L10–19, L20–29*, etc., representing the share of those aged 10–19, 20–29, etc. in the active population). The data are taken from the ILO, where they are available at 10-year intervals. To run estimates based on 5-year intervals, missing values are imputed using data on the age structure of total population that are provided by the UN Population Division.

5.3 Results

The results of a series of estimates that are based on equation (5.5), relating to the TFP residual in *levels*, are summarised in table 5.1. The different specifications of model 1 ("M 1") through model 6 ("M 6") are meant to explore, first, how much additional structure is needed for a simple regression of the TFP term on the age structure of the labour force to yield meaningful results and, second, how robust these results are with respect to alternative estimation procedures. Essentially serving the first of these goals, M 1 is a simple ordinary least squares ("OLS") regression, with all the available data simply pooled together, while M 2 adds country dummies and M 3, in addition, time dummies.[11] It is easy to see that allowing for country-specific effects contributes substantially to improving the overall fit of the estimation and to shaping the results regarding the age-structure variables *L*10–19 through *L*60+ more clearly. (*L*40–49 is omitted from the regression and therefore serves as a reference group, the coefficients for the other *L*-variables measuring effects relative to those of this prime-aged group of workers.) At the same time, introducing time dummies as additional regressors does not do much to increase the explanatory power of the model. Furthermore, it modifies the pattern of the *L*-coefficients somewhat, but leaves their basic structure unaffected.

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[11] To control for heterogeneity across countries in a very rough fashion, at least, M 1 includes dummies for OECD countries and a subset of "least" developed countries as additional regressors. With the introduction of country dummies, these broader controls can be dropped.

To understand the progress from M 1 to M 3 more fully, it is important to notice what the inclusion of time and country-specific effects implies in the present framework, with a regression of TFP levels on labour force demographics. Note, first of all, that all cross-country differences in output and productivity that are due to differences in investment in physical and human capital have already been taken into account when calculating the TFP residual. The estimates therefore focus on differences in productivity, both over time and across countries, that are not explained by factor accumulation alone.

Including time dummies in the estimation then allows for TFP to vary over time, with a trend growth rate that is common to all the countries considered. Given the long time period spanned by the data, with considerable change in global economic conditions and a number of technological innovations that are potentially fundamental in their nature, taking this possibility into account appears to be useful. Including country-level dummies means that individual countries may be away, some more and some less, from the current technology frontier defined at a global level. Finally, the additional effects of the age-structure variables indicate that the composition of the labour force may matter for closing, or widening, the gap to the world productivity frontier, for instance, through a role for the adoption and use of technology. Basically, this is the story – about a potential link between labour-force demographics and productivity levels, implying temporary differences in productivity growth across countries – that lies behind our estimates. We will see, later on, whether the age structure of the labour force in a given country also matters for persistent differences in trend growth rates across countries, pointing to a potential role of demographics for technological inventions and the position of the technological frontier as well.

Model M 4 is very similar to M 3, including country-level effects as well as time dummies. Now, residuals are clustered by countries to avoid potential distortions of the standard errors through serial correlation, a problem that is less pressing, but not fully removed, with our data taken at 5-year intervals. As can be expected, the coefficients of all the variables are largely unchanged against M 3, showing a pronounced age-related pattern of the impact of the *L*-variables on the log-TFP measure. What is more interesting is that the significance of these effects is also next to unaffected. As in Feyrer (2002), four of the five age-structure variables are significant in the regression relating to all countries in our sample. In an otherwise identical regression based on OECD countries only, the same is true for three out of five variables. Additional tests reveal that all of the five *L*-variables taken together are jointly significant at a 1-percent level

Table 5.1: The age structure of the labour force and TFP

	M 1	M 2	M 3	(a) M 4	(b)
Sample Estimation method	All Countries Pooled OLS	All Countries OLS	All Countries OLS	All Countries Robust OLS [a)]	OECD Robust OLS [a)]
Dep. variable:	ln (*TFP*)	ln (*TFP*)	ln (*TFP*)	ln (*TFP*)	ln (*TFP*)
*L*10–19	–3.066* (*1.668*)	–4.690*** (*0.973*)	–4.620*** (*0.991*)	–4.620*** (*1.266*)	–4.520*** (*1.292*)
*L*20–29	2.792* (*1.596*)	–2.307*** (*0.752*)	–2.380*** (*0.737*)	–2.380** (*1.067*)	–1.853* (*0.913*)
*L*30–39	–2.996 (*2.338*)	–5.517*** (*1.064*)	–3.214*** (*1.043*)	–3.214*** (*1.138*)	–3.427*** (*1.108*)
*L*40–49 (ref. group)					
*L*50–59	1.323 (*3.032*)	–3.383** (*1.459*)	–1.570 (*1.441*)	–1.570 (*1.250*)	–1.501 (*1.040*)
*L*60+	–3.875** (*1.854*)	–5.723*** (*1.221*)	–4.279*** (*1.203*)	–4.279** (*1.701*)	–0.830 (*1.497*)
1965			0.127*** (*0.034*)	0.127*** (*0.022*)	0.190*** (*0.020*)
1970			0.231*** (*0.035*)	0.231*** (*0.032*)	0.256*** (*0.044*)
1975			0.256*** (*0.037*)	0.256*** (*0.037*)	0.330*** (*0.046*)
1980			0.222*** (*0.039*)	0.222*** (*0.048*)	0.329*** (*0.057*)
1985			0.110*** (*0.040*)	0.110* (*0.058*)	0.299*** (*0.067*)
1990			0.049 (*0.045*)	0.049 (*0.065*)	0.338*** (*0.090*)
OECD	0.213*** (*0.076*)				
Least	–0.404*** (*0.068*)				
Country dummies	No	Yes	Yes	Yes	Yes
Constant	8.617*** (*1.535*)	10.655*** (*0.763*)	9.916*** (*0.756*)	9.916*** (*0.832*)	8.795*** (*0.699*)
Observations	638	638	638	638	183
Countries	104	104	104	104	27
(Adj.) R^2	31.2%	88.7%	90.3%	92.0%	92.7%

a) Residuals clustered by countries to avoid distortions of standard errors through serial correlation.

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

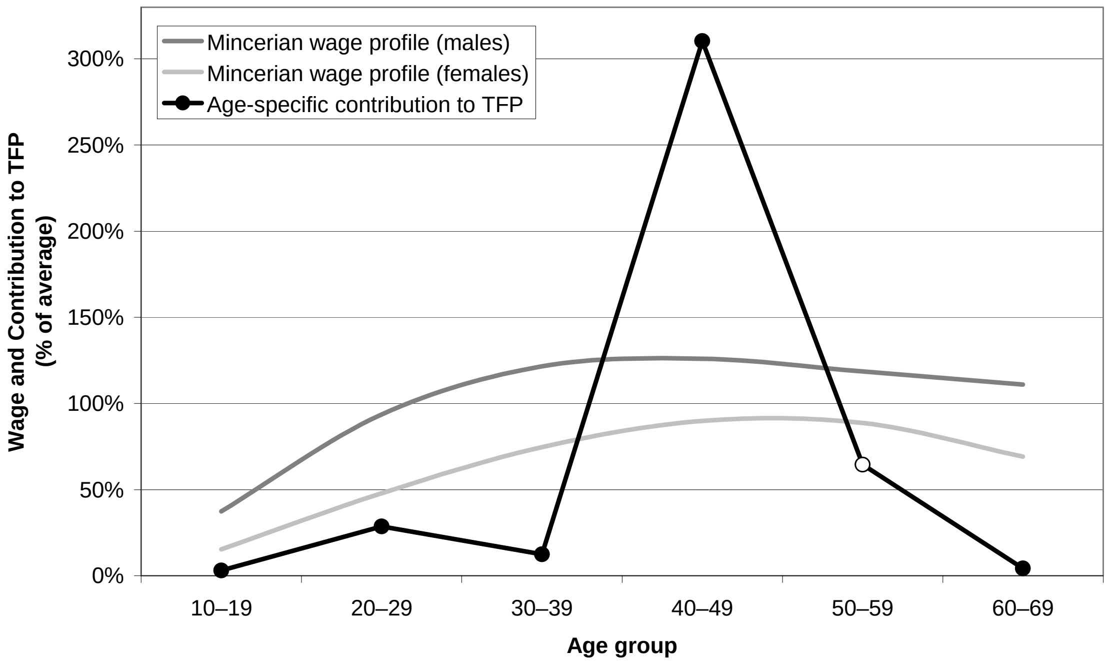
Table 5.1 (cont'd.): The age structure of the labour force and TFP

	(a) M 5	(b)	(a) M 6	(b)
Sample Estimation method	All Countries OLS (fixed effects)	OECD OLS (fixed effects)	All Countries GLS (random eff.)	OECD GLS (random eff.)
Dep. variable:	ln (*TFP*)	ln (*TFP*)	ln (*TFP*)	ln (*TFP*)
*L*10–19	–4.620***	–4.520***	–5.698***	–3.651***
	(*0.991*)	(*0.974*)	(*0.892*)	(*0.990*)
*L*20–29	–2.380***	–1.853***	–2.200***	–1.581**
	(*0.737*)	(*0.590*)	(*0.739*)	(*0.637*)
*L*30–39	–3.214***	–3.427***	–3.614***	–3.246***
	(*1.043*)	(*0.773*)	(*1.043*)	(*0.842*)
*L*40–49 (ref. group)				
*L*50–59	–1.570	–1.501	–1.577	–1.253
	(*1.441*)	(*1.031*)	(*1.448*)	(*1.118*)
*L*60+	–4.279***	–0.830	–4.489***	–0.834
	(*1.203*)	(*1.108*)	(*1.187*)	(*1.131*)
1965	0.127***	0.190***	0.123***	0.184***
	(*0.034*)	(*0.034*)	(*0.034*)	(*0.037*)
1970	0.231***	0.256***	0.222***	0.262***
	(*0.035*)	(*0.038*)	(*0.036*)	(*0.042*)
1975	0.256***	0.330***	0.238***	0.326***
	(*0.037*)	(*0.039*)	(*0.037*)	(*0.043*)
1980	0.222***	0.329***	0.192***	0.336***
	(*0.039*)	(*0.049*)	(*0.039*)	(*0.051*)
1985	0.110***	0.299***	0.074*	0.321***
	(*0.040*)	(*0.056*)	(*0.040*)	(*0.058*)
1990	0.049	0.338***	–0.003	0.368***
	(*0.045*)	(*0.065*)	(*0.045*)	(*0.067*)
Constant	-10.546***	-10.204***	10.777***	9.925***
	(*0.686*)	(*0.510*)	(*0.688*)	(*0.552*)
Observations	638	183	638	183
Countries	104	27	104	27
R^2 overall	23.2%	5.4%	25.4%	6.4%
within	21.8%	64.6%	21.4%	64.4%
between	25.9%	2.6%	28.0%	3.3%

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

for all countries, close to the 1-percent level in the case of OECD countries, in models M 4a and M 4b.[12]

Figure 5.1: Age-related wage profiles and age-specific contributions to TFP



Sources: Fenge et al. (2006), own calculations.

In the black curve, the points representing the results of model M 4a are filled if the underlying estimate is significant. The estimate for the 50–59 group is not significant.

Furthermore, the coefficients for variables *L*10–19 through *L*60+ exhibit a remarkable pattern. They clearly peak for workers in their forties and are substantially smaller for all other age groups. In fact, with a deviation related to those aged 30–39, their pattern closely resembles the inverse *u*-shape of a standard Mincer-type wage regression (see section 2.3). This is illustrated in figure 5.1.[13] (In the OECD-variant of M 4, the coefficient for the *L*60+ group also deviates from this pattern, but the estimate is insignificant

[12] The *F*-test on joint significance of all the *L*-variables rejects the Null hypothesis that they are all equal to zero with $prob > F = 0.0014$ for model M 4a. With M 4b, the test statistic is $prob > F = 0.0167$. Note that the same applies to virtually all the models considered here.

[13] For a typical Mincerian wage regression, figure 5.1 draws on results reported in Fenge et al. (2006), using micro-data taken from the German Socio-economic Panel (G-SOEP) that cover all employees who have been working subject to the German social insurance system in the period from 1991 to 2002. For illustrative purposes, the age-related relative contributions of each age group to the level of TFP are assessed based on the estimates derived from model M 4a above, using the year-2000 age structure of the German labour force.

in this case and labour force participation of those aged 60 and above is generally low in these countries.) If one were to take the age-related wage profile as an indication of age-specific productivity differentials that are internalised through wages, the structure of the contribution of each age group to TFP would therefore be similar to those of observable differences in productivity. At the same time, the differential impact on TFP appears to be much stronger than is implied by age-specific wage levels, pointing to quantitatively important growth externalities related to the age structure of the labour force. The latter may therefore turn out to be an important driving force of endogenous growth, indicating that the age composition of work teams, or the entire labour force of a country, matters a lot for technology adoption and levels and movements of total factor productivity.

The search for an appropriate specification is continued with M 5, a genuine fixed-effects model. Apart from the constant, the coefficients are identical to those of M 3 and M 4, and their significance turns out to be as high as in M 3, that is, without the adjustment in standard errors through clustered residuals. At the same time, the assumption of country-level fixed effects[14] takes away some of the explanatory power of the remaining regressors. In the regression covering all countries, this can be seen from the moderate results regarding "R^2 within" (measuring the model's fit over time for a given country) and the new, combined measure of the "overall R^2" (over time and across countries). In the OECD regression, the "within" fit that is of highest interest in the case of a fixed-effects model is still rather high. In any case, these observations are not uncommon in a context like the present one and certainly not at odds with our basic ideas.

Finally, M 6 is a random-effects specification using the generalised least squares (GLS) method for analysing the otherwise unchanged model. The results are qualitatively unchanged against M 3 through M 5. More importantly, additional tests do not support the random-effects specification.[15] In the light of all these findings, we are thus inclined to consider M 4 as the final specification of the present TFP-in-levels estimation. We will therefore use it as a baseline for a number of further analyses.

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[14] Note that these effects are jointly significant at a 1-percent level (with $prob > F = 0.0000$ for the relevant F-test).

[15] The Hausman test clearly rejects that the country-specific effects are uncorrelated with the other explanatory variables ($\chi^2 = 178.94$). The Breusch-Pagan test confirms that there is no autocorrelation in the country-specific effects ($\chi^2 = 1{,}037.91$). Both these results imply that the country-level effects are not randomly distributed.

The next step to take is to look at equation (5.6), now investigating whether *changes* in the age structure of the labour force have a significant impact on TFP *growth* that is in line with the results derived from the levels-equation (5.5). The new results are summarised in table 5.2, both for regressions covering the all-countries sample and the OECD sample. Note that, in this case, none of the estimations allows for a constant. Given that, the model that also does not include country dummies, i.e., M 7, is equivalent to the baseline model M 4: the common assumption is that the trend growth rate is determined by the global technology frontier and is thus fundamentally the same across countries, while the demographic structure of the labour force may speed up, or slow down, convergence. The alternative model with country dummies, M 8, allows for trend growth rates that would be permanently different across countries, potentially giving demographics an additional role as a driving force of technological change.

Table 5.2 shows that the results of M 7 are entirely in line with those of M 4. Most of the age-structure variables are again significant for explaining TFP growth, at least in the all-countries version of the estimation. The *L*-variables are also jointly significant at a close-to-1-percent level for all countries as well as for the OECD countries.[16] Most importantly, the age-related pattern of the impact of labour-force demographics on a given country's growth rate of TFP remains largely unchanged: as far as the estimated coefficients are significant, their structure is once more similar to inverse *u*-shape of a Mincer-type regression of age-specific wages or productivities.

Things are slightly different with respect to the results of M 8, the variant with country dummies. Here, the significance of the estimates for the *L*-variables is further reduced,[17] and there is no longer a clear-cut, age-related pattern in the *L*-coefficients. What is probably more interesting with this version of the TFP-in-differences model is that most of the country dummies turn out to be strongly significant, but that the overwhelming majority of the coefficients are in a very narrow band ranging from 0.2 to 0.4 in M 8a, from 0.05 to 0.15 in M 8b. It therefore appears that, once the potential impact of demographics on growth performance is controlled for, persistent cross-country differences in trend growth rates are not supported by our data.

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[16] The *F*-test on joint significance of all the *L*-variables yields $prob > F = 0.0133$ for model M 7a and $prob > F = 0.0194$ for model M 7b.

[17] Only in the case of model M 8a (all countries), the *L*-variables remain jointly significant at a 10-percent level ($prob > F = 0.0731$).

Table 5.2: The age structure of the labour force and TFP growth

	(a) M 7	(b)	(a) M 8	(b)
Sample Estimation method	All Countries Robust OLS [a)]	OECD Robust OLS [a)]	All Countries Robust OLS [a)]	OECD Robust OLS [a)]
Dep. variable:	Δ ln (*TFP*)	Δ ln (*TFP*)	Δ ln (*TFP*)	Δ ln (*TFP*)
Δ *L*10–19	–2.784*** (*0.747*)	–2.231** (*0.958*)	–2.221** (*0.970*)	–1.037 (*1.125*)
Δ *L*20–29	–2.221** (*0.920*)	–1.586** (*0.576*)	–2.391** (*1.090*)	–1.170 (*0.742*)
Δ *L*30–39	–2.385** (*1.002*)	–1.115 (*0.957*)	–2.004* (*1.209*)	–0.147 (*1.139*)
Δ *L*40–49 (ref. group)				
Δ *L*50–59	–1.791* (*0.986*)	–1.404 (*0.908*)	–1.271 (*1.172*)	–1.394 (*0.988*)
Δ *L*60+	–0.532 (*1.080*)	–1.253 (*0.842*)	–0.564 (*1.352*)	–1.368 (*1.012*)
1965	0.156*** (*0.015*)	0.182*** (*0.016*)	0.225*** (*0.043*)	0.105** (*0.042*)
1970	0.111*** (*0.019*)	0.105*** (*0.038*)	0.266*** (*0.038*)	0.048* (*0.026*)
1975	0.030 (*0.024*)	0.047** (*0.020*)	0.344*** (*0.052*)	–0.036 (*0.046*)
1980	0.014 (*0.026*)	–0.024 (*0.036*)	0.354*** (*0.044*)	–0.088 (*0.060*)
1985	0.109*** (*0.026*)	–0.024 (*0.024*)	0.485*** (*0.047*)	–0.079*** (*0.026*)
1990	0.042* (*0.025*)	0.035 (*0.030*)	0.416*** (*0.015*)	–0.023 (*0.031*)
Country dummies	No	No	Yes	Yes
Observations Countries R^2	534 101 18.0%	156 27 44.9%	534 101 34.0%	156 27 57.9%

a) Residuals clustered by countries to avoid distortions of standard errors through serial correlation.

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

To put our results in a broader perspective and to test for alternative channels of the impact of labour-force demographics on productivity and productivity growth, we can finally use equations (5.7) and (5.8) and regress all of their components on the vector of *L*-variables. The results of these estimations are summarised in tables 5.3 and 5.4. (Note that, in these tables, the columns representing results for ln (*TFP*) and Δ ln (*TFP*) are identical with those of models M 4a, M 4b, M 7a and M 7b, respectively.) All of the findings reported there point to a first-order importance of the TFP channel for the observed impact of the age composition of the labour force on output per worker and its development over time.

By construction, the coefficients for ln (q) (and Δ ln (q)) are equal to the sum of the coefficients related to ln (*TFP*) (or Δ ln (*TFP*)), $\alpha/(1-\alpha)$ ln (κ), etc. It is easy to see that, in tables 5.3 and 5.4, the *L*-coefficients related to the TFP-measure are always larger, by an order of magnitude, than the coefficients related to capital intensity, κ, and human capital, h. Furthermore, in the estimations for $\alpha/(1-\alpha)$ ln (κ) and ln (h) and their growth rates, very few of the *L*-coefficients are significant. In fact, they are all insignificant with respect to the human-capital measure, ln (h), and the variables in first differences, $\alpha/(1-\alpha)$ Δ ln (κ) and Δ ln (h). Only with respect to the level-version of capital intensity, $\alpha/(1-\alpha)$ ln (κ), the age-structure variables relating to younger workers are of limited significance. As the relevant coefficients are all negative (and, with one exception, larger than the ln (κ)-models' constants), they indicate a negative relationship between the relative size of the cohorts of workers aged less than 40 years and current capital intensity which, in turn, contributes to a lower level of output per worker. In the context of the present model, this may reflect, up to a point, the capital-dilution effect of a growing labour force for productivity that was discussed in chapter 2 (see, for instance, equation (2.4)) and has been empirically confirmed in some of the studies reviewed there (see section 2.4 and, in particular, Brandner and Dowrick 1994 or Ahituv 2001). There may thus be some influence of demographics on factor accumulation, but it appears to be next to negligible vis-à-vis the strong impact of the age structure of the labour force on total factor productivity.

All in all, our findings largely confirm the results obtained by Feyrer (2002), uncovering a significant role of the age composition of a given country's labour-force for both the level and the (transitory) growth rate of output per worker, or productivity. In addition, the observation that this effect mainly works via TFP, i.e. the Solow residual, not via factor accumulation, can be taken to indicate that labour-force demographics are effec-

Table 5.3: The composition of the impact of demographics on productivity

	M 9a			
Sample Estimation method	All Countries Robust OLS [a)]			
Dep. variable:	ln (q)	ln (TFP)	$\alpha/(1-\alpha)$ ln (κ)	ln (h)
*L*10–19	–6.416*** (*1.242*)	–4.620*** (*1.266*)	–1.422* (*0.742*)	–0.374 (*0.455*)
*L*20–29	–2.807*** (*0.921*)	–2.380** (*1.067*)	–0.824* (*0.436*)	0.397 (*0.290*)
*L*30–39	–4.370*** (*1.060*)	–3.214*** (*1.138*)	–1.230** (*0.507*)	0.075 (*0.368*)
*L*40–49 (ref. group)				
*L*50–59	–1.040 (*1.210*)	–1.570 (*1.250*)	–0.000 (*0.568*)	0.531 (*0.537*)
*L*60+	–4.179** (*1.605*)	–4.279** (*1.701*)	–0.314 (*0.728*)	0.414 (*0.539*)
1965	0.138*** (*0.021*)	0.127*** (*0.022*)	0.004 (*0.011*)	0.014** (*0.007*)
1970	0.297*** (*0.028*)	0.231*** (*0.032*)	0.003 (*0.015*)	0.063*** (*0.010*)
1975	0.401*** (*0.034*)	0.256*** (*0.037*)	0.047** (*0.019*)	–0.097*** (*0.011*)
1980	0.464*** (*0.045*)	0.222*** (*0.048*)	0.093*** (*0.025*)	–0.149*** (*0.016*)
1985	0.443*** (*0.054*)	0.110* (*0.058*)	0.153*** (*0.031*)	–0.181*** (*0.014*)
1990	0.403*** (*0.065*)	0.049 (*0.065*)	0.124*** (*0.041*)	–0.230*** (*0.017*)
Country dummies	Yes	Yes	Yes	Yes
Constant	10.282*** (*0.748*)	9.916*** (*0.832*)	0.506 (*0.437*)	–0.140 (*0.286*)
Observations Countries R^2	638 104 97.4%	638 104 92.0%	638 104 93.2%	638 104 97.5%

a) Residuals clustered by countries to avoid distortions of standard errors through serial correlation.

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

Table 5.3 (cont'd.): The composition of the impact of demographics on productivity

	M 9b			
Sample Estimation method	OECD Robust OLS [a)]			
Dep. variable:	ln (*q*)	ln (*TFP*)	$\alpha/(1-\alpha)$ ln (κ)	ln (*h*)
*L*10–19	–6.114*** (*1.327*)	–4.520*** (*1.292*)	–1.130 (*0.788*)	–0.464 (*1.027*)
*L*20–29	–2.354*** (*0.777*)	–1.853* (*0.913*)	–0.859** (*0.436*)	0.358 (*0.428*)
*L*30–39	–4.330*** (*0.736*)	–3.427*** (*1.108*)	–0.952* (*0.524*)	0.049 (*0.491*)
*L*40–49 (ref. group)				
*L*50–59	–0.637 (*0.902*)	–1.501 (*1.040*)	0.333 (*0.527*)	0.531 (*0.640*)
*L*60+	–0.190 (*1.802*)	–0.830 (*1.497*)	0.214 (*0.737*)	0.806 (*1.008*)
1965	0.239*** (*0.016*)	0.190*** (*0.020*)	0.025** (*0.009*)	0.024 (*0.016*)
1970	0.372*** (*0.040*)	0.256*** (*0.044*)	0.055*** (*0.014*)	0.061*** (*0.021*)
1975	0.555*** (*0.042*)	0.330*** (*0.046*)	0.130*** (*0.016*)	–0.095*** (*0.023*)
1980	0.659*** (*0.058*)	0.329*** (*0.057*)	0.162*** (*0.024*)	–0.167*** (*0.038*)
1985	0.656*** (*0.065*)	0.299*** (*0.067*)	0.175*** (*0.025*)	–0.182*** (*0.039*)
1990	0.744*** (*0.089*)	0.338*** (*0.090*)	0.159*** (*0.028*)	–0.247*** (*0.052*)
Country dummies	Yes	Yes	Yes	Yes
Constant	10.481*** (*0.528*)	8.795*** (*0.699*)	0.962*** (*0.289*)	0.723** (*0.307*)
Observations	183	183	183	183
Countries	27	27	27	27
R^2	96.5%	92.7%	91.3%	94.9%

a) Residuals clustered by countries to avoid distortions of standard errors through serial correlation.

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

Table 5.4: The composition of the impact of demographics on productivity growth

	M 10a			
Sample Estimation method	All Countries Robust OLS a)			
Dep. variable:	Δ ln (*q*)	Δ ln (*TFP*)	*α*/(1–*α*) Δ ln (*κ*)	Δ ln (*h*)
Δ *L*10–19	–2.999*** (*0.571*)	–2.784*** (*0.747*)	–0.022 (*0.341*)	–0.193 (*0.292*)
Δ *L*20–29	–2.181*** (*0.654*)	–2.221** (*0.920*)	–0.211 (*0.346*)	0.251 (*0.213*)
Δ *L*30–39	–2.682*** (*0.687*)	–2.385** (*1.002*)	–0.239 (*0.374*)	–0.059 (*0.321*)
Δ *L*40–49 (ref. group)				
Δ *L*50–59	–1.636** (*0.787*)	–1.791* (*0.986*)	–0.115 (*0.362*)	0.270 (*0.335*)
Δ *L*60+	–0.927 (*0.787*)	–0.532 (*1.080*)	–0.429 (*0.411*)	0.034 (*0.366*)
1965	0.167*** (*0.013*)	0.156*** (*0.015*)	0.003 (*0.007*)	0.013*** (*0.004*)
1970	0.168*** (*0.014*)	0.111*** (*0.019*)	0.009 (*0.008*)	0.047*** (*0.007*)
1975	0.117*** (*0.018*)	0.030 (*0.024*)	0.050*** (*0.009*)	–0.037*** (*0.005*)
1980	0.113*** (*0.020*)	0.014 (*0.026*)	0.045*** (*0.012*)	–0.054*** (*0.007*)
1985	–0.013 (*0.017*)	0.109*** (*0.026*)	0.060*** (*0.011*)	–0.036*** (*0.006*)
1990	–0.001 (*0.019*)	0.042* (*0.025*)	–0.009 (*0.009*)	–0.050*** (*0.007*)
Country dummies	No	No	No	No
Observations Countries R^2	534 101 14.7%	534 101 18.0%	534 101 18.9%	534 101 40.2%

a) Residuals clustered by countries to avoid distortions of standard errors through serial correlation.

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

Table 5.4 (cont'd.): The composition of the impact of demographics on productivity growth

	M 10b			
Sample Estimation method	OECD Robust OLS [a)]			
Dep. variable:	Δ ln (*q*)	Δ ln (*TFP*)	$\alpha/(1-\alpha)$ Δ ln (*κ*)	Δ ln (*h*)
Δ *L*10–19	–3.120*** (*0.407*)	–2.231** (*0.958*)	–0.332 (*0.375*)	–0.557 (*0.565*)
Δ *L*20–29	–1.890*** (*0.418*)	–1.586** (*0.576*)	–0.412 (*0.263*)	0.109 (*0.327*)
Δ *L*30–39	–1.974*** (*0.478*)	–1.115 (*0.957*)	–0.526 (*0.317*)	–0.333 (*0.422*)
Δ *L*40–49 (ref. group)				
Δ *L*50–59	–1.083 (*0.657*)	–1.404 (*0.908*)	0.297 (*0.369*)	0.023 (*0.347*)
Δ *L*60+	–0.881 (*0.531*)	–1.253 (*0.842*)	0.112 (*0.393*)	0.260 (*0.523*)
1965	0.220*** (*0.012*)	0.182*** (*0.016*)	0.019** (*0.009*)	0.020* (*0.012*)
1970	0.174*** (*0.028*)	0.105*** (*0.038*)	0.036*** (*0.007*)	0.033** (*0.014*)
1975	0.153*** (*0.015*)	0.047** (*0.020*)	0.070*** (*0.009*)	–0.036** (*0.013*)
1980	0.085*** (*0.020*)	–0.024 (*0.036*)	0.036** (*0.007*)	–0.074*** (*0.019*)
1985	–0.015 (*0.017*)	–0.024 (*0.024*)	0.021** (*0.010*)	–0.018* (*0.010*)
1990	–0.081*** (*0.023*)	0.035 (*0.030*)	–0.012 (*0.008*)	–0.057*** (*0.014*)
Country dummies	No	No	No	No
Observations Countries R^2	156 27 77.0%	156 27 44.9%	156 27 41.2%	156 27 43.5%

a) Residuals clustered by countries to avoid distortions of standard errors through serial correlation.

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

tively a major determinant of endogenous growth. One can, of course, only speculate about the precise nature of the economic mechanisms that drive these results. An interesting feature is that the age-related profile of the contributions of each age group to TFP (and, less so, to TFP growth) implies that workers in the age group 40–49 are most important for bringing about high levels (and faster growth) of productivity, while the contributions of younger and older workers are considerably smaller. Up to a point, the similarity of this pattern to a standard Mincer wage curve (see, again, figure 5.1) might prove helpful for interpreting our findings.

For instance, the particular age profile reflected in Mincerian wage regressions, which is usually taken to reflect productivity differentials related to age or experience, could feed through to TFP through externalities, or spillovers, in the utilisation of human capital and in the adoption and utilisation of technology. While, in the econometric set-up suggested here, human-capital accumulation as such and any internal effects for productivity related to it are already controlled for when calculating the TFP-measure, the age composition of work teams and their specific education–experience mix could also matter for their total productivity. In addition to this effect that would be mainly operative at a firm-level, Feyrer (2002) also points to existing evidence that entrepreneurial activities, the willingness to take risk and the capability to create and, perhaps even more so, to exploit innovations are age-specific and may also give rise to the observed link between labour-force demographics and TFP in an aggregate model of endogenous growth.

5.4 Simulations

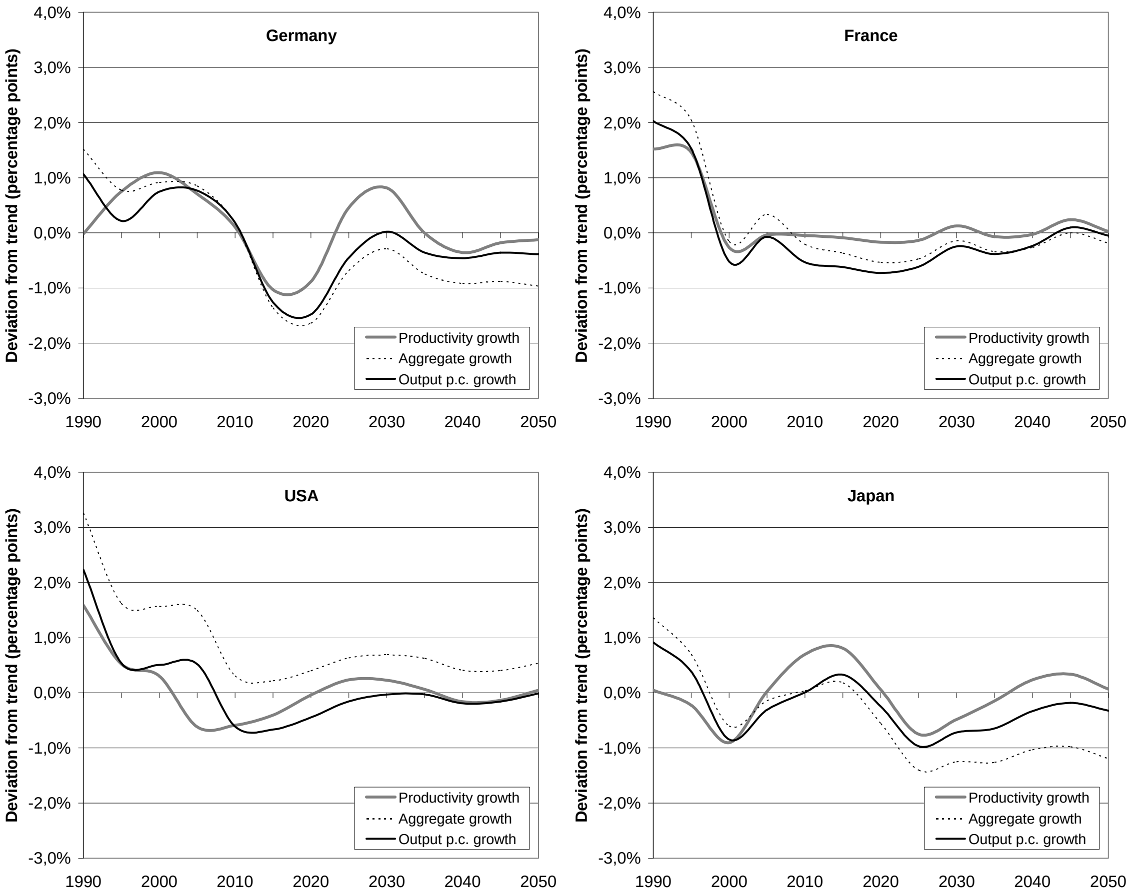
It has already been said that, for a given country and a given time period, the current age composition of the labour force is largely pre-determined through fertility decisions that have been taken up to six decades ago. Also, demographics nowadays exhibit a substantial amount of variation, both over time and across countries, as has been demonstrated in chapter 1. This is true even if one limits attention to a small number of highly developed countries. It may therefore be worthwhile to round off our econometric investigations regarding a link between the age structure of the active population and the economic development by a number of illustrative simulations that are meant to show how aggregate growth and per-capita growth in four countries – the US, Japan, Germany, and France, that is, four of the largest OECD economies that show a substantial degree of heterogeneity regarding their current and prospective population trends – are likely to be influenced by demographic change over the coming decades. Essentially, this can be done building on the econometric results presented in the previous section and on current long-term population projections for any of these countries.

Remember, first of all, that our econometric estimates based on models M 4 and M 7 imply that the age structure of the labour force affects the level of total factor productivity and that changes in this age structure lead to deviations from trend growth in TFP, while the trend growth rate as such is assumed to be basically the same across all countries. Using the results obtained for model M 7b (referring to the OECD sample) or M 7a (all countries), we can therefore start by simulating, for the countries mentioned above, predicted deviations from trend productivity growth implied in current demographic projections (combined with current age-specific participation rates) over the next few decades.[18] We can then combine the results with aggregate figures for employment and total population implied in the same projections to translate them into predicted deviations from aggregate trend growth and trend growth per capita. The simulations are illustrated in figures 5.2 (based on the OECD regression) and 5.3 (using the all-countries version), effectively spanning the time period from 1990 to 2050 to see how the predictions derived from our estimations relate to actual developments over the last fifteen years.

According to both versions of our results, the four countries considered are likely to be affected by changes in the age composition of their labour force in a rather different way. As to predictions for past and current developments (i.e., in the 1990–2005 subperiod), our estimates are able to explain, up to a point, the strong growth in productivity and aggregate output that the US have witnessed in the 1990s and also the underperformance that Japan has been faced with in the same time period. The model works less good for France and Germany, where it predicts above-trend growth for the periods from 1990–95 and 2000–05, respectively. In the case of France, some of this can probably be seen in relatively high growth rates of productivity and aggregate growth rates in the late 1980s, while in Germany the “e-commerce” boom of the years 1999/2000 was largely a business-cycle phenomenon and effectively much smaller than elsewhere. In fact, the German growth performance has been relatively weak during the entire period since 1995. A possible interpretation of these observations is that, due to a number of structural problems, such as persisting labour market rigidities, Germany is currently

[18] Population data and projections are taken from the 2004 release of the “World Population Prospects” prepared by the United Nations Population Division (2005, “constant-fertility” variant). Information regarding current activity rates is taken from the “LABORSTA” database provided by the ILO (2004).

Figure 5.2: The impact of projected demographic change on economic growth (1990–2050) – OECD regression

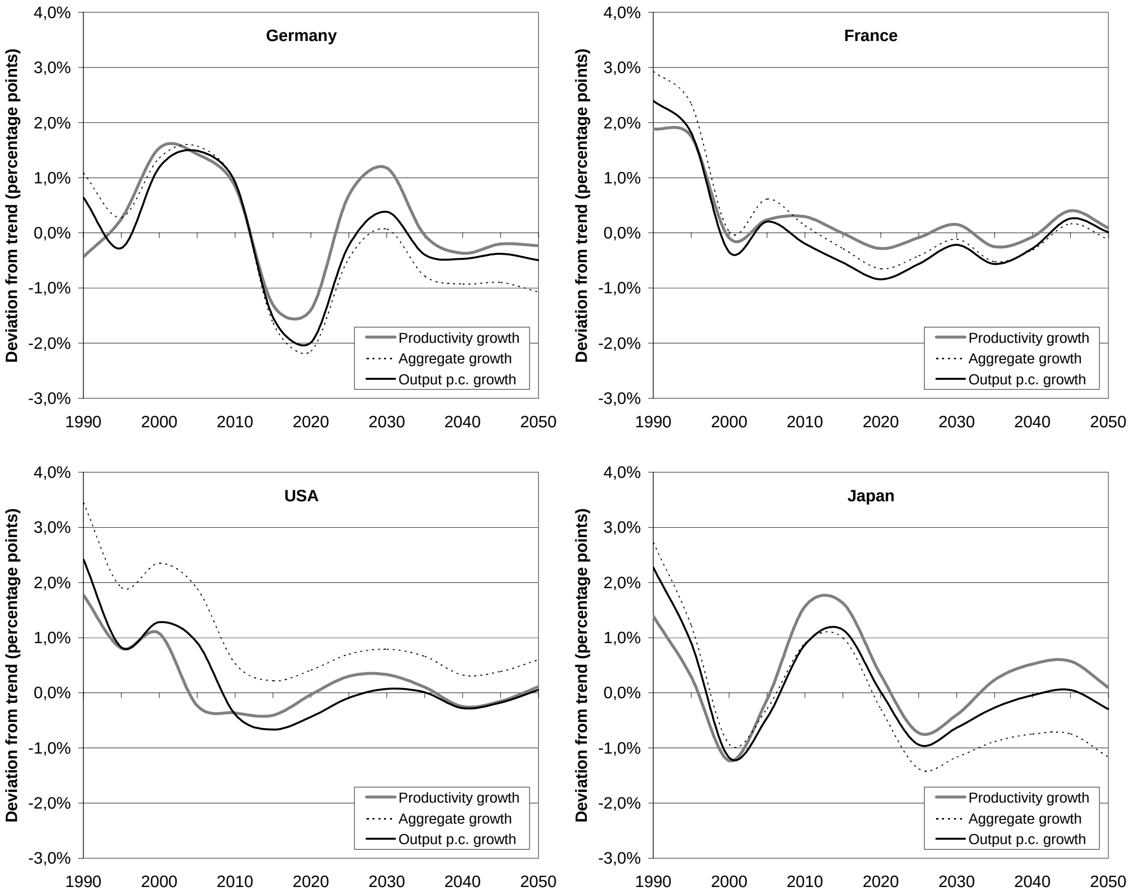


Sources: United Nations Population Division, ILO Labor Force Database, Ifo estimates.

foregoing the opportunity for some demographically induced extra-growth that could take place now while the German baby boomers are in their mid-forties, i.e., at the peak of their contribution to average productivity. The US, on the other hand, may have been able to exploit a similar opportunity during the 1990s, partly because of their more flexible labour markets. Note that the same reasoning does by no means imply that inflexible labour market institutions also isolate a country against the downward risks for growth performance implied in projected changes in the demographic structure. This is probably illustrated by the recent experience gathered in Japan.

Regarding future deviations from trend growth rates in productivity, aggregate output and output per capita, the predictions derived from the OECD regression (figure 5.2) and the all-countries regression (figure 5.3) are not altogether different. Only, the pro-

Figure 5.3: The impact of projected demographic change on economic growth (1990–2050) – All-countries regression



Sources: United Nations Population Division, ILO Labor Force Database, Ifo estimates.

files obtained in the latter case are a bit more pronounced than in the former. Based on our estimates, each of the growth rates we are looking at is likely to exhibit much stronger fluctuations in Germany and Japan than in France and the US. Given lower past and current birth rates observed in the two former countries (see chapter 1, table 1.1) and the consequences for the projected age composition of their labour force, this result is probably not too surprising.

Note that, in figures 5.2 and 5.3, our econometric estimates directly lead to the predicted patterns of productivity growth, while the results regarding aggregate growth and per-capita growth are merely a by-product obtained through additional calculations which, in themselves, involve little economics. According to current population projections and with current patterns of labour-force participation, France and the US will have a labour force with a relatively stable age structure, once the cohorts of the baby boomers, now already in their fifties in both cases, will have retired. This implies that in France there will be virtually no deviation from the trend growth rate of productivity caused by demographic shifts from 2005 onwards, while the US will have to deal with the ageing of a large group of baby boomers over the next ten to fifteen years, but the effect will still be modest and will then fade out. By contrast, due to projected changes in the age structure of their labour force, Germany as well as Japan will be faced with continued swings, both up and down, in productivity growth that are becoming smaller over time, but last until around 2040 or even 2050.

The simulated changes in productivity growth translate into lower rates of aggregate growth wherever the labour force must be expected to decline in the future, that is, in Germany and Japan and, less so, in France. In the US, predicted deviations from aggregate trend growth are higher than those in terms of productivity growth, simply because the labour force in this country is expected to grow over the entire time horizon of our simulations; in fact, the total demographic impact on aggregate growth rates predicted for the US is positive throughout as the projected increase in the labour force will be large enough to off-set any small, adverse effects for productivity. It has been mentioned before (see chapter 2) that, from an economist's perspective, changes in aggregate growth that are due to demographic change are clearly less important than changes in the growth rate of per-capita output, the latter representing something like a rough indicator of individual economic well-being. It is therefore interesting to note that, in Germany and Japan, future changes simulated for per-capita growth are less strong than those for aggregate growth. The reason is that, in these two countries, even the total population is expected to decline in the future, although at a smaller rate than their labour force. Things are different with respect to France and the US where, mainly due to increased longevity, the total population will roughly stay constant or, respectively, will increase at a higher rate than the labour force. In both cases, per-capita output must be expected to grow more slowly than aggregate output, a feature that also affects our simulations regarding deviations from the respective trend growth rates.

So far, our simulations confirm that changes in the age structure of the labour force can have sizable effects for annual growth rates of productivity, aggregate output and output per capita and that these effects may also show some diversity across countries. Building on these intermediate results that rest on our econometric analyses, we can now go ahead and simulate the accumulated effects of projected demographic change on future levels of aggregate output and output per capita in any of the countries considered here. We will do so under the assumption that, the impact of demographics aside, economic growth in all industrialised countries would be driven by a constant, uniform rate of productivity growth. As was explained above, this assumption of a common rate of global technological progress is fully in line with the construction of our econometric model. The common rate of trend productivity growth – set at 1.5 percent p.a. on real terms, which is about the average rate of annual real productivity growth in industrialised countries since 1990[19] – is then modified for each country using predicted deviations from trend productivity growth rates that are derived from our OECD regression (model M 7b, see figure 5.2). The results of this exercise are shown in figures 5.4 and 5.5, illustrating the predicted patterns of aggregate output and output per capita, respectively, for the period from 2005 to 2050.

If, for each country considered, the year-2005 level of aggregate output is set to 100, the fundamental rate of productivity growth assumed here implies that output, or GDP, would largely double until 2050 in the case of a stable population. In reality, populations are not expected to be stable in the sense that (a) the size of the labour force will vary over time and (b) the age structure of the labour force will also change. Together, these two effects potentially create a "demographic gap" in terms of smaller aggregate output that is indicated in figure 5.4 for the case of Germany, where this gap is effectively the largest among all the countries covered here. In this country, a major share of the total demographic gap that may become effective over the next four to five decades is due to the shrinking labour force. This can be seen from the graph representing future levels of output based on current population projections, but assuming that productivity growth would remain constant. From 2010 onwards, an additional reduction of accumulated output growth may result from the change in productivity predicted by our econometric estimates. This is the final result of our simulations for Germany, with the annual rates of productivity growth being adjusted according to the intermediate results shown in figure 5.2. All in all, demographic change could eat up almost two thirds of long-term growth implied in a stable population and a constant rate of productivity growth in this country if we are inclined to take our econometric findings seriously. Between 2010 and 2020, the negative impact of shifts in the age structure of the labour force on productivity growth could in fact imply that aggregate output remains largely constant on real terms. Later on, part of the gap against the two other, artificial scenarios could be made up through a transitional, positive impact of labour-force demographics on annual productivity growth. Yet, the gap as such will never disappear and may again become wider towards the end of the time horizon of our simulations.

