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Sectoral Diversification as Insurance against Economic Instability

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Abstract

This paper examines the extent to which sectoral diversification can act as an insurance mechanism against fluctuations in regional gross value added growth rates. I apply portfolio theory to the growth-instability properties of German districts. Furthermore, I define a comprehensive diversification measure and use Stochastic Frontier Analysis in order to estimate whether diversification allows regions to achieve more efficient growth-instability combinations, i.e., greater stability at given levels of economic growth. The results confirm that diversification does generate such effects. Spatial interactions do also play a role: The effects are less pronounced for regions whose economic performance is mainly driven by the surrounding regions.

JEL Code: L16, R11, R58.
Keywords: Sectoral diversification, regional growth, economic instability.

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1 Introduction

This paper deals with the impact of sectoral diversification on regional economic instability and annual growth. Comprehensive cluster initiatives set up by governments or private associations within the last few decades (e.g., the *European Cluster Alliance (ECA)*) suggest that policy makers find sectoral diversification less attractive than pushing industries they consider regional growth drivers. Policy makers might have good reasons to do so: First, sectoral specialization leads to agglomeration economies in the sense of Marshall (1890). They include advantages of common pools of knowledge as well as forward and backward linkages resulting from the spatial proximity of related companies. There is empirical evidence that such agglomeration economies might exist and lead to increased economic growth [for a survey see e.g. Beaudry and Schiffauerova (2009)]. Second, trade theory delivers further arguments in favor of sectoral specialization as gains from trade occur only if economies focus on their comparative advantages. Finally, increased sectoral specialization can be a historical matter when the availability of natural resources or transportation routes has formed local clusters of downstream industries. In such cases, politicians might have few incentives to deviate from what has worked in the past.

However, regardless which causes might have supported a particular region's specialization strategy and whatever advantages might have resulted, a highly specialized region might be more vulnerable to industry-specific shocks or fluctuations than more diverse regions. The consequences of such events might be unemployment, out-migration and fiscal distress. Examples of such formerly successful but in recent years troubled regions can be found all over the world, e.g., the city of Detroit that suffered from a struggling automotive industry or the Ruhr area in Germany that had to deal with a declining coal and steel industry.

In general, a region's sectoral structure is not a policy variable for local politicians as they are unable to shift economic activity from one industry to another. However, they can support policies that are appropriate to gradually increase the degree of sectoral diversification over time. This might be attractive for local policy makers in order to minimize a region's vulnerability and help reduce the volatility of the economic output figures. Economic theory predicts a negative relationship between diversification and instability. The most obvious way of thinking about this issue is probably portfolio theory [Markowitz (1952)]. Although it was designed for a different setting, Conroy (1974) introduced portfolio theory to the literature on regional growth and instability. The concept of reducing a portfolio's overall risk through diversification while keeping the expected return constant, given that assets are not perfectly correlated, is very close to the issue studied here. Following this logic, sectoral diversification should be expected to increase a region's overall economic stability.

However, diversification comes at the cost of growing less than with full specialization in the fastest-growing industry. The wasted growth potential can be interpreted as an insurance premium; the amount of secured regional output that would have been lost in the case of stronger specialization in a declining industry can be seen as insurance coverage. The trade-off between growth and stability is important for both politicians and voters. Politicians might have incentives to support diversification if voters are risk-averse. The literature on voter behavior clearly finds that risk-averse voters are more likely to re-elect the incumbent while risk-seeking voters opt for the challenger (see e.g. Eckles *et al.* (2014) or Kam and Simas (2012) for empirical results and Yakovlev (2011) for a theoretical approach). Thus, elected politicians who want to be re-elected should be expected to have a taste for economic stability and the incentives to use sectoral diversification as insurance.

In the obvious absence of market insurance against economic fluctuations, this mechanism can be called "self-insurance" according to the terminology in e.g. Becker and Ehrlich (1972). The policy tools that politicians might use in order to influence their region's economic development are the dedication of land use, administrative decision making, taxation and business development programs, among others. Because incumbents, who are expected to favor stability, are authorized to implement suitable policies, while challengers, who have a taste for growth, have no policy tools since they are not in office, I expect to find that regions give up growth prospects in order to gain stability over time.