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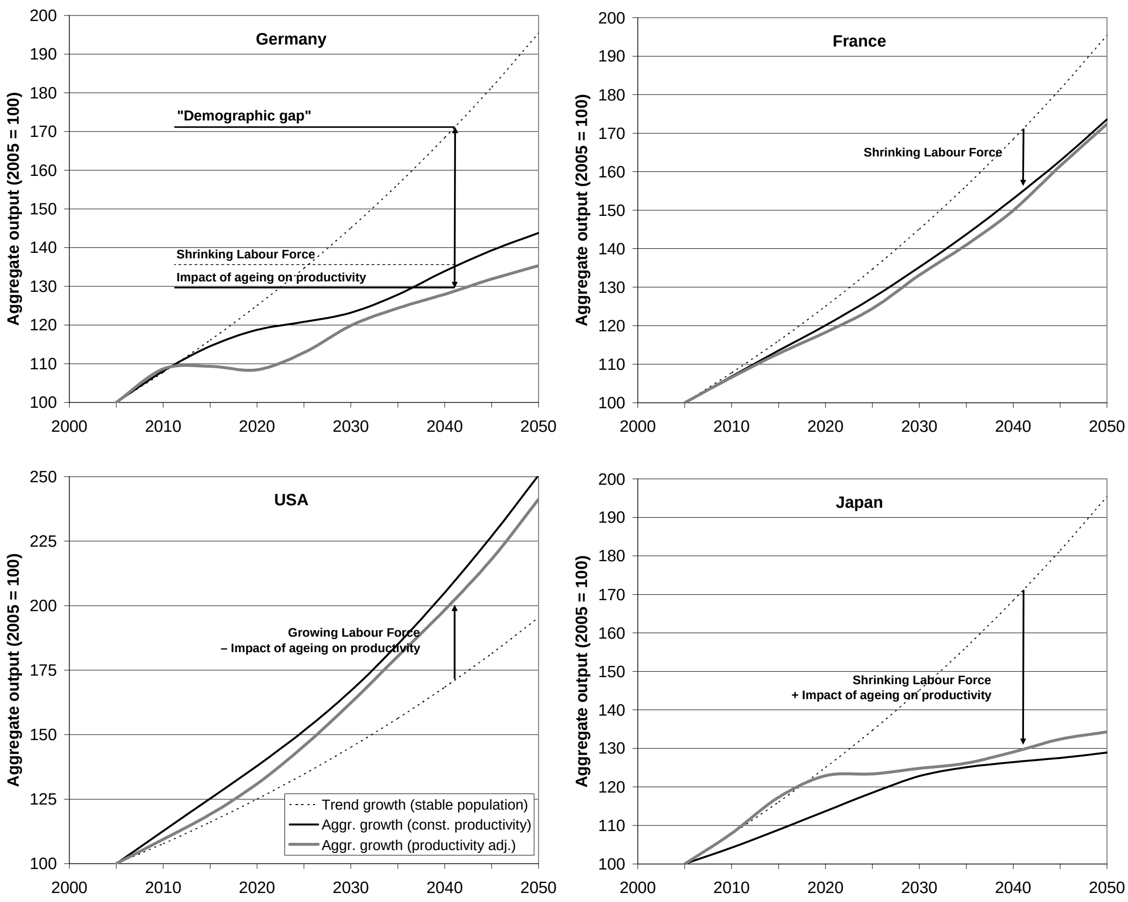
[19] See the OECD's (2005) database on „Main Economic Indicators".

Figure 5.4: The impact of projected demographic change on the level of aggregate output (2005–50) – OECD regression



Sources: United Nations Population Division, ILO Labor Force Database, Ifo estimates.

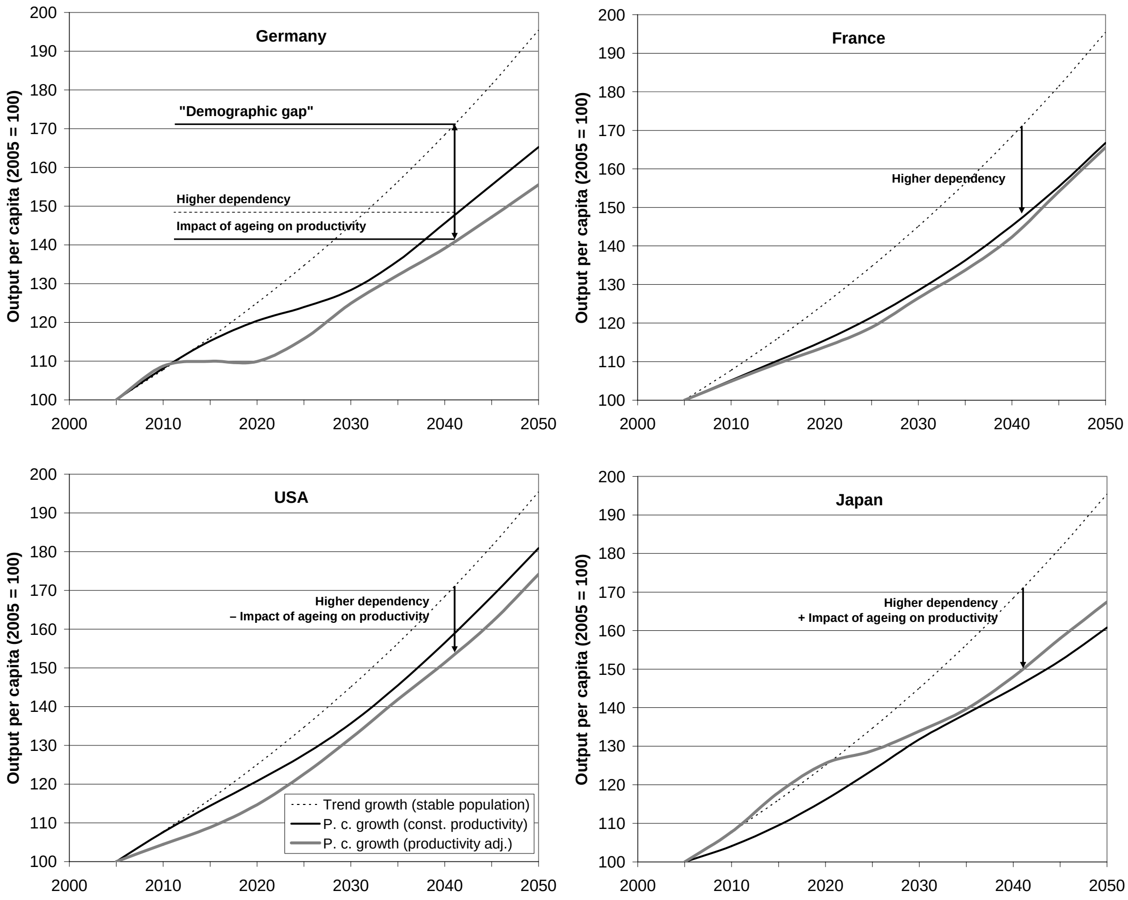
The situation appears to be rather different in the other countries considered here. In France and in the US, it is mainly the projected change in the number of active individuals that shows up in our results regarding aggregate output. In France, a shrinking labour force is likely to reduce the aggregate growth performance, although on a much smaller scale than in Germany, but there is next to no lasting effect of changes in the age composition of the labour force and their impact on productivity growth. In the US, a growing labour force contributes to higher aggregate growth than with a stable population, and this effect is reduced, to some extent, by a reduction in accumulated productivity growth. In Japan, the negative effect of a shrinking labour force is again very large. In this case, however, future shifts in the age structure of the labour force – which is already relatively old today – have a positive effect on accumulated productivity growth, so that the total demographic gap is effectively reduced if we take into account our econometric findings.

In a sense, one should not be too worried about any of these prospects for aggregate output growth in a selection of highly developed countries. After all, what matters a lot more than aggregate growth if both the size and the age structure of populations are affected by demographic change is the development of output per capita. This is what is being looked at in figure 5.5 as the last set of results derived from our illustrative simulations. Against the benchmark case of levels of output per capita that could be reached with a stable population, it is now changes in total (but mainly old-age) dependency that matters for the impact of demographic change if productivity growth is held constant. Again, there is an additional effect of the age structure of the labour force on productivity growth that yields the total "demographic gap", now in terms of a smaller level of output per capita that can be attained in the future.

As dependency rations are projected to increase almost everywhere in the industrialised world, per-capita output must be expected to grow at a lower rate in all the four countries considered here than it would do with a stable population structure. This effect is clearly weaker in the US than elsewhere, while it is only moderately stronger in Germany and Japan than it is in France. However, what really makes a difference for the future development of output per capita in all these countries is the direction and size of the productivity effect of projected shifts in the age structure of the labour force, as predicted by our econometric model. Its impact is again almost negligible in France and negative, but small, in the US. It is strongly negative, especially between 2010 and 2025, in Germany, while it turns out to be positive, again at least for a while, in Japan.

All in all, the "demographic gap" once more turns out to be the largest in Germany, even though it is considerably smaller on per-capital terms than with respect to aggregate output. Until 2020, it could cost more than two thirds of accumulated growth related to a stable population structure, about another two thirds of this effect being due to the impact of labour-force demographics on productivity. Over the remaining simulation period, the gap could then become smaller on relative terms, reducing per-capita output by "only" about 40 percent until 2050, of which 10 percentage points would have to be attributed to shifts in the age structure of the labour force that are expected to take place until then. In France, the total demographic gap amounts to about 30 percent of the entire time horizon, changes in the age structure basically playing no role for this result. In the US, the total gap is about 20 percent, about one third of this being related to the impact of the age structure of the labour force on productivity. Until about 2020, however, this latter effect could be rather strong in the US, explaining more than half of

Figure 5.5: The impact of projected demographic change on the level of output per capita (2005–50) – OECD regression



Sources: United Nations Population Division, ILO Labor Force Database, Ifo estimates.

the reduction in per-capita output. Once more, this is an implication of a very large cohort of baby boomers approaching and entering retirement. In Japan, the demographic gap could amount to about 25 percent of accumulated growth in output per-capita until 2050, being reduced by a positive productivity effect by about 8 percentage points. Until around 2020, the impact of shifts in the age structure of the labour force could even make up for the negative effect of higher dependency in this country, mainly because the age structure of the Japanese labour force is currently "recovering" from a very high fraction of older workers born between 1930 and 1950.

We hope we have thus been able to demonstrate that there is an impact of fertility on economic growth that works via the age structure of the labour force and its impact on productivity and productivity growth and goes beyond the simple arithmetics of changes in population size and dependency ratios.

Chapter 6
Economic Development and Endogenous Fertility: Empirical Results

In the last chapter, we have investigated more closely the role of the demographic structure of a given country's labour force, which is essentially a function of fertility behaviour observed some time in the past, for productivity levels and productivity growth as two of the most important aspects of economic development. In this chapter, we will address another set of potential links between fertility and economic development that could effectively work the other way round. The economic theory of "endogenous" fertility (see chapter 4) has established that, when making decisions regarding the number of their children and the amount of resources to spend on each child, parents typically respond to economic incentives in a rational way, taking into account the economic situation of their household, the current stage of economic development in their country and, last but not least, incentives and disincentives created by fiscal instruments and other public interventions.

As it has been unfolded, the theory of endogenous fertility has worked out a number of specific mechanisms that may help explaining the observed decline in fertility rates in industrialised countries since the 1950s (see section 4.1). The same mechanisms may also be operative in the decline of fertility that has already started, and is expected to continue over future decades, in less developed countries. Using the same set of countries and the same data base as in our work for chapter 5, we will therefore now seek to find empirical evidence regarding the relevant theoretical hypotheses. To the extent that data limitations permit us to do so, we will thus look at the impact of the quantity–quality interaction, the role of rising opportunity costs and, most notably, the effect of fiscal externalities (i.e., the "social security hypothesis") for actual fertility trends in both developed and developing countries.

6.1 The empirical approach

Our empirical design is meant to capture as much as possible of the fundamental hypotheses that can be derived from endogenous-fertility theory (see, again, chapter 4). The analysis is built on an overlapping-generations (OLG) framework, as this is the standard approach to dealing with a context where variations in fertility rates and all kinds of investment, including investment in the children's human capital, are assumed to follow from rational decisions taken at an individual level. In the background of our modelling strategy, there is the simple notion of a closed economy with competitive product and labour markets and homogeneous workers with fixed labour supply. The main engine of growth in this economy is human capital, and its accumulation is based on a production technology linking the parents' human capital and their investment in the children's education to the human capital embodied in the latter.

Note that, because of the nature of our macro-level data, we are unable to look at household decisions that would simultaneously determine fertility *and* household (or female) labour supply. Nevertheless, the potential impact of rising opportunity costs on parental fertility decisions will be taken into account in our model in an indirect fashion. Due to data limitations, but to more fundamental problems as well, we are also unable to directly test for the quantity–quality interaction that could affect fertility choices.[1] Again, our model can offer indirect evidence on this point, but it will effectively lump together the outcome of this interaction with usual income effects involved in parental fertility choices. We are able to employ direct controls for the potential effects of unfunded public pension schemes as well as various kinds of family allowances as the most important sources of fiscal externalities related to children, thus directly testing for the empirical validity of the "social security hypothesis". In any case, some of the empirical evidence outlined in section 4.5 effectively employs a very similar framework as we do (see, in particular, Ehrlich and Zhong 1998, Ehrlich and Kim 2005, or Ahituv 2001).

The model subjected to empirical testing based on our large international data panel is a reduced-form specification including elements of all the three theoretical approaches summarised in sections 4.2 through 4.4. Our regressions are based on a simple linear, log-level model:[2]

$$\ln(TFR_{it}) = \alpha_0 + \alpha_1 p_{it} + \alpha_2 fa_{it} + \alpha_3 g_{it} + \alpha_4 le_{it} + \alpha_5 \ln(y_{it}) + \alpha_6 h_{it}^m + \alpha_7 h_{it}^f \quad (6.1)$$

Here, subscript i refers to countries, t denotes time and the α_j's are a constant and a vector of coefficients representing the effects of individual regressors on fertility. We add an error term, $u_{it} = \mu_i + v_{it}$, where μ_i is a country-specific effect that can be mod-

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1 Remember that, already at an early stage, the fact that the relevant price component, viz., the price per quality unit of each child, is not observable even when micro data are being used has been objected to this theoretically conclusive element of Becker's (1960) theory of endogenous fertility (see section 4.5 as well as the contributions by Becker and Lewis 1973 or Leibenstein 1974).

2 With this functional form, where the dependent variable is a natural logarithm, while some of the independent variables are measured in (relative) levels, the coefficients α_j have to be multiplied by 100 to get the percentage change in the dependent variable given a 1-percentage-point change in the relevant independent variable.

elled as either fixed or random, while v_{it} is a standard random disturbance. Disturbances are generally assumed to follow a one-way error component model (Baltagi 2005). The variables are defined as:

- $\ln(TFR)$ denotes the (natural logarithm of the) total fertility rate of each country in a given year, as proxy for average population fertility;
- *p* denotes pension income per adult aged 65 years and above, measured as a percentage of current GDP per capita; if the pension system's budget were balanced, *p* would also measure the tax rate applying to workers who are currently active;
- *fa* denotes family allowances per child aged less than 16 years, again related to current GDP per capita;
- *g* denotes general-government final consumption expenditure as a percentage of GDP, corrected for expenditure already captured through variables *p* and *f*;
- *le* measures percentage changes in current life expectancy at birth, mainly seen as a proxy for the survival probability of each child;
- ln(*y*) denotes (log)-GDP per capita (in constant local currency units) as a rough measure of average household income; if the human-capital endowments of females and males are held constant, *y* is specifically expected to capture the effects of financial wealth, physical capital and natural resource endowments per adult;
- h^m and h^f denote average years of schooling in, respectively, the male and female population aged 15 years and older; "years of schooling" are usually found to be highly correlated with individual wage rates and can thus serve as a proxy for opportunity costs, especially in the case of women; they can also be interpreted as a direct measure of per-capita investment in the human capital of children.

In some of the empirical specifications we add dummies for OECD countries and a subset of "least" developed countries as in chapter 5.

Country dummies or country-specific effect μ_i that are assumed to be fixed are meant to control for unobserved heterogeneity across countries, such as institutional factors not included in the model or differences in initial stocks of physical capital. A fixed-effects specification mainly captures within-country variation in the regressors around country averages, exploiting the time-series dimension of the data set. It is best suited to answer policy questions that relate to time-series changes such as, "What is the fertility effect of economic development of a country/of a more generous public pension scheme/of higher family allowances per child, etc.?" Only up to a point, this can be contrasted with cross-sectional question such as, "How much higher/lower is fertility in countries with stronger economic growth than in countries with a poor economic performance?" (see

Glick and Rose 2002). The fixed-effects “within” estimator is usually seen as the most appropriate way to exploit the panel nature of a data set without making heroïc assumptions. There are only two major drawbacks to this estimator: the impossibility of estimating time-invariant factors, and a potential lack of efficiency, for instance, in cases of serial correlation. As long as we concentrate on time-series variation in our conclusions and remain careful with respect to explaining cross-country differences, the former problem does not arise here. Also, as our data set is fairly large and as most of the regressors included in the present model are not likely to show any systematic, parallel trends, the latter problem may be less pressing than, for instance, with the TFP-regressions run in the previous chapter, even if were are now using time series of annual data as far as these are available.

6.2 Results

We estimate equation (6.1), again using a number of slightly differing specifications, based on our international data panel.[3] Descriptive statistics for the relevant data are summarised in table 6.1.

Table 6.1: Economic development and fertility – Descriptive statistics

	Mean	Std. dev.
ln(*TFR*) (total fertility rate; in logs)	1.06	0.51
p (pensions per adult aged 65+; income adjusted)	34.34	27.33
fa (family allowances per child aged –15; income adjusted)	3.06	4.12
g (general-government final consumption; % of GDP)	15.64	5.04
le (life expectancy at birth; %-age change)	0.47	0.38
ln(*y*) (real GDP per capita; in logs)	9.93	2.13
h^m (average years of schooling of males aged 15+)	6.40	2.65
h^f (average years of schooling of females aged 15+)	5.71	2.84
Least (least developed countries; dummy variable)	0.61	0.49
OECD (OECD countries; dummy variable)	0.06	0.24
Observations	*N* = 1.033	

Building on the three main theoretical approaches to explaining the current fertility decline in developed as well as in developing countries (see section 4.1), the model sug-

3 For a closer description of the data set, see section 5.2 and appendix 6.A at the end of this chapter.

gested here for analysing the life-time fertility demand of typical parents will be used for testing the following predictions (see Schultz 1997):

1. Increased education of women raises the opportunity cost of child-bearing and should reduce fertility.
2. Increased education of men may increase or decrease fertility, but in either case should affect fertility less (algebraically) than the education of women.
3. Increases in national income per adult that are not associated with increased education of adults approximate changes in the share of income from wealth and natural resource; this income from sources other than human capital should be expected to increase the demand for children, if these are a “normal” good.
4. Reduced child mortality should be associated with a decline in the number of births, assuming that the demand is for surviving children.
5. Increased public pension expenditure per pensioner increases the fiscal externality of child-rearing which should result in a decline in fertility rates.
6. Increased family allowances per child that are financed by taxes reduce the marginal cost of having children and should induce a positive effect on fertility.
7. Furthermore, fertility should be lower in developed countries than in developing ones as the net cost of child-rearing is higher for parents in urban areas than in agricultural areas and as the opportunities for children to work productively in a context where they can be monitored by parents tend to be smaller in a non-agricultural setting than in an agricultural one.

Note that our predictions regarding the effects of direct and indirect measures of wages and income (no.s 1 through 3) are likely to be obscured by the fact that we are generally unable to control for the impact of the quantity–quality interaction on the final outcome of parental fertility decisions (see section 4.2). With a distinction between these two dimensions of the demand for total child services, an increase in the parents’ (full) income increases the shadow price of additional children. If, in addition, parents have stronger preferences for higher “child quality” (i.e., higher expenditure per child) than for a larger number of children, an increase in income may effectively imply a reduction in observed fertility rates. This concern is most relevant for our estimates related to the GDP-per-capita variable, while the two educational variables effectively serve a different purpose in the context of the present model.

The predictions regarding the differing roles of male vs female education (no.s 1 and 2) are based on the following considerations. In both cases, wage rates raise full income, which should have a positive effect on the number of children if fertility is endogenous (see no. 3). However, wage rates – and, in particular, the mother's wage – also raise the opportunity cost of having children. In endogenous fertility models, there is thus a substitution effect away from the number of children. In other words, different sources of household income imply different changes in the shadow price of children and, hence, in the demand for children. This is one of the most important insights derived from the household production model of the demand for children that (see section 4.3). As long as the bulk of child care occurs within the family and not in some external child care institution and as long as couples of parents mainly follow a traditional division of labour between mothers and fathers, an increase in the productive value of women's time should have a more negative effect on fertility than an increase in the value of men's time. In fact, if men are typically not involved in child-care activities, or if the GDP-per-capita measure takes up the negative quantity–quality effect, changes in their wage rates may even have a positive effect.

Because of the econometric complexities of estimating the shadow price of the time of mothers and fathers, average educational attainments of females and males may serve as a proxy for the relevant wage rates,[4] even though they undoubtedly represent a lot more than just that. Up until recently, macroeconomic growth regressions mostly relied on current enrolment rates to represent the level of education attained by the current labour force (see, e.g., Barro 1991 or Mankiw et al. 1992). As has been noted already some time ago (Denison 1962), this is not a promising solution. If available, the amount of education per adult is a much better measure of the current stock of human capital. Specifically, "years of schooling" as defined by Barro and Lee (1993, 1996) have been found to be highly correlated with the (log) wage rate of individuals and groups.

Among the different hypotheses that are potentially captured by equation (6.1), testing for the impact of public pensions, family allowances and other fiscal measures on fertility decisions is probably the most straightforward. It was already mentioned that we employ direct measures for the generosity of public pension schemes and child benefits in different countries. Given that the estimates related to these two variables turn out to be well-behaved, we may take the effect of further general-government expenditure as an indication of whether all the other fiscal instruments not explicitly covered in our model generally create a positive or a negative net fiscal externality of bringing up a child.

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4 Note that only in a handful of countries, gender-specific wages are reported. Furthermore, the variation in these wages is also determined by differences in participation and hours-of-work decisions and therefore still falls short of measuring wage *rates* in a meaningful way.

Table 6.2 summarises our estimates for a number of different specifications of the fertility equation. Again, specifications M 1 through M 6a mainly reflect the search for an appropriate structure of the overall model, gradually introducing country dummies as well as some of the variables included in our full set of regressors. Models M 6b through M 10 are meant to explore the robustness of our findings with respect to alternative sub-samples (defined by countries with different income levels as well as different time periods) and alternative estimation methods. It turns out that the majority of the results are consistent with the main hypotheses suggested above and that model M 6 can be considered as the final specification of our fertility regression.

For the basic ordinary least squares (OLS) regression M 1, all data included the entire sample are simply pooled together. Regression M 2 is based on the same data set, but adds country dummies. Model M 1 works well in some dimensions, but because country-specific effects are ignored, the standard errors computed by OLS can be severely biased. It is easy to see that the explanatory power of the overall model, as well as that of individual regressors, is substantially improved in M 2.[5] In this model, the majority of coefficients are statistically significant and have an economically sensible interpretation. For instance, in countries with higher educational attainments of females, women give birth to less children, while the effect of educational attainments of males is smaller, but significantly positive. Also, increasing public provision for pensioners reduces fertility, whereas increasing family allowances has a positive effect on fertility, as was expected.

Models M 3 through M 6 replicate the analysis in the context of regressions with country-level fixed effects. Model M 6a is basically the fixed-effects equivalent to model M 2, while some of the regressors are dropped in models M 3, M 4 and M 5. Regression M 3 includes only per-capita GDP, ln (*y*), and other variables that could affect productivity levels (changes in life expectancy at birth, *le*, as well as average years of school-

[5] Following Baltagi and Pinnoi (1995), we construct a simple *F*-test regarding the significance of country-specific effects. The value of the F-test (7,87) is 154.27 with prob > $F = 0.000$ for model 2. Therefore, we can easily reject the Null hypothesis that country-specific effects are insignificant.

Table 6.2: Economic determinants of total fertility rates

	M 1	M 2	M 3	M 4	M 5	(a) M 6	(b)
Sample Estimation method	All Countries Pooled OLS	All Countries OLS	All Countries OLS (fixed eff.)	All Countries OLS (fixed eff.)	All Countries OLS (fixed eff.)	All Countries OLS (fixed eff.)	OECD OLS (fixed eff.)
Dep. variable:	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)
p	–0.005***	–0.001***			–0.001**	–0.001***	–0.001*
	(*0.001*)	(*0.000*)			(*0.000*)	(*0.000*)	(*0.001*)
fa	–0.0007	0.0137***				0.0137***	0.0139***
	(*0.006*)	(*0.003*)				(*0.0019*)	(*0.002*)
g	–0.001	–0.016***		–0.0048***	–0.015***	–0.0159***	–0.026**
	(*0.004*)	(*0.003*)		(*0.001*)	(*0.0016*)	(*0.0016*)	(*0.003*)
le	0.032	–0.052*	0.010***	0.011**	–0.045***	–0.052***	–0.089***
	(*0.051*)	(*0.022*)	(*0.003*)	(*0.003*)	(*0.0147*)	(*0.014*)	(*0.018*)
ln (*y*)	–0.0027	–0.275***	–0.168***	–0.1805***	–0.280***	–0.275**	–0.228**
	(*0.01*)	(*0.085*)	(*0.012*)	(*0.013*)	(*0.0235*)	(*0.023*)	(*0.033*)
h^m	–0.061*	0.009	–0.0157**	0.019**	0.014	0.009	0.031**
	(*0.034*)	(*0.029*)	(*0.007*)	(*0.007*)	(*0.0129*)	(*0.011*)	(*0.016*)
h^f	–0.013	–0.0989***	–0.1286***	–0.119***	–0.100***	–0.098***	–0.113**
	(*0.029*)	(*0.031*)	(*0.007*)	(*0.008*)	(*0.0115*)	(*0.0126*)	(*0.017*)
OECD	–0.317***	0.663					
	(*0.094*)	(*0.220*)					
Least	0.191***	–-6.402***					
	(*0.0636*)	(1.802)					
Country dummies	No	Yes					
Constant	1.919***	4.222***	3.518**	3.689***	4.619***	4.573**	4.147***
	(*0.1412*)	(*0.524*)	(*0.104*)	(*0.113*)	(*0.2859*)	(*0.202*)	(*0.289*)
Observations	1,033	1033	2,398	2,272	1,035	1,033	635
Countries	88	88	106	102	88	88	25
(Adj.) R^2 (overall)	78.4%	95.9%	39,8%	35.4%	23.0%	21.9%	12.5%
within			68.3%	69.0%	70.1%	71.5%	77.3%
between			34.1%	29.8%	12.1%	11.4%	4.3%

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

ing of males and females, h^m and h^f, respectively) as the independent variables. Together, these variables explain 40 % of the variation in fertility rates across countries and over time. Furthermore, the coefficients for ln (y) and h^f are significantly negative across all specifications from M 3 to M 6, indicating that this partial correlation is robust even when the set of behavioural and control variables on the right-hand side of the regression are altered. The sign and significance of these coefficients even remain stable for countries with different levels of income and for sub-periods of the full sample (see models M 6b, M 7 and M 8).

Another interesting finding is that the h^f-coefficient is significantly negative throughout, while the one for h^m is significantly positive in M 2, but changes its sign, or is no longer statistically significant, in other specifications of the model. For instance, the h^m-coefficient is positive in model M 6a, as it was in M 2, but the estimate is not significant. It becomes significant again for the OECD sub-sample (M 6b), but this finding is not entirely robust against changes in the sample period (see models M 7b and M 8b). Note that a negative effect of female wages and a positive effect of male wages for fertility is also found in Cigno and Rosati (1996), plus all of their related work (see section 4.5), using longer time series for a number of industrialised countries. Similarly, Ahituv (2001) finds a positive fertility effect of the difference between variables related to male and female education, indicating that better educated men are likely to raise fertility, while better educated women tend to reduce it. Ehrlich and Kim (2005) obtain a qualitatively similar result for a variable referring to female labour-force participation, while they have no parallel control for male participation or wage rates. We therefore take the negative effect of female education derived in our estimations to reflect the unambiguously negative impact of higher opportunity costs on fertility. At the same time, we conjecture that the (mainly positive) effect of male education takes up a positive income effect for fertility, but may be downward-biased and have a distorted level of significance as well through a negative impact of Becker's quantity–quality interaction. As we see it, this latter aspect that cannot be directly controlled for is also the main factor behind the coefficient for per-capita GDP which is consistently negative (in itself, this finding again corresponds to a parallel result in Ehrlich and Kim 2005).

In M 2 as well as in M 5 and M 6, the coefficient related to changes in life expectancy at birth, *le*, is significantly negative. This is in line with the interpretation that higher life expectancy effectively means that fewer births are required to reach some target level of the number of surviving children, so that fertility is consequently reduced (for parallel findings, see Ahituv 2001 or Ehrlich and Kim 2005).

Table 6.2 (cont'd.): Economic determinants of total fertility rates

	(a) M 7	(b)	(a) M 8	(b)	M 9	M 10
Sample Estimation method	All Countr. 1960–74 OLS (fixed effects)	OECD 1960–74 OLS (fixed effects)	All Countr. 1975–89 OLS (fixed effects)	OECD 1975–89 OLS (fixed effects)	All Countries OLS ("between")	All Countries GLS (random eff.)
Dep. variable:	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)	ln (*TFR*)
p	–0.003*** (*0.001*)	–0.002** (*0.001*)	–0.0005** (*0.000*)	–0.002*** (*0.001*)	–0.003** (*0.001*)	–0.002*** (*0.000*)
fa	0.019*** (*0.005*)	0.022*** (*0.006*)	0.013*** (*0.002*)	0.014*** (*0.002*)	–0.013 (*0.012*)	0.013*** (*0.002*)
g	–0.016*** (*0.003*)	–0.029*** (*0.005*)	–0.006*** (*0.002*)	–0.011*** (*0.004*)	0.008 (*0.006*)	–0.016*** (*0.002*)
le	–0.055*** (*0.020*)	–0.065*** (*0.020*)	–0.020 (*0.014*)	0.014 (*0.021*)	0.136 (*0.106*)	–0.046*** (*0.015*)
ln (*y*)	–0.191*** (*0.038*)	–0.073* (*0.042*)	–0.058* (*0.032*)	–0.152** (*0.061*)	0.001 (*0.007*)	–0.025*** (*0.007*)
h^m	–0.026** (*0.018*)	–0.014 (*0.023*)	0.008 (*0.018*)	–0.082*** (*0.020*)	–0.050 (*0.036*)	–0.108 (*0.011*)
h^f	–0.068*** (*0.023*)	–0.091*** (*0.031*)	–0.116*** (*0.015*)	–0.157*** (*0.020*)	–0.037 (*0.034*)	–0.018*** (*0.011*)
OECD					–0.254*** (*0.086*)	–0.239** (*0.062*)
Least					0.154* (*0.079*)	0.009 (*0.074*)
Constant	3.861*** (*0.341*)	2.818*** (*0.379*)	2.281*** (*0.313*)	3.002*** (*0.585*)	1.719*** (*0.166*)	2.513*** (*0.075*)
Observations	430	293	603	342	1,033	1,033
Countries	64	25	86	25	88	88
(Adj.) R^2 (overall)	30.3%	14.8%	52.8%	6.0%	76.6%	69.6%
within	59.3%	63.2%	47.5%	56.6%	43.6%	67.8%
between	28.3%	21.0%	49.6%	6.0%	81.4%	71.3%

***, ** and * denote significance at a 1-percent, 5-percent or 10-percent level, respectively. (Standard errors are in parentheses.)

Compared to M 3, models M 4 through M 6 introduce general-government expenditure, *g*, and the two variables representing specific types of benefits, viz. pensions, *p*, and family allowances, *fa*, as additional regressors into the fixed-effects model. The *g*-coefficient is negative and significant in all the relevant specifications, including those of M 5 and M 6. The same applies to the pension variable. Family allowances, on the other hand, turn out to be significantly positive in all these models. Our findings therefore support that there is a negative impact of public pension expenditure (measured per individual aged 65 and above and normalised by GDP per capita) on fertility, as predicted by the "social security hypothesis". The result clearly conforms to the findings in Cigno and Rosati (1996) and all of their related work as well as the results provided by Ehrlich and Zhong (1998) or, in an up-dated version, Ehrlich and Kim (2005).

The positive effect of family allowances (per children up to the age of 15, again normalised by GDP per capita) should not be surprising. It corresponds to the results in Cigno et al. (2003) and is in line with numerous studies using micro-level data for single countries (for an up-to-date survey, see Meier 2005). Finally, the negative coefficient related to general-government expenditure (per GDP) could point to several effects that are not really mutually exclusive. For instance, it could mean that public expenditure on budget items other than pension benefits (and child benefits) also substitute for possible intra-family arrangements and, hence, reduce the value of having a child. Also, it could indicate that, to the extent that this expenditure is effectively financed by explicit or implicit government debt, higher current expenditure necessarily involves a higher fiscal externality of children who have to pay for servicing these kinds of debt.

All the models M 3 to M 8 are based on the assumption that country-specific effects are fixed. Alternatively, the country-level effects could be treated as random, so that the generalised least squares (GLS) method would be more efficient than the OLS with fixed effects (if the random effects were not correlated with other regressors). The GLS results reported for model M 10 are not much different from those of M 6. More importantly, the relevant test statistics do not support the random-effects specification. The Hausman test indicates that the country-specific effects are correlated with the other explanatory variables ($\chi^2 = 184.93$). The Breusch-Pagan test confirms that there is no autocorrelation in the country-specific effects ($\chi^2 = 3{,}279.2$).

6.3 Simulations

Based on a number of hypotheses established by the economic theory of endogenous fertility, we have now looked at determinants of current fertility rates that are related to a given country's current stage of economic development and the institutional environment in which potential parents are making their fertility decisions. Using plausible assumptions regarding future trends in any of these determinants that we have found to be important in our econometric analysis, we can finally try to infer how total fertility rates might evolve in the future in another series of illustrative simulations. Building on our earlier predictions regarding how past fertility trends may influence the future economic performance in a number of industrialised countries (see section 5.4), we are even able to link our two distinct sets of empirical results, thus looking, in a highly tentative fashion, at the potential stability or instability of the process of demographic change. This is what we will do now, rounding off, in a sense, our investigation into the nature and the long-term consequences of the interplay between fertility and economic growth. We will do so with respect to same four highly developed countries – the US, Japan, Germany, and France – that we have addressed for similar purposes at the end of the previous chapter.

In the following, we will use the OECD-variant of our main econometric model (M 6b) and a number of additional assumptions to simulate total fertility rates (TFRs) that could materialise in the countries mentioned above in the period from 2005 to 2050. For comparison, we also simulate TFR outcomes for the years from 1990 to 2005 as predicted by our econometric model and confront them with actual figures observed between 1990 and 2004. As applying our econometric results to a real-world context turns out to be a bit difficult, especially with respect to the measures of household income included in our estimation, we effectively construct two different "baseline scenarios" and then introduce the changes in future economic performance simulated in chapter 5 in order to see whether they could make a difference with respect to prospective fertility trends. Table 6.3 summarises our assumptions regarding the future development of the determinants of TFRs included in model M 6 that we are using in all of the variants of our simulations. Figure 6.1 illustrates the results of our new simulation exercise.

With the "baseline scenario #1", we are primarily interested in constructing a benchmark scenario reflecting current figures observed at a national level and plausible future trends regarding all the variables included in our model. In doing so, we are careful not to introduce too much idiosyncratic, country-level developments with respect to expected future changes in variables such as male and female years of schooling or changes in life expectancy at birth because different trends in any of these areas could be mainly taken to reflect larger differences in economic development related to the

Table 6.3: Assumptions for the TFR simulations

Baseline scenario #1	*Real per-capita GDP* (*y*): growth at a constant rate of 1.5% p.a. (as with a constant rate of productivity growth and a stable population) *Male years of schooling* (h^m): growth at a constant rate of 0.2% p.a. (as observed for the average of OECD countries over the full sample period) *Female years of schooling* (h^f): growth at a constant rate of 0.4% p.a. until 2005 (as observed for the average of OECD countries over the full sample period); closure of the gap against h^m until 2050 *Life expectancy at birth* (*le*): growth at a rate of approx. 3% p.a. (about one year per decade, as observed for the average of OECD countries over the full sample period) *Family allowances per child aged –15* (*fa*): constant when normalised to GDP per capita *Pensions per adult aged* 65+ (*p*): growth or decline as projected in OECD (2001, chapter 4), normalised to GDP per capita (*Other*) *government expenditure* (*g*): constant on per-GDP terms
Baseline scenario #2	*All assumptions*: same as in “baseline scenario #1” except: *Male years of schooling* (h^m): artificially increased to reflect changes in *y* assumed for the “baseline scenario #1” based on the decomposition of GDP per worker in equation (5.1)
Higher-dependency scenario	*Real per-capita GDP* (*y*): periodic growth rates adjusted to reflect the impact of higher dependency on *y* as predicted in section 5.4 *Male years of schooling* (h^m): same as in “baseline scenario #2” *All other assumptions*: same as in “baseline scenario #1”
Demographic-repercussion scenario	*Real per-capita GDP* (*y*): periodic growth rates adjusted to reflect the additional impact of ageing on *y* as predicted in section 5.4 *Male years of schooling* (h^m): same as in “baseline scenario #2”, adjusted to reflect further changes in assumptions regarding *y* *All other assumptions*: same as in “baseline scenario #1”

past, rather than indicating persistent differences that may also matter in the future. In these cases, we therefore use harmonised assumptions based on OECD-wide averages and on the idea that, where they exist, current gender-specific education differentials may largely disappear over time. To some extent, we also want to take into account policy changes already enacted as a response to demographic change that cannot be inferred from current figures and historical trends – an aspect that appears to be mainly relevant for the future development of public pension benefits. Here, we rely on the results of comparable projections regarding the future development pension expenditure per GDP prepared for the OECD (see OECD 2001, chapter 4, and Dang et al. 2001), translating the results into our income-adjusted measure of pension expenditure per adult aged 65 and above.[6] Other variables, such as the income-adjusted measure of family allowances per child and the share in GDP of general government consumption expenditure (on items other than pensions and child benefits), are simply kept constant over time, while we assume that per-capita GDP will be growing at a constant rate of 1.5 percent p.a. on real terms everywhere in each year of the simulation period. As in section 5.4, this assumption reflects the case where in all industrialised countries economic growth would be driven by a uniform rate of productivity growth and the population were stable in terms of its size and age composition.

It turns out that, under these assumptions, total fertility rates would continuously decline until 2050 in all the countries considered here – to around 1.0 in Germany and Japan and to around 1.5 in France and the US (see figure 6.1). Based on our interpretation of the econometric results we obtained in section 6.2, this tendency is hardly surprising as, so far, our simulations only capture the negative impact of higher opportunity costs associated with higher levels of female education and the negative effect of the quantity–quality interaction that may be operative behind the coefficient for per-capita GDP. In the “baseline scenario #1”, the positive impact of increasing levels of male education on TFRs is simply too weak, due to a smaller coefficient for h^m than for h^f and to smaller changes hypothesized to take place in this respect until 2050 than with regard to female education, to make up for the two other, adverse effects. On the other hand, we may still be missing an important part of the positive income effect for fertility implied in higher GDP per capita that we have conjectured to be taken up by the h^m-variable.

In an attempt to overcome this problem that is ultimately related to the impossibility of directly controlling for Becker’s quantity–quality interaction and measuring the “true” income effect for fertility, we construct our “baseline scenario #2”. It is based on our conjecture that the effect of higher income for fertility is reflected in the positive coefficient of male years of schooling.[7] In order to make it fully visible, we then have to artificially increase h^m to reflect the changes in GDP per capita (i.e., y) that we have assumed to take place in the “baseline scenario #1” (again, based on the assumptions of a

6 Note that the results for France reported in OECD (2001) only span the period until 2040. In our simulations, the French final-year result in terms of pension expenditure per GDP is therefore kept constant in 2045 and 2050. Given the small coefficient estimated for the *p*-variable, larger changes would not really make a difference regarding the level of TFRs predicted for these years.

7 Remember that, apart from the family-allowances measure, male education is the only variable that has a positive impact, at all, in our TFR-estimates based on model M 6.

constant rate of productivity growth and a stable population). In other words, we have to determine how high h^m would have to be at each point in time in the future to “explain”, as a sole cause, the expected increase in per-capita GDP. We can do so using the decomposition of GDP per worker in equation (5.1) and the definition of human capital based on average years of schooling in the active population that are behind our econometric estimates obtained in chapter 5.[8] Against the “baseline scenario #1”, assumptions regarding all other determinants of future TFRs remain unchanged in our “baseline scenario #2”. The result of these operations is striking: with our correction of male years of schooling, total fertility rates next to perfectly level off at their current values in all the countries considered and over the full time horizon of our simulations (see, again, figure 6.1).[9] This could be taken to indicate that the positive effect of higher income on parental demand for the number of children and the negative substitution effects of higher expenditure per child and (a limited amount of) higher opportunity costs almost exactly cancel out. We have to admit that this conclusion is weak in that, although it is based on a consistent modelling, it is critically dependent on our interpretation of the econometric evidence which cannot be proven to be reliable in a strict sense.[10] But in any case, we are not prepared to accept the results derived from “baseline scenario #1”, by which higher income would unambiguously reduce fertility without any lower limit, as conveying the full story that is of interest here.

Faute de mieux, we therefore go ahead using scenario #2 as the baseline for introducing further variation in our measures of income. Building on our simulations reported at the end of the previous chapter, we first replace the changes in GDP per capita related to a stable population by those predicted for the case of “higher dependency”, as implied in current population projections. Then, we also drop the assumption of a constant, uniform rate of productivity growth and switch to a scenario where periodic productivity growth is adjusted to reflect the impact of projected changes in the age composition of

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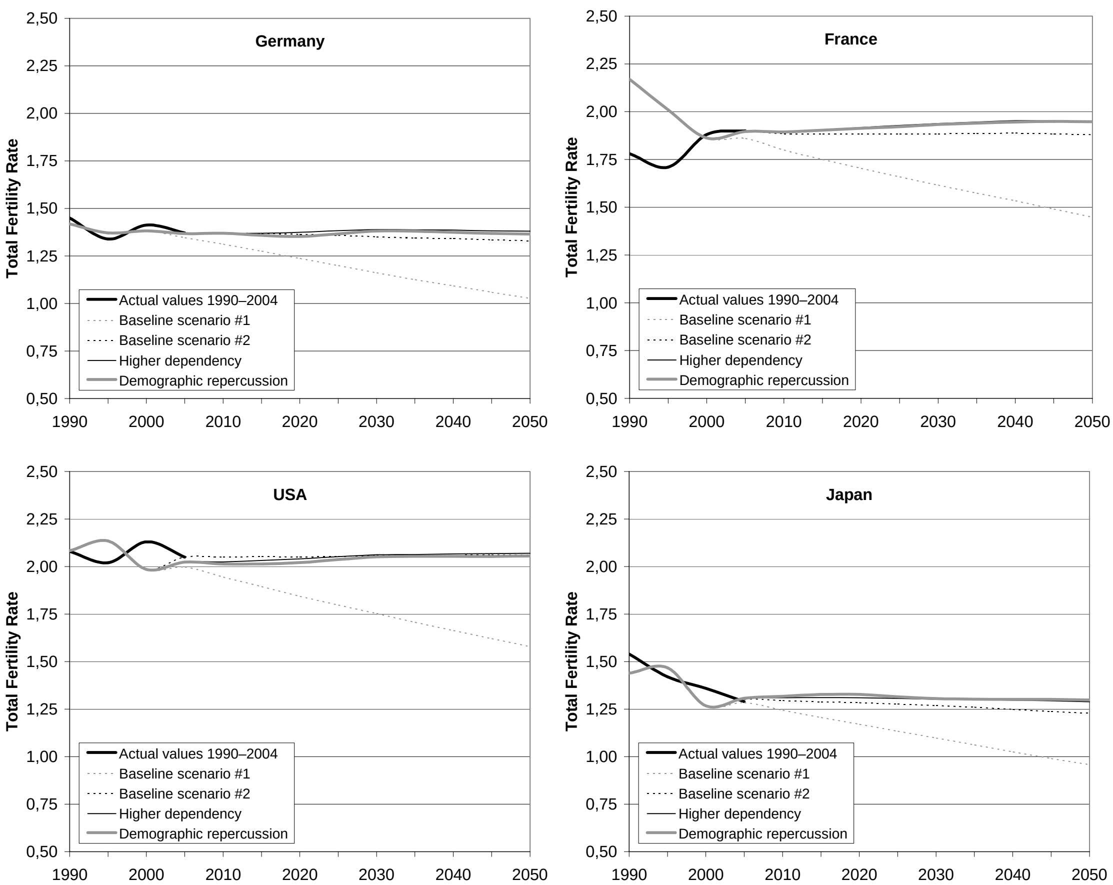
8 Regarding the sub-distinction of years of “primary”, “secondary” and “higher” education that enters the calculation of our human-capital variable, we take as given the current structure of years of schooling at any of these educational levels observed in each country and increase h^m by a linear multiple of its current duration.

9 Note that this outcome is not an artefact of additional assumptions, or manipulations, but is immediate from the way we have modelled the link between higher y and higher h^m.

10 By our interpretation of the econometric evidence, the coefficient for h^m may even understate the true income effect for fertility as it may be downward biased through the presence of the quantity–quality interaction. If this were true, an increase in GDP per capita could, all other things equal, have a positive impact on a given country’s total fertility rate. Yet, we have even less of a proof for this view, let alone a yardstick that could be used for any tentative quantifications.

the labour force on economic performance – this latter scenario effectively allowing for a “demographic repercussion” in the sense that, through their impact on current and future economic growth, changes in past fertility rates may also increase or decrease current and future fertility rates. In both cases, the male-education variable is adjusted to reflect the changes in assumptions regarding *y*. Figure 6.1 reveals that there may be a weak effect of higher dependency – the slow-down in growth of income per capita expected in virtually all industrialised countries may effectively increase future TFRs by a bit because productivity growth and, therefore, the time path of h^m are unchanged. But, according to our simulations, there is next to no additional effect of the ageing labour force. These observations are true even for countries and time periods (for instance, Germany in the 2010–20 period) where the growth of per-capita GDP as such may be subject to a relatively strong “demographic gap” (cf. figure 5.5).

Figure 6.1: The impact of projected changes in economic determinants on total fertility rates (2005–50) – OECD regression



Sources: see table 6.3; Ifo estimates.

We therefore find no signs of a strong "demographic repercussion" by which, based on a long-term interplay between fertility rates and economic growth, the demographic development in a given country could stabilise over time or, by contrast, could entirely destabilise in an endogenous fashion. Rather, it would seem that, in the absence of further policy changes, a plausible amount of further income growth and even a continued increase in female education could largely fix total fertility rates at their current levels – whether these are high or low – in each of the countries considered. This conclusion, assuming that it is really supported by our econometric results and our illustrative simulations, would then still require two qualifications that are worth mentioning.

One qualification is that our baseline assumptions regarding the future development of female years of schooling are highly stylised and may be too moderate in terms of possible increases. In a number of industrialised countries, the gap between the average number of years of schooling between males and females aged 15 and above is still substantial, while in others average females are close to outperforming their male counterparts in terms of this variable. At the same time, current growth rates in female years of schooling are actually much higher in some countries than those used in our simulations. What would happen to fertility rates if the tendency towards higher education for females were stronger than we have assumed here and were not bounded from above by male education levels? Our estimates clearly imply that fertility rates could then continue to decrease even where they are already low. However, in part II of this study, we will see that there is effectively no unambiguous negative relationship between fertility rates and female labour force participation in industrialised countries. Instead, the extent to which the negative impact of female years of schooling on fertility which appears to be straightforward from economic theory becomes effective under real-world conditions is also a matter of framing labour-force participation of an increasing number of well-educated women with an appropriate increase in the supply of child-care facilities.[11] Taking into account potential changes in the availability (and the cost) of such services – at least in countries where there is still room for improvement –, a stronger increase in female education need thus not be harmful for fertility rates as it does not necessarily translate into higher opportunity costs of rearing children.

The second qualification is partly related to this last statement, but is potentially of much broader relevance. If plausible changes in levels of income and female education would essentially leave fertility rates at where they are now, increasing low levels of

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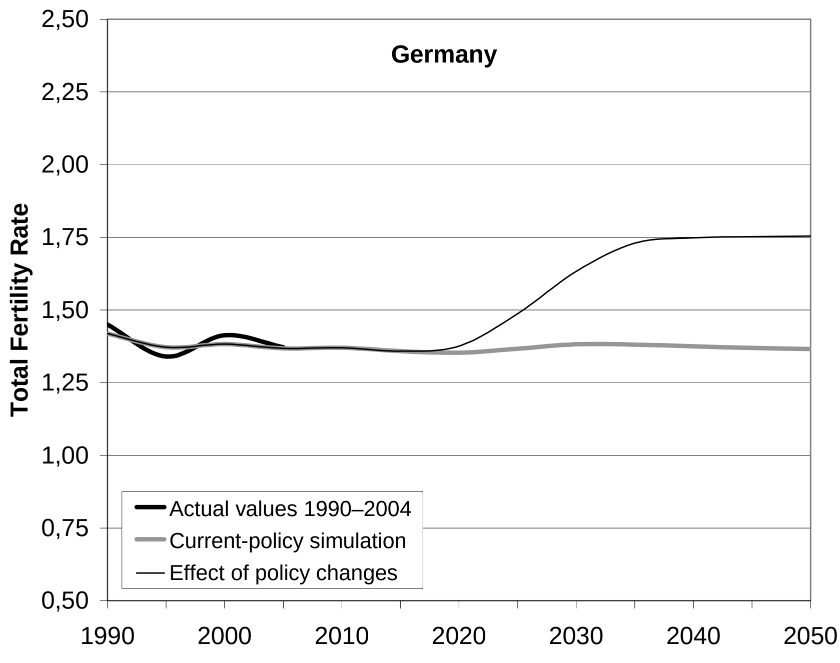
[11] This was conjectured in Apps and Rees (2004) and was empirically validated in Kögel (2004).

fertility appears to be mainly a matter of the existing institutional framework and of related policy decisions. We are able to demonstrate this with another illustrative simulation, now focussing exclusively on the case of Germany, a country with a current TFR of about 1.35. In our econometric estimates, the two variables that mainly reflect parameters of public policy are the income-adjusted measures of pension expenditure per adult aged 65 and above and of family allowances per child aged less than 16 years. Assuming, just for the sake of the argument, that (a) the increase in pension expenditure per GDP that is projected (in OECD 2001, chapter 4) to take place in Germany from 2020 onwards is avoided (for instance, through a corresponding decline in average benefit levels) and that (b) half of the reduction in pension expenditure is channelled into higher child benefits,[12] total fertility rates in this country could easily recover to a level of about 1.75 within a period of less than two decades (see figure 6.2). At least, this is what would be implied in our econometric analyses and our earlier simulations,

Figure 6.2: The impact of policy changes on total fertility rates in Germany (2005–50) – OECD regression



Source: Ifo estimates.

[12] One way of interpreting this specific bundle of policy changes is that it could be the result of a stronger differentiation of pension benefits between those who have children and those who have none, motivated by the fact that child-rearing is effectively a major contribution to continuing unfunded pension systems and by the ambition to remove the adverse fiscal externality of raising children; see section 4.4 and, for similar policy proposals, Sinn (2000), Sinn and Werding (2000), or Werding (2003, 2006).

taking the former “demographic-repercussion” scenario as a “current-policy simulation” now and adding the policy changes just sketched.

Before concluding this chapter, a final word of caution may be highly appropriate. None of the simulations presented in this section should be taken to be a serious prognosis of future total fertility rates in any of the countries covered. Instead, they are meant to highlight relevant fundamental tendencies that appear to be implied in the current stage and in prospective trends of economic development in these countries. Whether, and to what extent, these tendencies will materialise in the future is, among other things, contingent on a host of decisions that are to be taken both at an individual and a collective level. Pension reform combined with an expansion of family allowances offers just one example: building on our empirical results, we are able to demonstrate that institutional changes in these areas would have an impact on fertility rates – an idea that, in itself, is sometimes rejected altogether – but bringing these changes about often requires a supportive public vote, lengthy parliamentary procedures and, last but not least, behavioural changes that respond to the new set of incentives.

Discussing these or other reforms for a German context in some more detail, or deriving meaningful policy packages for all the industrialised countries with currently low levels of fertility, is clearly beyond the scope of the present study. In fact, we have now completed our econometric work and its interpretation, based on a multi-country panel with longer time series of aggregate and average (in any case, macro-level) data. In the second part of our study, we will look at fertility outcomes and family policies in a small number of industrialised countries, trying to unearth a number of details that are impossible to deal with in work such as that covered here so far. At the same time, when looking at these details one should keep in mind the results we have established in part I of the study as this may help in selecting interesting sub-topics on the one hand and in avoiding premature conclusions that could suffer from a small-sample bias on the other.

Appendix A.6
The "Fertility and Prosperity" database[13]

a) List of variables included in the database

Our data base contains information regarding 213 countries for a maximum time period of 1950 to 2002. An exception is the data on birth rates that are available, for many countries, back until 1900. The data cover a large number of variables on economic development in general as well as on population, investment in physical and human capital, labour force, indicators for government activity with special attention given to social security. The main variables, data sources and definitions are listed in the following.

GDP

Variables on the general economic development of a country include a number of different measures of the GDP. In particular, nominal and real GDP measures based on different statistical calculation methods and definitions as well as GDP deflator data have been collected from PWT, WDI (2003) and Easterly and Levine (2000).

Theme	Indicator	Data Source
GDP	GDP (constant 1995 US-$)	WDI (2003)
	GDP (constant LCU)	WDI (2003)
	GDP (current LCU)	WDI (2003)
	GDP (current US-$)	WDI (2003)
	GDP deflator (base year varies by country)	WDI (2003)
	GDP growth (% p.a.)	WDI (2003)
	GDP per capita (constant 1995 US-$)	WDI (2003)
	GDP per capita (constant LCU)	WDI (2003)
	GDP per capita growth (% p.a.)	WDI (2003)
	GDP per capita, PPP (current international $)	WDI (2003)
	GDP, PPP (current international $)	WDI (2003)
	Real GDP per capita (Chain method)	PWT 6.1
	Real GDP per equivalent adult (Chain method)	PWT 6.1
	Real GDP per capita (Laspeyres)	PWT 6.1
	Real GDP per worker (Chain method)	PWT 6.1
	Real GDP adjusted for changes in terms of trade	PWT 6.1
	Real output per worker in 1990 US-$	Easterly & Levine (2000)

[13] We would like to thank three student research assistants, Andreas Leitenstorfer, Ruth Seitz and Kiril Stojanov, for excellent support in collecting and processing data.

- *Gross domestic product* (GDP) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output.
- *GDP per capita* is GDP divided by mid-year population.
- *Gross domestic product at purchaser prices* is the sum of gross value added by all resident producers in the economy plus any product taxes (less subsidies) not included in the valuation of output. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources
- *LCU* refers to Local Currency Units.
- *Real GDP per capita (Laspeyres)* is obtained by adding up consumption, investment, government and exports, and subtracting imports in any given year. The components for a given year are obtained by extrapolating the 1996 values in international dollars from the Geary aggregation using national growth rates. It is thus a fixed base index, where the reference year is 1996.
- *Real GDP chain* is a chain index obtained by applying first the component growth rates between each pair of consecutive years, t–1 and t (t = 1951, ... 2000), to the current-price component shares in year t–1 to obtain the DA growth rate for each year. This DA growth rate for each year t is then applied backwards and forwards from 1996, and summed up to form the constant-price net foreign balance to obtain the chain GDP series.
- *Real GDP chain per equivalent adult*: A weight of 1 is assigned to all persons aged 15 and over, a weight of 0.5 to those under age 15.
- *Real GDP chain per worker* uses a census definition of workers based on the economically active population.
- *Real GDP adjusted for changes in terms of trade* is the 1996 international-price value of domestic absorption of a country in a given year plus current exports minus current imports deflated by the deflator and the 1996 purchasing power parity of domestic absorption.

Population and demographic data

Mitchell (2003) collects historical data on crude birth rates (per 1,000s of population) for the time period 1900–2000 for all 67 countries for which data was available. Further data on fertility and other demographic variables for the time period 1960–2002 are included in the WDI. Data on the economically active population by age groups are provided in the ILO–LABORSTA database. Note, however, that consistent data on the age structure of the labour force is in general not available for all countries and all years.

Theme	Indicator	Data Source
Population	Population, total	WDI (2003)
Fertility	Total fertility rates	WDI (2003)
	Crude birth rates (per 1000 population)	WDI (2003)
	Crude birth rates (per 1000 population)	Mitchell (2003)
Life expectancy	Life expectancy at birth, females (years)	WDI (2003)
	Life expectancy at birth, males (years)	WDI (2003)
	Life expectancy at birth, total (years)	WDI (2003)

- *Total population* of an economy includes all residents regardless of legal status or citizenship – except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. The data included are mid-year estimates for 1980 and 2001 and projections until 2015.
- *Crude birth rates* are the number of live births occurring during a year per 1,000s of population estimated at mid-year.
- *Total fertility rates* are the number of children who would be born to a woman if she were to bear children in accordance with age-specific fertility rates observed in a given year.
- *Life expectancy at birth* is the number of years a newborn child would live if patterns of mortality prevailing at the time of its birth were to stay the same throughout its life.

Physical Capital

Data on gross capital formation is collected from WDI for 1960–2002. Easterly and Levine (2000) provide calculations regarding two main capital stock variables. They are available for a number of countries at 5-year intervals for the period 1965–1990. Estimations of the countries' capital stocks using aggregated investment data are available for at most 140 countries, while estimations based on disaggregated investment data are available only for a maximum of 57 countries.

Theme	Indicator	Data Source
Capital	Gross capital formation (% of GDP)	WDI (2003)
	Gross fixed capital formation (% of GDP)	WDI (2003)
	Imputed capital stock	Easterly & Levine (2000)

- *Gross capital formation* consists of outlays on additions to the fixed assets of the economy, net changes in the level of inventories, and net acquisitions of valuables.

Fixed assets include land improvements (fences, ditches, drains, etc.), plant, machinery, and equipment purchases, and the construction of roads, railways, etc., including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress".

- For a detailed description of the capital stock measures generated by Easterly and Levine (2000), see chapter 3.

Interest Rate

Theme	Indicator	Data Source
Interest Rate	Long term real interest rate Real interest rate (%)	OECD WDI (2003)

- *Real interest rate* as defined by the WDI is the lending interest rate (the rate charged by banks on loans to prime customers) adjusted for inflation as measured by the GDP deflator.
- *Long term real interest rate* as provided by the OECD are yields on long-term government bonds on the secondary market with residual maturity of about 10 years.

Education – Human Capital – Education Gap

Education and human capital indicators involve flows of school enrolment rates, completion rates of primary, secondary and tertiary education as well as information on public expenditures on education and the extent of research and development in a country. The data are mostly taken from WDI and the collections and calculations of Barro and Lee (1994).

Theme	Indicator	Data Source
Education/ Human Capital	Primary completion rate, female (% of relevant age group)	WDI (2003)
	Primary completion rate, male (% of relevant age group)	WDI (2003)
	Primary completion rate, total (% of relevant age group)	WDI (2003)
	Public spending on education, total (% of GDP)	WDI (2003)
	Scientists and engineers in R&D (per million people)	WDI (2003)

	Research and development expenditure (% of GDP)	WDI (2003)
	School enrolment, primary gross	WDI (2003)
	Percentage with primary school completed in total pop. aged 25 years and above	Barro & Lee (1993)
	Percentage with secondary school completed in the total pop. aged 25 years and above	Barro & Lee (1993)
	Percentage with higher school completed in the total pop. aged 25 years and above	Barro & Lee (1994)
	Percentage with primary school completed in the total male pop. aged 25 years and above	Barro & Lee (1994)
	Percentage with secondary school completed in the total male pop. aged 25 years and above	Barro & Lee (1994)
	Percentage with higher school completed in the total male pop. aged 25 years and above	Barro & Lee (1994)
	Percentage with primary school completed in the total female pop. aged 25 years and above	Barro & Lee (1994)
	Percentage with secondary school completed in the total female pop. aged 25 years and above	Barro & Lee (1994)
	Percentage with higher school completed in the total female pop. aged 25 years and above	Barro & Lee (1994)
	Average schooling years in the total population aged 25 years and above	Barro & Lee (1994)
	Average schooling years in the total male population aged 25 years and above	Barro & Lee (1994)
	Average schooling years in the total female population aged 25 years and above	Barro & Lee (1994)

- *Gross enrolment ratio* is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education considered.
- *Net enrolment ratio* is the ratio of children of official school age (as defined by the national education system) who are enrolled in school to the population of the same age. (Based on the International Standard Classification of Education, 1997, ISCED97.)
- *Primary education* provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music.
- *Secondary education* completes the provision of basic education that began at the primary level, and aims at laying the foundations for life-long learning and human

development, by offering more subject- or skill-oriented instruction using more specialized teachers.

- *Tertiary education***,** whether or not leading to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level.
- *Primary completion rate* is the number of students successfully completing the last year of (or graduating from) primary school in a given year, divided by the number of children of official graduation age in the population.
- *Average years of schooling* are the years of formal schooling received, on average, by adults aged 15 and above.
- *Public expenditure on education* consists of public spending on public education plus subsidies to private education at the primary, secondary, and tertiary levels.
- *Scientists and engineers in R&D* are people engaged in professional R&D activity who have received tertiary-level training to work in any field of science.
- *Expenditures for R&D* are current and capital expenditures on creative, systematic activity that increases the stock of knowledge. Included are fundamental and applied research and experimental development work leading to new devices, products, or processes.

Government

Theme	**Indicator**	**Data Source**
Government	General-government final consumption expenditure (% of GDP)	WDI (2003)
	Overall budget balance, including grants (% of GDP)	WDI (2003)

- *General-government final consumption expenditure* includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defence and security but excludes government military expenditures that potentially have wider public use and are part of government capital formation.
- *Overall budget balance* is current revenue (including all revenue from taxes and current non-tax revenues (other than grants), such as fines, fees, recoveries, and income from property or sales) and capital revenue and official grants received, less total expenditure and lending minus repayments.

Social Security

Data on social security issues have been mainly collected from ILO and OECD data bases and publications.

Theme	Indicator	Data Source
Social Security	Total social expenditure – Public (% of GDP)	OECD
	Old age cash benefits – Public (% of GDP)	OECD
	Social security transfers (% of GDP)	OECD
	Total social security receipts in national currency units	ILO-COSS
	Contributions from employers (% of total social security receipts)	ILO-COSS
	Contributions from insured persons (% of total social security receipts)	ILO-COSS
	Special taxes allocated to social security (% of total social security receipts)	ILO-COSS
	State Participation (% of total social security receipts)	ILO-COSS
	Income from capital (% of total social security receipts)	ILO-COSS
	Total insurance expenditure (in national currency units)	ILO-COSS
	Social insurance and assimilated schemes (% of total insurance expenditure)	ILO-COSS
	Family Allowances (% of total insurance expenditure)	ILO-COSS
	Total benefit expenditure (in national currency units)	ILO-COSS
	Pensions (% of total benefit expenditure)	ILO-COSS

– *Total Social expenditure* is the provision by public (and private) institutions of benefits to, and financial contributions targeted at, households and individuals in order to provide support during circumstances which adversely affect their welfare, provided that the provision of the benefits and financial contributions constitutes neither a direct payment for a particular good or service nor an individual contract or transfer. Such benefits can be cash transfers, or can be the direct ("in-kind") provision of goods and services.
– *Old age cash benefits* comprise all cash expenditure (including lump-sum payments) on old-age pensions within the public sphere.

Labour Force

Besides the data on the distribution of the active population by age group already mentioned, labour force statistics are taken from the WDI database.

Theme	Indicator	Data Source
Labour Force	Total labour force Total active population by age group (10-year intervals)	WDI (2003) LABORSTA (ILO)

– According to the ILO definition of the economically active population, *total labour force* comprises individuals who supply labour for the production of goods and services during a specified period. It includes both the employed and the unemployed. While national practices vary in the treatment of such groups as the armed forces and seasonal or part-time workers, the labour force generally includes the armed forces, the unemployed, and first-time job-seekers, but excludes homemakers and other unpaid caregivers and workers in the informal sector.

b) List of countries covered in the database

Afghanistan	Chad	Grenada	Liechtenstein	Oman
Albania	Channel Islands	Guam	Lithuania	
Algeria	Chile	Guadaloupe	Luxembourg	Pakistan
American Samoa	China	Guatemala		Palau
Andorra	Colombia	Guinea	Macao, China	Panama
Angola	Comoros	Guinea-Bissau	Macedonia, FYR	Papua New Guinea
Antigua	Congo, Dem. Rep.	Guyana	Madagascar	Paraguay
and Barbuda	Congo, Rep.		Malawi	Peru
Argentina	Costa Rica	Haiti	Malaysia	Philippines
Armenia	Cote d’Ivoire	Hawaii	Maldives	Poland
Aruba	Croatia	Honduras	Mali	Portugal
Australia	Cuba	Hong Kong, China	Malta	Puerto Rico
Austria	Cyprus	Hungary	Marshall Islands	
Azerbaijan	Czech Republic		Martinique	Qatar
		Iceland	Mauritania	
Bahamas, The	Denmark	India	Mauritius	Romania
Bahrain	Djibouti	Indonesia	Mayotte	Russian Federation
Bangladesh	Dominica	Iran, Islamic Rep.	Mexico	Rwanda
Barbados	Dominican	Iraq	Micronesia,	
Belarus	Republic	Ireland	Fed. Sts.	Samoa
Belgium		Isle of Man	Moldova	San Marino
Belize	Ecuador	Israel	Monaco	Sao Tome
Benin	Egypt, Arab Rep.	Italy	Mongolia	and Principe
Bermuda	El Salvador		Morocco	Saudi Arabia
Bhutan	Equatorial Guinea	Jamaica	Mozambique	Senegal
Bolivia	Eritrea	Japan	Myanmar	Seychelles
Bosnia and	Estonia	Jordan		Sierra Leone
Herzegovina	Ethiopia		Namibia	Singapore
Botswana		Kazakhstan	Nepal	Slovak Republic
Brazil	Faeroe Islands	Kenya	Netherlands	Slovenia
Brunei	Fiji	Kiribati	Netherlands	Solomon Islands
Bulgaria	Finland	Korea, Dem.Rep.	Antilles	Somalia
Burkina Faso	France	Korea, Rep.	New Caledonia	South Africa
Burundi	French Polynesia	Kuwait	New Zealand	Spain
		Kyrgyz Republic	Nicaragua	Sri Lanka
Cambodia	Gabon		Niger	St. Kitts and Nevis
Cameroon	Gambia, The	Lao PDR	Nigeria	St. Lucia
Canada	Georgia	Latvia	Northern Mariana	St. Vincent and
Cape Verde	Germany	Lebanon	Islands	the Grenadines
Cayman	Ghana	Lesotho	Northern Ireland	Sudan
Central African	Greece	Liberia	Norway	Suriname
Republic	Greenland	Libya		Swaziland

Sweden Switzerland Syrian Arab Republic Taiwan Tajikistan Tanzania Thailand	Timor-Leste Togo Tonga Trinidad and Tobago Tunisia Turkey Turkmenistan	Uganda Ukraine United Arab Emirates United Kingdom United States Uruguay Uzbekistan	Vanuatu Venezuela, RB Vietnam Virgin Islands (U.S.) West Bank and Gaza	Yemen, Rep. Yugoslavia, Fed. Rep. Zambia Zimbabwe

Part II:

The Effectiveness of Family Policies – Case Studies

Chapter 7
Fertility Outcomes in Selected European Countries

Part II of the present study is meant to address in some more detail the effectiveness of family policies that are operative at a national level in a number of developed countries. Here "family policies" are broadly defined to encompass not only a number of instruments that are conventionally included in relevant surveys, such as child-related cash benefits or tax allowances, plus transfers in-kind in the area of public, or publicly subsidised, child care. In addition, child-related benefits in the areas of housing, schooling and health care are covered as well. We also look at special child-related elements in public pension schemes by which parents are rewarded, to some extent, for child rearing and child-care activities through higher pension benefits, keeping in mind, though, that unfunded public pension schemes are basically a means of imposing a considerable burden on families and children, i.e., are effectively a type of family policies with a negative sign (see chapter 4 and 6).

In order to accomplish the goal of a comparative discussion for this broad set of instruments, we now have to concentrate on a narrow set of countries. In fact, while we will collect some basic amount of information for quite a number of countries in Europe and the other OECD world wherever this is possible, we will focus in particular on just four European countries, viz. Germany, France, the UK, and Sweden, in much of what follows. The concentration on countries in Western Europe is motivated not only by the availability of in-depth information but also by the presumption that these countries are relatively homogenous in many important respects and, hence, can be meaningfully compared to each other. At the same time, the selection of these four countries may still lead to a sufficient degree of heterogeneity between the systems of national family policies covered as they are taken to represent three rather different types of social systems and welfare-state regimes, usually classified as the "continental", the "Anglo-Saxon" and the "Nordic" model. Looking primarily at these countries may therefore yield an interesting set of case studies.

As the first step to take, we will review fertility outcomes in these and other developed countries more closely than this has been done in chapter 1. Therefore, chapter 7 describes the relevant trends taking into account a number of sub-issues, such as the timing of births and the structure of family households as well as the links between fertility and female education and labour-force participation. We also highlight the impact of past and current fertility decline on the future age structure of the (working-age) population. Chapter 8 is then devoted to addressing family policies in the countries that we have selected for closer scrutiny, discussing to what extent these may help explaining the cross-country differences in terms of changes and current patterns in fertility.

7.1 Fertility rates and prospective demographic change

In chapter 1, we have already given a rough account of the fertility decline observed in developed (and, with a considerable time lag, in developing) countries based on figures for crude birth rates and total fertility rates that span the period until the year of 2000. Figure 7.1 illustrates current (i.e., year 2004) fertility outcomes, again based on crude birth rates and total fertility rates,[1] for most OECD countries including a large set of countries in Western Europe and some countries in Eastern Europe.

It is easy to see that, within the developed world, three of the countries we have selected for closer scrutiny, viz. France, the United Kingdom and Sweden, rank relatively high in terms of their current fertility rates, while Germany ranks rather low. Total fertility rates (TFRs) in the first three countries fall in the range between 1.7 and 1.9 (live births per woman), France taking the lead and being outperformed only by Ireland and the US. On the other hand, the German TFR is below 1.4. It is thus not the lowest among the total fertility rates reported here, but in Western Europe it is only undercut, by a small margin, in Italy, Spain and Greece. The situation may be different in Eastern European countries, where year-2004 TFRs are even smaller, as the current depression could be only a temporary phenomenon, caused by the economic uncertainties arising during the transition period, and may not last for a longer period of time.[2]

According to figure 7.1, fertility in Germany is actually the lowest among the entire OECD world when measured in terms of crude birth rates (CBRs). The reason for this discrepancy to arise between the two types of fertility indicators used here is given by their definition. TFRs are an artificial index that is normalised with respect to the age

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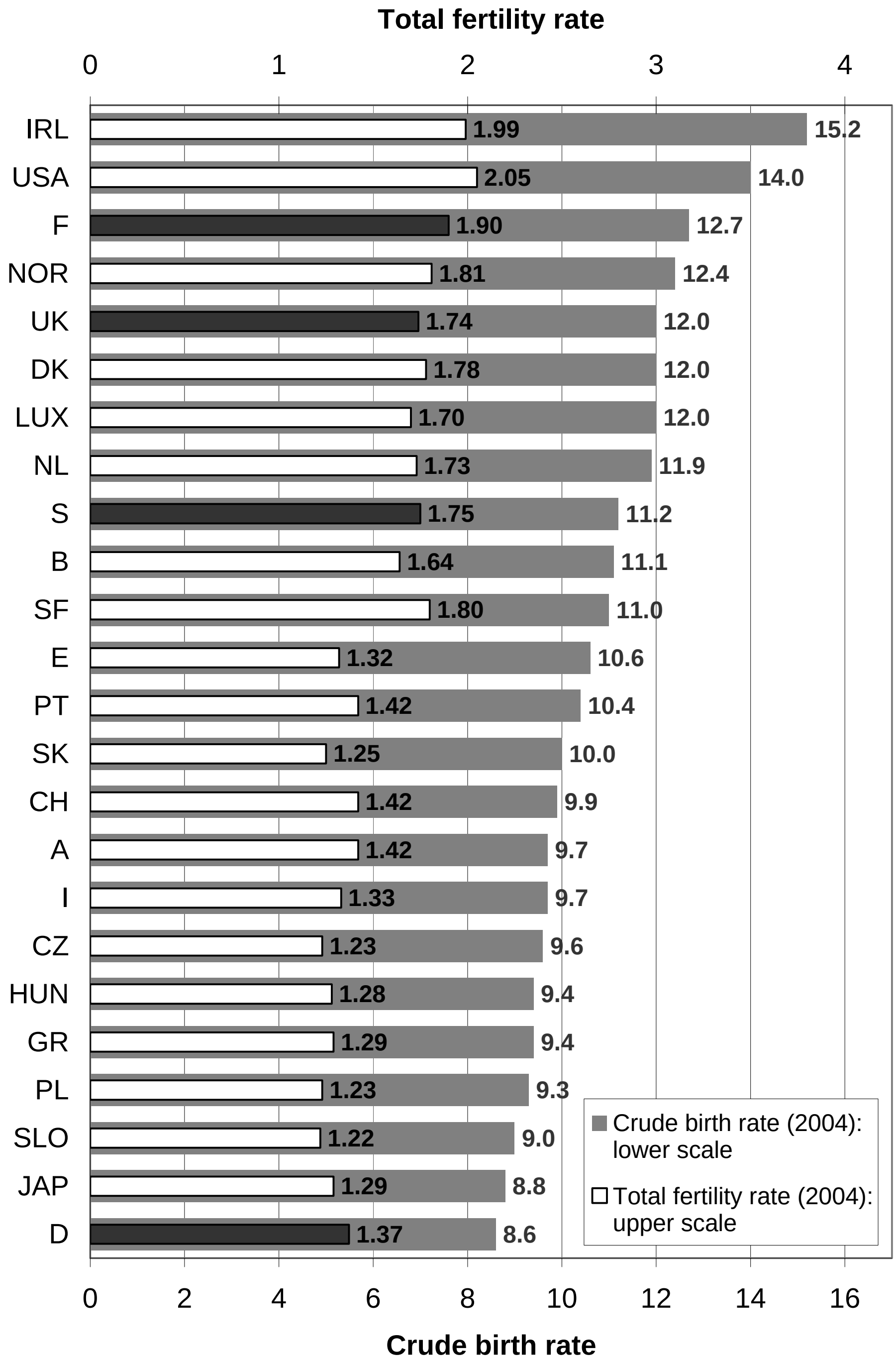
[1] For a definition of these and other widely-used fertility indicators, see Appendix A.1

[2] Partly, the current reduction in annual TFRs may even be caused by a mere process of postponing births that has occurred much earlier elsewhere (see section 7.2) and is now taking place, in a condensed fashion, in these countries as well. This is indicated by a comparison of the latest "completed fertility rates" (CFRs; see, again, Appendix A.1) measured in these and other developed countries (relevant data are also provided by Eurostat). For the age cohorts of women that have just completed their fertile ages, giving births to children mainly before the economic transition has set in, CFRs in Eastern Europe are still considerably higher than in most Western European countries. However, CFRs are too much backward-looking as a fertility indicator to allow for final conclusions in this area.

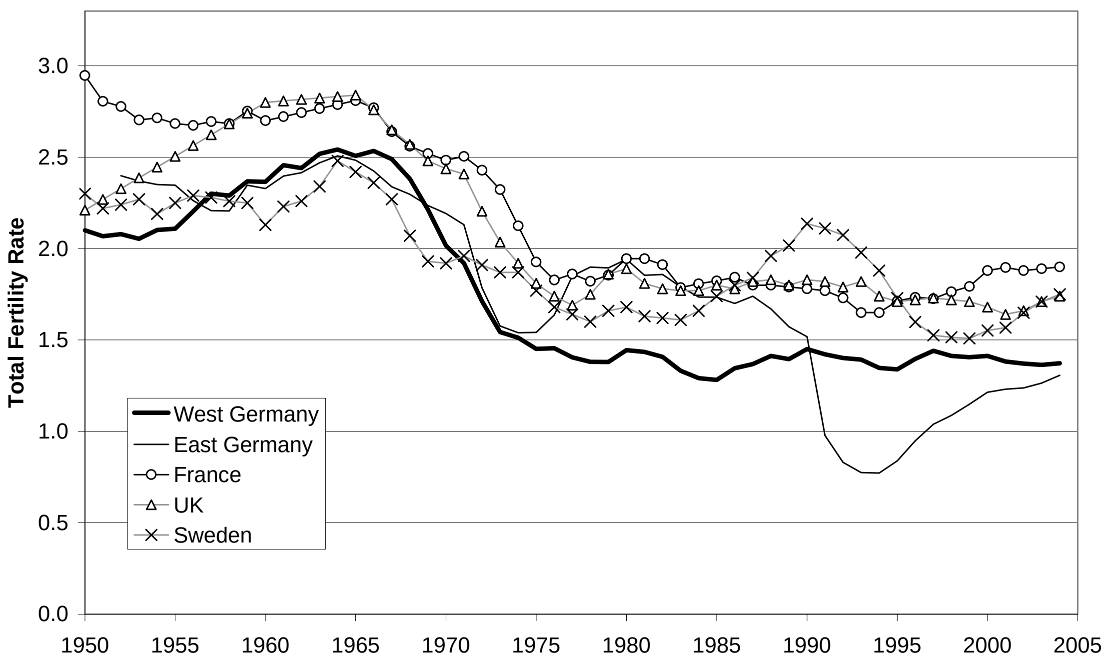
Figure 7.1: Crude birth rates and total fertility rates in OECD countries (2004)



Source: Eurostat (2005).

structure of women living in each country. Therefore, it focuses on the fertility behaviour of all women of fertile age, i.e., those aged between 15 and 44, regardless of their number or their share in the population. While this normalisation may be useful for some purposes of comparison, it is a bit misleading with respect to the impact of low fertility on the future age structure of the population affected. If, like in Germany, annual TFRs haven been very low for a longer period of time, the share of women who could actually reproduce also starts declining substantially. Hence, the number of their children becomes even smaller in relation to the total population, even if fertility behaviour of all potential mothers remains unchanged. This becomes apparent if one looks at the simple CBR measure that lacks any such normalisation but has an immediate bearing on the current and future age structure of the total population.

Figure 7.2: Total fertility rates in Germany, France, the UK, and Sweden (1950–2004)



Sources: World Bank (2003); national statistical offices.

This interpretation is illustrated in figure 7.2, representing the time paths of total fertility rates for our four countries from 1950 to the present. While the general picture is the same everywhere – a “baby boom” in the 1950–70 period, followed by a decline in fertility rates – it is the details that show a substantial degree of variation. For instance, the so-called baby boom is weak, i.e., it starts late and is not very pronounced in terms of peak levels of annual fertility rates, in Germany and Sweden. Fertility rates in France, by contrast, do not so much exhibit a baby boom that is concentrated in a limited number of years but have been rather high over the entire post-war period.

On the other hand, the fertility decline has been most pronounced in (West-)Germany, where total fertility rates went down by more than 1.0 (live births per woman) in a period of roughly 10 years, starting from about 2.5 in 1966, falling below the replacement level (of about 2.1) in 1970 and below 1.5 in 1975.[3] Since then, total fertility rates in (West-) Germany have largely stayed stable, without showing much fluctuations, at a level of around 1.4. In France and in the UK, fertility rates fell to the 1.7 to 1.8 range during the 1970s. They recovered to around 1.9 in France in the late 1990s, while they continued a mild decline to around 1.7 in the UK. Over the last three decades, there were considerable fluctuations in total fertility rates in Sweden. They were down to around 1.6 in the late 1970s and early 1980s. They increased to more than 2.1 around the year of 1990, fell down to about 1.5 in the second half of the 1990s and have now recovered to around 1.75 during the last few years.[4]

Among the European countries selected here for closer scrutiny, (West-)Germany has thus clearly witnessed a much stronger decline in fertility than the other countries. All in all, the decline in annual fertility rates was faster, stronger and more long-lasting than elsewhere. This, in turn, translates into the very low level of crude birth rates observed today and in an expected future change in the age structure of the population that is also a lot more pronounced than in the other countries considered here. This latter aspect is highlighted in figure 7.3, illustrating the age structure of the population in the four countries in terms of their population "pyramids" for the years 1950, 2000 and 2050. While the year-1950 and year-2000 graphs are based on actual data, the 2050 graphs are derived from the latest release of the population projections prepared by the United Nations' Population Division (2005, "constant-fertility variant").

In any of the countries covered in figure 7.3 , the population pyramids for 1950 reflect the changing tides of European history in the first half of the 20th century, with numer-

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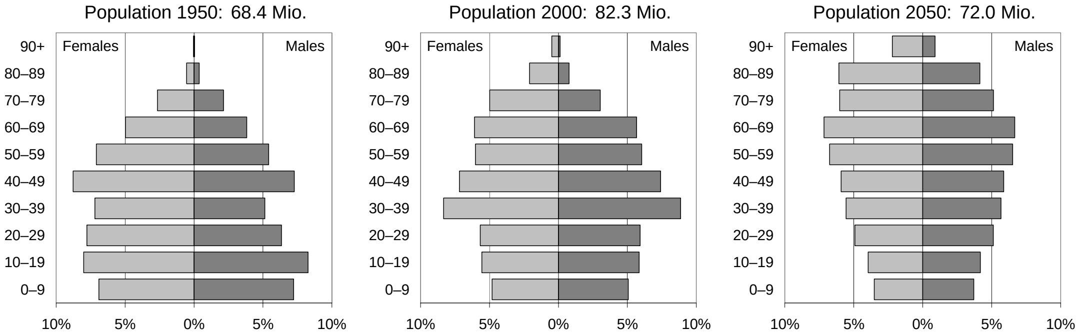
[3] This is when the development in East-Germany, that had been remarkably similar until then, in spite of a very different political and economic system, started deviating from the West-German pattern. The increase in East-German fertility rates observed between 1975 and 1990 is usually attributed to a very strong system of fertility incentives created through measures of active family policies (Lampert 1996; Sinn 2003), the following sharp decline to the uncertainties arising from political unification and economic transition. Partly, it may also be a matter of a change in the timing of births under an entirely new framework for individual fertility decisions (see footnote 2).

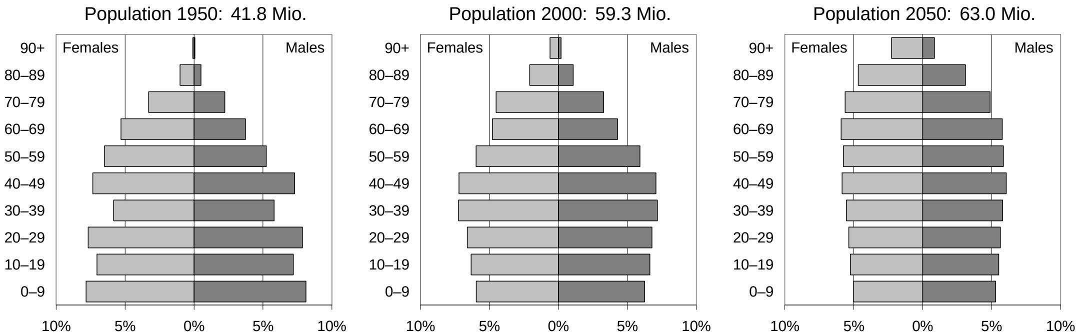
[4] However, longer time series of "completed fertility rates" suggest that these fluctuations are mainly due to shifts in the timing of births, not so much to more fundamental changes in fertility behaviour. It appears that, in terms of CFRs, the final number of children of Swedish mothers has been roughly constant at about 1.8 during the last three decades (cf. the relevant data provided on-line by Eurostat).

Figure 7.3: Population pyramids for Germany, France, the UK, and Sweden (1950, 2000, 2050)

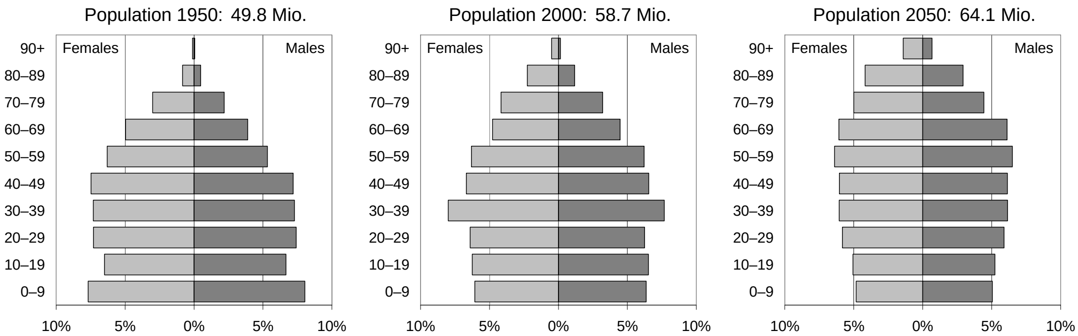
a) Germany



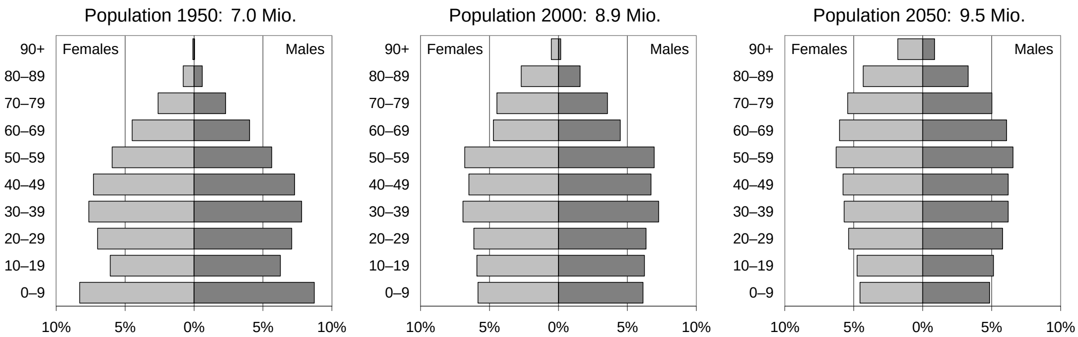
b) France



c) UK



d) Sweden



Sources: national statistical offices; United Nations Population Division (2005).

ous political and economic shocks that also affected the demographic structure of European countries. High levels of fertility rates that had lasted until the turn to the new century (see chapter 1) translate into relatively large cohorts of older individuals in 1950. The subsequent decline in fertility, plus the consequences of World War I, a period of hyperinflation and the Great Depression, and World War II for fertility rates as well as for survival probabilities of children and adults contribute to shaping the lower half of the year-1950 "pyramids".

The population pyramids for the year of 2000 mainly show the slightly diverging patterns of fertility – and also the impact of some amount of immigration – in the post-World-War-II period. In Germany and in the UK, we see large groups of individuals in their thirties. These are the age cohorts of the baby boomers, many of them born between 1960 and 1965 in these countries (see figure 7.2), who now make their way through the age structure of total population. They are followed by significantly smaller age cohorts of those who were born during and after the period of fertility decline. This is most apparent in Germany where the year-2000 population pyramid effectively resembles the shape of a fir tree, with a relatively narrow trunk at the bottom. In France and Sweden the large, high-fertility cohorts born in the early post-war period are generally a bit older than the German and British baby boomers. Also, due a less significant fertility decline, the overall shape of the population pyramids for 2000 appears less distorted than in the other two countries.

Finally, the population pyramids for 2050 indicate the expected age composition of the population that would arise if current fertility rates in each country, whatever their level, were to remain constant over the entire time horizon of the population projections (and if life expectancy continues to increases at a moderate speed according to the UN Population Division's "medium" assumptions in this area). In all the four countries, the large age cohorts of the post-war baby boomers will be dying out rather quickly at this point in time. Nevertheless, the oldest age cohorts still alive will be substantially larger in terms of their share in total population than in each of the earlier years considered here. As there is now way of predicting the occurrence and timing of future economic and political shocks to fertility and other demographic aspects, the central and bottom parts of the year-2050 population pyramids are mainly shaped by the long-term consequences of the fertility decline that has taken place between about 1965 and 2000 for the age structure of total population. (In addition, there are different levels of net immigration to each country, the relevant assumptions also corresponding to the UN Population Division's "medium" assumptions that are based on historical, long-term averages.) Among the four European countries considered here, the two extremes that arise are given by the cases of Germany and France. While in Germany, what was formerly called a population "pyramid" could be next to reverted over the next 45 years if fertility rates remained at their current low level, with the largest age group being those aged 60–69, the French population pyramid would mainly stretch out to become a "column" over time. Here the largest age group would be given by those in their forties, but the difference over all other age groups below age 80 is only a minor one. The age composition expected for the UK and Sweden is between these two polar cases. In both countries, the year-2050 population pyramids could take on the shape of stretched "pineapples", the largest age groups being given by those aged 50–59 in both cases, and the age structures narrowing a bit towards the bottom of the distribution.