This paper contributes to the literature in several ways. First, I develop a comprehensive measure for industrial diversification that is based on sectoral growth decomposition. This measure does not focus on the equality of sectoral shares but on the distribution of (absolute) growth contributions. The advantage of this approach is that two industries with identical growth contributions can be different in sizes and grow at different rates. A policy aiming at maximizing the degree of diversification is therefore not necessarily about distributing economic activity equally as traditional diversification measures suppose. Instead, the measure allows relatively stable industries to be larger than those with fluctuating growth rates.

Second, I use a contemporary version of *Stochastic Frontier Analysis (SFA)* in order to estimate not only whether more diversified regions are more stable than others but also whether they achieve more efficient growth-instability combinations. The advantage of this method is that it jointly analyzes growth and instability and assesses whether the costs of diversification are in due proportion to the gains in economic stability. Thus, *SFA* is the most appropriate method for investigating the insurance characteristics of sectoral diversification.

A third contribution of this paper is the inclusion of the spatial dimension. In the case of regional interrelations, e.g. cross-regional supply chains or commuter flows, the sectoral structure of a region's surrounding area can have an impact on the region's economic performance. If two regions' growth rates are not perfectly correlated, it seems less likely that both will be hit by an industry-specific downturn, and thus, they might implicitly insure one another. Again, portfolio theory can be the inspiration for this effect. Furthermore, regions whose economic performance depends crucially on the economic activity in neighboring areas (e.g. large manufacturers in region A but suppliers and service providers in region B) might gain only small effects from their own diversification efforts. Much stronger effects from diversification can therefore be expected for regions that can be considered economic hotspots and strongly determine the economic performance of a broader area.

Finally, I include the temporal perspective and investigate regional changes in the proportions of growth and instability and the effects of diversification during the recent economic crisis. Because not all industries have been hit to the same extent, there should have been opportunities to achieve a more stable development between 2008 and 2012 by means of sectoral diversification.

This paper shows that diversification is correlated with more efficient growth-instability combinations. Therefore, diversified regions are not necessarily more stable than others, but experience a more appropriate volatility given the achieved gross value added (GVA) growth rates. The effect is larger for economic hotspots that determine the GVA of a broader area and, accordingly, smaller for regions whose economic performance depends mainly on their surroundings. This indicates that diversification is less effective if regions "import" fluctuations from neighboring hotspots.

The remaining paper is structured as follows: Section 2 reviews the issue of measuring diversification, and then section 3 describes the analytical framework used in this study. The results are shown and discussed in section 4. Section 5 concludes.

2 Measuring Diversification

The impact of sectoral diversification on economic instability has been of interest to empirical researchers for decades. Among the most influential works on this issue are those by McLaughlin (1930) and Tress (1938) who find indications for the stabilizing effects of sectoral diversification in cities. Since then, a huge number of studies that used different measures of stability and diversification have been published. The reason for the ongoing interest in this field seems to be the multitude of measures and methods and the ambiguousness of the results (see e.g. Dissart (2003) for a survey).

The first group of diversification measures uses the sectoral distribution of employment or GVA in a particular region. The idea behind these measures is that regions are perfectly diversified if all sectors are the same size. The most prominent examples are the entropy index [see e.g. Kort (1981), Malizia and Ke (1993) or Trendle (2006)], the Ogive index [see e.g. Tress (1938), Jackson (1984) or Brewer and Moomaw (1985)] and the Herfindahl index [see e.g. Baldwin and Brown (2004), Essletzbichler (2007) or Ezcurra (2011)].

Another group of measures compares a particular region's sectoral shares (in employment or GVA) to those of the respective higher administrative level. A region is considered diversified if it resembles that higher administrative level. Examples are the national averages index (see e.g. Jackson (1984), Brewer (1985) or Sherwood-Call (1990)) and measures motivated by shift-share analysis.