Based on a long-term projection using current fertility rates and a small set of other, plausible assumptions, it is thus once more easy to see that the decline in fertility is much more significant in Germany than it is in other developed countries. It is interesting to note that, among our four countries, Germany is the only one where the total population is actually projected to decline until 2050, in spite of continuous net immigration that tends to be higher than elsewhere on relative terms. In the other countries, population growth will slow down considerably in the 2000–50 period against the 1950–2000 period, but will still be positive. At the same time, as the continued growth is mainly due to higher longevity of elderly people, working-age populations are indeed expected to decline everywhere, yet, again, in Germany much more than in France, the UK or Sweden. Furthermore, building on the econometric estimates presented in chapter 5 and as far as demographic fundamentals are concerned, the different age compositions of those of working age (15–64, say) expected for the different countries could have a direct bearing on prospects for future economic growth. We cannot know beforehand the participation rates, differentiated by gender and age, that apply to the year-2050 population structures. Nor can we seriously forecast unemployment rates and many other relevant details. Still, the demographic projections displayed in figure 7.3 illustrate very clearly why, in our simulations included in section 5.4, long-term growth prospects are much more favourable for France than they are for Germany, while those for the UK and Sweden would have to be placed in between the two former cases. According to our estimates, it is the relative size of the age group 40–49 that matters most for (total factor) productivity growth, while younger and older age groups are making smaller contributions to economic growth by an inversely *u*-shaped overall pattern.

7.2 The timing of births and the structure of family households

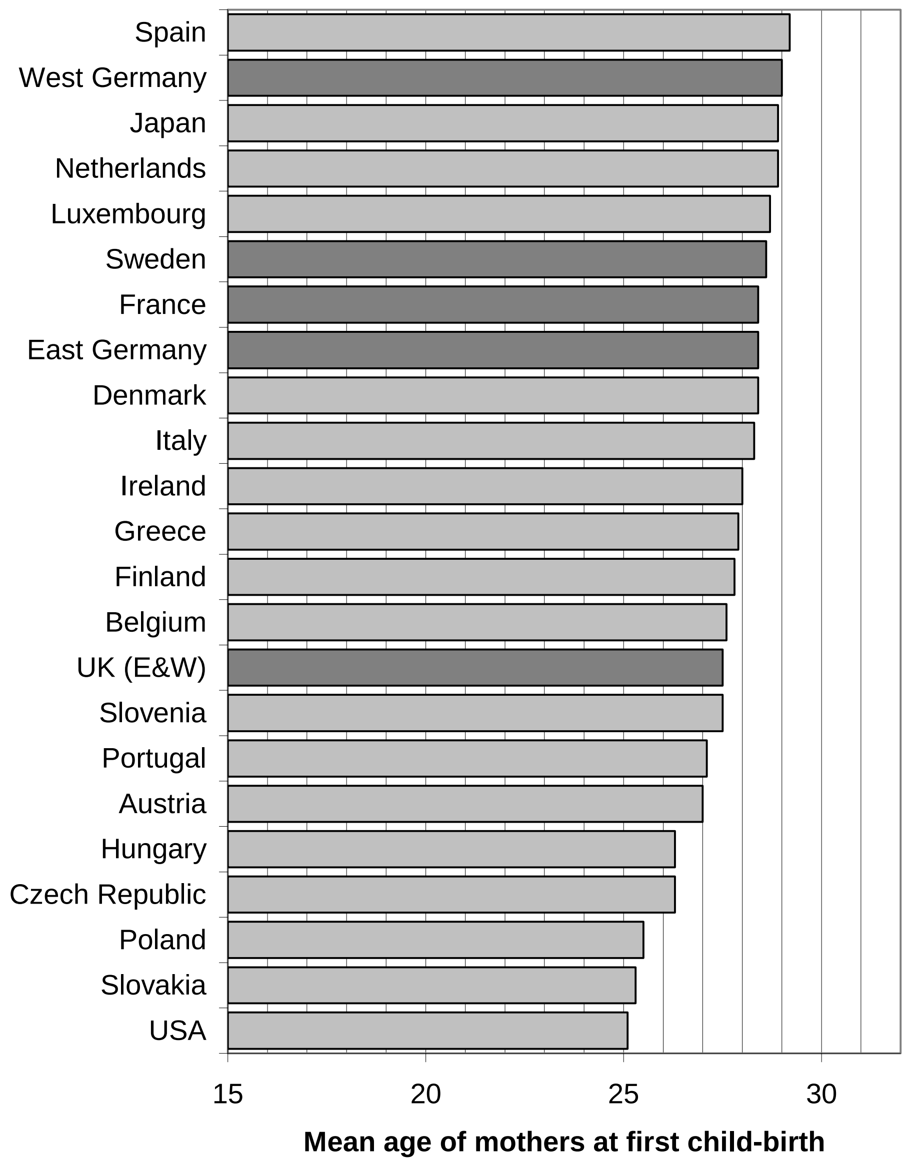
In the remainder of this chapter, we will go beyond a presentation of rough aggregate and average data as those covered in section 7.1, attempting to explore the cross-country differences in patterns of fertility alongside a number of relevant structural dimensions. We will start by looking at developments regarding the timing of births and the structure of family households, disaggregated by the total (and, ideally, final) number of children born in a given family.

It was mentioned repeatedly in section 7.1 that, together with the fertility decline observed since the 1960s, there has been a wide-spread change in the timing of births. The general tendency was a continuous postponement of births within the typical life cycle of a woman. In other words, younger cohorts of mothers tended to have their first child – and all consecutive children, if any – at ever higher ages. Logically, the two phenomena of a postponement of births and a reduction in fertility can be considered as independent of each other. Ultimately, however, the former process may have had an impact on the average number of children born to all women if some of them reached the end of their fertile period of life before they had given birth to their desired number of children (not having paid sufficient attention to the so-called "biological clock", or not having been able to do so for many reasons).

Yet, the existing evidence does not suggest that the postponement of births as such is a major reason for the fertility decline in developed countries. Even the current cross-country differences in fertility rates can not be fully explained by differences in the timing of births. (In any case, if there were a strong correlation causality could in fact be the other way round: women who want to raise fewer children can effectively wait longer until they start having them.) Figures 7.4 and 7.5 are meant to illustrate these points, based on current data for the mean age of mothers who give birth to a first child for a larger set of countries and on time series data tracking the increase in the mean age of mothers at first child-birth over time in Germany, France, the UK (or England and Wales, respectively) and Sweden.[5]

[5] Of course, the mean age of mothers at first child-birth is just one among various possible indicators. For instance, the mean age of mothers of children of higher birth-order could also be of interest here. As far as they are available, relevant figures basically show a parallel increase to that of the age at first child-birth. (There is thus little evidence that a major share of women simply runs out of time for having a second, third or forth child if they really intend to do so.) Furthermore, as with fertility rates, the unstandardised cross-section data used here (based on first births occurring in a given year) could be augmented by standardised indicators (corrected for the age distribution of women in the population) or cohort-specific measures, with results that would be qualitatively unchanged.

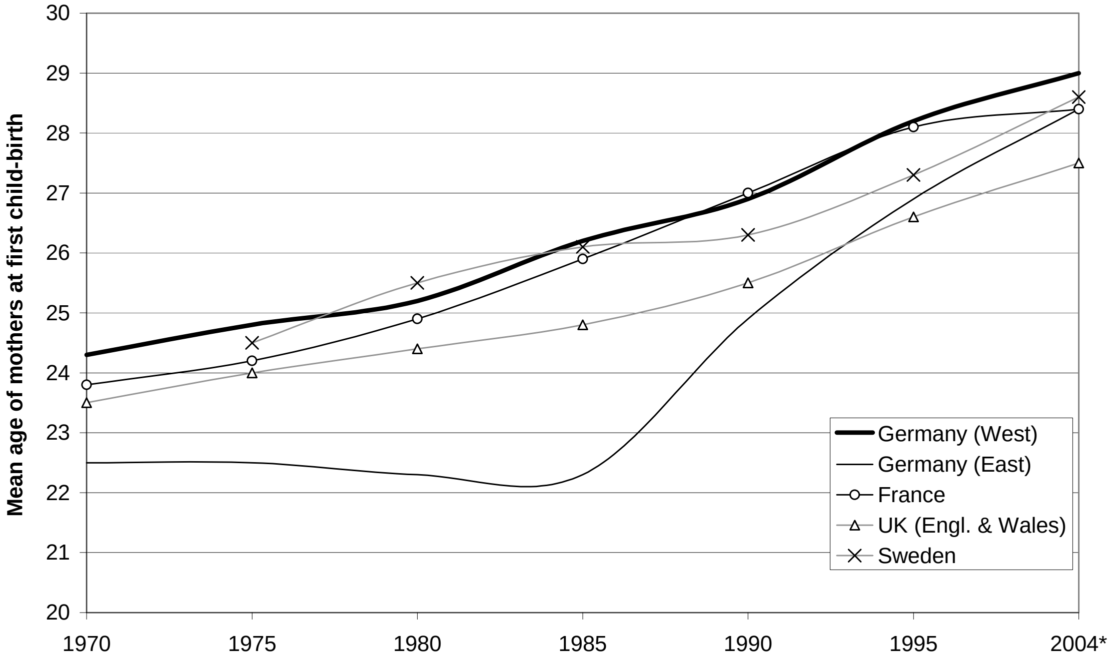
Figure 7.4: Mean age of mothers at first child-birth in OECD countries (2004)



Sources: Eurostat (2005); national statistical offices.

Figure 7.4 shows that the timing of childbirths does not vary significantly across countries of the EU-15, the mean age of mothers at first childbirth ranging between 27 and 29 in most cases. In Eastern Europe, the corresponding figures are still a little lower, mainly ranging between age 25 and 27. By European standards, mothers in the US are also relatively young. All in all, however, the correlation between mothers' age and current fertility rates is at best very weak. For instance, French and Swedish women are on average not so much younger than German ones when having their first children, but tend to have considerably more children. On the other hand, women in the UK, here re-

Figure 7.5: Mean age of mothers at first child-birth in Germany, France, the UK, and Sweden (1950–2004)



Sources: Eurostat (2005); German and British national statistical offices.

presented by those living in England and Wales[6] are somewhat younger, but typically have about as many children as those in Sweden. This impression is confirmed by figure 7.5 which illustrates the increase in the mean age of mothers at first child-birth observed since 1970 in the four countries subjected here to closer inspection. Apart from East Germany (where levels and trends were substantially different from those in West Germany before unification), all these countries experienced a parallel increase in the average age of mothers from around 24 in 1970 to around 28 in 2004. Across countries, the spread has increased a little over time, but the differences between, say, Germany and France could be no means explain the different levels and trends in fertility rates (see figure 7.2). Finally, it is interesting to note that annual fertility rates in West Germany have been next to unchanged from the mid-1970s until today, while the mean age of mothers at first childbirth has continued to increase throughout this time period.

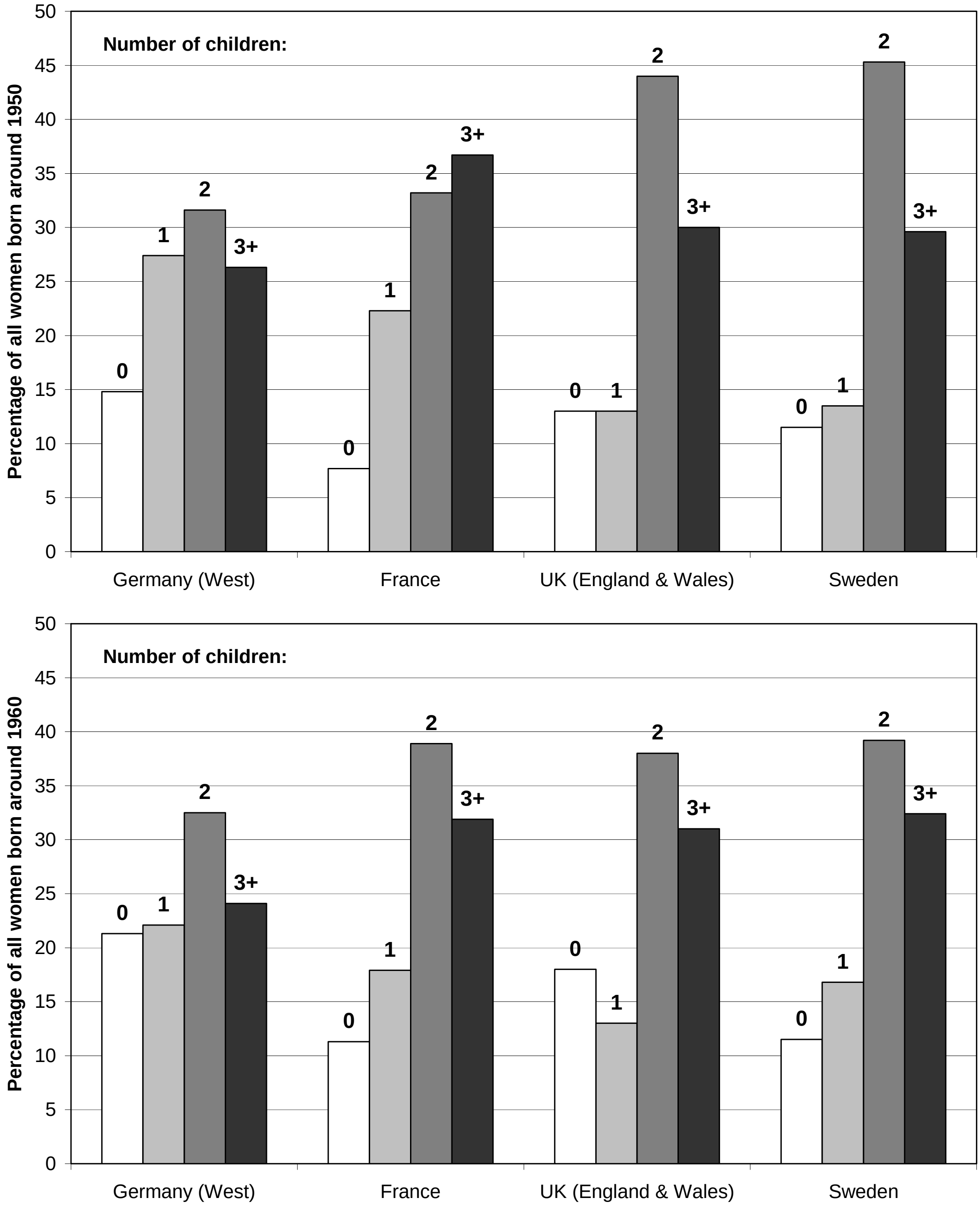
[6] In the UK, many population statistics are primarily recorded at the level of the regions “England and Wales”, “Scotland” and “Northern Ireland” and cannot easily be combined to form country-wide averages. The average figures for the UK reported by Eurostat only refer to married women and, hence, are not fully comparable to those for other countries. We therefore use figures for the most populated part of the United Kingdom deriving from national statistics here and in some of what follows.

While (changes in) the timing of births appear to be of secondary importance for understanding cross-country differences in fertility rates in developed countries, there are considerable differences in the structure of family households, i.e., in the distribution of mothers by the (completed) number of their children. Results regarding this differentiated, direct measure of fertility outcomes that are fully comparable across countries are actually hard to come by. Furthermore, as far as they exist, they are much backward-looking, that is, they are necessarily lagging behind a measurement of current developments as the women whose fertile period can safely be considered completed must have reached age 45 or even 50, especially if one takes into account the changes in the timing of births observed over the past few decades.

Figure 7.6 collects information regarding the final number of children of women born around 1950 (upper panel) and around 1960 (lower panel) in (West) Germany, France, the UK (or, again, England and Wales) and Sweden that appears to be comparable at an international level as well as the most reliable among a number of alternative, potential data sources. Here, we effectively combine results for France and Sweden derived from the series of “Fertility and Family Surveys” conducted by the United Nations’ Economic Commission for Europe (UNECE) in the late-1990s with up-dated information that is available for Germany and the UK from their national statistical offices. In spite of a number of limitations – for instance, the results cover only (important) sub-regions in the cases of Germany and the UK and, considering the period of data collection, fertility may not be entirely completed for women born around 1960 in the cases of France and Sweden – the cross-country differences shown in this figure are really striking.

First of all, for all the countries covered, figure 7.6 indicates a general decline in cohort fertility of women born between 1950 and 1960, in line with all our earlier observations. This decline is immediate, probably with the exception of Sweden, from increased shares of women who remain childless and a decrease in the shares of women with children of higher birth order, i.e., with two or three and more children. Also, there are some differences in the distribution of women by the numbers of their children (and the related changes over time) between France, the UK, and Sweden. Most notably, however, Germany turns out to be the main outlier here, displaying a structure of family households that really deviates from that in the other countries for both the age groups considered. Not only is childlessness much more pronounced in Germany than elsewhere, but also the distribution of women who actually have children is not just proportionally affected by the higher share of childless women. Specifically, there are significantly more women born around 1950 and 1960 with only one child. At the same time,

Figure 7.6: Distribution of women by the number of children in Germany, France, the UK, and Sweden (cohorts born around 1950 and 1960)



Sources: United Nations Economic Commission for Europe (2005); Bundesinstitut für Bevölkerungsforschung (2004); Office of National Statistics (2004).

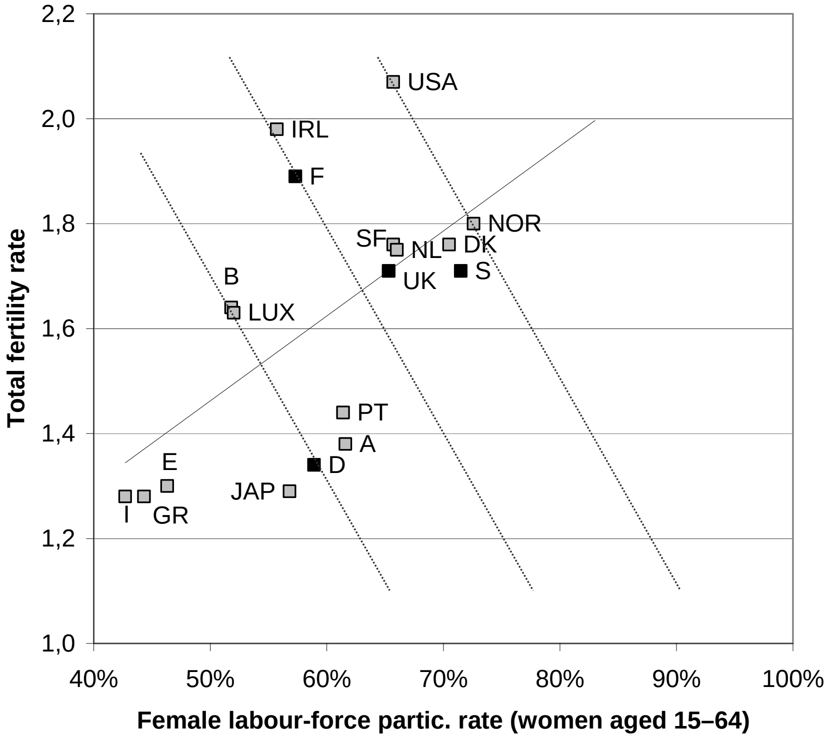
there are fewer women born around 1950 having two children (vis-à-vis the UK and Sweden) or three or more children (vis-à-vis France), and there are clearly fewer women born around 1960 having two children or more than in the any of other countries looked at here. It therefore appears, that the lower level of aggregate fertility rates in Germany is driven by two major trends, towards more wide-spread childlessness and a lower share of women with higher numbers of children. Chances are that these trends are still under way but it is, as of yet, too early to gauge to what extent they will affect completed fertility for younger women living in Germany when compared at an international level. In the following, we will therefore try to address additional background factors that could help explaining the cross-country differences in fertility and family structures that we have demonstrated to exist in this chapter so far.

7.3 Fertility and female labour-force participation

A very important covariate of fertility in developed countries is the share of women who engage in formal employment which usually takes place outside the family household, thus creating a conflict between different ways of using their time, for instance, for participating in the labour market vs. taking care of children. Of course, this type of conflict is not necessarily relevant for women alone. Yet, even in European countries with a very high rate of female labour-force participation, the distribution of labour between the two gender regarding homework and child-care responsibilities still appears to be rather asymmetric (Aliaga and Winqvist 2003). Effectively, it is thus mainly women who have adjust their time use to the competing demands of working in the labour market and raising children.

Building on simple models of household time allocation (see section 4.3), one would expect that there is a fundamental trade-off between high fertility rates and high female labour-force participation rates that shows up, at an aggregate level, in cross-country comparisons regarding these two indicators. Figure 7.7 shows that this is not precisely what real-world data taken from a larger set of Western European and other-OECD countries would support. The scatter-plot of combined outcomes in the two areas of total fertility rates and female labour-force participation rates for each of the countries covered turns out to show no clear correlation. The results stretch out from the south-east corner (“Italy”) to the north-west (“Norway”, while the data point representing the “USA” appears to be an outlier) in the fertility–participation plane, indicating a weak positive relationship, if anything. Even if we concentrate on Germany, France, the UK, and Sweden, no clear pattern arises, as France has about the same female participation rate as Germany, but a much higher fertility rate. Similarly, Sweden has about the same fertility rate as the UK, but a higher female participation rate. Also, both these countries perform considerably better than Germany in any of the two areas involved here.

Figure 7.7: Fertility vs. female labour force participation in OECD countries (2003)



Sources: Eurostat (2005); OECD (2005a); national statistical offices.

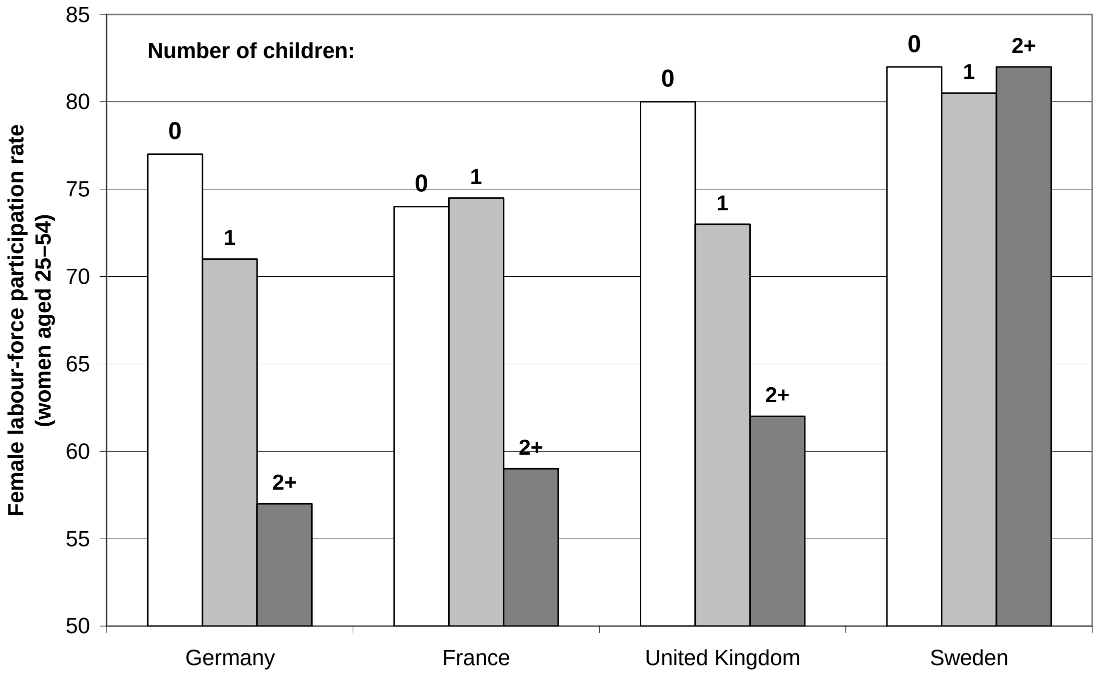
Of course, there is a lot to discuss about the precise definition of the two standard indicators used here. They are both widely used in their respective areas, but one (total fertility rate) is normalised with respect to the actual age structure of women, while the other (female participation rate) is not. Furthermore, the range of ages spanned by the female participation rate appears to be rather broad for the suggestive combination with the fertility rate. Also, there is no distinction here between full-time and part-time work. Still, more refined indicators would not yield a substantially different picture.

Another, more differentiated way of interpreting aggregate-level results as those displayed in figure 7.7 has been suggested by Apps and Rees (2004) and has been empirically investigated by Kögel (2004). Their common idea is that, within each country and for all the women faced with the choice between having (more) children or working (longer hours) in the labour market, the trade-off that is immediate from the individual-level time constraint is fully operative, while countries are framing these kinds of decisions in a very different way. In this sense, women living in different countries may effectively find themselves located on different "budget lines" (as those tentatively introduced in the above graph). On average, in the Nordic countries and, a bit less so, in the UK they appear to be able to deal much better with the conflicts that next to inevitably arise under whatever circumstances than in most of continental Europe. Even in France, women who are able to reconcile a comparable participation rate as in Germany with a much higher average number of children would then be better off in terms of this simple two-dimensional comparison.

The missing link that could help explaining the coexistence of low (or high) fertility rates and low (or high) participation rates of women, or potential mothers, is therefore mainly given by the availability and the affordability of child-care services in each of the countries looked at here. We will directly address this issue in the next chapter (see section 8.4). However, some light will be shed on the role of child-care facilities for children at different ages also from a more detailed review of female labour-force participation rates in Germany, France, the UK, and Sweden that fits in with the current themes and sub-themes.

First of all, figure 7.8 shows the labour-force participation rates of women in our four countries differentiated by the number of their children, zooming in on a narrower definition of the age group of women (25–54) for which choices regarding work or child-care may be more acute than for all women of working age. The following observations can be taken away. In Germany, the participation rate of women who have no children is at an intermediate level when compared to that in the other three countries. At the same time, the participation rates of German women who have (one or two and more) children are always lower than elsewhere. Assuming that participating in the labour market now ranks high among the preferences of women and that the decline in participation rates of mothers is mainly determined by exogenous factors, such as limited availability of institutional child-care, this could explain to some extent the high prevalence of childlessness in Germany. Further, female participation rates consistently fall off with a growing number of children in Germany as well as in the UK, though with higher participation rates in each category in the latter case. By contrast, French women who have just one child appear to be able to maintain the same degree of labour-force attachment as their childless compatriots. In France, having two or more children seems to mark a relevant threshold for women to reduce their labour-force participation. The situation in Sweden is most striking. Here, there appears to be no significant change at all in women's participation rates, whatever the number of their children is. In fact, Swedish women with two or more children still have a higher average participation rate than women with any number of children, including zero, in the other three countries.

Figure 7.8: Female labour-force participation by the number of children in Germany, France, the UK, and Sweden (2000)

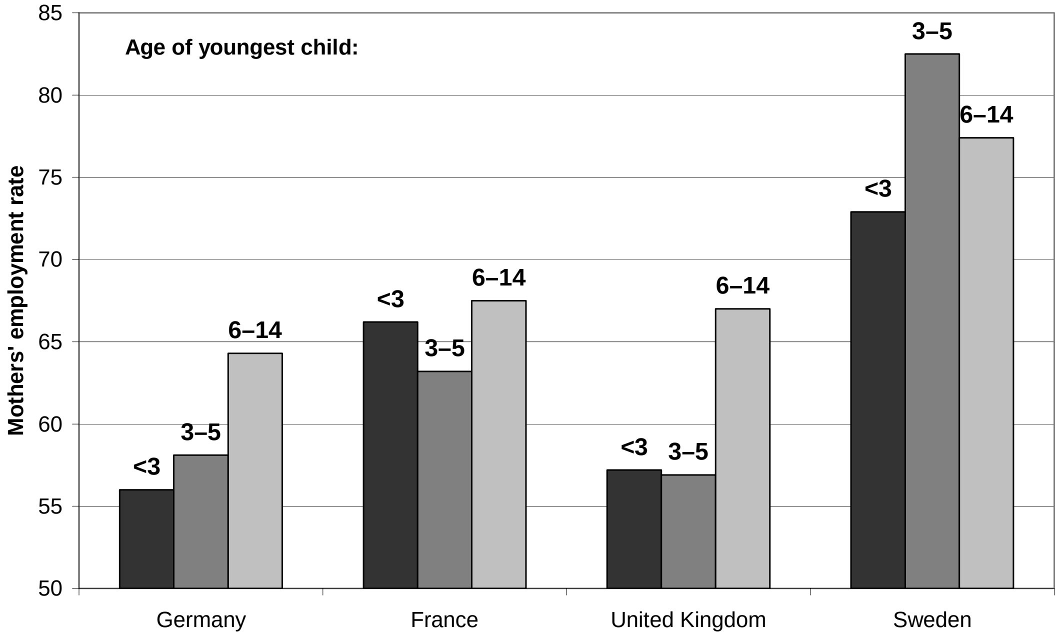


Source: OECD (2002).

It is most likely impossible to explain the huge cross-country differences in female labour force participation that show up in figures 7.7 and 7.8 by the availability of child-care facilities alone. Other aspects that may matter here, besides the possibility of deep-rooted international differences in women's preferences, are differences in national tax codes regarding the tax-treatment of income earned by (married) couples and in national rules that are relevant for building up social insurance entitlements etc. Nevertheless, access to (public) child care may matter to some extent, at least, as is suggested by the data exhibited in figure 7.9.

Arguably, it is not so much the total number of children a woman has that could divert her from actively participating in the labour market, but rather the age of her children, in particular, the age of her youngest child. Therefore, figure 7.9 shows the employment rates of women who are actually mothers in Germany, France, the UK, and Sweden differentiated by the age of the youngest child. Effectively, there is a distinction between three age groups of children – less than 3 years, 3–5 years and 6–14 years – that usually correspond to different types of institutions taking care of children during early childhood ("nursery schools"), at pre-school age ("kindergartens") or while visiting school (where all-day schools themselves may play a role for taking care of children).

Figure 7.9: Mothers' employment rates by the age of the youngest child in Germany, France, the UK, and Sweden (2002)



Source: OECD (2005b).

Basically, one should expect employment rates of mothers to increase as the youngest child gets older. At least, this is what would conform to smaller demands on mothers' time and attention in the absence of child-care institutions. Among the four countries considered here, this simple scheme only applies to German mothers who, at the same time, show the lowest employment rates in almost any of the age categories of children defined here. The only exception is that mothers in the UK with children aged 3 to 5 have a lower employment rate than German mothers with children of the same age. In the UK, it seems, it does not make a difference for mothers' opportunities to work whether their children are less than 3 or above, as long as they are still of pre-school age, pointing to a potential lack of kindergarten-type institutions. As soon as British children enter school, however, the employment rate of their mothers jumps upward.

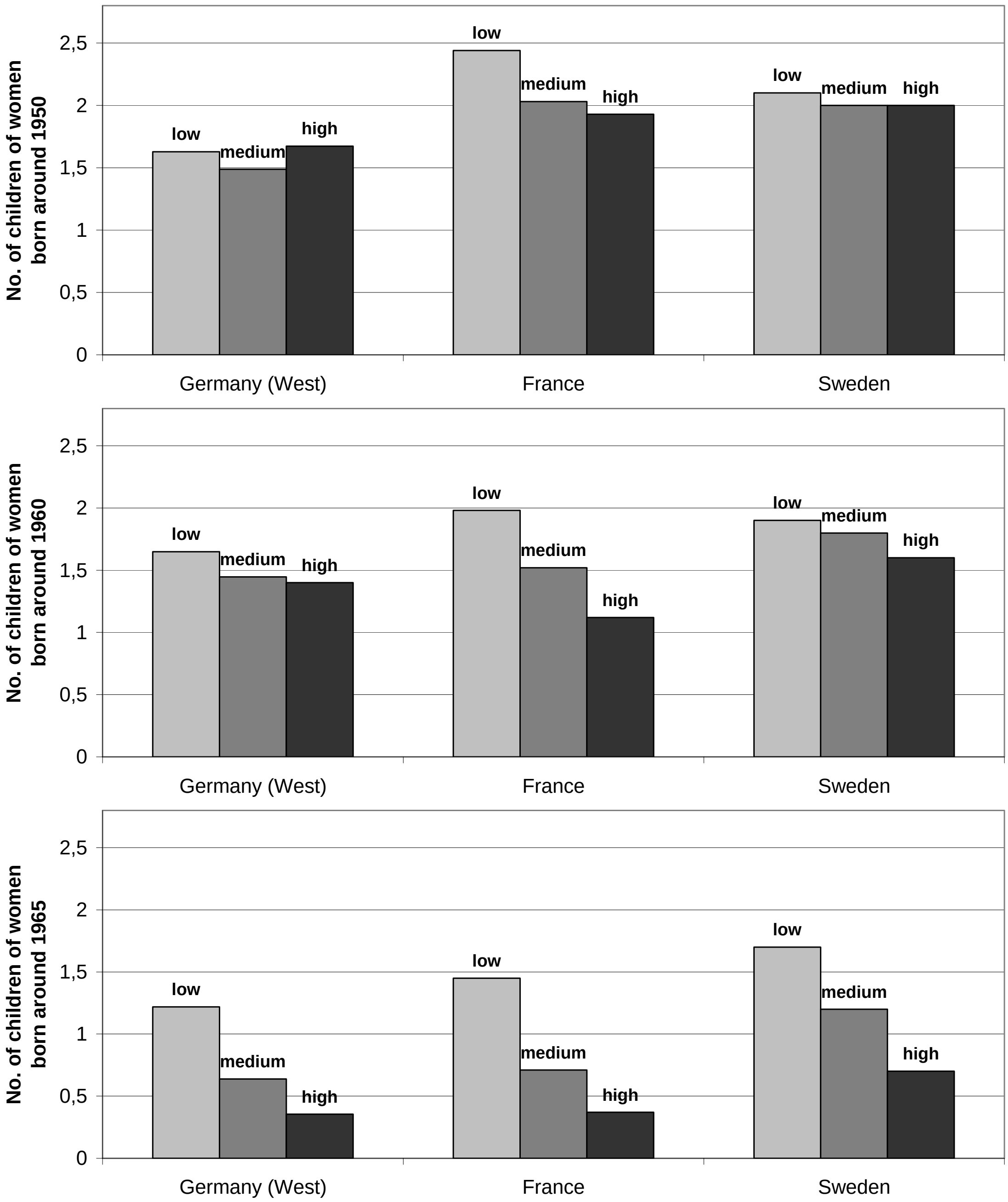
The situation of mothers with children at pre-school age turns out to be really different in both France and Sweden. Here, employment rates of mothers of small children are substantially higher than in Germany and the UK. In Sweden, they again reach out-standing levels that most likely outperform most other developed countries in terms of corresponding figures. But also the employment rates of French mothers appear to be substantial. Against this background, two anomalies can be seen in figure 7.9. In France, there is a slight gap in the employment rate of mothers with children aged 3–5 (when compared to that of mothers with younger and older children), indicating that the system of institutional child care may even be more effective for very small children in this country than for those at kindergarten age. In Sweden, the employment rate of mothers with children of school age is lower than that of mothers with children aged 3–5. Part of this difference may be due to a cohort effect (mothers with older children tend to belong to older cohorts, with labour-force participation rates that are generally lower than those of younger women). Up to a point, it could also reflect the preferences of mothers who may want to support their children more while at school. For the rest of it, it may also relate to a system of public child care and (all-day) schooling that is most effective with respect to children at pre-school age.

7.4 Fertility, female education and household income

A major reason why one would expect growing female labour-force participation to explain at least part of the fertility decline observed in developed countries (see chapter 4, in particular section 4.3, for a theoretical discussion) is the increase in the opportunity cost, i.e., in earnings foregone through child-care activities, for women who basically intend to follow a professional career in addition to, not necessarily instead of, having children. An important signal for a woman's willingness to work in the labour market and also an important determinant of her expected opportunity cost in the case of a child-birth is the level of education that she chooses. Women with higher education should therefore basically have fewer children. On the other hand, institutional factors, such as the availability of child care and the way it is financed by women with different levels of earnings, may again contribute to shaping cross-country differences regarding the combined fertility–education outcomes – for instance, these factors may widen or reduce the natural spread of fertility rates across women with different levels of education – that may be of interest for our comparison between selected European countries.

Unfortunately, reliable data regarding these issues that are comparable at an international level are once again hard to find. Figure 7.10 presents data on the average number of children already born (at the time the surveys were made) to women at different educational levels who were born around 1950, 1960 and 1965. The data source is the set of "Fertility and Family Surveys" conducted on behalf of UNECE in the late 1990s. This implies that the number of children already born does not fully correspond to the final, or completed, number of children for the two younger groups of age cohorts of women. Also, as no such survey has been conducted in the UK, the figures only refer to Germany, France and Sweden.

Figure 7.10: Average number of children by mothers' educational attainments in Germany, France, and Sweden (women born around 1950, 1960, and 1965)



Source: United Nations Economic Commission for Europe (2005).

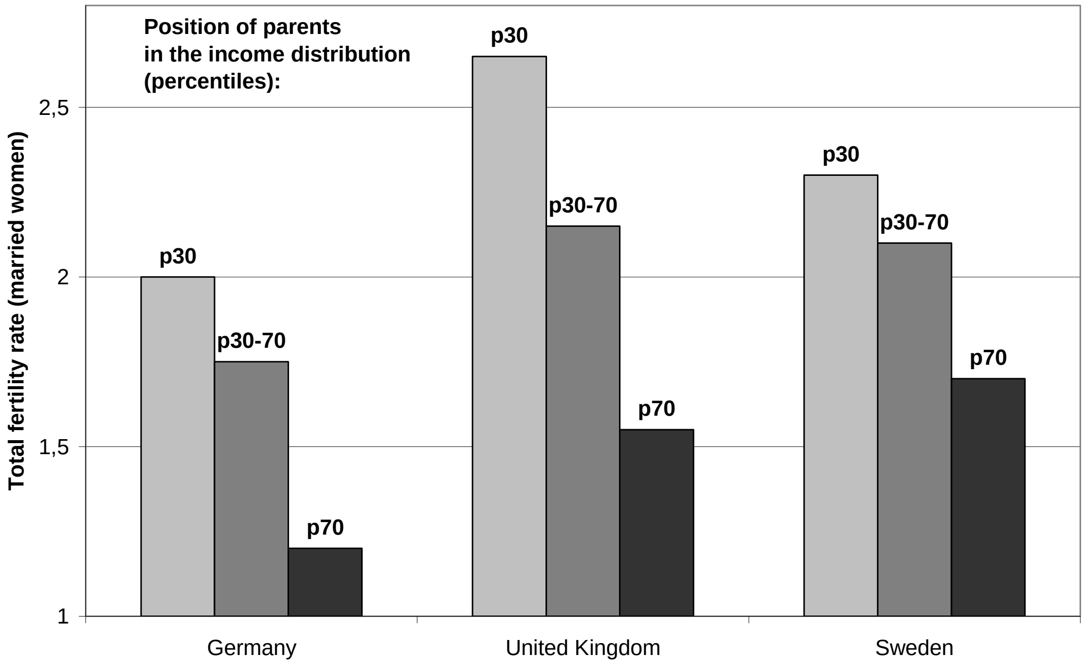
The differentiation by educational levels is based on a distinction between a "low" level of education (representing women who have completed, at most, education at a lower-secondary level, classified as ISCED 0 to 2 by the International Standard Classification of Education), a "medium" level of education (upper-secondary and post-secondary, non-tertiary education, including vocational training; ISCED 3 and 4) or a “high” level of education (tertiary education, with an academic degree; ISCED 5 and 6). The patterns that emerge from this comparison are not easy to interpret, among other things because differences in the timing of births, not so much across countries but across the educational levels considered, may matter for the results relating to women born around 1960 and 1965. Nevertheless, it is interesting to see that only in France, the average number of children born to women consistently appears to decline with their educational attainments. Here, the spread that arises as natural from the variation in opportunity costs of women who are basically oriented towards some degree of labour-force participation becomes more pronounced over time, but it is present throughout. In Sweden, by contrast, there is “initially”, i.e., for women born around 1950, next to no difference between the number of children born to women at different educational levels. Over time, for the younger age cohorts, that is, the average number of children born to women with higher levels of education decreases more than that of women with lower levels of education, perhaps partly due to a pure timing-effect. In Germany, the initial pattern also appears to be undifferentiated by educational attainments of women, but the overall (and largely completed) number of children is substantially lower than in France or Sweden. As in Sweden, a growing spread between the numbers of children of women at different levels of education becomes visible for the younger age cohorts. Again, this may be partly a result of a different timing of births by educational attainments, partly a result of a growing labour-force attachment of better educated women that could have an impact on the final number of children of women in each educational category.

Given the uncertainties that arise from the nature of the data used here, what is probably most telling about these results is that the observed fertility differentials between German and Swedish women born around 1965 are almost constant across educational levels on absolute terms, implying that the relative differentials are increasing with higher educational attainments. The same observation, though with similar limitations, can be derived from a broader international comparison of total fertility rates of married women, differentiated by the same categories of educational attainments as those applied here, for the year of 2000 in d’Addio and d’Ercole (2005, Figure 9). The TFRs reported there are based on the international data set of the “Luxembourg Income Study (LIS)”. In Germany (in brackets: Sweden), they are 1.75 (2.3) for women with a “low” level of education, 1.45 (2.05) for women with a “medium” level of education, and 1.3 (1.8) for women with a “high” level of education. Unfortunately, neither France nor the UK are among the other OECD countries covered there, but the observation of a relatively low level of German women with higher education is not just an artefact of picking just one country for comparison here. If this observation is assumed to apply to completed numbers of children as well – not just to non-completed figures or to annual fertility rates based on current births to women of all ages – and to become more and more relevant for younger age cohorts of women, it would mean that German women with higher levels of education find it relatively more difficult to raise children than well-educated women elsewhere.

An issue that is related to the link between fertility and female education, though not necessarily identical, is the relationship between fertility and parental income. As far as marriages are formed based on an "assortative mating", implying that partners tend to have a similar educational background, and as far as higher education robustly translates into higher earnings and income, fertility should basically exhibit a similar pattern when differentiated by mothers' educational attainments or by different levels of household income of parents. At the same time, another aspect of the potential impact of public policies on the joint distribution of fertility and income moves to the fore. National family policies can be built on rather different principles, with measures that are mainly targeted at families and children at the lower end of the income distribution or with benefits that are basically uniform or even increasing across the range of family incomes. In any of these cases, the distribution of fertility outcomes by parental income levels would be affected in different ways.

Figure 7.11 illustrates data that are suited to look into this issue, now for the cases of Germany, the UK, and Sweden only, as comparable data for France are missing. They are again based on the year-2000 wave of the LIS data set and show total fertility rates of married women living in households that are located at the 30th, between the 30th and the 70th, and at the 70th percentile of the income distribution, that is, between the lower and the upper end of this distribution, neglecting the extremes. The pattern that arises in each country is very clear, indicating that, on average, fertility rates strongly decrease with parental income, at least over the central parts of the income distribution. But also the cross-country pattern is instructive. Once more, Germany has the lowest fertility rates at each income level among the countries considered. Furthermore, British family policies that pay special attention to poverty relief for poor families and children may effectively contribute to widening the income-related fertility differential, mainly by inducing low-income families to have more children. Under Swedish family policies, granting benefits that are much more uniform across different income levels, the fertility differential is considerably smaller than in the UK. The same applies to the income-related fertility differential in the lower half and in the middle of the income distribution.

Figure 7.11: Total fertility rate of married women by levels of household income in Germany, the UK, and Sweden (2000)



Source: D'Addio and d'Ercole (2005).

Whether the sharp decline in fertility rates towards the upper end of the income distribution could be explained by German family policies, or whether it must be determined by other factors, is an interesting question to which we will turn in the following chapter.

This completes our review of fertility outcomes in a number of developed countries, covering a number of structural aspects that are potentially important for understanding the different patterns and trends that can be observed at an international level and mainly concentrating on a narrow selection of European countries. In the next chapter, we will address national family policies that are currently in place in many developed countries, again going into much detail with respect to the same small set of European countries as in the present chapter.

Chapter 8
Family Policies in Selected European Countries[1]

Family policy is not just one distinct field of public policy that is laid down in a specific law act and relies on a well-defined set of instruments. Rather, it is virtually omnipresent in all areas of civil law, with basic rules defining the constitution of, and the legal relationships within, a family, of national tax codes, with special regulations applying to the tax treatment of couples of parents as well as children, and of national social security codes, with legal duties and benefit entitlements that are differentiated by household size and composition, often taking into account the special relationship between parents and dependent children.

In the following, we will mainly concentrate on aspects and measures of family policies that are related to the fiscal system and usually involve some amount of child-related variation in public revenue or expenditure. One could spend quite some time on introducing and discussing an appropriate, distinctive taxonomy comprising all the different types of (extra-)benefits, tax breaks, subsidies, services, etc. that would fall under this rough definition. In practice, however, there is not even a sharp distinction between monetary benefits on the one hand and benefits in-kind on the other. Rather, the instruments typically applied are located somewhere in a continuum of possible solutions between these two extremes, ranging from measures that increase the family budget in an unspecific way, over ear-marked, monetary benefits tied to specific categories of family expenditure, the subsidisation of specific goods and services that families buy to the public provision of such goods and services. Furthermore, one has to take into account the enormous diversity of general approaches and specific instruments that effectively exist in different countries, where different types of benefits may effectively serve very similar purposes (and probably also vice versa).

For simplicity, we will therefore organise our survey of national family policies and of the benefits we are particularly interested in by a number of more or less specific contexts in which these benefits accrue to families. First of all, we will look at generic child-related cash benefits and tax allowances that basically apply to all families with dependent children, spelling out in some detail how they are shaped in different countries and how they vary with the number of children and parental income (section 8.1).

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[1] We are indebted to Eva Berger, a student apprentice, for collecting, commenting and very carefully preparing the presentation of much of the materials presented in this chapter.

As, in many cases, they are also potentially important for the family budget, we will next deal with (child-related aspects of) housing benefits, showing how they vary with income and how they combine with unspecific monetary benefits (section 8.2). We will then turn to discussing monetary extra-benefits that are targeted at families with small children aged less than 3 (section 8.3) and the delivery of child-care services (section 8.4). Furthermore, we are also going to look at the strong public involvement in the areas of schooling (section 8.5) and the provision of health-care services for children (section 8.6). All the benefits mentioned so far mainly accrue to families with dependent children, that is, that are being granted while the children are still young and typically live with their parents. In addition, we will also cover child-related pension benefits accruing to older parents that exist within the public pension schemes of many developed countries, while these schemes as such are likely to create a burden, not a benefit, for families and children (section 8.7). Finally, we will also review in a little more detail the empirical evidence regarding the impact of any of the measures of family policies covered here on parental fertility decisions (section 8.8) which, according to our own macro-level estimates reported earlier (cf. chapter 6), should be expected to exist.

8.1 Cash benefits and tax allowances for families with dependent children

Most developed countries operate some kind of system of child-related tax allowances and/or cash benefits in order to generally support families with children. These systems of monetary benefits differ considerably across countries in terms of the instruments applied as well as the amounts of benefits that are granted. As the first step to take, we will now have a look at the total amounts of monetary benefits granted in different OECD countries that are conditional on having dependent children and are not tied to further, more specific contingencies. Against this background, we will then focus once again on a smaller sub-set of just four European countries, viz. Germany, France, the UK, and Sweden, describing the elements of their programmes of child-related monetary benefits. For the same set of countries, we will then compare the effects of these programmes for families with different numbers of children and with different levels of family income.

8.1.1 An overview of benefit schemes operated in OECD countries

For the following comparisons, we start by defining two "baseline" cases that correspond to (specific variants of) rather different living arrangements of families and are usually treated in a different way in terms of their entitlements to receive monetary benefits. The two baseline cases are

a) a single parent living with one child aged 7, with a household income that corresponds to the national average of female earnings and
b) a two-earner couple with two children aged 7 and 14, with a household income that is given by the national average of male earnings plus half the national average of female earnings.

While, for the moment, we are mainly interested in the amounts of benefits granted to single parents vs. (married) couples with children, we have to be specific about many other aspects as well, such as the number and age of children or the amount of parental earnings that is taken to represent total family income, as these are all important sources of variation in actual benefit entitlements. The precise assumptions on earnings are meant to reflect the facts that, all over the world, the vast majority of single parents are mothers and that among couples with more than one under-aged child many women effectively work only part-time.[2] We will deviate from these baseline cases later on, when analyzing how benefit entitlements vary with different numbers or ages of children and with different levels of earnings. In each of these cases, we will adjust the baseline assumptions with regard to just one aspect in turn.

Based on a recent, large-scale survey of family policies in developed countries (Bradshaw and Finch 2002), figure 8.1 shows the amounts of child-related monetary benefits related to the two baseline cases as they are being paid on a monthly base in 18 OECD countries. The results displayed in the figure represent differences between net disposable income after taxes and benefits for a single parent with one child and a single adult or for a couple with two children and a childless couple, respectively, the households used as a benchmark having the same amount of earnings in both cases. In the graph, total benefits are sub-distinguished into tax reductions (resulting from child-related income tax allowances or a family-splitting approach applied to income taxation) and cash benefits (covering all kinds of direct, child-related public transfers, income-related or not, and, in the case of single parents, also maintenance payments provided by the state in lieu of regular payments of the absent parent).[3]

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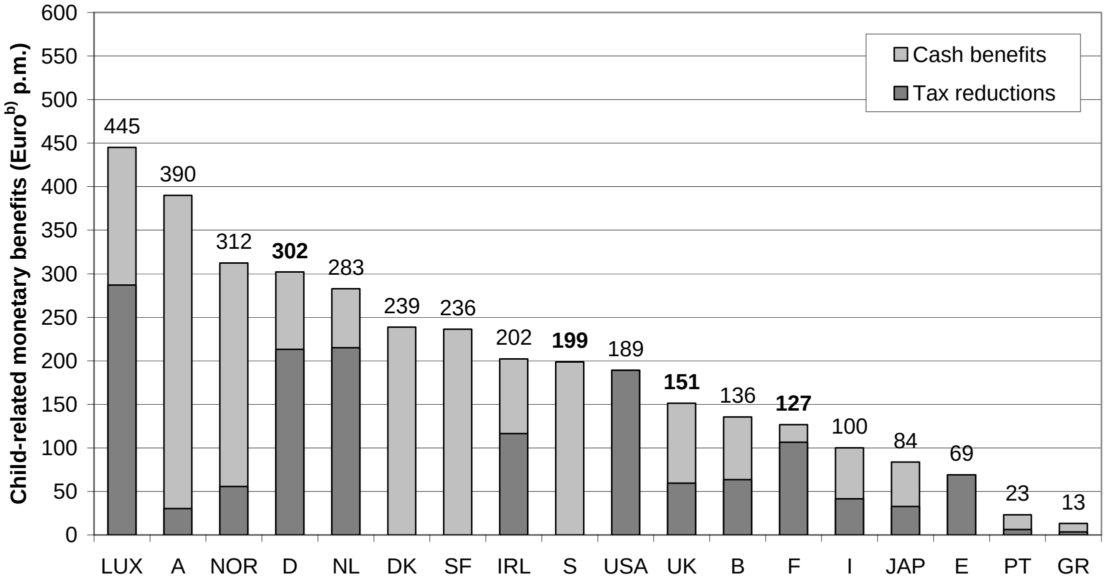
[2] In the case of French married women, we use the minimum wage applied to a 35-hour week instead of half of national average female earnings as, only in France, minimum-wage earnings exceed those entering the other income definition.

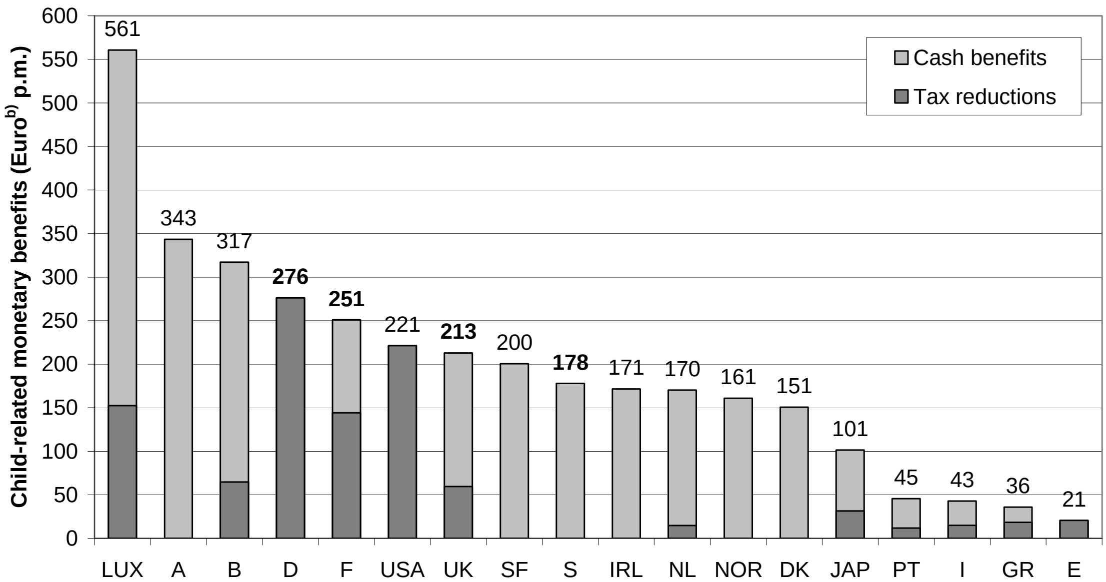
[3] Note, however, that the distinction between tax reductions and cash benefits is partly arbitrary. In Germany, for instance, the general, and largely uniform, child benefit ("Kindergeld") is classified as a tax reduction and not as a direct cash benefit because, for all taxable persons, the relevant legal entitlement is now defined in the German income tax code.

Figure 8.1: Child-related monetary benefits[a)] in OECD countries (2001)

a) Single parent with one child aged 7, at national average female earnings



b) Two-earner couple with two children aged 7 and 14, at national average male earnings plus half national average female earnings



Notes:

a) Calculated as differences between net disposable income (after taxes and benefits) for a single parent with one child and a single adult or for a couple with two children and a childless couple, respectively, with the same level of household income in both cases.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

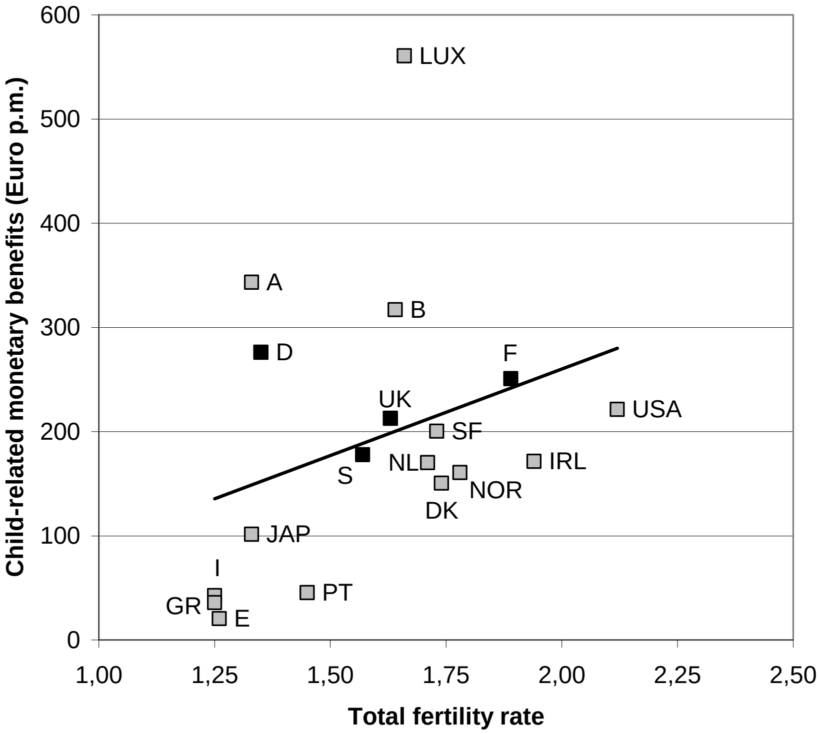
Source: Bradshaw and Finch (2002), plus information taken from the related "country matrices".

According to figure 8.1, total monthly benefit entitlements range from almost nothing (€ 13 Euros for a single parent with one child in Greece) to more than 550 Euros (€ 560 for a couple with two children in Luxembourg). In Germany – a country with particularly low fertility, as was shown in the previous chapter – a single parent with one child and a couple with two children are entitled to receive € 302 and € 276 per month, respectively. In terms of child-related monetary benefits, the country therefore appears to be located within the upper half of the developed countries considered here. In France – a high-fertility country by European standards – benefits accruing to a single parent with one child are among the lowest within the larger group of countries covered here. In any case, they are substantially lower than in Germany, Sweden, and the UK. For a couple with two children, benefits granted in France are considerably higher, but still slightly below those in Germany. The UK and Sweden – countries with an intermediate level of fertility in our small sample – both offer benefits to single parents as well as to couples with children that range at about the average of the countries considered.

It would be definitely premature to infer from these first observations that family policies and, in particular, high-level monetary benefits such as those paid in Germany appear to be ineffective with regard to increasing fertility rates, or that lower benefits as those in France are unimportant for explaining the level of fertility rates in a given country. Many additional aspects may matter here as well, over-ruling the impact of monetary child-related benefits on fertility in the cases just mentioned. Not taking into account aspects other than child-related benefit programmes themselves, the following caveats should be kept in mind. First, the results displayed in figure 8.1 apply to specific cases, defined by the number and age of children and by the level of family income. Still, the overall structure of monetary benefits, i.e., the patterns of their differentiation for other cases, may not be optimal. Second, monetary benefits are certainly not the only element of national family policies that matters for fertility outcomes. There may thus be gaps in other areas, such as child care, or even adverse effects of other fiscal measures, such as large-scale public pay-as-you-go pension schemes ("family policies with a negative sign"), that we have not uncovered yet. Third, there could effectively also be a reverse causality between monetary benefits offered in a given country and national fertility rates. In other words, benefits in Germany could be high today precisely because fertility in this country has been low for quite a while and the effects of recent increases in benefit entitlements might simply take their time to unfold.

We will look into some of the issues raised here as we go along. For the moment, it may suffice to demonstrate, in figure 8.2, that there is at least some correlation between the total amounts of monetary benefits paid to couples with two children at a typical level of household income (as in the lower panel of figure 8.1) and the current level of national total fertility rates. It should be clear that this does not necessarily indicate a causal relationship, not only because the two variables combined here are each just one, specific measure of what they are supposed to represent, viz. child-related benefits and fertility outcomes. But it illustrates that the co-variation of these two variables is not erratic and may deserve closer inspection. Our current, in-depth discussion of child-related monetary benefits and family policies in general is thus not entirely ill-advised. Also, we will return to the issue of a causal impact of child-related benefits on fertility later on (in section 8.8).

Figure 8.2: Child-related monetary benefits and total fertility rates in OECD countries (2001)



Sources: Bradshaw and Finch (2002); Eurostat (2005); national statistical offices.

8.1.2 The rules applied in Germany, France, the UK, and Sweden

For further analysis of national programmes of child-related monetary benefits, we will now focus on Germany, France, the UK, and Sweden. Therefore, we will now briefly describe the most important elements of their monetary benefit programmes as covered in the above summary measures, plus some others not captured there because of the specific assumptions made regarding the number and age of children as well as the parents' income. Table 8.1 summarises a number of characteristics of national benefit packages, based on "questionnaires" filled in by national experts for the Bradshaw and Finch (2002) study and augmented by information taken from the European Commission's (2006) MISSOC on-line database. The descriptions of national benefit systems that follow are entirely based on MISSOC ("Mutual Information System on Social Protection") data and reflect the rules in force as of January 1st, 2005.

Table 8.1: Characteristics of child-related monetary benefits in Germany, France, the UK, and Sweden (2005)

Country / Benefit programme	Benefit type	Varies by:					
		Inc	Emp	Hrs	Bth order	Age	Hh type
a) Germany							
Kindergeld*	Tax deduction	no	no	no	yes	no	no
Kinder- + Betreuungsfreibetrag*	Tax allowance	yes	no	no	no	no	no
Haushaltsfreibetrag (single parents)	Tax allowance	yes	no	no	lump sum	no	yes
Ausbildungsfreibetrag (children 18+)	Tax allowance	yes	no	no	no	yes	no
Erziehungsgeld (children <2)	Cash benefit	yes	yes	yes	no	yes	no
Kindergeld (non-taxpayers)	Cash benefit	no	no	no	yes	no	no
Unterhaltsvorschuss (single parents)	Cash benefit	no	no	no	no	yes	yes
b) France							
Quotient familial	Tax splitting	yes	no	no	yes	no	yes
Créd. d'imp./garde de jeunes (chi. <7)	Tax allowance	yes	yes	yes	no	no	no
Réd. d'impôts/scolarité (chi. 11–25)	Tax allowance	yes	yes	no	no	yes	no
Prime pour l'emploi (low-wage earn.)	Tax deduction	yes	yes	yes	no	no	yes
Allocation familiale (2+ children)	Cash benefit	no	no	no	yes	yes	no
Complément familial (3+ children)	Cash benefit	yes	no	no	lump sum	no	yes
Prest. d'acc./jeune enfant (2+ chi., 1 <3)	Cash benefit	yes	yes	yes	yes	yes	no
Alloc. de rentrée scolaire (chi. 6–18)	Cash benefit	yes	no	no	no	no	no
Alloc. de soutien familial (single par.)	Cash benefit	no	no	no	no	no	yes
c) UK							
Child tax benefit	Tax deduction	yes	no	no	no	no	no
Child benefit	Cash benefit	no	no	no	yes	no	no
d) Sweden							
Barnbidrag	Cash benefit	no	no	no	yes	no	no
Föräldrapenning (chi. <13 months)	Cash benefit	yes	yes	no	no	yes	no
Underhållsbidrag (single parents)	Cash benefit	no	no	no	no	no	yes

Notes:
"Inc": effect varies with income; "Emp": varies by employment status; "Hrs": varies by hours worked; "Bth order": varies by birth order (i.e., amount per child depends on no. of children); "Age": varies by age of child; "Hh type": varies by type of family household; "*": instruments not cumulative.

Sources: Bradshaw and Finch (2002, additional "questionnaires"), European Commission (2006).

a) Germany

In Germany, the main instruments for financially supporting families with dependent children (aged <27) are a child cash benefit (Kindergeld) or, if higher, a children's tax allowance involved in the income tax (Kinder- und Betreuungsfreibetrag). The direct cash benefit amounts to € 154 per child and month for the first three children and increases to € 179 for the fourth and each subsequent child. The children's tax allowance that is granted as an alternative measure is beneficial for families with a higher income and amounts to € 5,808 per child and year (as a deduction from taxable income) for married couples who are jointly filed, half of this amount for single parents. In addition, single parents are entitled to deduct a household allowance (Entlastungsbetrag für Alleinerziehende, formerly "Haushaltsfreibetrag") which is independent of the number of their children. Parents with older children (aged 18+) who continue to be in education can also claim a limited deduction.

While, for all taxable parents, the child cash benefit is now formally based on a special section in the income tax code, a separate law makes sure that the same benefit also extends to parents who are not taxable, for instance, because they do not have any income. Another major cash benefit is the child-raising cash benefit (Erziehungsgeld) for a parent of children aged less than two years who is not working or working part-time (less than 30 hours a week) in order to take care of a small child. The maximum amount is € 300 per month paid for two years (or € 600 for one year), but benefit entitlements are negatively related to family income and are zero above a certain income ceiling that becomes binding rather often. Single parents who do not receive (full) child maintenance payments from the absent parent can receive a maintenance benefit (Unterhaltsvorschuss).

b) France

The French system of child-related monetary benefits is mainly based on three instruments, a family-splitting scheme (quotient familial) in the income tax system, a child cash benefit (allocation familiale) and a child-raising cash benefit (prestation d'accueil de jeune enfant) for families with small children.

Among the very differing approaches taken at an international level with respect to taxing married couples and families, the French system of a family-related splitting is virtually unique. In this system, the total amount of a family's taxable income is divided by a weighted number of household members (i.e., by the "splitting factor") before otherwise uniform tax rates are applied and the resulting tax liability is again multiplied with the splitting factor. For married couples, the weights attached to the first and second child are 0.5, the third and further children 1.0. For a single parent, the weight of the first child is 1.0, that of the second child 0.5, and that of the third and further children again 1.0. To further reduce the tax burden of families, parents can claim additional tax allowances for children under 7 (child-care tax credit, credit d'impôts au titre des frais de garde de jeunes) or for children aged 11–25 who are attending school (réduction d'impôts au titre des frais de scolarité). In addition, families with low earnings are entitled to receive a working tax credit ("prime pour l'emploi") that varies with the number of dependent children.

The child cash benefit (allocation familiale) is independent of the parents' income situation and is payable only for families with two ore more children (aged <20). It amounts to € 111.26 per month for a second child and € 142.55 per month for each subsequent child. There are supplements (majorisations) of € 31.29 for children aged 11–15 and of € 55.63 for children aged 16 and older.

The child-raising cash benefit (prestation d'accueil de jeune enfant) has recently replaced a number of earlier benefit programmes targeted at parents with two or more children (of which if at least one child is aged <3). It entails a base amount (allocation de base) that is paid largely unconditional on the parents' income (up to a relatively high ceiling) and on their employment status. This base amount of benefits is € 160 per month. Higher payments are made depending on whether a parent interrupts or reduces his or her labour-force participation (complément de libre-choix d'activité) and how the small child is taken care of (complément de libre-choix de mode de garde).

In addition to these benefits, France runs a number of further monetary benefit programmes mainly supporting low-income families, for instance, the family supplement (complément familial) for low-income families with three or more children and an annual new-school-year allowance (allocation de rentrée scolaire for children aged 6–18). There is also a special allowance for single parents relating to child maintenance (allocation de soutien familial).

c) United Kingdom

The British system for financially supporting families with dependent children (aged <19) is mainly based on two elements, the Child Tax Benefit and the Child Benefit.

The child tax benefit (formerly split between the Working Families Tax Credit and the Children's Tax Credit) is targeted at low-income families as it is tapered away in two steps when the parents' income exceeds certain thresholds that are relevant for income taxation. It is paid in the form of a family element, with a maximum of £ 45.42 (€ 64) per month, and a child element, with a maximum of £ 135.42 (€ 191) per month for each child if children are not disabled (disabled children are entitled to a higher child element). The child element is withdrawn already at relatively low level of income, while the family element falls to zero only at higher levels of income.

By contrast, the child cash benefit is universal in that it is not contingent on the parents' income. It is also invariant in the children's age (as long as children age aged <16, or <19 for children who are still in non-advanced education), but – unlike in the other countries considered here – it increases less than proportionally with their number. It amounts to £ 71.50 (€ 101) per month for the first and £ 47.88 (€ 68) per month for each subsequent child.

d) Sweden

The Swedish system of child-related monetary benefits is mainly based on a universal cash benefit (barnbidrag) which is not income-related. It increases more than proportionally with the number of children (aged <16; older children in upper-secondary education receive a similar benefit), while the age of children is irrelevant. The benefit amounts to SEK 950 (€ 106) per child and month for the first two children, SEK 1,204 (€ 134) for the third, SEK 1,710 (€ 191) for the forth and SEK 1,900 (€ 212) for each subsequent child.

For parents interrupting their professional career to take care of small children, the Swedish operate an income-replacement scheme (föräldraförsäkring) that effectively pays out a child-raising cash benefit (föräldrapenning) which is positively related to parental income foregone during most of the benefit period. The amount of the child-raising benefit is therefore exceptional in Europe, while its duration is relatively short. The benefit amounts to 80% of the previous gross wage, up to a high ceiling (of SKR 39.300 or € 4.380 per month). It is granted during the first 13 month after birth (at least one month off the workplace has to be taken by the second parent). Afterwards it is reduced sharply to a flat rate of SEK 60 (€ 6.50) a day for the following 3 months. For women giving birth to another child within 30 months, the benefit is assessed based on the gross wage earned previous to the latest birth.

In Sweden, there is also an advanced maintenance benefit (underhållsbidrag) applying to single parents that do not receive (full) child maintenance payments by the absent parent. Another allowance that is not granted to families only, but is very significant in the context of financial support of families in Sweden by its amount as well as by the way it is linked to general cash benefits, is the housing allowance (bostadsbidrag). Low-income households with the need for a certain size and standard of housing – hence, mainly families with children – are entitled to receive this allowance, while childless households have higher entitlements to receive other, less specific income-support measures in return.

8.1.3 Benefits differentiated by the number of children

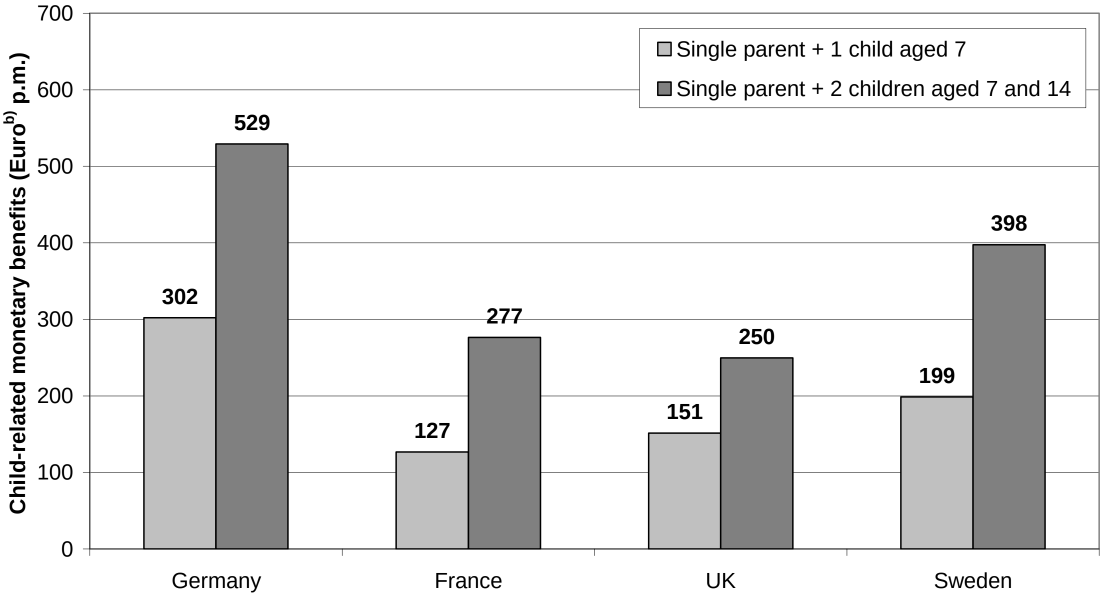
As can be seen from table 8.1 and the following descriptions, two important dimensions of variation of child-related monetary benefits are the number of (eligible) children living in the household (in some cases, benefits extend to dependent children who have already moved out from the parental household) as well as the income situation of parents. We will therefore address these two aspects in turn now, comparing the amounts of child-related monetary benefits in Germany, France, the UK, and Sweden for families that deviate from our two "baseline cases" either with respect to the number of children (in this sub-section) or with respect to the level of family income (in the next one).

Based on the data collected by Bradshaw and Finch (2002), and therefore related to the legal framework as of 2001, figure 8.3 shows the amounts of child-related monetary benefits for families with one, two, and three children, keeping fixed the "baseline" assumptions regarding the levels parental income for a single parent and a (married) couple, respectively.

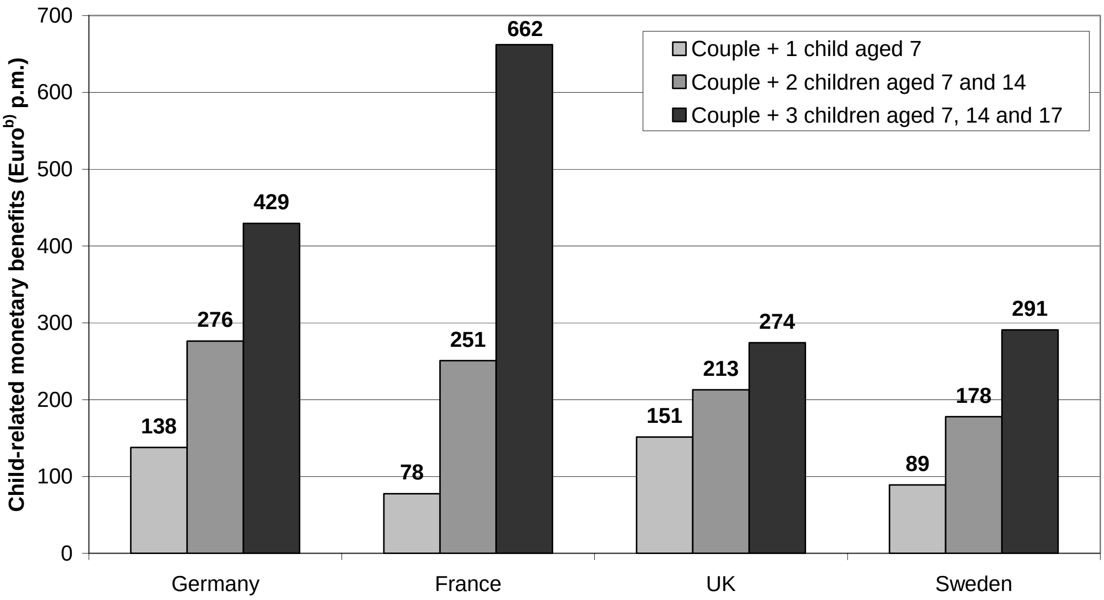
In Germany, child-related monetary benefits basically increase with the number of children in an almost proportional fashion, i.e., support starts with the first child and there are no special incentives towards having higher numbers of children. The slightly more than proportional increase in benefits in the case of a couple is due to the higher child cash benefit paid out from the third child onwards in 2001. Today, benefit rates are constant until the fourth child, as was mentioned before. In the case of a single parent, there is an under-proportional increase of benefits, due to the special household tax allowance applying in this case that is not dependent on the number of children.

Figure 8.3: Child-related monetary benefits[a)] in Germany, France, the UK, and Sweden by the number of children (2001)

a) Single parent, national average female earnings



b) Two-earner couple, national average male plus half average female earnings



Notes:

a) Calculated as differences between net disposable income (after taxes and benefits) for a single parent with one child and a single adult or for a couple with two children and a childless couple, respectively, with the same level of household income in both cases.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related "country matrices".

In France, we observe that child-related monetary benefits are clearly increasing more than proportionally with the number of children, thus creating an incentive towards having higher numbers of children. This is above all due to the structure of weights within the family splitting system and the universal child cash benefit which paid from the second child onward and increases for subsequent children. (Note, however, that other measures, such as the child-raising cash benefit and the family supplement, are also "biased" towards supporting families with two or three and more children). In the single-parent case, the structure of payments is less progressive through the effect of the family splitting system (with a full weight attached to the first child, half a full weight to the second one). Up to a point, this feature works in the same direction as the single-parent household allowance that is explicitly granted in Germany.

In the UK, by contrast, one can observe an under-proportional increase of child-related monetary benefits, mainly due to the 2001-system of the Working Families' Tax Credit and the Children's Tax Credit. With the current combination of the Child Tax Credit and the Child Benefit, the British system is now almost proportional in the number of children – at least, at a given level of parental income. In Sweden there is also a next to proportional increase of monetary benefits, similarly as in Germany. However, the universal child cash benefit increases more than proportionally for third and, even more so, for subsequent children. All in all, Swedish benefits thus tend to grow a lot stronger than proportionally with the number of children than in Germany. In other words, there is also some incentive to have higher numbers of children in Sweden.

8.1.4 Benefits differentiated by parental income

Figure 8.4 shows how child-related monetary benefits vary by earnings levels, or by levels of parental income, again referring to the two "baseline" types of families, i.e., a single parent with one child aged 7 and a couple with two children aged 7 and 14. For closer inspection, we define five earnings levels in the case of a single parent and six combinations of earnings levels in case of a (married) couple, looking at households with no wage earners living on social assistance, households with low earnings derived from part-time jobs at national minimum wages,[4] and households with higher earnings derived from (half or full) national averages of female and/or male earnings (for further details, see the indications included in figure 8.3). As before, parental earnings are taken to represent total family income.

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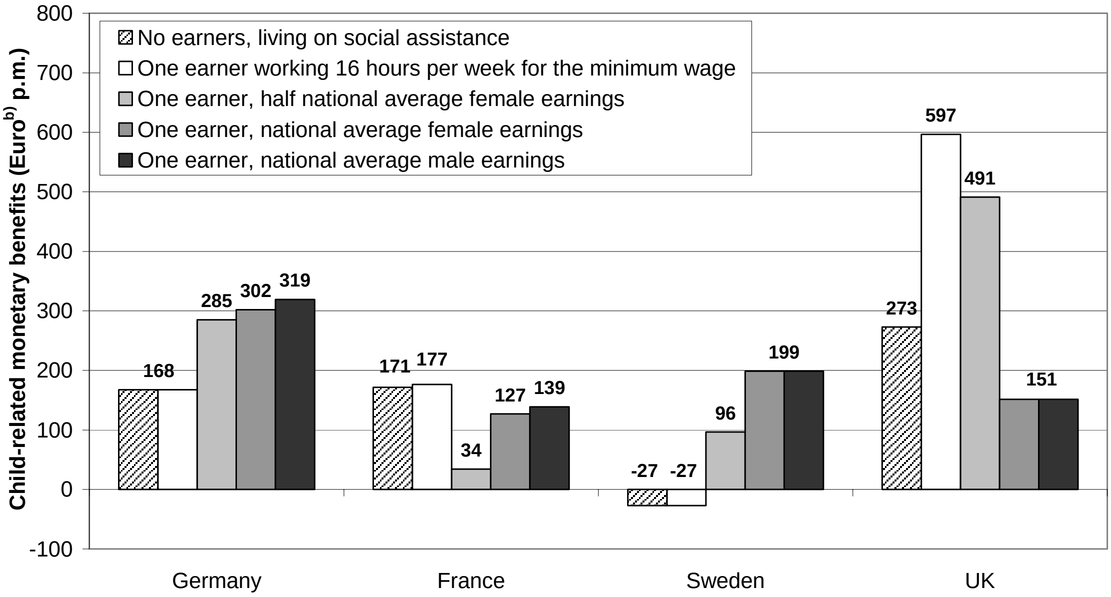
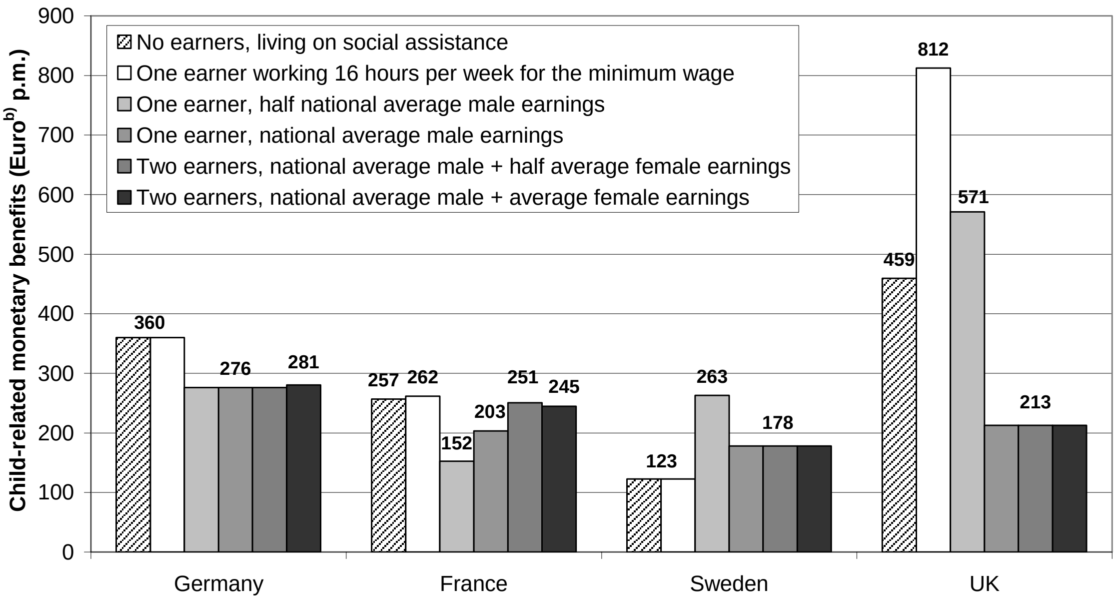
4 As in Bradshaw and Finch (2002), we impute low-wage earnings based on 14% of the national average wage for those countries that do not have a legal minimum wage.

Figure 8.4: Child-related monetary benefits[a)] in Germany, France, the UK, and Sweden by parental income (2001)

a) Single parent with one child aged 7



b) Two-earner couple with two children aged 7 and 14



Notes:

a) Calculated as differences between net disposable income (after taxes and benefits) for a single parent with one child and a single adult or for a couple with two children and a childless couple, respectively, with the same level of household income in both cases.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related "country matrices".

In Germany, no-income or very-low-income families fall under the social assistance programme that over-rules all special child-related cash benefits. For couples with two children and higher levels of income, child-related benefits are lower than those involved in social assistance. Furthermore, at intermediate levels of income, benefits accruing to couples are basically not income-related, due to the uniform child cash benefit. For high levels of income, higher effects of the children's tax allowance are applicable and benefits start to increase moderately with taxable income. For single parents, the increase with earnings starts at a lower level of earnings as they have higher tax allowances (through the household allowance) and are faced with a more progressive tax scheme (as they do not benefit from the income-splitting applied to married couples).

In France, the structure of child-related monetary benefits for families with no or very low income vis-à-vis those with higher levels of income is similar as in Germany. At the same time, mainly due to the family-splitting system, benefits tend to increase relatively strongly with income once the income of the family exceeds the social assistance threshold. This basic pattern uniformly applies to (married) couples with children as well as to single parents. Note that, aspects of a fair amount of redistribution towards low-income families aside, the idea that child-related benefits should increase with parental income reflects a specific notion of distributive justice in the context of income taxation. If, in a progressive tax system, tax liabilities grow more than proportional with taxable income according to the "ability-to-pay" principle, any reduction in the ability to pay taxes, e.g., through expenditure on children, necessarily reduces tax liabilities more at higher levels of income than at lower levels of income. The German children's tax allowances have basically the same effect, but it is over-ruled in many cases through the alternative instrument of a uniform cash benefit. The French family-splitting approach is operative throughout and renders this effect much more pronounced than with tax allowances that are, as such, uniform over the entire range of taxable income.

The UK follows a different philosophy in the design of their system of child-related monetary benefits. Here, benefits are constant for families – (married) couples and single parents alike – with average or higher incomes. At the same time, poverty relief ranks high among the goals pursued with the instruments of British family policies, though with special attention paid to avoiding the creation of a "poverty trap". This is why families with very low earnings receive substantially higher amounts of benefits than those who have no earnings at all. This distinctive feature of the Working Families Tax Credit that was in place in 2001 invariably applies to the current combination of a Working Tax Credit and the Child Tax Credit.

In Sweden, the universal child cash benefit should have effects that are basically uniform across all income levels. Nevertheless, in figure 8.4 child-related benefits increase with income, mainly because of "other" measures (that are not fully specified in Bradshaw and Finch 2002 and cannot be traced back to legal entitlements described in other sources). For families on no or very low income, the total amount of child-related benefits even appears to be negative. This is formally correct but nevertheless misleading, as it will change significantly when we include housing benefits in the analysis. This is where we turn now.

8.2 Housing benefits

8.2.1 Housing benefits differentiated by parental income

In many countries, housing allowances granted to families are generally higher than those to households without children, mainly in order to compensate for the need of more space for a larger household. In some countries, local taxes are also substantial and often vary by the number of children or, more generally, by the number of household members. Furthermore, these additional benefits or costs for families with children usually vary significantly by family income.

In figure 8.5, we look at the resulting net benefits (positive amounts) or net costs (negative amounts) for our two "baseline" family types at different levels of income, once again based on the comparative study by Bradshaw and Finch (2002). The results represent differences in net rent and net local taxes payable by families with children vis-à-vis the respective cases of childless households. To make things comparable, gross rents are assumed to be the same for all income variants and all types of households. Otherwise, it would be impossible to see whether households receive higher benefits simply because they have rented larger apartments and not because they have higher or lower incomes or higher or lower numbers of children. The differences in benefit entitlements would thus be overstated, in a sense. On the other hand, the counterfactual assumption of uniform gross rents makes the comparison difficult on other grounds, as we will see.

In Germany, housing allowances (Wohngeld) are paid to low-income households and, at a given level of income, mainly depend on housing costs. Because housing costs are assumed to be the same across all households, additional housing benefits for families with children mostly amount to zero – when compared to a childless household that has the same amount of income. In other words, in the German system of housing benefits children matter only insofar as they require more space, which usually involves a higher gross rent. Also, if families were assumed to have lower incomes than their childless counterparts, for instance, due to tighter time restrictions applying to hours worked by at least one parent, they would be entitled to receive higher benefits. There are only two exemptions from this observation of a uniform treatment of households with and without children, that is partly driven by the way child-related extra-benefits are calculated here. A single parent with one child at half average female earnings as well as a couple with two children at half average male earnings are entitled to receiving some amount of a housing allowance while single adults and a childless couple, respectively, are not. The reason is that the earnings threshold for benefit entitlements to become effective increases with the number of household members.

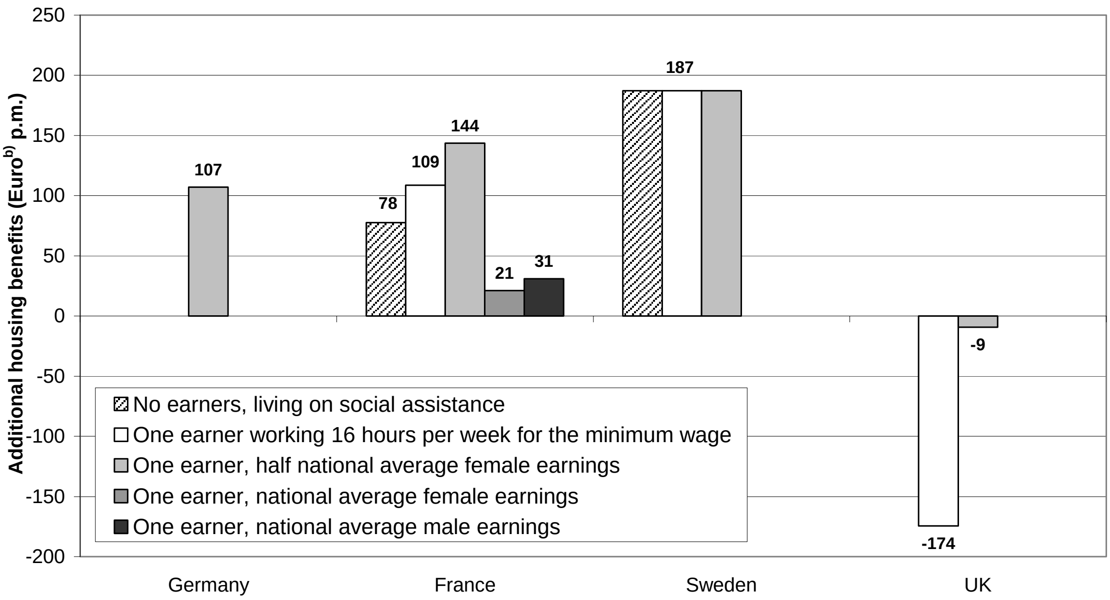
In France, there is some variation in the amount of additional housing benefits that is purely child-related. Interestingly, The difference in benefit entitlements increases with earnings at low levels of income. This is due to the fact that housing allowances are phased out more strongly for childless households than for families with children. Local taxes, by contrast, usually grow slightly with the number of household members. Therefore, they can imply negative effects for families with higher income that are no longer entitled to receiving housing allowance allowances.

In Sweden, housing allowances are paid to low-income households as in most other countries. Furthermore, they clearly increase with the number of children, even if household income and gross rents are assumed to be the same in the relevant benchmark cases of childless households. This outweighs the fact that, they way they were calculated, child-related benefits accruing to low-income families that are not linked to housing costs turned out to be low and sometimes even negative in Sweden (vis-à-vis childless households at the same level of income; see sub-section 8.1.4 and figure 8.4).

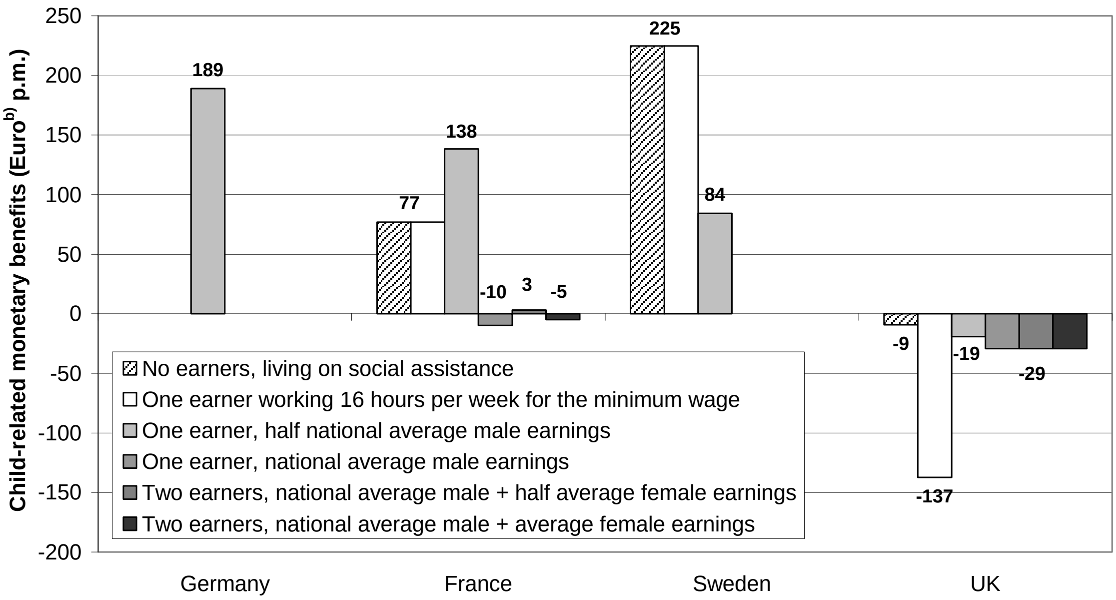
In the UK, housing allowances tend to interact with other child-related monetary benefits precisely the other way round. The resulting pattern is similar to the German one, yet with a negative sign. For households with no earnings living on social assistance, housing costs are fully paid for by public authorities regardless of the presence of children in the household or not. For households with very low earnings, the relatively high amount of the Child Tax Credit (see above) is counteracted by smaller entitlements to receiving housing allowances. All other cases with at least average female earnings do not receive any housing benefits at all, whether they are with or without children. At the same time, local taxes are important in the UK that increase with the number household members, implying small negative values of “additional housing benefits” for families.

Figure 8.5: Additional housing benefits[a)] in Germany, France, the UK, and Sweden by parental income (2001)

a) Single parent with one child aged 7



b) Two-earner couple with two children aged 7 and 14



Notes:

a) Calculated as differences between net rent and net local taxes payable for a single parent with one child and a single adult or for a couple with two children and a childless couple, respectively, with the same level of household income in both cases.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related “country matrices”.

8.2.2 Child-related monetary benefits after housing

Taking into account the interactions between housing benefits and other benefit entitlements just mentioned, we will now also look at total child-related monetary benefits, including tax allowances, cash benefits, and differences in net housing costs. Figure 8.6 combines the results shown in figures 8.4 (in section 8.1.4) and 8.5 (in section 8.2.1) and shows the differences between net disposable income after taxes, benefits, and housing for a single parent with one child and a single adult or for a couple with two children and a childless couple, respectively, differentiated by household income and assuming that the households used as a benchmark all have the same amount of gross income. As before, positive results indicate that there are net benefits accruing to families with children, while negative results would indicate net costs.

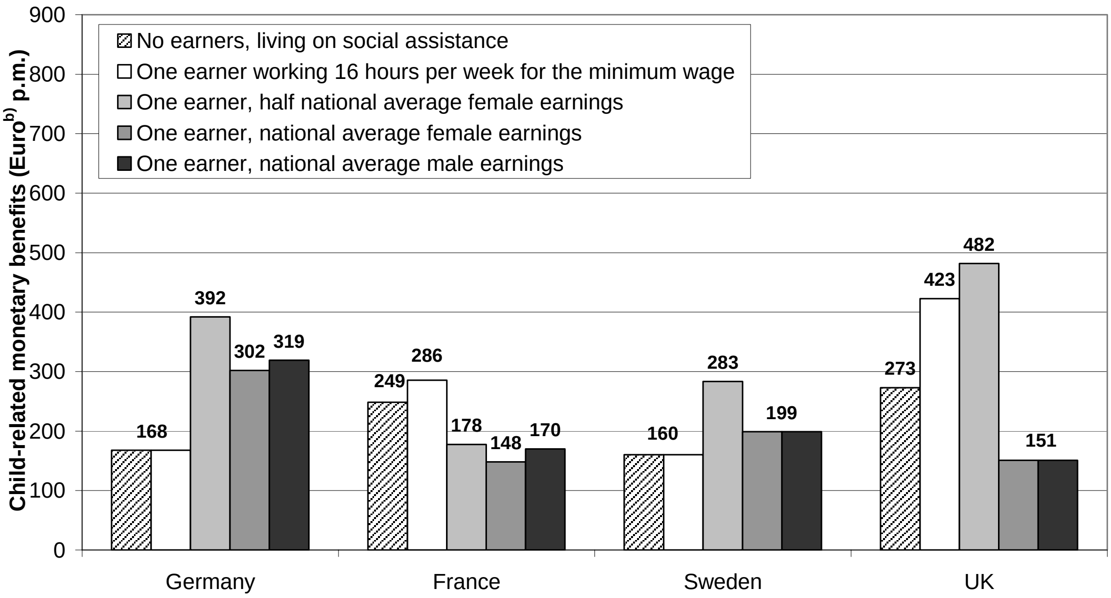
Refining our observations based on figure 8.4, the following features can be seen from figure 8.6. First, benefits paid to families with less than average earnings are mostly higher than those accruing to families with higher earnings, or income. The only exceptions appear to be single parents with no or very low earnings in Germany as well as in Sweden.[5] Second, benefits are often somewhat higher in cases with very low or low earnings than they are if there are no earnings at all. Here, the only exceptions are couples with children in Sweden and France, while the differentiation is clearly most pronounced in the UK, being part of a deliberate policy of avoiding a poverty trap and encouraging work effort in low-income families in this country. Third, including housing benefits now resolves some of the puzzles involved in the earlier figure. Total child-related monetary benefits accruing to families in the two lowest income cases in Sweden have increased from € –27 to € 160 per month for single parents with one child and from € 123 to € 348 for couples with two children. Similarly, a single parent on average female earnings in France no longer receives much less than the two higher income groups (€ 34 against around € 130) but even slightly more (€ 178 against € 150–170).

Last but not least, with respect to the four countries under closer inspection here we can conclude that low-income families (those with less than average earnings) are entitled to receive the highest monetary benefits in the UK. Families with higher earnings appear to be best off in Germany, certainly in the case of single parents, while the difference against benefit entitlements in France is not really notable in the case of (married) couples with children.

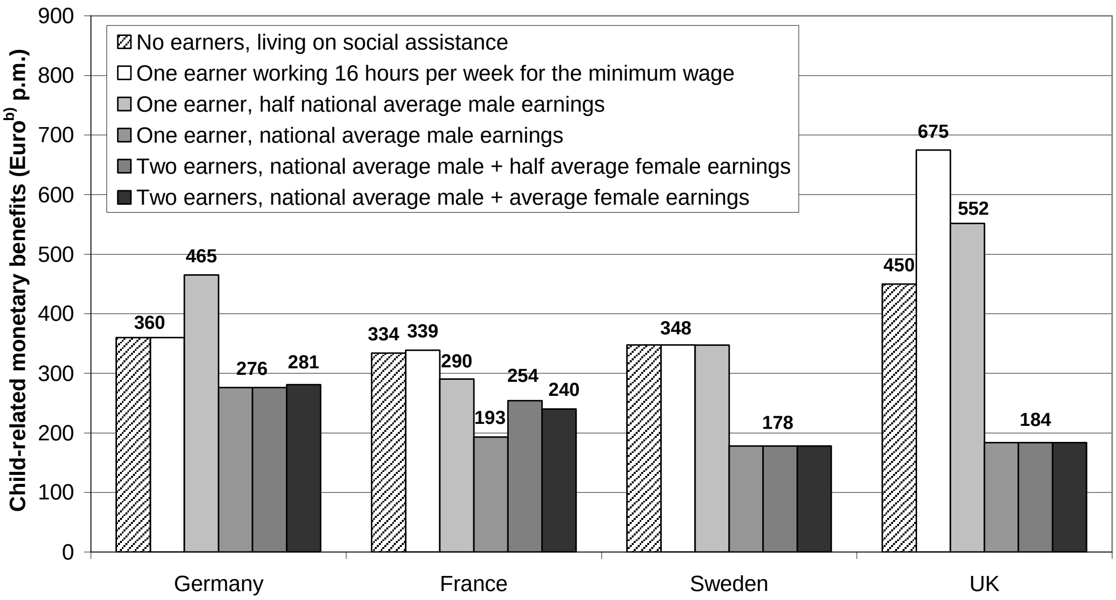
[5] Remember that, for the case of "minimum-wage earners" in these two countries, we impute low-wage earnings based on 14% of the national average wage as there is no legal minimum wage.

Figure 8.6: Child-related monetary benefits after housing[a)] in Germany, France, the UK, and Sweden by parental income (2001)

a) Single parent with one child aged 7



b) Two-earner couple with two children aged 7 and 14



Notes:

a) Calculated as differences between net disposable income (after taxes, benefits, and housing costs) for a single parent with one child and a single adult or for a couple with two children and a childless couple, respectively, with the same level of household income in both cases.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related "country matrices".

8.3 Extra-benefits for families with small children

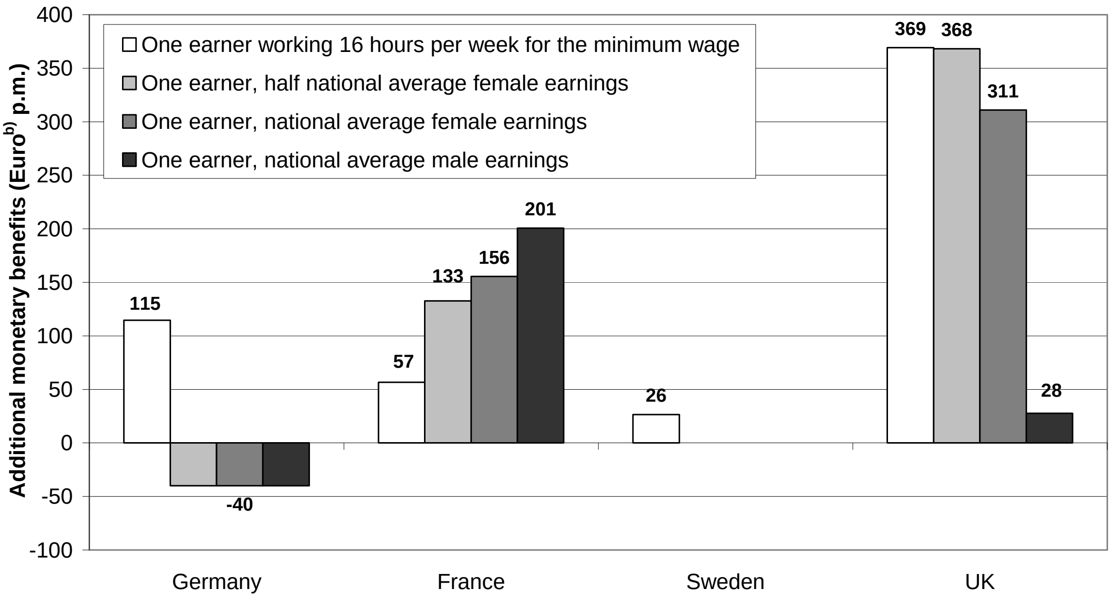
Some countries, such as France and the UK, are granting additional tax allowances or cash benefits to families with small children in order to support them with respect to the costs involved in child-care. At the same time, families often receive these benefits regardless of whether they send their child to institutional day-care or take care of the children themselves. These extra-benefits should therefore be considered as separate from subsidized day-care costs. Other countries, here Sweden and Germany, offer extra-benefits for families with small children that are targeted at a period (in Sweden: 13 to 16 months; in Germany: two years after the child has been born) where, in most cases, one of the parents is taking care of the children himself or herself, interrupting his or her professional career and staying at home.

As they vary a lot in their construction, comparing these additional benefit entitlements across countries is difficult. Lacking better measures, we build on the survey by Bradshaw and Finch (2002) who collect data which, to some extent, allow for a comparison of benefit entitlements (i.e., tax allowances and cash benefits) accruing to a one-child family with a child at pre-school age and to a family with a child at school age. Figure 8.7 shows the results that represent differences between net disposable income after taxes and cash benefits for a single parent or a couple with one child under the age of three (precisely speaking, a child aged two years and 11 months) and a single parent or couple with one child aged 7, respectively, differentiated by parental income. In other words, we now look at child-related monetary benefits that have not been captured in our earlier figures because of our specific assumptions regarding the age of children. As benefits meant to offer a choice between domestic and institutional child care are often immaterial for social assistance recipients, we leave out this specific case here.

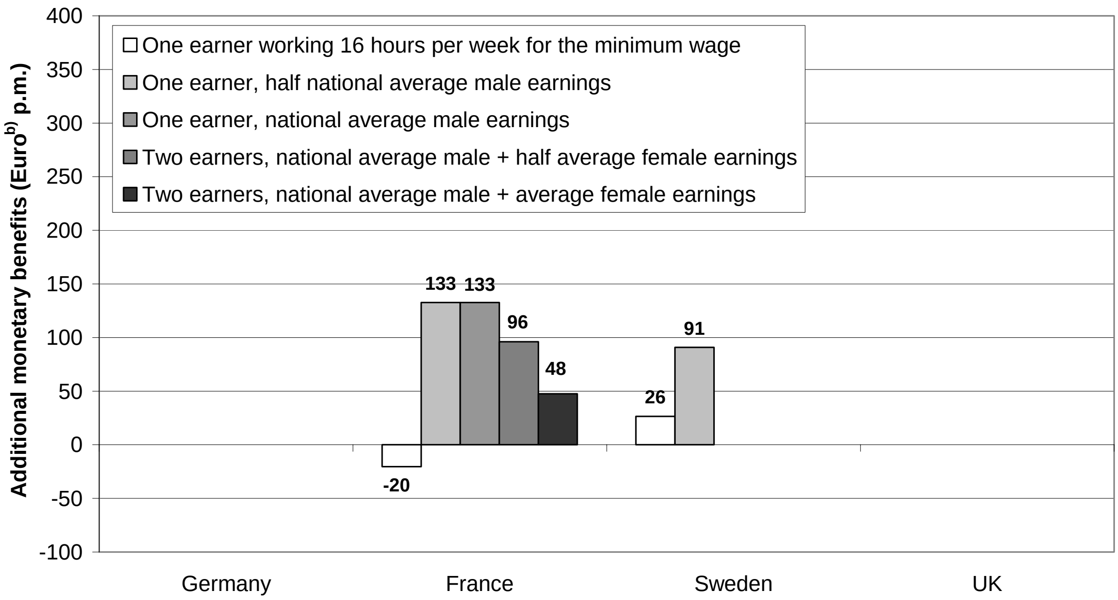
In France, additional monetary benefits for small children decrease with income in the case of couples with children, while they increase with (less-than-average) income in the case of single parents. The inverse relationship with parental income is an effect of the former infants' allowance (allocation pour jeune enfant) which was paid to parents with children aged <3 subject to a strong means test. At the same time, families with very low earnings still receive social assistance and this is higher for a school-age child than for a child at pre-school age. That is what happens in the case of a couple on earnings derived from a part-time job at the minimum wage and drives the results for single parents with low earnings. In the latter cases, the importance of social assistance decreases and the importance of the infants' allowance increases. At higher earnings, the allowance would also be tapered away in this case.

Figure 8.7: Additional child-related monetary benefits for children aged <3[a)] *in Germany, France, the UK, and Sweden by parental income (2001)*

a) Single parent with one child aged 2 years and 11 months



b) Two-earner couple with one child aged 2 years and 11 months



Notes:

a) Calculated as differences between net disposable income (after taxes and benefits) for a single parent or a couple with one child aged 2 years and 11 months and with one child aged 7, respectively, with the same level of household income in each case.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related "country matrices".

In the UK, single parents are eligible for special child-care credits within the Working Families Tax Credit effective in 2001. These credits can amount to a considerable sum of money for low-income families with children in institutional child care. This is needed as child-care services are not subsidised in any other way in the UK, implying that all families basically have to pay the same fee for child care, irrespective of their income situation. The child-care credit programme is not applicable to the households of (married) couples considered here as there is either only just one wage earner, or family income exceeds the phase-out range of the Working Families Tax Credit.

In France as well as in the UK, the benefit schemes that are relevant in this context have meanwhile been restructured. In France, the allocation pour jeune enfant and a number of other, more specialised benefit programmes have been replaced by the prestation d'accueil de jeune enfant. In the UK, the Working Families Tax Benefit has been replaced by the Working Tax Credit (and the Child Tax Credit, see section 8.1.2) which again involves special child-care credits. In spite of these restructurings, the basic form of benefit entitlements for parents with small children is still unchanged against 2004.

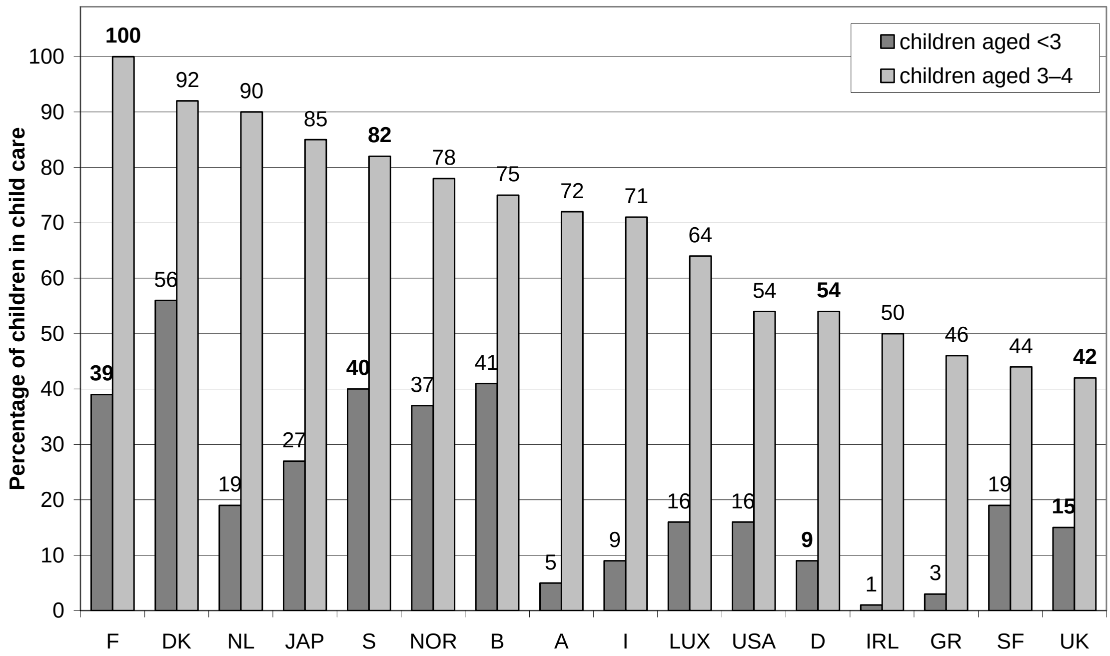
In the cases of Germany and Sweden, figure 8.7 misses important elements of their systems of monetary benefits for families with small children because of the precise definition of the age of a pre-school child. Neither the German child-raising benefit (Erziehungsgeld) nor the Swedish child-raising benefit (föraldrapenning) are paid until a child is close to age 3. Whether this really a disadvantage is disputable, certainly in the case of the Swedish short-term income-replacement scheme that is now likely to be followed by the Germans. But in any case, there are no special child-care benefits paid in Germany and Sweden for parents of children aged two years and 11 months, as can be seen in the figure. In Germany, single parents with small children effectively receive smaller benefits than those with children at school age due to age-related variations in maintenance support. Variations that work in the other direction in a few cases in Germany and Sweden (here also for couples with small children) are an effect of other, special benefit entitlements.

8.4 Child care

What is probably more important than monetary extra-benefits in the context of family policies directed at families with small children are day-care arrangements for children at pre-school age. In most developed countries, child-care facilities are publicly provided or highly subsidised. In any case, establishing child-care facilities or offering child-care services in an official way is usually strongly regulated to ensure the quality of services. This implies that the availability of day care for children at pre-school age is to a large extent a public responsibility.

Age 3 turns out to be an important threshold regarding the provision of child-care facilities in many countries. Among the four countries considered here only one, viz. Sweden, guarantees access to child care in municipal day-care centres for children below this age. The most prevalent form of child care for children aged less than 3 in France and the UK is a child-minder, while in Germany it is a nursery school. In France, children enter a pre-primary school (école maternelle) at the age of 3. The UK offers free access to nursery schools for children starting age 4. Germany is currently preparing to guarantee public (half-day) child care for children aged 3 to 6. For younger children, supply is rather limited and priority access is given to single parents and, to some extent, also to two-earner couples. Figure 8.8 shows the percentages of children aged less than 3 and 3–4 who are actually in child care in a larger number of OECD-countries.

Figure 8.8: Proportion of children aged <3[a] and 3–4[b] in child care in OECD countries (2000)[c]



Notes:

a) Belgium: 3 months to 2.5 year-olds; Ireland: <4; Norway: 1–2 year-olds.

b) Belgium: 2.5–6 year-olds; Greece: 3–5.5 year-olds; Ireland: 4 year-olds; Italy: 3–5 year-olds; Netherlands 3 year-olds; Norway: 2 year-olds,

c) Finland, Italy: 1998; Belgium, Germany (3–4 year-olds), Japan, Netherlands, Sweden, UK, USA: 1999.

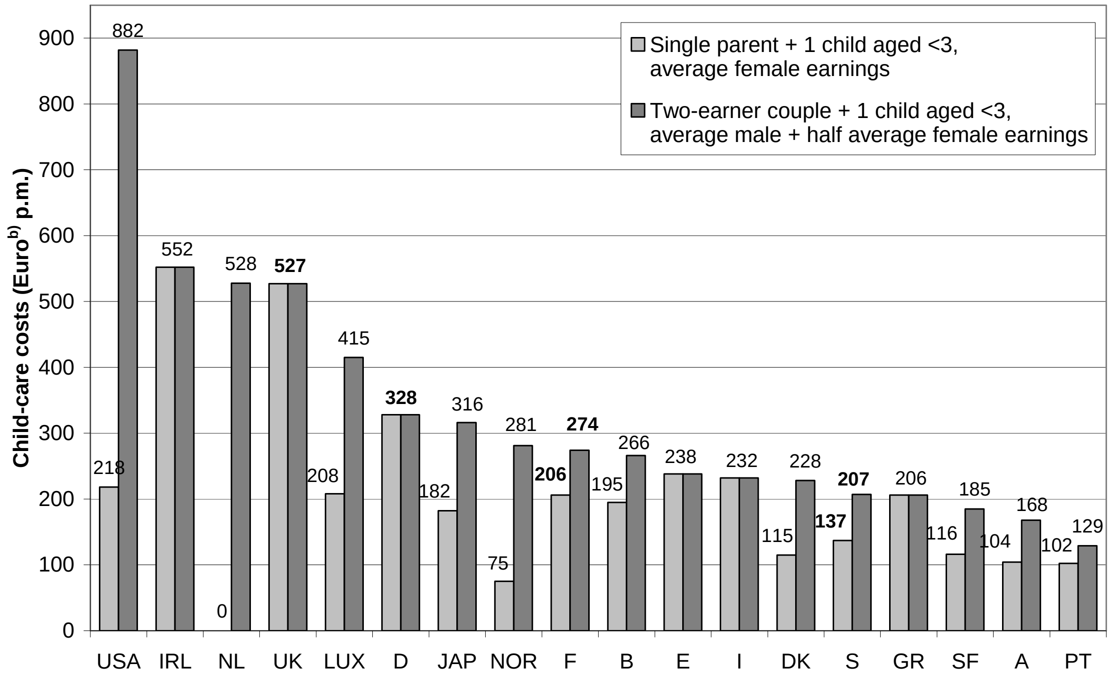
Source: Bradshaw and Finch (2002, chapter 5).

In our discussion of child-related monetary benefits, we have observed a number of details that are a bit peculiar about the German benefit programmes. For instance, they are not so much targeted at encouraging parents to have higher numbers of children (two or more) as they are in France. Also, they are less geared towards supporting parents with high opportunity costs than they are in France (through the quotient familial mainly) or in Sweden (through the föraldraförsäkring). But all in all, the level of child-related monetary benefits in Germany is nowadays relatively generous (see figures 8.1 and 8.6) and, as such, does not appear to be a major reason why fertility is so low in this country.

In an international comparison, the availability of child-care facilities for children at pre-school age turns out to be a likely candidate for explaining the low fertility rates observed in Germany vis-à-vis the other countries looked at here. In terms of the proportion of children who are actually in child care, Germany (9%) ranks at the fourth lowest level – followed only by Austria (5%), Greece (3%), and Ireland (1%) – with respect to children aged less than 3. It ranks at the fifth lowest level with respect to children aged 3–4 (see figure 8.8). With 15% of the under 3 year-olds and only 42% of the 3–4 year-olds, the UK also ranges at the lower end of the countries considered here. Sweden and France both range at positions in the upper half of this ranking, with respect to children aged below 3 as well as with respect to children aged 3–4. For children in France who reach the age of 3, pre-primary school is compulsory, which explains the 100% rate of children in day care in the age category of 3–4 year-olds.

It is of course unclear whether a low proportion of children attending nursery schools etc. is mainly a matter of limited supply or whether it is, at least partly, a result of high fees and other costs that could reduce demand for such services. For instance, this could be the case in the UK (and also in the US), as we will see, but not so much in Germany. We will illustrate this in figure 8.9 which shows the net costs of full-time pre-school childcare for children aged 2 years and 11 months in a number of OECD countries, based on information collected in the Bradshaw and Finch (2002) study. Net costs indicated in this figure refer to the most prevalent type of pre-school child care in each of the countries considered and to two types of families, viz., a single parent and a (married) couple, both with one child of the age defined above. The levels of income are the same as in the two "baseline" types of families introduced in sub-section 8.1.1, i.e., the single parent is assumed to earn national average female earnings and the two-earner couple earns national average male plus half average female earnings. The results are expressed in terms of net costs after direct and indirect subsidies (but before special tax allowances and benefits that have been addressed in section 8.3).

Figure 8.9: Costs of full-time pre-school child care[a] in OECD countries (2001)



Notes:

a) After direct and indirect subsidies, but before taxes and benefits.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related "country matrices".

Once more, it is difficult to determine the precise amount of benefits involved in the delivery of child-care services in a comparable fashion, in particular, because public provision plays an important role in this respect in many countries. As a rule, accounting standards applied in the public sector throughout the world do not allow for measuring the full costs of these services which could then be compared to the costs effectively charged on parents, often implying a substantial subsidy. Nevertheless, virtually all countries considered here charge some amount of net costs for day care of children aged less than 3 on parents with average or higher income. At the same time, the fees or prices actually payable by parents can vary a lot by family type and income.

Among the four European countries subjected to closer scrutiny here, all but the UK offer some kind of public subsidies, often related to parental income, for the most prevalent forms of child care. Thus, the net costs of child care imposed on parents for children aged less than 3 amounts to more than € 500 per month in the UK for single parents as well as for couples, each at average or higher income. (Among the larger set of

OECD countries covered in figure 8.9, only the US, Ireland, and the Netherlands charge higher costs, and even only in the case of couples in two of these countries.) Germany also ranges among countries that charge relatively high costs for child care of small children. With over € 300 per month, applying to single parents as well as to couples with (higher than) average income, it is however much closer to the (unweighted) average of countries looked at here.[6] France and Sweden tend to charge relatively low costs for pre-school child care. Also, the costs are lower for single parents than for couples in the two types of family considered here. In France, this result would even hold for single parents vs. couples at the same level of income, while in Sweden, net costs charged would be identical for single parents and couples in the same income situation.[7]

For our four countries, figure 8.10 illustrates how net costs of pre-school child care charged on parents vary by parental income. The relevant costs are again measured after direct and indirect subsidies, but before taxes and benefits (see section 8.3). It is easy to see that there is no differentiation in charges by family income in the UK. (Remember, however, that British families with low earnings can benefit from child-care credits involved in the income tax in order to reduce the effective amount of these costs.) The same appears to be true in Germany, at least as far as parents with average or higher income are concerned. Also, there still appears to be a substantial amount of subsidisation of child-care costs in this country as the full cost per child and month of running public (or publicly subsidised non-profit) child-care facilities is allegedly much higher than the maximum amount of charges imposed on parents all over the country. As a rule, families with low income do not have to pay at all if their children are being given access to public child-care institutions in Germany.

In France as well as in Sweden, the child-care costs effectively charged to parents appear to vary more – in France only slightly, in Sweden significantly – according to family income. Note, that the case of families with no earnings living on social assistance is again not included in this chart because these families do not have to pay for child care in any of these countries or they are assumed not to need any child care.

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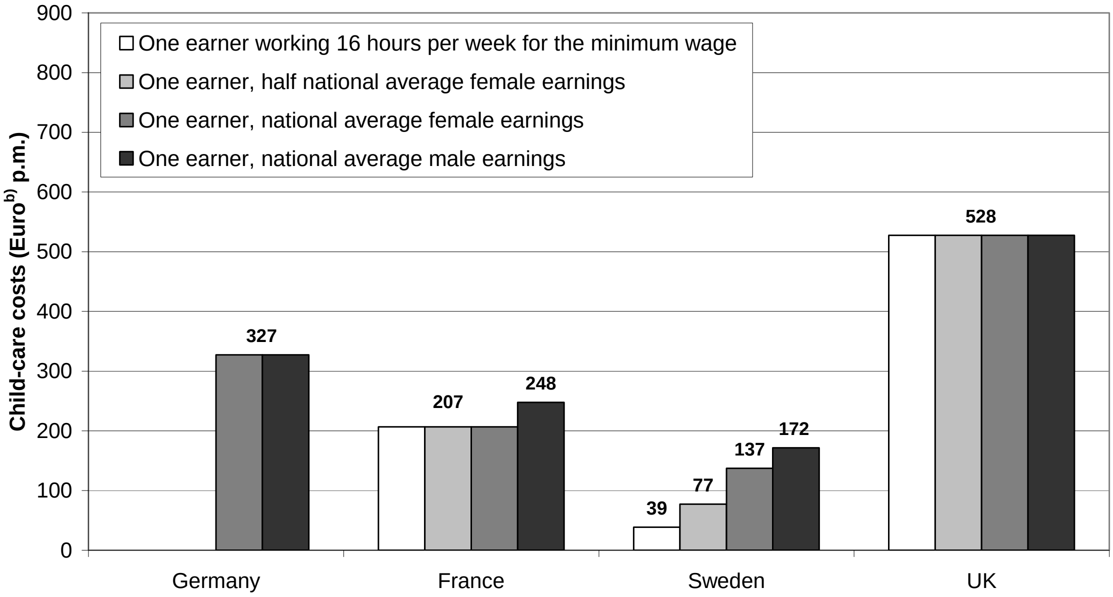
6 In Germany, the provision and financing of child-care facilities for pre-school children is a responsibility of municipalities. Local authorities also decide on the level and structure of fees charged to parents. Hence, the system is very differentiated. The results used here are based on indications of national experts (in the "questionnaires" related to the Bradshaw and Finch 2002 project) and are taken to reflect a reliable average treatment.

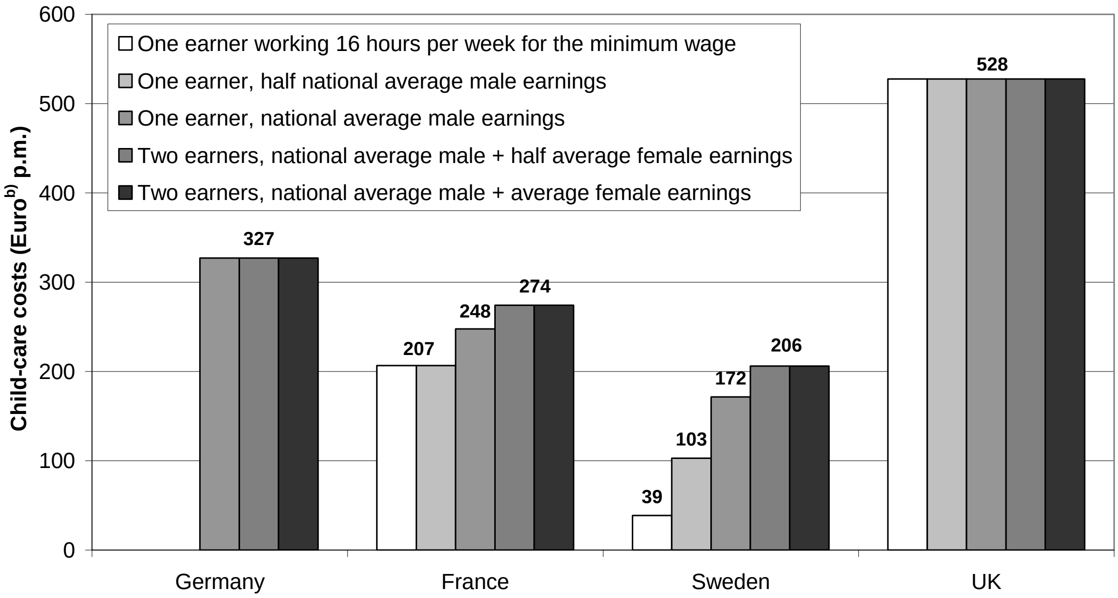
7 This can be seen from the "country matrices" related to the Bradshaw and Finch (2002) study as well as from figure 8.10 below.

Figure 8.10: Costs of full-time pre-school child care[a)] in Germany, France, the UK, and Sweden by parental income (2001)

a) Single parent with one child aged 2 years and 11 months



b) Two-earner couple with one child aged 2 years and 11 months



Notes:

a) After direct and indirect subsidies, but before taxes and benefits.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related “country matrices”.

8.5 Schooling

For several reasons, schooling can be considered an important aspect of national family policies. First of all, giving children access to free public schooling during the entire period of compulsory education and even beyond, as many developed countries do, is in itself a huge public transfer which, by its annual monetary equivalent as well as by its duration, can easily dwarf most programmes of cash benefits and tax allowances targeted at families and children. Second, parents usually face some additional costs when their children attend school, such as expenditure on books, transportation, meals, school uniforms, etc. These costs vary significantly across countries, among other things because there are often additional subsidies involved in expenditure on such items as well as special tax allowances granted to parents with children of school age. Finally, third, for working parents schools can effectively serve as a kind of day-care arrangement for younger children – an aspect that may matter at least at lower educational levels, such as primary schooling and lower-secondary schooling.

Here, we will concentrate on the first and the third of these issues, while we consider the second aspect as being less important compared to the other two.[8] The third aspect is rarely looked at as it is usually dominated by an interest in the amount of public expenditure on schooling and in the quality of educational services delivered to children. Yet, from the point of view of parents, and with potential repercussions on their fertility decisions taken at an earlier stage, the extent to which children are effectively being taken care of while in school at age 6 to 12, say, may be far from negligible.

8.5.1 Public expenditure on schooling

For a broader selection of OECD countries, figure 8.11 indicates total expenditure on educational institutions from both public and private sources as a percentage of GDP. The data illustrated here cover primary, secondary and post-secondary non tertiary levels of education. In the figure, Sweden, the UK, and France all range in the upper half of OECD countries, with relatively high shares of expenditure on education in GDP. Germany is located in the lower half, i.e., among the OECD countries spending relatively little on educational institutions of a non-tertiary level. In addition, the share of private

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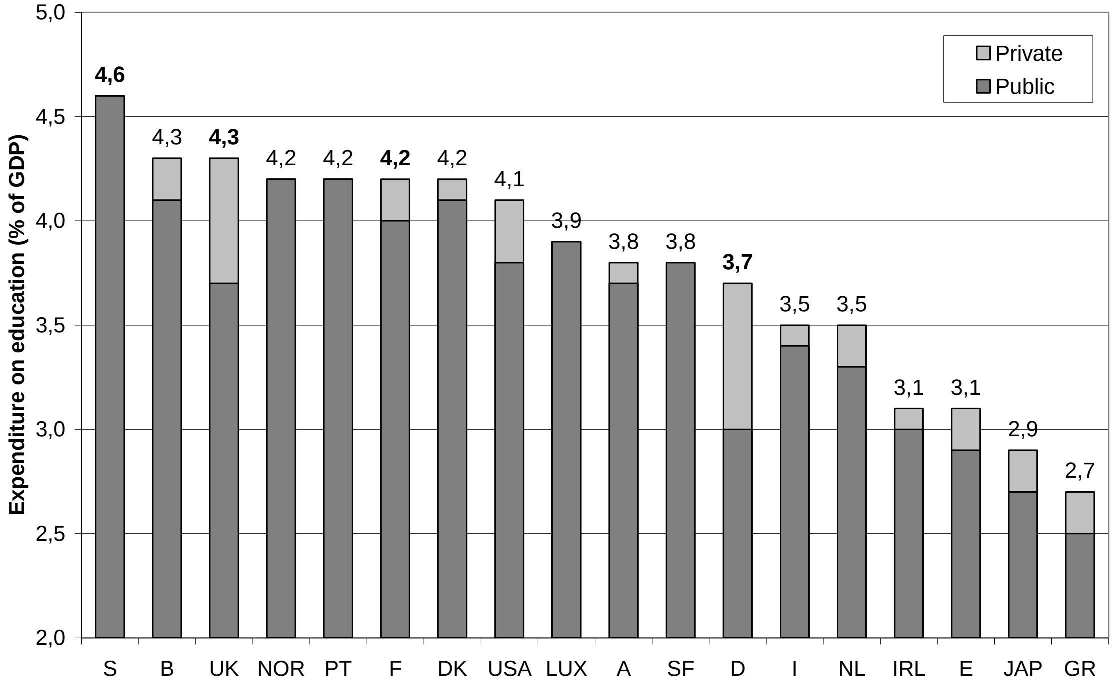
[8] Some amount of information regarding the extra-costs related to schooling is once again collected in Bradshaw and Finch (2002, pp. 90–94). It turns out that, at least in Germany, France, the UK, and Sweden, additional costs of education that parents are faced with are not important. Up to a point, this indicates that there are indeed special subsidies of various kinds granted in these countries.

Figure 8.11: Expenditure on educational institutions[a)] from public[b)] and private[c)] sources as a percentage of current GDP in OECD countries (2002)



Notes:

a) At the primary, secondary and post-secondary non-tertiary level of education.

b) Including public subsidies to households attributable to educational institutions (except in Portugal, Denmark, Luxembourg, and Greece) and including direct expenditure on educational institutions from international sources.

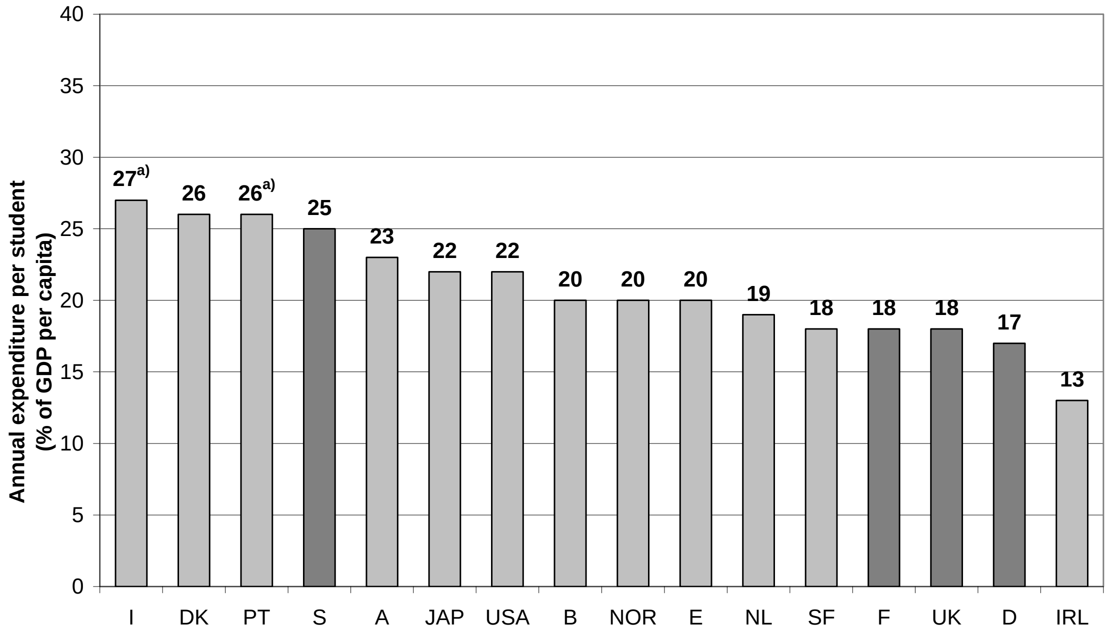
c) Net of public subsidies to households attributable to educational institutions (except in Portugal, Denmark, Luxembourg, and Greece).

Source: OECD (2005c, chapter B).

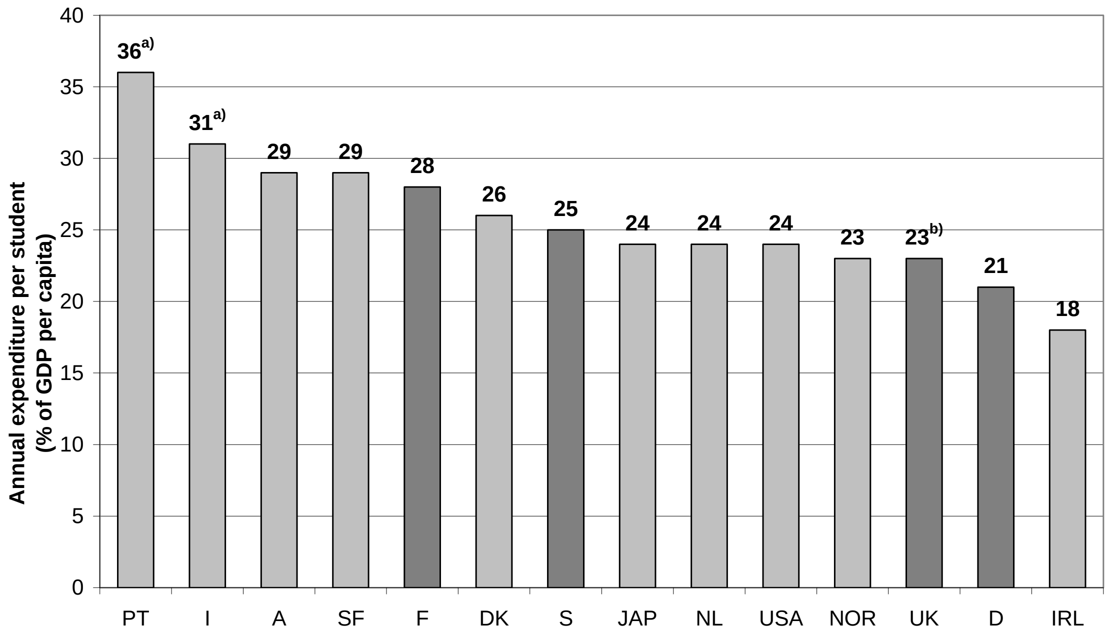
expenditure in total expenditure on educational institutions is the highest among all countries considered here in Germany. This is mainly due to the system of vocational training in private enterprises that is combined with education in vocational schools (duales Ausbildungssystem). In terms of public expenditure alone, there are only three countries which spend less on educational institutions than Germany, namely Greece, Japan and Spain. It is interesting to note that, including Germany, these are all low-fertility countries where there may be substantially fewer youths in education than elsewhere. For closer inspection, one should therefore look at expenditure per student, adjusted for national levels of income as represented by GDP per capita. (In other words, educational expenditure per GDP should be normalised by the relevant student-to-population ratio.) This is what we do in figure 8.12, further differentiating total educational expenditure by levels of education.

Figure 8.12: Expenditure on educational institutions per student relative to GDP per capita in OECD countries, by educational level (2002)

a) Primary education



b) Lower-secondary education



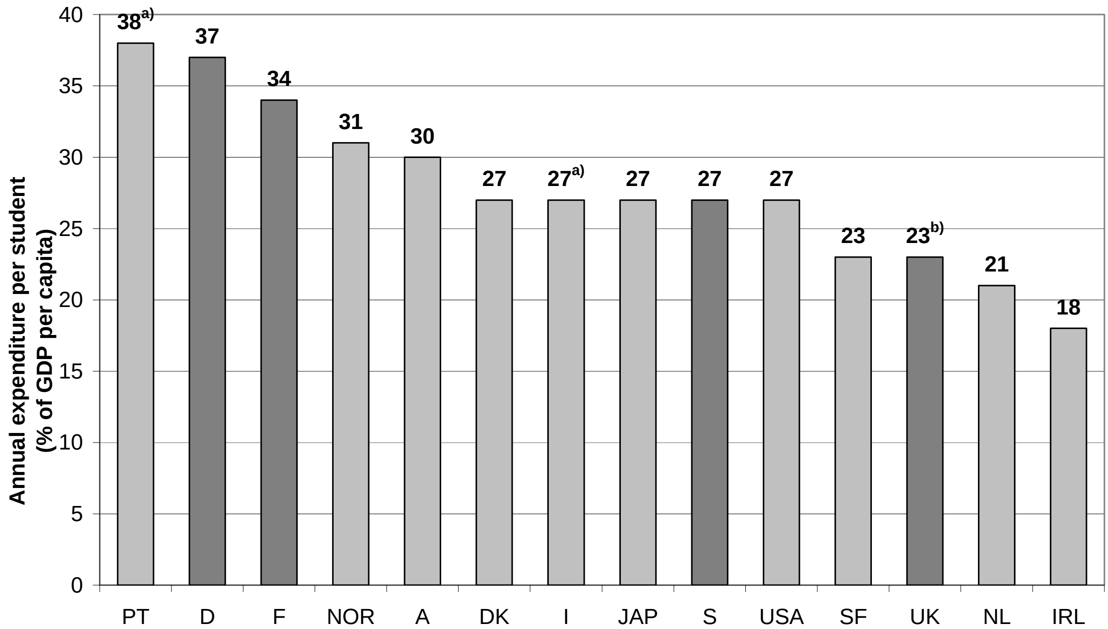
Notes:

a) Public institutions only.

b) Average of lower-secondary and upper-secondary education.

Figure 8.12 (cont'd): Annual expenditure on educational institutions per student relative to GDP per capita in OECD countries, by educational level (2002)

c) Upper-secondary education



Notes:

a) Public institutions only.

b) Average of lower-secondary and upper-secondary education.

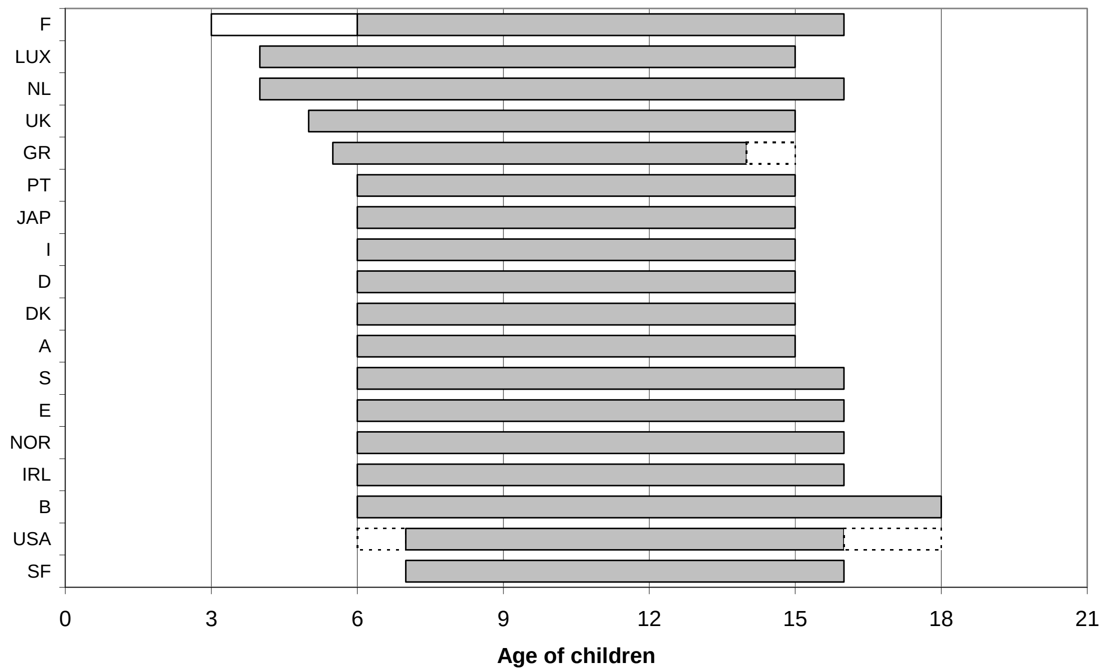
Source: OECD (2005c, chapter B).

Figure 8.12 shows that, at each educational level, annual expenditure per student on primary and secondary educational institutions differs significantly across OECD countries. Measured as a fraction of GDP per capita, it varies by a factor of up to 2. In addition, while the ranking of countries turns out to be a bit different from that obtained in figure 8.11, it turns out that Germany definitely has a relatively low level of educational expenditure per student at lower levels of education. At the primary level, though, expenditure is not much lower in the UK and in France. At the lower-secondary level, expenditure per student increases in France, while an even sharper increase takes place in Germany only at the upper-secondary level. In the UK, expenditure per student remains low at all educational levels covered here, whereas it is relatively flat, i.e., high initially and in a medium range later on, in Sweden. It is difficult to assess these different levels and patterns of educational expenditure per student, as international evaluation studies largely show that there is at best a very weak correlation between expenditure on schooling on the one hand and the quality of outcomes in terms of students' achievements and testable capabilities (see, for instance, Wößmann 2002, 2005). However, what these studies also suggest is that, inasmuch as higher levels of expenditure per student matter at all for explaining better test scores of students, they make a difference only at early stages of the education system. Against this background, the structure of educational expenditure per student may be more appropriate in Sweden than in the other countries looked at here, while the German structure may be the least efficient.

8.5.2 The time spent at school

The time that children spend at school, not only being educated in a way that should contribute to increasing their future productivity and income but also being taken care of in an appropriate environment and spending time with other children, has many dimensions. One is the age span of the period of (compulsory) schooling, another is the time spent at school in the course of a given year or even the course of a regular school day. We will try to shed light at each of these issues in turn.

Figure 8.13: Age of compulsory schooling in OECD countries (2001)



Source: Bradshaw and Finch (2002, p. 78).

Figure 8.13 indicates the regular age span of compulsory schooling in a number of OECD countries. If schooling is considered as a specific form of child care, it is effectively the regular age at entry that matters most. It turns out that age 6 marks the relevant threshold in the majority of developed countries. The age at which children usually enter school is lower than 6 only in five countries, viz. France (age 3 for the école maternelle), Luxembourg and the Netherlands (age 4 in both cases), the UK (age 5), and Greece (age 5 ½). Germany and Sweden both stick to the standard age at entry, and only in some states in the USA as well as in Finland, compulsory schooling starts at age 7. Compulsory schooling lasts until the age of 15 or 16 in most of the countries considered here, that is, well above the age at which children need regular day care. Belgium and some states of the USA are an exception with a period of compulsory schooling that last until age 18. Only in Greece, pupils are under some conditions allowed to leave school when they are only 14 years old.

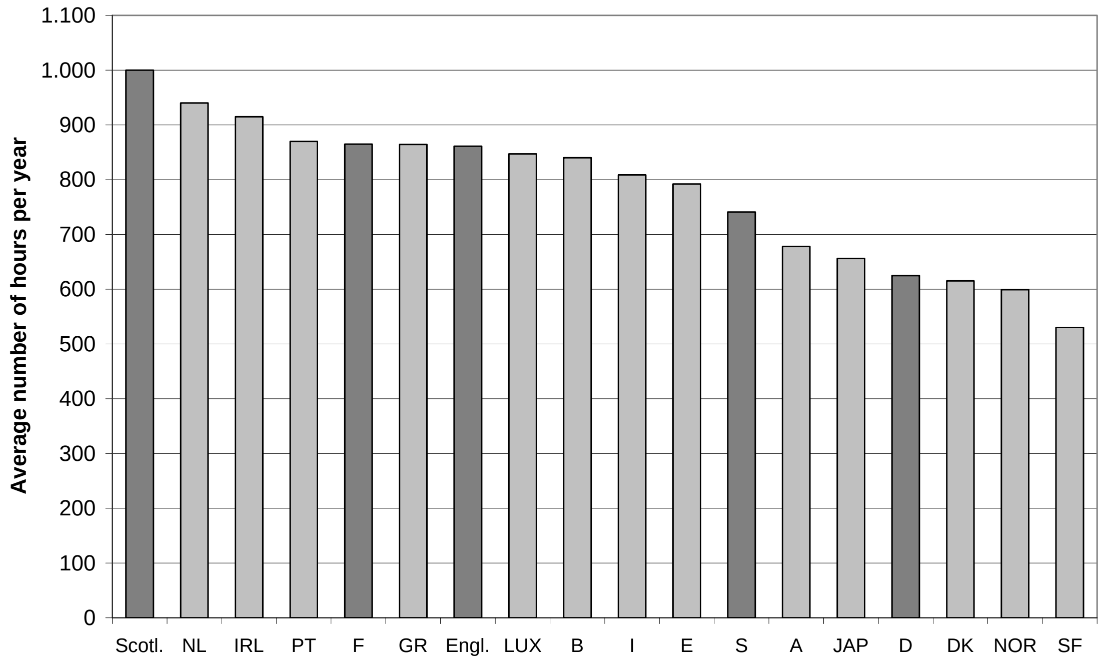
However, the sheer fact that children beyond the age of 6 usually attend school does not fully settle the case for an effective day-care arrangement.[9] The extent to which their parents are available for participating in the labour market, on a part-time or a full time basis, if they wish to do so, is also influenced by the regular length of terms and the regular duration of classes per day. Unfortunately, comparative information regarding these sub-issues is not available. Figure 8.14 summarises pieces of information that are available for a larger set of OECD countries, relating to the average number of hours of instruction time per year in public educational institutions, differentiated by several age brackets of students. The figure concentrates on children aged 7–8 and 9–11 and shows, once more, that there is considerable variation in this combined measure of the length of terms and classes, in particular, with respect to the younger age group covered here. This time, Germany and Sweden tend to range in the lower half, i.e., among the countries with a relative small number of annual hours of instruction, while the UK (represented by its two major parts, Scotland and England) has a relatively high number of instruction hours. In fact, this number is higher in Scotland than in Germany by almost one half (age 7–8: 1,000 against 625) or close to one third (9–11: 1,000 against 780).

These differences are hardly explained by the length of terms or school holidays, or by the length of the school week (including or excluding Saturday). What really matters here is the regular length of a school day. In addition, the role of schools as a “day-care arrangement” is not only represented by the hours of instruction that are offered, but also by institutional provisions for offering a school meal, times of supervised homework as well as times of supervised leisure. Again, reliable information on these issues is largely lacking (partly because these services can be an integral part of the school system or may be provided by separate institutions, at least for a sub-set of students).

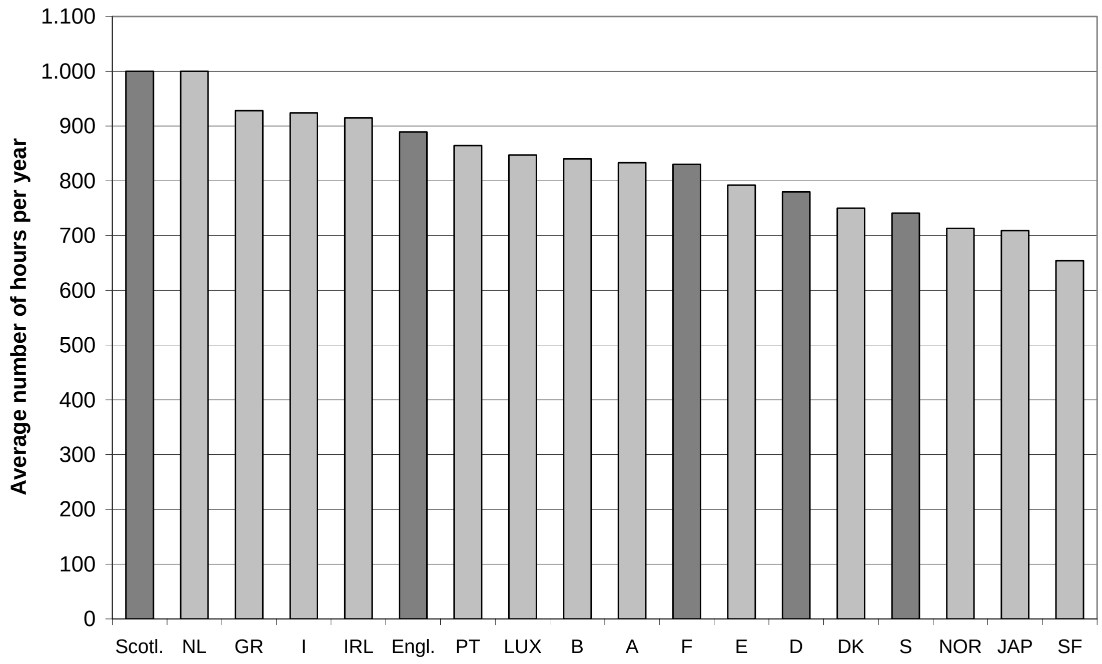
[9] For information regarding child-care arrangements for younger children, see section 8.4.

Figure 8.14: Average number of instruction hours per year in public educational institutions in OECD countries, by age of students (2003)

a) Children aged 7–8



b) Children aged 9–11



Source: OECD (2005c, chapter D).

Yet, it is interesting to note that, among the four countries we are particularly interested in, Germany is the only one where school lessons regularly end around noon and children are expected to return home at this time without being offered a meal. In France, the UK, and Sweden, children usually stay at school for the whole day, i.e., until around five o'clock in the evening.

8.6 Health care

Another important type of benefits in kind that is extended to children or their parents in most developed countries is involved in the provision of health care for children through public health services or public health insurance systems. Cover for health costs of children is usually free of charge in these systems, often implying that parents may have to pay income-related contributions for themselves (and, sometimes, also for an inactive spouse) but do not have to make additional contributions for dependent children. In many cases, children are even exempted from co-payments for prescriptions, hospital care, or out-patient care that have been introduced in many countries over the last decades as an additional way of funding public health care systems and as a means to alleviate moral-hazard problems that are typically involved in insurance arrangements with full cover.

Such co-payments, where they exist and are applicable to children, vary a lot in their size and structure.[10] To obtain a summary measure of effective health costs for children, Bradshaw and Finch (2002) define a standard health package for children and compare the charges typically incurred in its consumption across different types of family households and, ultimately, across countries. For a number of OECD countries, figure 8.15 illustrates the results for the two "baseline" cases of families as defined in section 8.1.

It is easy to see that only in the US, where public health insurance exists only for the poor and for elderly people, the health costs of a child that parents have to pay for correspond to full, risk-oriented insurance premiums. It appears that the amount of public subsidisation of health costs for children is strongly, and to no surprise inversely, related to parental income in the Netherlands, such that parents with higher-than-average income have to pay a notable monthly contribution for health services offered to their child. In all the other countries covered here, effective health costs for children are negligible (for instance, in France, where there are low, income-related co-payments even for children) or entirely absent (among others, in Germany, the UK, and Sweden).

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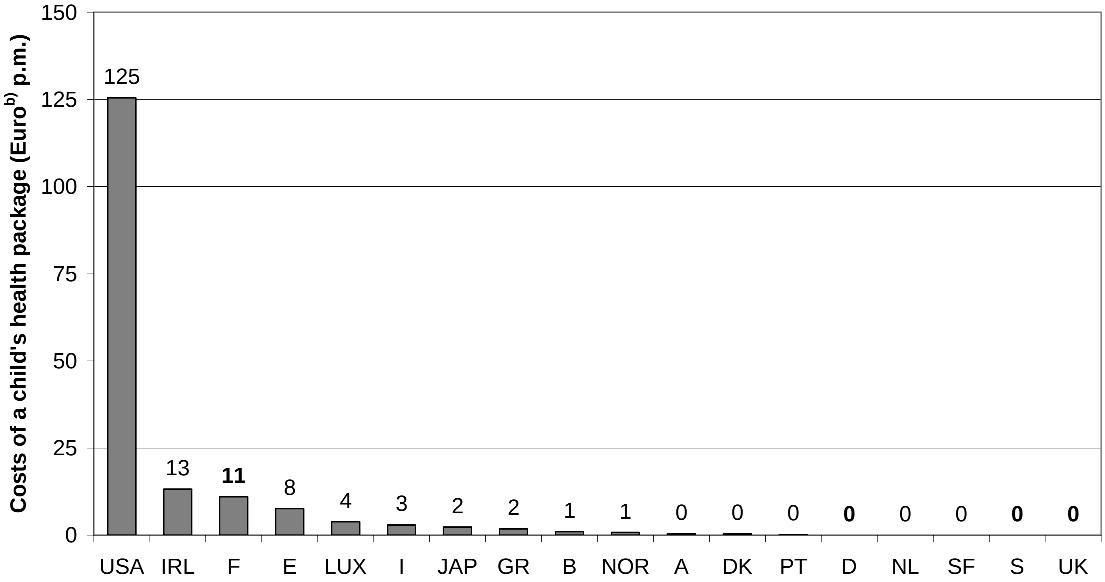
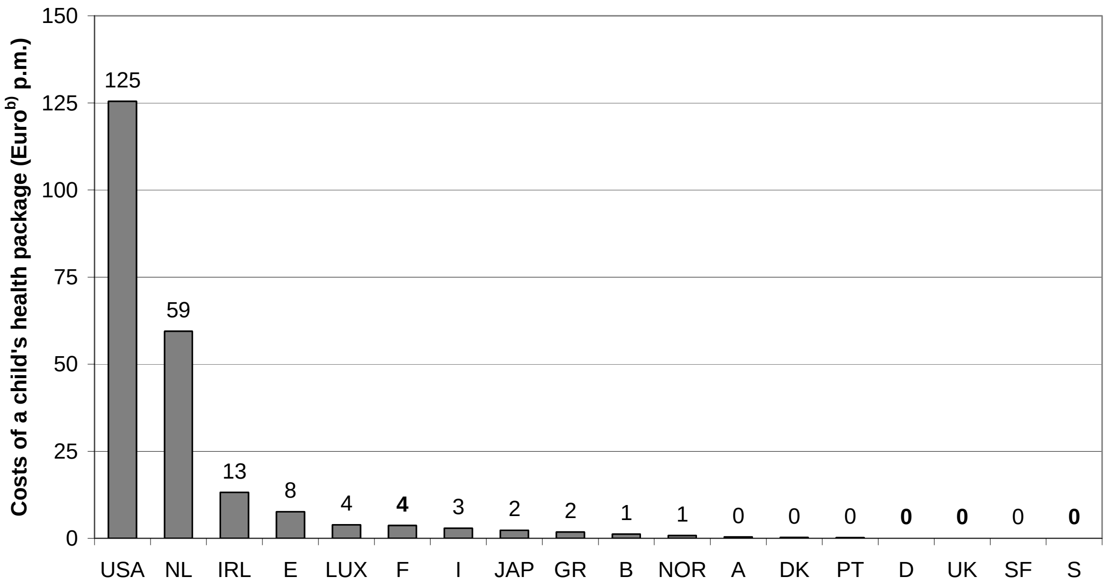
[10] For a brief survey, see Bradshaw and Finch (2002, chapter 6, especially tables 6.1 and 6.2).

Figure 8.15: Charges for health costs of children[a)] in OECD countries (2001)

a) Single parent with one child aged 7, at national average female earnings



b) Two-earner couple with two children aged 7 and 14, at national average male earnings plus half national average female earnings



Notes:

a) Calculated as difference between health costs (related to a standardised health package) for a single parent with one child and a single adult or for a couple with one child and a childless couple, respectively, with the same level of household income in both cases.

b) Original results are in national currency units; converted into € using official conversion rates of the ECB for Eurozone countries, OECD purchasing power parities for non-Eurozone countries.

Source: Bradshaw and Finch (2002), plus information taken from the related “country matrices”.

It should be noted, however, that subsidised health care services for children do not necessarily convert into genuine net benefits accruing to these children over their entire life cycle. In virtually all systems of public health services or public health insurance, children must be expected to start paying for their health care costs through taxes or contributions (related to income or earnings, rather than to the relevant risk) as soon as they enter employment. As a rule, they will then pay off within short time the "loans" they have received in terms of subsidised or free health care while they were children. In addition, they will also have to pay for the health costs of elderly people at this stage, as these do nowhere pay taxes or contributions that would be sufficient to cover their current health costs.

Given the overall pay-as-you-go nature of the relevant financing mechanisms and the fact that health costs usually increase very sharply at higher ages, the effective stream of net payments occurring within a typical public health care system over the entire life cycle of a given individual is very similar to that involved in a public pay-as-you-go pension scheme – except that some amount of benefits already accrues before the individual starts making contributions. A priori, it is unclear whether the life-time balance of all benefits received and all contributions made in such schemes, all assessed in terms of net present values, will ultimately leave the individual with a net benefit or a net burden. For the case of Germany and of a child born today, however, it has been demonstrated, based on a careful projection of the effects of the current legal framework into the future, that the total effect is unambiguously negative from the child's point of view (see Werding and Hofmann 2005, section 4.1 b).[11] In other words, even if a public health care system offers health services free of charge for children, it may effectively create a net fiscal burden for families and children,[12] partly off-setting the positive effects of many other programmes of national family policies or even rendering a negative total effect of all fiscal instruments applying to children.

8.7 Public pension schemes

Other very important candidates for fiscal instruments that are highly likely to create a net burden, not a benefit, for families and children are given by pay-as-you-go financed

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[11] By a parallel reasoning, one could of course argue that children also pay for child-related monetary benefits, child-care facilities, etc. at later stages of their life cycle, through the universal pay-as-you-go system of the general government budget. However, simply by the timing of these benefits and any "related" tax payments

[12] Note that parallel results for other countries, especially those that are hit less strongly by the fertility decline and demographic ageing, may not be equally likely to show a negative sign.

public pension schemes that are widely used throughout the OECD world. This has been mentioned already in chapter 4 (see, in particular, section 4.4), and the negative impact of pay-as-you-go public pension schemes on fertility that has to be expected as a consequence has been shown to exist in the empirical analyses presented in chapter 6.

Here, we will take a closer look at the size of the fiscal externalities that drive this effect in the four countries we are particularly interested in in part II of the present study, i.e., in Germany, France, the UK, and Sweden. For the same set of countries we will then also address a distinct type of child-related benefits, namely additional, non-contributory pension benefits for parents that have grown in scope during the last two decades and meanwhile exist within the public pension schemes of quite a number of developed countries.

8.7.1 The tax implied in public pension schemes

In a sense, pay-as-you-go public pension schemes are funded, not through an accumulated stock of financial capital or through claims on returns to physical capital derived from a long-term process of saving and investment, but through the human capital embodied in the next generation of tax-payers and contributors. Rearing children, investing in their future earnings capacities, and creating an economic environment in which they will find appropriate employment opportunities are thus the major provisions of a generation who is currently active for being able to receive an adequate pension at old age.

At the same time, pay-as-you-go public pension schemes almost inevitably involve a fiscal burden for all their members who have paid contributions over the entire course of their active period of life before they are entitled to draw pension benefits. The reason is that, at least for an average individual,[13] contributions made to such schemes are converted into benefit entitlements based on an internal rate of return that must be expected to be lower than the market rate of interest applied to calculating present values of any of these payments. (In theory, this is required by the so-called “Aaron condition”, with reference to Aaron 1966, making sure that the economy considered is “dynamically

[13] This is where pension schemes in the competing traditions of Bismarck (with a strong tax-benefit that is operative for each individual covered) and Beveridge (with benefits that are basically uniform for all individuals) differ. In schemes of the former type, the above reasoning applies at an individual level. In schemes of the latter type, it is true only for individuals with average earnings, while low-earners benefit from the redistribution of income involved in the combination of earnings-related contributions and flat-rate benefits and high-earners have to pay for it. For more details, see Fenge and Werding (2003, 2004).

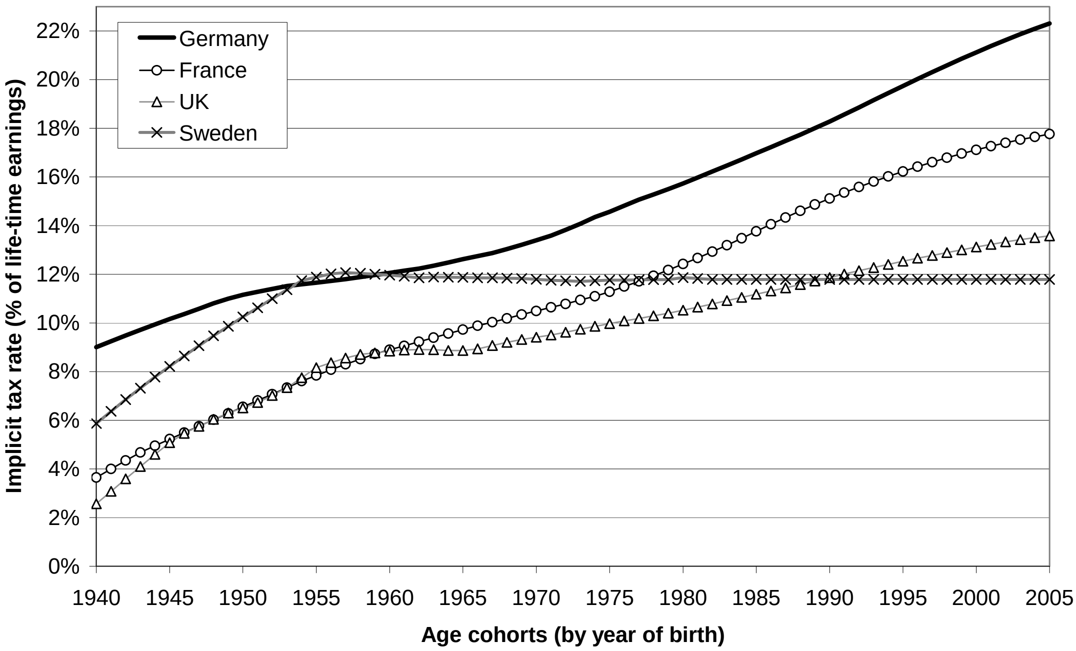
efficient", see Abel et al. 1989). In other words, the present value of benefits is usually considerably smaller than the present value of earlier contributions. As membership in public pension schemes is mostly compulsory and contribution rates are part of the fiscal system of countries running such schemes, it is straightforward to call the resulting financial loss involved in the pay-as-you-go financing mechanism an "implicit (wage) tax" (see Thum and Weizsäcker 2000, Fenge and Werding 2003).

Closer inspection reveals that this tax is a burden that has to be imposed on each new young generation as long as the pay-as-you-go public pension scheme continues to exist in order to pay for the "inaugural gains" that the first generation of pensioners has enjoyed when the system was established (Sinn 2000). Here, the reason is that these individuals were entitled to receive pension benefits that the new scheme started paying out at once, without haven paid contributions to the scheme (over the entire course of their active life span). These inaugural gains effectively create an implicit type of public debt (representing future benefit entitlements related to contributions that have been used to finance for these early benefits) that is then continuously rolled over from one generation to another and kept within reasonable limits precisely through the implicit tax levied from all subsequent generations.

The existence of an implicit tax involved in pay-as-you-go public pension schemes for all those who participate on a life-long basis, first as contributors, then as pensioners, is thus a universal feature. The tax is there even in the case of a stationary or stably growing population and a pension scheme with a constant contribution rate, if only the interest rate (r) exceeds the internal rate of return of the scheme, which is then equivalent to the respective economy's rate of payroll growth ($\rho = (1+g)(1+n) - 1$, i.e., productivity growth g combined with the growth rate of the active population, n). Under these circumstances, its ("steady-state") size can easily be measured as a percentage of (average) earnings and is determined by the difference between r and ρ and by the contribution rate applied, that is, by the generosity of the pension scheme (see, again, Fenge and Werding 2003, 2004). This implicit tax rate increases in the course of demographic change (n becomes smaller) – at least for some generations involved in the resulting transition process, with a change in the age structure of the population – and can differ a lot across generations and countries because of the precise way in which the transition is handled. In particular, if contribution rates are increased in order to keep the level of pension benefits constant, a new pay-as-you-go scheme is effectively placed on top of the existing one, giving rise to new inaugural gains for those who are currently old and increasing the tax rate imposed the young and all future generations.

In a paper that deals with the impact of differing institutional arrangements, all within the dominant pay-as-you-go variety of public pension schemes, and with different strategies for coping with the consequences of demographic change, Fenge and Werding (2004) have assessed the levels and changes of implicit taxes involved in the national pension schemes of selected OECD countries for all age cohorts born between 1940 and 2000. The results for Germany, France, the UK, and Sweden, all expressed as tax rates in percent of life-time earnings of average individuals in each of these cohorts and extended to include those born until 2005, are summarised in figure 8.16.

Figure 8.16: Implicit taxes involved in the public pension schemes in Germany, France, the UK, and Sweden (2003 legal framework)



Note:

For each age cohort, the "implicit tax rate" is defined as the difference between the net present values of life-time contributions and life-time pension benefits (accruing in cases of early disablement, at old age as well as to survivors), divided by the present value of life-time gross earnings. The calculations are based on a stylized biography of an "average individual" and on long-run financial projections for each of the national public pension schemes covered that were prepared using the CESifo Pension Model.

Source: Fenge and Werding (2004, p. 167).

Without going into too much institutional detail[14] we can conclude from this figure that, among the countries considered here, the level of implicit tax rates that is imposed on

[14] Those who are interested in such details are referred to Fenge and Werding (2004).

those born currently is nowhere as high as in Germany.[15] This is largely a result of German pension policies that, until very recently, were meant to keep up the (relatively high) level of pension benefits as much as possible, in spite of the effects of relatively strong demographic change (see section 7.1), while accepting large increases in contribution rates projected for the future.

Faced with similar, yet less dramatic, problems, the UK and Sweden have made larger adjustments in their national public pension schemes at an earlier stage. In the UK, for instance, (flat-rate) State Basic Pensions paid out by the British National Insurance and a number of further parameters of the scheme have only been indexed to prices in annual upratings, not keeping track with real earnings growth, that is, for about two decades since the early 1980s. Starting from 2002, the British government has now basically returned to earnings-upratings in order to preserve an adequate minimum level of basic pensions. Following a longer period of discussions, the Swedish have entirely reorganised their public pension scheme in 1998 fixing, among other things, the contribution rate in a credible way at its current level from the year of 2000 onwards. As a consequence, the profiles of implicit tax rates, which still show some of the inaugural gains in terms of lower tax rates falling on the early age cohorts covered in figure 8.16, show much more moderate increases (in the case of the UK) or next to perfectly level out (in the case of Sweden), indicating that the amount of intergenerational redistribution from the young to the old involved in the national pension schemes of both countries is far more limited than in Germany.

Only in France, the time profile of implicit tax rates is basically similar to the German one, albeit at a lower level throughout and with a weaker upward trend for the youngest age cohorts covered in figure 8.16. The lower level is mainly due to the fact that the French public pension scheme, the Régime Général, has a lower level of benefits (as it is augmented by a parallel system of mandatory, employer-based "second pillar" pensions for most employed individuals). The slightly weaker upward trend is a result of more favourable demographics (again, see section 7.1), while far-reaching adjustments

[15] Through further reductions in future benefit levels and the resulting moderation of the expected increase in contribution rates, the most recent pension reform enacted in Germany in 2004 should have dampened the increase in implicit tax rates for all generations born from around 1975 onwards, while implicit tax rates for those born earlier should now have become higher than in the year-2003 legal framework. Reform with similar effects have not been taken since in any of the other countries. Yet, as the effects of the 2004 reform are rather strong, probably stronger than what could be reasonably expected a few years age, the German tax profile displayed in figure 8.16 is what may effectively have contributed to shaping fertility decisions taken in Germany during the last three decades.

of the French public pension scheme in the face of demographic change are also largely absent in France, just as they have been in Germany for a very long time.

As was argued in section 4.4, the implicit tax that each young generation who participates in a pay-as-you-go public pension scheme has to pay creates a fiscal externality of rearing children that may feed back on parental fertility decisions. The reason is that, under a mandatory pay-as-you-go pension scheme, the decision to give birth to a child leads to positive effects for the rest of society because the contributions to the pension scheme that a child would make in the future are shared among all members of the parents' generation, while the parents themselves are expropriated to a large extent of a potential source of old-age support that they could receive from their own children. The negative impact on fertility that results from this type of public intervention could of course be off-set by other fiscal instruments, such as monetary child-related benefits, subsidised public child-care, and public schooling discussed here before. Yet, given the size of public pension schemes and the amount of other intergenerational transfers involved in public health-care systems etc., this may actually not happen in reality.

For instance, in a recent study that focuses on Germany, Werding and Hofmann (2005, section 4.1 a) estimate the implicit tax, or the fiscal externality, involved in the German Statutory Pension Scheme for an average child born today (i.e., in the year of 2000) to be € 139,000 when measured as a year-2000 net present value. The total effect of the German social insurance system is a fiscal externality of € 241,000 (of which € 70,000 are related to the public health insurance, in spite of the benefits accruing to children in this scheme, see section 8.6). Together with income taxes and consumption taxes that the child can be expected to pay over his or her entire life cycle, and deducting the net present values of all kinds of tax-financed benefits (including measures of family policies in a narrow sense, public schooling and higher education, etc.), they find that an additional child leads to a total fiscal net externality of about € 77,000 in the current German tax–transfer system (see Werding and Hofmann 2005, section 4.4). In other words, the effects of the system of pay-as-you-go financed social insurance effectively turn over all the positive effects of child-related benefits that are also involved in the overall fiscal system. It has already been mentioned that parallel results for other countries are likely to be less extreme. But in any case, countries that are operating large and generous social insurance systems and, in particular, public pension schemes can effectively engage in making "family policies with a negative sign" of a substantial order of magnitude that must taken into account when assessing and comparing national systems of child-related benefits.

8.7.2 Child-related benefits involved in public pension schemes

Over the last two decades, many developed countries have amended their public pension schemes with a new type of "non-contributory" benefits, related to the number of children that the pensioners have raised or, more narrowly, to periods of non-participation or part-time work that were due to child-care activities. The motivation for introducing such benefit entitlements, it appears, has been twofold. Rewarding parents, especially mothers, for having children can be meant to off-set, at least partially, the negative fertility incentives that are generally involved in pay-as-you-go public pension schemes (see sections 4.4 and 8.7.1). Linking extra-benefits for parents to periods of parental leaves can also be meant to compensate the individuals affected, to some extent, for the losses in regular benefit entitlements that often result from any gaps in the individuals' work records. At least, this latter aspect usually ranked high in public debates in those countries that have adopted this kind of policy, even though it is not entirely appropriate.

If, as was argued above, pay-as-you-go public pension schemes regularly involve an implicit tax for those who participate in such schemes, those who do not pay contributions for a certain period of time should be considered to enjoy an advantage, rather than to suffer from a loss. This argument fully applies to individuals who, due to specific details of membership rules, are able to earn an income that is not subjected to compulsory contributions, as the money that they save by evading the implicit tax is then available for alternative uses. Those who stay outside the pension system by staying out of the labour market, for instance, during a parental leave, do not have an equivalent monetary gain. The money they save simply is not there. More precisely speaking, individuals who take a parental leave suffer a financial loss in terms of all the income that they do not earn in the relevant period which is limited, through lower taxes and social insurance contributions, to the amount of net earnings forgone. (In this sense, there is a small financial advantage involved in avoiding the implicit tax involved in the pension scheme even for these people: the wedge between gross earnings and net earnings that is partly due to the implicit tax effectively reduces their financial losses, i.e., their opportunity costs.) However, from an economist's point of view, the loss in net earnings is part of a broader picture in which potential parents choose to have a child if they are (more than) compensated for all kinds of costs involved by the increase in their utility derived from the same child. For children who are actually born, there is thus no special compensation needed for any pension benefits foregone or other, similar financial "losses". Yet, as the balance of costs and benefits related to having a child may be different for different individuals, offering child-related extra-pension benefits in an otherwise unconditional way, or so that they further reduce the opportunity costs of child-rearing, can be a means for stimulating additional births just like conventional child-related monetary benefits and other transfers that we discussed in earlier sections of this chapter. Given this clarification, we can now review the special rules regarding child-related pension benefits that have been implemented in Germany, France, the UK, and Sweden and highlight their main effects.

a) Germany

In the German Statutory Pension Scheme, child-related benefit entitlements were introduced in 1986 and have since then be expanded more than once. Currently, mothers or fathers (in any case, just one parent) are credited additional benefit entitlements that are equivalent to regular benefits derived from paying contributions on average earnings for three years after a child is born. These extra-benefits add to regular entitlements acquired during the same period as long as total benefit entitlements do not exceed the equivalent of the annual upper earnings threshold at about twice the amount of average earnings. In addition, since 2002, regular benefit entitlements acquired during the first ten years after a child is born are increased by up to 50% based on a complicated, highly redistributive formula. The effect is zero if either earnings in this period (hence, regular benefit entitlements) are zero or if earnings are higher than average; the effect is strongest for mothers or, alternatively, fathers with low wages and/or in part-time work who earn exactly two thirds of average earnings.[16] At the same time, based on the child-related benefit entitlement linked to the first three years alone, a parent can qualify for a low-level pension by just raising two or more children even if he or she has never paid regular contributions.

b) France

In the French Régime Général, there are also several special rules applying to mothers or fathers who have raised children, some linked to having taken a parental leave and some not. Since 1974, the number of years of contributions is artificially increased by two years per child for mothers (starting from 1972, the increase was one year per child for mothers of at least two children; nowadays, the augmented rule can also apply to

[16] Starting from the same year, survivor benefits have also been made partly contingent on the number of children raised. There is yet another aspect by which periods with child-care obligations can make a difference for benefit entitlements of individuals with very fragmented work records in the German public pension scheme. Up to ten years per child can be "disregarded" when calculating average annual contributions that are used to value certain types of non-participation spells (spent, for instance, in training or unemployment).

fathers, but again to just one of the two). In principle, the rule is effective regardless of whether the parent affected has worked or not during the first two years after a child is born. However, as the amount of extra-benefits that can be earned under this rule is contingent on the actual number of years with contributions and on average wages earned during this period, benefits for parents who actually withdrew from the labour market for a longer period of time can be rather small. The same applies to an additional 10%-increase in benefit entitlements for mothers who have brought up three or more children, implying once more that measures of family policy in France are especially targeted at families with higher numbers of children. Also, there is another special rule giving rise to higher benefit entitlements for mothers earnings very low wages that requires some amount of labour-force participation and is strongly increasing with higher numbers of children.

c) United Kingdom

The UK offers the example of a country where special child-related pension benefits are largely absent. (To be sure, the British National Insurance offers orphans' pensions for under-aged children and higher benefits for survivors who have to take care of dependent children, but apart from these contingencies that are also covered in virtually all the other countries looked at here, there are no special rules of the type we are particularly interested in in this section.) Of course, State Basic Pensions are basically not earnings-related, but only adjusted pro rata temporis to the length of the individual work record. To qualify for a basic pension at all, the number of years covered with contributions must exceed 11, while for a full basic pension, 44 or more years of contributions are required. The only special rule applying to parents is that the number of years with contributions needed to qualify for a full basic pension can be reduced to a minimum of 20 years if the other years were spent in a number of specified "home responsibilities", where taking care of children ranges as a prominent type of relevant responsibilities. As an alternative, the British public pension scheme offers spouse benefits of 60% of a full basic pension for married individuals who do not qualify for higher benefits based on their own work records, irrespective of whether they have raised children or not. In many cases, this regulation that is not specifically targeted at parents over-rules the effect of the home-responsibilities rule.

d) Sweden

The Swedish public pension scheme, by contrast, now includes a considerable amount of child-related extra-benefits for parents. Following the most recent pension reform, the potential for gaps to arise in regular benefit entitlements for individuals with fragmented work records was substantially increased. To counter this effect, Sweden has introduced a very flexible scheme of imputing additional benefit entitlements to individuals with children that offers a differentiated set of options that are applied according to which one implies the strongest effects in each individual case. For four years after a child is born, one of the parents can be credited benefit entitlements that correspond to those he or she has acquired during the last year before the child's birth. For those with low previous earnings, the benefit entitlements credited at least amount to 75% of those derived from current average earnings. Those who continue to work or return to work earlier can enjoy a top-up of their regular entitlements by about 20% of those with average earnings. All these methods can be used alternatively for each of the relevant years and for either the mother or the father, depending on who acquires the lower amount of regular entitlements in a given year.

e) Cross-country comparison of the effects

Child-related pension benefits are so far mostly neglected in comparative work on measures of family policies applied in different countries. To compare the effects of the different rules that are embedded in very different pension schemes, one needs a simple summary measure of changes in benefit entitlements that result from having children and spending time taking care of them. Furthermore, this measure should be assessed within a stylised setting using harmonised assumptions which, at the same time, allow for sufficient differentiation in order to highlight the characteristics of the different arrangements reviewed above. Building on Cigno and Werding (2006, chapter 4), we will therefore concentrate on looking at percentage changes in life-time pension entitlements of (married) mothers with different patterns of labour-force participation and different numbers of children that are due to the rules described above. To put the results obtained into a perspective, i.e., to create an impression of their dimension, we will confront them with changes in regular benefit entitlements of mothers that are mainly due to the corresponding reductions in labour-force participation. In other words, we will also demonstrate the extent to which child-related extra-benefits effectively compensate for losses in regular pension benefits, even if this is not necessarily a meaningful ultimate goal of such policies. In each case, the relevant benchmark is given by the benefit entitlements of a childless (married) woman with average earnings and a complete work record in any of the pension schemes under consideration.

As a common background for all of the results presented in the following, we will use an age-related earnings profile for women who participate in the labour market working full-time throughout their active period of life.[17] Also, we will define a set of scenarios for the labour-force participation of women who become mothers (of one child), ranging from a complete "withdrawal" from the labour market to a "no-leave" scenario with continued full-time work. As intermediate solutions, we also consider the cases of a "standard leave" (i.e., the stylised pattern most often chosen by German mothers,[18] with three years of a parental leave, three years of part-time work at 50% of a full-time workload, and another five years of part-time work at 75%), an "extended leave" (with six years of a parental leave and five years of part-time work at a 50%-workload), and a "short leave" (one year of a parental leave, two years of part-time work at 50%, and another three years of part-time work at 75%).[19] Furthermore, we will also look at the consequences for pension benefits accruing to mothers having more than one child (assuming that the births follow each other at three-year intervals and that the "standard-leave" pattern will therefore include six or nine years of a full parental leave in the cases of two or three children, respectively).

In all of the cases considered, i.e., for mothers as well as for the "benchmark" women without children, we also include "regular" entitlements to receive spouse benefits (offered in the UK) and survivor benefits (granted in all the four countries considered except Sweden), taking into account how they interact with own, non-derived benefit entitlements. For married women with periods of non-participation, these types of benefits usually off-set part of the reduction in benefit entitlements that are purely related to the women's own work records or earnings, but they are typically not linked to child-care activities, hence not accounted for as additional "child-related" benefits (here, the exception is Germany where we have to differentiate between survivor benefits granted to all women and a top-up that is linked to the number of children raised).

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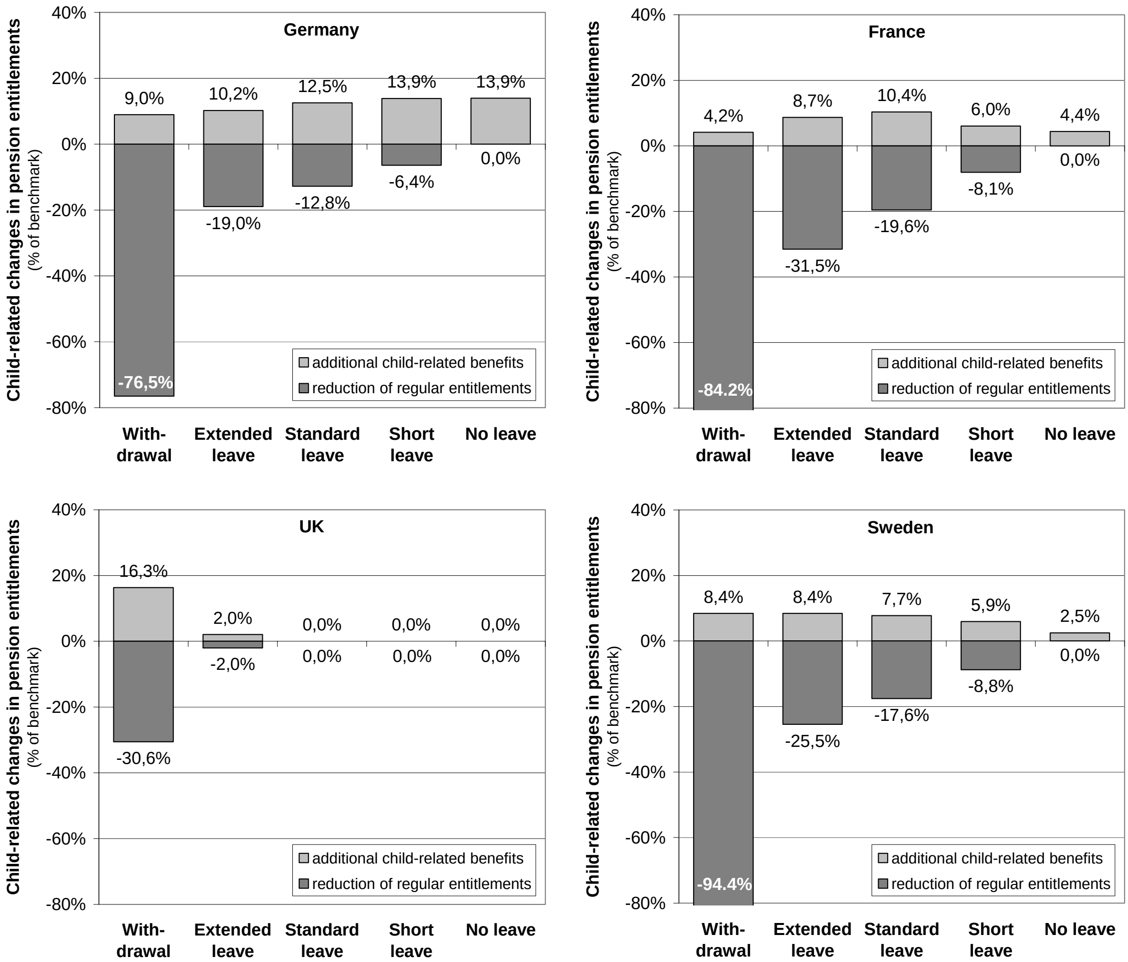
[17] The wage profile that is actually used here is based on German micro-data taken from the German Socio-economic Panel (G-SOEP; see Fenge et al. 2006 for further details). It has been used in this study for illustrative purposes already at an earlier stage (see chapter 5, epecially figure 5.1). The underlying assumption is that its basic structure, with annual wage earnings of women measured as a percentage of national average wages, is applicable also to other countries.

[18] This has been shown by Beblo and Wolf (2002) using the same data set as in Fenge et al. (2006).

[19] What is considered here to be a "standard" pattern of restricted labour-force participation of mothers in Germany may not equally apply to the other countries. In Sweden and in the UK, periods of parental leaves tend to be shorter than in Germany; in France, the same may be true for the average leave taken per child, while the average number of children is considerably higher as in Germany (see chapter 7 , in particular figure 7.7). But in any case, this possible variation is covered here through the definition of alternative scenarios.

Figure 8.17: Child-related pension benefits in Germany, France, the UK, and Sweden by alternative work records of mothers (2005 legal framework)



Sources: Cigno and Werding (2006, section 4.2).

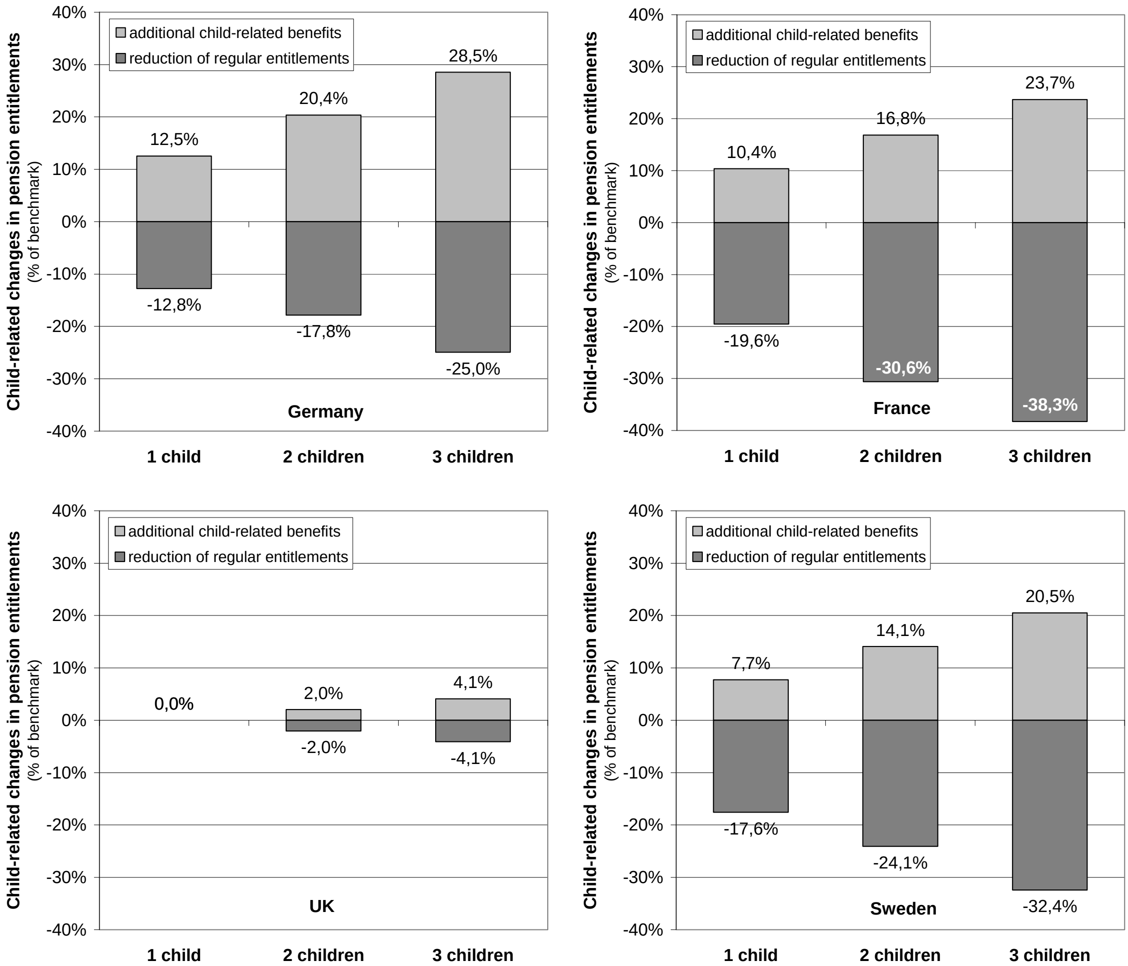
Figure 8.17 summarises the changes in life-time pension benefit entitlements that are a result of giving birth to one child under the varying assumptions regarding labour-force participation of mothers and under the different pension arrangements applied in Germany, France, the UK, and Sweden (compared to a childless woman who continues to work full time throughout her active period of life). It is easy to see that the losses in regular benefit entitlements associated with all variants of a reduced labour-force participation of mothers are much more pronounced in "Bismarckian" pension schemes that are based on a strong tax-benefit link, that is, in Germany, France, and Sweden, than in a "Beveridgean" system with benefits that are basically a flat rate, such as in the UK. British women who do not participate in the labour market in a substantial way are entitled to receive non-contributory spouse benefits. Together with the "home-responsibilities” rule applying to periods of child-rearing, only mothers who completely withdraw from the labour market upon a child’s birth are faced with a reduction in their total benefit entitlements at all. In the case of an “extended” leave, the total effect is already zero, partly because of the time allowed for home responsibilities. In all other cases, regular benefits are unchanged, and there is no effect of special child-related measures.

In Germany and France, the consequences of completely withdrawing from the labour market are alleviated through survivor benefits that are based on the husband’s pension contributions. In Sweden, where there are no survivor benefits, women with a complete withdrawal are left with the very small benefit entitlements they have accumulated during a few years of labour-force participation before their child was born. In non of these cases, the reductions in regular benefits are off-set by child-related benefit entitlements. In the “Bismarckian” countries, scenarios that are base on less extreme assumptions regarding the length of parental leaves all lead to reductions in regular benefit entitlements. However, these are off-set, sometimes even more than that, through additional child-related elements of the relevant benefit formula.

What is most interesting here, are the different national patterns of these child-related benefit entitlements over the different scenarios of maternal labour-force participation. It was already explained, that the British “home-responsibilities” rule is especially targeted at mothers with very short work records, hence very low life-time earnings. The Swedish rules also imply a pattern that is declining in the length of a mother’s work record. However, it does so only moderately for women with a “standard” or a “short” leave, and it still leaves women who take no leave at all with a small amount of additional benefits. In France, the pattern is first increasing and then declining, thus especially encouraging an intermediate length of the parental leave. Again, there is also a small net effect for pension benefits of mothers with no leave. Germany, by contrast, has established a pattern of child-related pension entitlements that is basically increasing in the length of the mother’s work record. The differences in these entitlements between mothers who completely withdraw and those with no leave are however small.[20] Another observation is that, in Germany, the reduction in regular benefit entitlements is already off-set for women with a “standard” leave, while women with more complete work records receive a substantial net transfer through additional child-related benefits.

[20] Note that the result that mothers with only a short leave or no leave at all receive the highest amounts of child-related pension benefits is true only for women earning average female wages. Women with no leave and high earnings that approach the upper earnings threshold can in fact end up receiving none of these special benefits as their regular entitlements already reach the relevant ceiling.

Figure 8.18: Child-related pension benefits in Germany, France, the UK, and Sweden by the number of children (2005 legal framework)



Sources: Cigno and Werding (2006, section 4.2).

Figure 8.18 shows the changes in life-time pension benefit entitlements that are due to reduced labour-force participation (according to the "standard leave" scenario) and additional child-related benefit entitlements for mothers of one, two, or three children, respectively. In the case of the UK, neither the effects of shorter work records nor the impact of the "home-responsibilities" rule applying to periods of child-rearing appear to be very important. By contrast, for the same reasons as those explained above, both these aspects are indeed important in the other countries covered here. Again, the amount of child-related extra-benefit entitlements appears to be most significant in Germany, basically off-setting the parallel losses in regular benefit entitlements in all the cases covered. At the same time, child-related benefits are increasing in a less-than-proportional fashion with the number of children in this country, while the increase is largely linear in France and in Sweden. This latter aspect indicates that child-related elements involved in national public pension schemes create stronger incentives to have a higher number of children in these countries than they do in Germany – an observation that is fully in line with what he have seen with respect to other child-related monetary benefits (see section 8.1).

The overall conclusions that can be taken away from this brief survey of new child-related pension entitlements are the following. The UK State Basic Pension scheme is essentially designed to accomplish poverty relief at old age, making most of the supplementary old-age provision a matter of private choice. Rewarding mothers for child-care activities that have diverted them from contributing to the system effectively only plays an ancillary role in this context. At the same time, by its construction, with low-level benefits that are basically a flat rate, the scheme is likely to have a relatively weak negative impact on fertility rates. In this sense, the British solution for running a public pension scheme and including only a tiny portion of child-related benefits may be basically consistent. The level of pay-as-you-go financed pension benefits is higher and their role for old-age provision in general is much more pronounced in Germany, France, and Sweden. Also, regular pension benefits in these countries are more strongly related to individual work records and earnings. As a consequence, the opportunity costs involved in having children and taking care of them also extend to old age in these countries. To counter this effect, all these countries have introduced child-related benefit entitlements for parents that are now of considerable size. In addition to that, the special rules devised for this purpose entail elements that go beyond the superficial motivation to fill potential gaps in mothers' work records end regular pension entitlements: even if regular benefits are unchanged, additional pension entitlements create an additional incentive to have children. The national systems slightly differ in how precisely they are trying to accomplish this goal. For instance, the French rules are designed in such a way that they especially incentivate mothers to reconcile labour-force participation and child-care responsibilities based on a limited period of a parental leave and also encourage them to have higher numbers of children. The German rules, on the other hand, appear to establish the strongest, direct link between child-related pension benefits and having children, irrespective of how child-rearing affects the mothers' labour-supply decisions. At the same time, this particular feature may be more needed in Germany than elsewhere if we take into account the particularly high level of implicit taxes that the German Statutory Pension Scheme imposes on children an families (see the previous sub-section).

8.8 The impact of child-related benefits on fertility

In this chapter, we have unfolded a rich and rather detailed picture of the national systems of family policies operated in developed countries, with a special eye on Germany, France, the UK, and Sweden. Still, this picture may not be sufficient for offering a full-scale explanation for all the differences in fertility behaviour that we have observed between the same countries (see chapter 7). Yet, we are now able to highlight a number of basic features of national family policies that can at least contribute to understanding the existing cross-country variation in average fertility rates, in the structure of family households, and in the patterns of female labour-force participation which we have considered before, knowing that all these aspects interact with each other in the simultaneous fertility and labour-supply decisions of potential parents.

Remember, first of all, that among the countries we have subjected to closer scrutiny, Germany is the one with the lowest fertility rate, the highest share of childless women, especially among women with higher qualifications and in high-income households, and the lowest labour-force participation rate of mothers, especially among those with small children. France, by contrast, has the highest fertility rate, the lowest share of childless women and a considerable degree of labour-force participation of mothers, especially considering the high number of their children. Finally, the UK and Sweden exhibit intermediate levels of fertility rates, and the levels of female labour-force participation are really high in these countries, indeed outstandingly high in Sweden. At the same time, the Swedish fertility rate has shown remarkable fluctuations over the last two decades. These stylised facts certainly require an explanation.

At first sight, different levels and structures of national packages of child-related monetary benefits paid to families with dependent children are not fully suited to explain the above observations in a simple, yet consistent way. For example, benefits of this kind offered in Germany appear to be relatively high compared to those in the other countries. Only at closer scrutiny, there are a few specific features of the German benefit package, say, vis-à-vis the French one, that may be of interest here. One is that in France benefits increase much more sharply with family size, the other is that there is also a more pronounced increase with parental income, at least for families with average or higher incomes, in France than in Germany. Also, France has a more developed system of monetary benefits for families with small children (paying relatively high benefits over a longer period of time) that is also different from the Swedish system (with very high benefits that are positively related to parental earnings, but are paid for a rather short period of time). These features may partly explain the varying fertility patterns in these countries. Yet, in our international comparison, the major deficiencies of German family policies appear to be mainly located in other fields.

One aspect that is potentially important in this context is that the availability of child-care facilities for children at pre-school age, in particular, for those aged less than three, appears to be underdeveloped in Germany vis-à-vis the other countries considered here. Also, even when children start attending primary school, the German school system does not relieve parents from child-care responsibilities to the same, substantial extent as schools in other countries do. Merely as an aside, we may also note that the level of public expenditure on schooling appears to be rather low in Germany (even when measured on a per-student basis) and, probably even more so, the structure of such expenditure could be sub-optimal (as differentiated by educational levels). Another important aspect is that the level of pay-as-you-go financed social insurance benefits (especially in terms of public pensions, but also with respect to health care and long-term care) is relatively high in Germany, while other countries have been more successful at containing the financial burden that is implied in such schemes for families and children. This may well be relevant in this context because pay-as-you-go social insurance schemes are likely to have an adverse effect on parental fertility decisions, hence may effectively constitute a distinct kind of family policies "with a negative sign". Taken together, that is, controlling for the existing cross-country heterogeneity in any of the areas affected, these aspects might indeed offer an important part of the explanation for the observed differences in fertility behaviour one would like to come up with.

A rigorous empirical investigation that would be suited to back these views should ideally be based on a vast set of micro data taken from various countries, covering individual tax liabilities and benefit entitlements in all branches of the national tax–transfer system, especially regarding benefits accruing to families with dependent children and other instruments of intergenerational redistribution, as well as access to all kinds of benefits in-kind, together with lots of socio-demographic data on individuals and households included in the data set. Unfortunately, due to the lack of suitable data that even only come close to meeting these standards, investigations of this kind are non-existent and basically impossible. Therefore, the scope for empirical investigations regarding the impact of child-related benefits on fertility is rather limited when gauged by the above description of an ideal analysis. Usually, researchers engaging in this field of study limit their attention to single countries, most of the time even to single instruments, for which suitable data appear to be available. To identify any effects, they then need a sufficient degree of variation in the relevant benefits over time, or across regions, to obtain a quasi-experiment that can be meaningfully addressed using econometric procedures. Alternatively, researchers can use international data that are ultimately based on rough, macro-level measures of benefit entitlements, sometimes also spanning a time dimension that can be exploited for international panel analyses. All in all, the body of empirical evidence on the fertility-effects of particular categories of child benefits is therefore small. Nevertheless, it has established a number of results, some directly relating to the countries and benefit programmes we have been looking at, that are of interest in concluding the present study.

In a recent survey, Meier (2005) has reviewed the existing evidence regarding the impact of measures of national family policies on fertility, paying special attention to empirical studies covering Germany, France, the UK, and Sweden. The results of the micro-level studies covered in this survey confirm – in line with our own aggregate-level results reported in chapter 6 – that child-related monetary benefits can significantly influence the timing as well as the total number of births in a given country and, overall, have a positive effect on fertility rates. The findings are less clear-cut with respect to the link between the availability and utilisation of child-care facilities on the one hand and fertility on the other, but this appears to be mainly due to data limitations, identification problems, and accidental, reverse correlations that obscure the results, rather than proving that (public) child care is really unimportant for parental fertility decisions. It was already mentioned in chapter 6 that the existing evidence largely confirms the negative relationship between national pay-as-you-go public pension schemes and fertility rates, even if none of the relevant studies are based on genuine micro-data.

Studies conducted at a national level for Germany offer a first set of examples for any of these general conclusions. Studies using a rough summary measure of child-related cash benefits and tax allowances (Genosko and Weber 1992) or concentrating on just one, major instrument, the German Kindergeld (Althammer 2000), provide evidence that annual birth rates tend to go up or that the time span between first and higher-order births becomes shorter if monetary benefits are increased, respectively. In both cases, however, measurement issues and data limitations imply that a potential lasting impact on fertility cannot be distinguished from pure timing effects. In a series of papers, Hank (2002), Hank and Kreyenfeld (2003) and Hank et al. (2004) are unable to find a significant impact of the local supply of institutional child-care on the probability for mothers to give birth to a first (and, in one of these papers, a second) child. As modelling the simultaneous decisions regarding labour-force participation, parenthood, and child care for a given child and the sequential decisions shaping the final number of children of a family is apparently difficult, these results do not necessarily indicate that there is no link between child-care facilities and fertility. Yet, if it exists it has so far not been identified in a reliable, methodologically rigorous fashion using German micro data. In a contribution that emerges from a longer series of papers dealing with other countries as well, Cigno et al. (2003) show, based on German macro-level time-series data, that monetary child benefits have a positive impact on annual fertility rates, while public pension benefits (measured per capita of the population aged 65 and older) have a negative impact. We have referred to these findings that are both in line with reasonable theoretical expectations already in chapters 4 and 6.

From a methodological point of view, probably the most interesting studies regarding the impact of child-related monetary benefits on fertility are those prepared by Laroque and Salanié (2004, 2005) for the case of France. Using econometric techniques that fully meet up-to-date standards, they are able to investigate major changes in the structure of benefits enacted in 1990s as a quasi-experiment showing, among other things, that the extension of the child-rearing benefit (allocation parental d'éducation) from families with three or more children to those with two or more children in 1994 has increased the fertility rate in a substantial way (+3.7%), basically because the increase in the number of second births has more than compensated for the resulting reduction in third and higher-order births. This aspect is fully confirmed by parallel work by Piketty (2005) based on alternative data and a different econometric approach. Laroque and Salanié also find a strong positive fertility effect of a larger array of monetary child benefits offered in France, concluding that the benefit package covered in their study increases fertility by about 24% neglecting how the benefits are being financed, by about 13% taking into account the adverse effects of taxes needed to fund for the package. All in all, they estimate the price elasticity of fertility to be –0.22. This implies that reducing child costs by 10% would increase fertility by 2.2% (i.e., by about 0.04 births per woman), which would require additional benefits of about € 30 per child and month according to their calculations.

For the UK, the empirical micro-data evidence mainly consists of a set of twin papers by Ermisch (1988a, 1988b) who also provides evidence for a potentially strong positive impact of child-related monetary benefits on fertility.

Sweden offers another example of a country where larger changes in the structure and level of benefits enacted in the past create a special opportunity to assess the effectiveness of family policy measures. Here, the main experiment is that, starting from 1980, the high child-rearing benefit (föräldrapenning) linked to earnings foregone was assessed based on wages earned prior to a previous birth if, within a period of 24 months, a next child was born. Since Swedish mothers typically work part time for a few years after a child is born, while most of them have been working full time before their first birth, this legal change can make a substantial difference with respect to their benefit entitlements. Sundström and Stafford (1992) as well as Taşiran (1995) show that this has significantly increased the probability of mothers giving birth to a second or third child within two years after the first or the second one. However, considering the large fluctuations of total fertility rates in Sweden observed over the last two decades, which may or may not have been influenced by large-scale macroeconomic shocks that hit the country during the same period, these empirical results could also mainly relate to a timing effect of the policy change.[21] Similar problems may affect the results of studies based on Swedish data that are looking at the role of child-care institutions in this country (again, Taşiran 1995 as well as Andersson et al. 2004). As in Germany, the link to fertility is basically insignificant and sometimes even suggests a negative impact. However, this could be due to an accidental correlation between data representing the availability of child-care facilities and annual fertility rates that have been falling for other reasons during the observation period. Also, it could indicate once more that modelling the relevant household decisions and testing for how they can be influenced is difficult.

There are also a number of multi-country studies covering one or more of the countries that we have paid particular attention to in part II of our study. Blanchet and Ekert-Jaffé (1994) look at the impact of a rough summary measure of child-related benefits on fertility rates in 11 European countries during the 1969–1983 period, observing a significant positive effect. Gauthier and Hatzius (1997) differentiate more carefully between the effects of generic child-related cash benefits and tax allowances on the one hand and special rules applying to the length of parental leaves and child-rearing benefits targeted at families with small children on the other, covering 22 OECD countries and the 1973–1990 period in their study. They find that instruments of the former type increase fertility, while instruments of the latter type appear to have no additional effect. Castles

[21] Based on Swedish data taken from a special fertility survey covering the years 1968 to 1980, Walker (1996) provides one of the very few empirical studies that do not support a positive impact of child-related monetary benefits in fertility. In his work, an increase in such benefits turns out to be insignificant for women who are employed, and there even appears to be a negative effect for women who are not employed. Walker (1996) attributes this surprising result to the fact that, during his observation period and merely by coincidence, female wages increased in a very significant way, while Sweden was also hit by the acute phase of fertility decline of the late 1960s and the 1970s that occurred throughout the developed world.

(2003) and Sleebos (2003) look at the role of child-care facilities for fertility using year-1998 macro-level data that cover of 20 OECD or year-2000 macro-level data for all OECD countries, respectively. Both these international cross-section studies find that the availability and utilisation of child-care institutions has a strong, positive correlation with national fertility rates. Sleebos (2003) also shows that the share of child-related cash benefits in national GDP is positively correlated with fertility. This latter result is confirmed once again through the set of macro-level time-series studies provided by Cigno and Rosati (1996) and Cigno et al. (2003), where child-related monetary benefits are included in the single-country regressions for the UK and for Germany. However, the main contribution of their papers (see also Cigno and Rosati 1992, 1997) is that they also include variables representing the size of national public pension schemes among the explanatory variables and, as was already mentioned in chapters 4 and 6, consistently find a negative impact on fertility.

Of course, one should note that there are quite a number of interesting questions that would be highly relevant for designing national family policies, but cannot be answered based on the existing empirical evidence. For instance, there is next to no evidence that would be suited to define an optimum structure of child-related benefit packages. First of all, this applies to the choice between offering direct, monetary benefits or benefits in-kind: if anything, the existing studies suggest that the positive impact of monetary benefits on fertility is a lot more obvious than similar effects of public provision of child-care facilities and similar services, but one should be reluctant to build strong conclusions an this observation. Also, there is no clear-cut evidence whether aggregate fertility is affected more strongly through benefits that apply to all children in a uniform way or through benefits that favour children of higher birth orders. The same is true for benefits that apply to all families alike vs. benefits that give preferential treatment to families at the lower or at the higher end of the income distribution. Furthermore, little is known about an optimal timing of child-related benefits, i.e., about the relative effectiveness of measures basically applying to all families with dependent children compared to special benefit entitlements accruing to families with small children or, as another extreme, to older parents whose children have already moved out and who are meanwhile entering retirement.

At the same time, the existing empirical evidence clearly rejects the idea that the fertility decline that has been observed in developed countries over the last few decades is entirely exogenous, i.e., is not at all driven by economic incentives and disincentives and, hence, cannot be influenced by instruments of public policies, among them those that involve special financial benefits or subsidised services accruing to children and families.[22] Together with the empirical evidence that we have produced in chapter 6, the results of many other studies are therefore suited to support the conclusion that, especially in countries that were hit rather strongly by the fertility decline of the post-war period, the future development of fertility rates could be influenced through institutional changes in the areas of public policy considered here, that is, through more active family policies defined in a broad sense. In addition, the empirical results presented in chapter 5 suggest that efforts of this kind which are ultimately aimed at establishing a more balanced structure of the working age population, for instance, through (total and cohort) fertility rates that approach the replacement level of about 2.0 again, could be useful also with regard to long-term prospects for economic growth. Again, this aspect may be particularly important for countries that are now about to enter a period of acute demographic change that, due to very low fertility rates, is much more pronounced than elsewhere in the developed world.

[22] In the above summary review, we have focused on empirical evidence regarding precisely these kinds of policy measures – to the extent that they are covered in existing work. We have therefore neglected the overwhelming evidence regarding the influence of other economic aspects, such as changes in child costs, especially opportunity costs, that is provided by the same and many other studies and also fits in with an economic explanation of some of the major driving forces of the fertility decline and the resulting demographic change that is taking place throughout the world and, so far with a special momentum, in developed countries.

References

Aaron, H. (1966), “The Social Insurance Paradox”, *Canadian Journal of Economics and Political Science* 32, 371–374.

Abel, A.B., N.G. Mankiw, L. Summers and R.J. Zeckhauser (1989), “Assessing dynamic efficiency: theory and evidence”, *Review of Economic Studies* 56, 1–19.

Abramovitz, M. (1956), “Resource and Output Trends in the United States since 1870”, *American Economic Review, Papers and Proceedings* 46, 5–23.

Ahituv, A. (2001), “Be Fruitful or Multiply: On the Interplay Between Fertility and Economic Development”, *Journal of Population Economics* 14, 51–71.

Ahituv, A. and O. Moav (2003), “Fertility Clubs and Economic Growth”, in: T. Eicher and S. Turnovsky (eds.), *Inequality and Growth: Theory and Policy Implications*, Cambridge MA: MIT Press, 61–87.

Aiyar, S. and J. Feyrer (2002), “A Contribution to the Empirics of Total Factor Productivity”, IMF and Dartmouth College, mimeo.

Aliaga, C. and K. Winqvist (2003), “How women and men spend their time: Results from 13 European countries”, *Eurostat: Statistics in Focus*, Theme 3, Issue 12/2003.

Althammer, J. (2000), *Ökonomische Theorie der Familienpolitik*, Physica: Heidelberg.

Andersson, G., A.-Z. Duvander and K. Hank (2004), “Do Child-Care Characteristics Influence Continued Child Bearing in Sweden? An Investigation of the Quantity, Quality, and Price Dimension”, *Journal of European Social Policy* 14, 407–418.

Apps, P. and R. Rees (2004), “Fertility, Female Labour Supply and Public Policy”, *Scandinavian Journal of Economics* 106, 745–763.

Azariadis, C. and A. Drazen (1990), “Threshold Externalities in Economic Development”, *Quarterly Journal of Economics* 105, 501–526.

Baltagi, B.H. (2005), *Econometric Analysis of Panel Data*, West Sussex: Wiley.

Baltagi B.H. and N. Pinnoi (1995), “Public capital stock and state productivity growth: Further evidence from an error components model”, *Empirical Economics* 20, 351–359.

Barro, R.J. (1974), “Are Government Bonds Net Wealth?”, *Journal of Political Economy* 81, 1095–1117.

Barro, R.J. (1991), “Economic growth in a cross section of countries”, *Quarterly Journal of Economics* 106, 406–441.

Barro, R.J. (1998), “Notes on Growth Accounting”, *NBER Working Paper* No. 6654.

Barro, R.J. and G.S. Becker (1989), “Fertility Choice in a Model of Economic Growth”, *Econometrica* 57, 481–501.

Barro, R.J. and J.-W. Lee (1993), "International Comparisons of Educational Attainment", *Journal of Monetary Economics* 32, 363–394 (including a related data set).

Barro, R.J. and J.-W. Lee (1996), "International measures of schooling years and schooling quality", *American Economic Review* 86, 218–223.

Barro, R.J. and X. Sala-i-Martin (1995), *Economic Growth*, New York: Mc Graw-Hill.

Beblo, M. and E. Wolf (2002), "How Much Does a Year off Cost?" Estimating the Wage Effects of Employment Breaks and Part-time Periods", *Cahiers Économique de Bruxelles* 45, 191–217.

Becker, Gary S. (1960), "An Economic Analysis of Fertility", in: NBER (ed.), *Demographic and Economic Change in Developed Countries*, New York, London: Columbia University Press, 209–231.

Becker, Gary S. (1965), „A Theory of the Allocation of Time", *Economic Journal* 75, 439–517.

Becker, G.S. and R.J. Barro, (1988), "A reformulation of the theory of fertility", *Quarterly Journal of Economics* 193, 1–26.

Becker, G. and H.G. Lewis (1973), "On the interaction between quantity and quality of children", *Journal of Political Economy* 81, 279–288.

Benhabib, J. and M.M. Spiegel, "The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data", *Journal of Monetary Economics* 34, 143–173.

Billari F.C. and H.-P. Kohler (2002), "Patterns of Low and Lowest-Low Fertility in Europe", *Max Planck Institute for Demographic Research Working Paper* No. WP 2002-040.

Bils, M. and P.J. Klenow (2000), "Does Schooling Cause Growth?", *American Economic Review* 90, 1160–1183.

Birg, H. (1987), *A Biography Approach to Theoretical Demography*, Materials of the Institute for Population Research and Social Policy, Vol. 23, University of Bielefeld: Bielefeld.

Birg, H. (1995), *World Population Projections for the 21st Century: Theoretical Interpretations and Quantitative Simulations*, Frankfurt/Main and New York: Campus and St. Martin's.

Blanchet, D. and O. Ekert-Jaffé (1994), "The Demographic Impact of Family Benefits: Evidence from a Micro-Model and from Macro-Data", in: J. Ermisch and N. Ogawa (eds.), *The Family, the Market and the State in Ageing Societies*, Oxford: Clarendon Press, 79–104.

Bloom, D.E., D. Canning and J. Sevilla (2002), "The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change", *RAND Population Matters Monograph Series* MR-1274.

Börsch-Supan, A. (2003), "Labor Market Effects of Population Aging", *Review of Labour Economics and Industrial Relations* 17, 5–44.

Boldrin, M., M. De Nardi and L.E. Jones (2005), "Fertility and Social Security", *NBER Working Paper* No. 11146.

Bradshaw, J. and N. Finch (2002), *A Comparison of Child Benefit Packages in 22 Countries*, Research Report No. 174, London: Department for Work and Pensions (additional material is provided in the form of "country matrices" prepared by the authors and "questionnaires" filled in by national experts; download from http://www.york.ac.uk/inst/spru/research/summs/childben22.htm).

Brandner, J.A. and S. Dowrick (1994), "The Role of Fe rtility and Population in Economic Growth: Empirical Results from Aggregate Cross-National Data", *Journal of Population Economics* 7, 1–25.

Bundesinstitut für Bevölkerungsforschung (2004), *Bevölkerung: Fakten – Trends – Ursachen – Erwartungen*, Wiesbaden: BIB.

Castles, F.G. (2003), "The World Turned Upside Down: Below Replacement Fertility, Changing Preferences and Family-Friendly Public Policy in 21 OECD Countries", *Journal of European Social Policy* 13, 209–227.

Cigno, Alessandro (1991), *Economics of the Family*, Oxford: Clarendon Press.

Cigno, A. (1992), "Children and pensions", *Journal of Population Economics* 5, 175–183.

Cigno, A. (1993), "Intergenerational transfers without altruism. Family, market and state", *European Journal of Political Economy* 9, 505–518.

Cigno, A., L. Casolaro and F.C. Rosati (2003), "The Role of Social Security in Household Decisions", *Finanzarchiv* 59, 189–211.

Cigno, A. and F.C. Rosati (1992), "The effects of financial markets and social security on saving and fertility behaviour in Italy", *Journal of Population Economics* 5, 319–341.

Cigno, A. and F.C. Rosati (1996), "Jointly determined saving and fertility behaviour: theory, and estimates for Germany, Italy, UK and USA", *European Economic Review* 40, 1561–1589.

Cigno, A. and F.C. Rosati (1997), "Rise and fall of the Japanese saving rate: the role of social security and intra-family transfers", *Japan and the World Economy* 9, 81–92.

Cigno, A. and M. Werding (2006), *Children and Pensions*, Cambridge MA: MIT Press (in preparation)

D’Addio, A.C. and M.M. d’Ercole (2005), “Trends and Determinants of Fertility Rates in OECD Countries: The Role of Policies”, *OECD Social, Employment and Migration Working Papers* No. 27.

Dang, T.T., P. Antolin and H. Oxley (2001), “Fiscal Implications of Ageing: Projections of Age-Related Spending”, *OECD Economics Department Working Paper* No. 305.

De la Fuente, A. and A. Ciccone (2002), *Human Capital in a Global and Knowledge-Based Society*, EU Commission, DG Employment and Social Affairs: Brussels.

De la Fuente, A. and R. Doménech (2000), “Human Capital in Growth Regressions: How Much Difference Does Data Quality Make?”, *CEPR Discussion Paper* No. 2466.

De la Fuente, A. and R. Doménech (2001), “Schooling Data, Technological Diffusion and the Neoclassical Model”, *American Economic Review, Papers and Proceedings* 91, 323–327.

Denison, E.F. (1962), *Sources of Economic Growth in the United States and the Alternatives Before Us*, New York: Committee for Economic Development.

Denison, E.F. (1967), *Why Growth Rates Differ*, Washington, DC: The Brookings Institute.

Diamond, P. (1965), “National Debt in a Neoclassical Growth Model”, *American Economic Review* 55, 1126–1150.

Easterly, W. and R. Levine (2000), “It’s Not Factor Accumulation: Stylized Facts and Growth Models”, *Central Bank of Chile Working Papers* No. 164.

Easterly, W., M. Kremer, L. Pritchard and L. Summers (1993), “Good Policy or Good Luck? Country Growth Performance and Temporary Shocks”, *Journal of Monetary Economics* 32, 459–483 (including a related data set).

Ehrlich, I. and J. Kim (2005), “Social security, demographic trends, and economic growth, Theory and Evidence from the international experience”, *NBER Working Paper* No. 11121.

Ehrlich, I.B. and J.-G. Zhong (1998), “Social Security and the Real Economy”, *American Economic Review* 88, 151–157.

Ermisch, J. (1988a), “Econometric Analysis of Birth Rate Dynamics in Britain”, *Journal of Human Resources* 23, 563–576.

Ermisch, J. (1988b), “Economic Influences on Birth Rates”, *National Institute Economic Review*, Issue 4/1988, 71–81.

European Commission (2006), *MISSOC* (*Mutual Information System on Social Protection in the EU Member States and the EEA*) *on-line database*, accessible via http://ec.europa.eu/employment_social/social_protection/missoc_en.htm

Eurostat (2005), *On-line data*, download via http://epp.eurostat.cec.eu.int/.

Fenge, R., S. Uebelmesser and M. Werding (2006), "On the optimal timing of implicit social security taxes over the life cycle", *Finanzarchiv* 62, 68–107.

Fenge, R. and M. Werding (2003), "Ageing and Fiscal Imbalances Across Generations: Concepts of Measurement", *CESifo Working Paper* No. 842.

Fenge, R. and M. Werding (2004), "Ageing and the Tax Implied in Public Pension Schemes: Simulations for Selected OECD Countries", *Fiscal Studies* 25, 159–200.

Feyrer, J. (2002), "Demographics and Productivity", Dartmouth College, mimeo.

Gauthier, A.H. and J. Hatzius (1997), "Family Benefits and Fertility: An Econometric Model", *Population Studies* 51, 295–346.

Genosko, J. and R. Weber (1992), "The Impact of Family Allowances on Demographic Changes: A Case Study for Germany", *Diskussionsbeiträge der Wirtschaftswissenschaftlichen Fakultät Ingolstadt der Katholischen Universität Eichstätt* No. 18.

Glick, R. and A.K. Rose (2002), "Does a currency union affect trade? The time-series evidence", *European Economic Review*, Vol. 46, 1125–1151.

Gollin, D. (2002), "Getting Income Shares Right", *Journal of Political Economy* 110, 458–474.

Hall, R. and C.I. Jones (1999), "Why Do Some Countries Produce So Much More Output per Worker than Others?", *Quarterly Journal of Economics* 114, 83–116.

Harrod, R.F. (1942), *Toward a Dynamic Economics: Some Recent Developments of Economic Theory and their Application to Policy*, London: Macmillan.

Hank, K. (2002), "Regional Social Contexts and Individual Fertility Decisions: A Multilevel Analysis of First and Second Births in Western Germany", *European Journal of Population* 18, 281–299.

Hank, K. and M. Kreyenfeld (2003), "A Multilevel Analysis of Child Care and Women's Fertility Decisions in Western Germany", *Journal of Marriage and Family* 65, 584–596.

Hank, K., M. Kreyenfeld and C.K. Spieß (2004), "Kinderbetreuung und Fertilität in Deutschland", *Zeitschrift für Soziologie* 33, 228–244.

Hanushek, E.A. and D.D. Kimko (2000), "Schooling, Labour Force Quality, and the Growth of Nations", *American Economic Review* 90, 1184–1208.

Heston, A., R. Summers and B. Aten (2002), *Penn World Tables* (Version 6.1, "PWT 6.1"), Philadelphia: Center for International Comparisons at the University of Pennsylvania (CICUP).

Hicks, J. (1932), *The Theory of Wages*, London: Macmillan.

Hotz, V.J., J. Klerman and R. Willis (1997), "The Economics of Fertility in Developed Countries", in: M.R. Rosenzweig and O. Stark, (eds.), *Handbook of Population and Family Economics*, Volume 1 A, Amsterdam: Elsevier, 275–347.

ILO (various years), *The Cost of Social Security* ("ILO-COSS", publications 1967–1989), Geneva: International Labor Organisation.

ILO (2004), *Labor Force Database* ("LABORSTA", last up-date 2004, accessible via http://laborsta.ilo.org), Geneva: International Labor Organisation.

Jones, C.I. (1995), "R&D Based Models of Economic Growth", *Journal of Political Economy* 103, 759–784.

Jones, C.I. (1996), "Human Capital, Ideas, and Economic Growth", Stanford University, mimeo.

Jorgenson, D.W. (1995), *Productivity*, Cambridge MA: MIT Press.

Jorgenson, D.W. and Z. Griliches (1967), "The Explanation of Productivity Change", *Review of Economic Studies* 34, 249–283.

Jorgenson, D.W., F.M. Gallop and B.M. Fraumeni (1987), *Productivity and U.S. Economic Growth*, Cambridge MA: Harvard University Press.

Joshi, H. (1998), "The opportunity costs of childbearing. More than mothers' business", *Journal of Population Economics* 11, 161–184.

Kögel, T. (2004), "Did the association between fertility and female employment within OECD countries really change its sign?", *Journal of Population Economics* 17, 45–65.

Kyriacou, G.A. (1991), "Level and Growth Effects of Human Capital: A Cross-Country Study of the Convergence Hypothesis", *C.V. Starr Centre Working Paper* No. 91-26.

Lampert, H. (1996), *Priorität für die Familie: Plädoyer für eine rationale Familienpolitik*, Berlin: Duncker & Humblot.

Laroque, G. and B. Salanié (2004), "Fertility and Financial Incentives in France", *CESifo Economic Studies* 50, 423–450.

Laroque, G. and B. Salanié (2005), "Does Fertility Respond to Financial Incentives?", *CEPR Discussion Paper* No. 5007.

Leibenstein, H. (1957), *Economic Backwardness and Economic Growth. Studies in the Theory of Economic Development*, New York: John Wiley & Sons.

Leibenstein, Harvey (1974), „An Interpretation of the Economic Theory of Fertility: Promising Path or Blind Alley?", *Journal of Economic Literature* 12, 457–478.

Lindh, T. and B. Malmberg (1999), "Age Structure Effects and Growth in the OECD 1950–1990", *Journal of Population Economics* 12, 431–449.

Lucas, R.E. (1988), "On the Mechanics of Economic Development", *Journal of Monetary Economics* 22, 3–42.

Mankiw, N.G., D. Romer and T.D. Wallace (1984), "A contribution to the empirics of economic growth", *Quarterly Journal of Economics* 107, 407–437.

Mankiw, G.N., D. Romer and D.N. Weil (1992), "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics* 107, 407–437.

McNown, R. and S. Rajbhandary (2003), "Time series analysis of fertility and female labor behaviour", *Journal of Population Economics* 16, 501–523.

Meier, V. (2005), *Auswirkungen familienpolitischer Instrumente auf die Fertilität: Internationaler Vergleich für ausgewählte Länder*, Ifo Forschungsbericht No. 26, Munich: Ifo Institute.

Mincer, J. (1974), *Schooling, experience and earnings*, New York: Columbia University Press.

Mitchell, B. (2003), *International Historical Statistics, 1750-2000 (Europe, The Americas, Africa, Asia and Oceania)*, 5th Edition, New York: Palgrave MacMillan.

Nelson, and E.S. Phelps (1966), "Investment in Humans, Technological Diffusion, and Economic Growth", *American Economic Review* 56, 69–82.

Nugent, J. B. (1985), „The Old-Age Security Motive for Fertility“,*Population and Development Review* 11, 75–97.

OECD (2001), *Economic Outlook* No. 69 (June 2001), Paris: Organisation for Economic Co-operation and Development.

OECD (2002), *Employment Outlook 2002*, Paris: Organisation for Economic Co-operation and Development.

OECD (2003), *Health Data: A Comparative Analysis of 30 Countries*, Paris: Organisation for Economic Co-operation and Development.

OECD (2004), *The OECD Statistical Compendium* / *Historical Compendium*, Edition 2004/1, Paris: Organisation for Economic Co-operation and Development.

OECD (2005a), *Main Economic Indicators* (last up-date 2005, accessible via: http://www.oecd.org).

OECD (2005b), *Society at a Glance: OECD Social Indicators*, 2005 edition, Paris: Organisation for Economic Co-operation and Development.

OECD (2005c), *Education at a Glance*, 2005 edition, Paris: Organisation for Economic Co-operation and Development.

Office for National Statistics (2004), *Birth statistics: Review of the Registrar General on births and patterns of family building in England and Wales*, 2004, London: ONS.

Piketty, T. (2005), "L'impact de l'allocation parentale d'éducation sur l'activité féminine et la fécondité en France, 1982-2002", in: C. Lefèvre and A Filhon (eds.), *Histoires de familles, histoires familiales. Les résultats de l'enquête famille de 1999*, Paris: INED, 79–109.

Psacharopoulos, G. (1994), "Returns to Investment in Education: A Global Update", *World Development* 22, 1325–1343.

Psacharopoulos, G. and A.M. Arriagada (1986), "The Educational Composition of the Labour Force: An International Comparison", *International Labour Review* 125, 561–574.

Ramsey, F. (1928), "A Mathematical Theory of Saving", *Economic Journal* 38, 543–559.

Romer, P.M. (1986), "Increasing Returns and Long-Run Growth", *Journal of Political Economy* 94, 1002–1037.

Romer, P.M. (1990), "Endogenous Technological Change", *Journal of Political Economy* 98, S71–S102.

Rosati, F.C. (1996), "Social security in a non-altruistic model with uncertainty and endogenous fertility", *Journal of Public Economics* 58, 283–294.

Rosen, S. (1976), "A Theory of Life Earnings", *Journal of Political Economy* 84, 545–567.

Rosenzweig, M.R. and T.P. Schultz (1985), "The Demand and Supply of Births: Fertility and Its Life-cycle Consequences", *American Economic Review* 75, 992–1015.

Samuelson, P.A. (1958), "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money", *Journal of Political Economy* 66, 467–482.

Schultz, T.P. (1997), "Demand for children in low income countries", in: M.R. Rosenzweig, M.R. and O. Stark, (eds.), *Handbook of Population and Family Economics*, Volume 1 A , Amsterdam: Elsevier, 349–430.

Sinn, H.W. (1997), "The Value of Children and Immigrants in a Pay-As-You-Go Pension System", *NBER Working Paper* No. 6229 (reprinted in: *ifo Studien* 47, 2001, 77–94).

Sinn, H.-W. (2000), "Why a Funded Pension System is Useful and Why It is Not Useful", *International Tax and Public Finance* 7, 389–410.

Sinn, H.-W. (2003), "Das demographische Defizit – die Fakten, die Folgen, die Ursachen und die Politikimplikationen", *Ifo Schnelldienst* 56, Issue 5/2003, 20–36.

Sinn, H.-W. and M. Werding (2000), "Rentenniveausenkung und Teilkapitaldeckung: ifo Empfehlungen zur Konsolidierung des Umlageverfahrens", *Ifo Schnelldienst* 53, Issue 18/2000, 12–25.

Sleebos, J.E. (2003), "Low Fertility Rates in OECD Countries: Facts and Policy Responses", *OECD Social, Employment and Migration Working Paper* No. 15.

Solow, R.M. (1956), "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics* 70, 65–94.

Solow, R.M. (1957), "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics* 39, 312–320.

Solow, R.M. (1994), “Perspectives on Growth Theory”, *Journal of Economic Perspectives* 8, 45–54.

Summers, R. and A. Heston (1988), “A New Set of International Comparisons of Real Product and Price Levels Estimates for 130 Countries, 1950–1985”, *Review of Income and Wealth* 34, 1–25.

Summers, R. and A. Heston (1991), “The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950–1988”, *Quarterly Journal of Economics* 106, 327–368.

Sundström, M. and F.P. Stafford (1992), “Female Labor Force Participation, Fertility and Public Policy in Sweden”, *European Journal of Population* 8, 199–215

Swan, T.W. (1956), “Economic Growth and Capital Accumulation”, *Economic Record* 32, 334–361.

Taşiran, A.C. (1995), *Fertility Dynamics: Spacing and Timing of Births in Sweden and in the United States*, Amsterdam: Elsevier.

Thum, M. and J.v. Weizsäcker (2000), “Implizite Einkommensteuer als Messlatte für die aktuellen Rentenreformvorschläge”, *Perspektiven der Wirtschaftspolitik* 1, 453–468.

United Nations Economic Commission for Europe (UNECE, 2005), Fertility and Family Surveys, download via http://www.unece.org/pay/ffs/.

United Nations Population Division (2005), *World Population Prospects: The 2004 Revision*, download via http://esa.un.org/unpp/.

Uzawa, H. (1961), “Neutral Inventions and the Stability of Growth Equilibrium”, *Review of Economic Studies* 28, 117–124.

Uzawa, H. (1965), “Optimum Technical Change in an Aggregative Model of Economic Growth”, *International Economic Review* 6, 18–31.

Walker, J.R. (1996), “Parental Benefits, Employment, and Fertility Dynamics”, *Research in Population Economics* 8, 125–172.

Werding, M. (1998), *Zur Rekonstruktion des Generationenvertrages*, Tübingen: Mohr-Siebeck.

Werding, M. (2003), “Child expenditure and public pensions: Policy issues”, *International Studies on Social Security* 8, 141–165.

Werding, M. (2006), “Kinderrente und Vorsorgepflicht: Der ifo-Vorschlag zur Lösung der demographischen Krise des Rentrensystems”, *Ifo Schnelldienst* 59, Issue 7/2006, 44–53.

Werding, M. and H. Hofmann (2005), *Die fiskalische Bilanz eines Kindes im deutschen Steuer- und Sozialrecht*, Ifo Forschungsbericht No. 27, Munich: Ifo Institute.

Willis, R.J. (1973), “A New Approach to the Economic Theory of Fertility Behavior”, *Journal of Political Economy* 81, 14–64.

World Bank (2003), *World Development Indicators* (“WDI”), Washington D.C.: The World Bank.

Wößmann, L. (2002), *Schooling and the Quality of Human Capital*, Berlin: Springer.

Wößmann, L. (2003), “Specifying Human Capital”, *Journal of Economic Surveys* 17, 239–270.

Wößmann, L. (2005), “Kleinere Klassen = bessere Leistungen?”, *Ifo Schnelldienst* 58, Issue 17/2005, 6–15.