The size-based approaches have in common that they focus on the sizes of the industries and ignore other important characteristics. This feature makes such measures attractive for empirical investigations on, e.g., localization or urbanization economies where the mere sizes of industries influence the extent of knowledge spillovers (see, e.g., Beaudry and Schiffauerova (2009)). However, since these measures ignore the fact that industries are not equally volatile, these measures are not very informative for the purpose at hand. For example, such measures cannot distinguish between a rural region where agricultural firms prevail and a dense city with a large service sector. If all other sectors (construction, manufacturing etc.) have equal shares, then size-based diversification measures would yield equal values in both regions, even though agriculture and services are not equally volatile and, thus do not imply equal risks. In order to increase the degree of diversification, both regions would be forced to cut back on their largest sector. This might be an intuitive idea for the rural region because a large agricultural sector makes a region more vulnerable to storms, pests or price fluctuations. For the city, however, diversification means cutting back on the usually stable service sector and shift economic activity to more volatile sectors such as agriculture or manufacturing. Therefore, these measures can be misleading when the relationship between diversification and regional instability is investigated. By neglecting the fact that industries are not equally volatile and that their volatilities can also be region-specific, the size-based measures fail to explain regional ex-post volatility and are not good measures for the ex-ante risk of being hit by industry-specific downturns.

Approaches based on input-output analysis have been created that include industry-specific characteristics (see, e.g., Wundt and Martin (1993), Siegel *et al.* (1995) or Wagner and Deller (1998)). The key feature of this method is to track fluctuations from one sector to another and investigate the impact of industry-specific shocks on the overall regional economy. However, these techniques cannot be used for regionally disaggregated studies as there are no meaningful input-output tables for sub-national levels.

The emergence of portfolio theory inspired additional approaches of measuring sectoral diversification. The idea is to consider a region to be a portfolio of industries that are characterized by variations in the GVA figures that are not independent of one another. Researchers expect a low overall portfolio variance to be associated with increased economic stability. In doing so, they allow the sectoral distribution of GVA shares to be unequal and the variances to be high as long as the respective covariances make sure that the overall portfolio is hedged against industry-specific fluctuations. This is the first diversification measure that takes into account that sectors have different characteristics and that regions with identical distributions, say identical Herfindahl indices, need not be at equal risk of being hit by industry-specific downturns. This approach was put forward by Conroy (1974, 1975) and used by, e.g., Jackson (1984), Brewer (1985) or Kurre and Weller (1989). However, this approach has also drawn criticism. Sherwood-Call (1990) argues that the portfolio variance is an inappropriate diversification measure since it depends on the region's overall volatility. Hence, the measure might as well be used as a measure for instability. She indicates that this is why researchers usually find the portfolio variance to have great explanatory power for economic stability measures.

Neither portfolio theory nor input-output analysis has provided fully convincing diversification measures due to methodological problems and issues of data availability. Consequently, these approaches have not become widely accepted among researchers. In the more recent literature, authors seem to reclaim the Herfindahl index [e.g., Chandra (2003), Essletzbichler (2007), Ezcurra (2011) or Brown (2012)]. Few efforts have been made to construct new measures that have similar advantages (e.g., easily computable with different types of data) but overcome the problem of abstracting away from region- and industry-specific volatilities. In this paper, an advanced diversification measure that considers the following issues is constructed:

(1) Industries are not equally volatile (ex-post) and, thus must be assumed to incorporate different risks (ex-ante). For example, overall instability would increase in most regions if the share of manufacturing approached that of public services because the former is usually much more volatile than the latter. Therefore, a diversification measure that explains the ex-ante risk of being hit by industry-specific downturns should not demand equal sizes.

(2) Industries can have different growth-instability parameters in different regions. For example, manufacturing (public services) should be the most unstable (stable) sector in most regions, but there might also be regions in which a traditional and stable manufacturing sector meets unstable public services (e.g., due to restructuring). Thus, regional heterogeneity should be considered; this requirement is particularly violated in the national averages index as it blends regional and national data.

(3) Diversification measures that focus on the mere size of industries yield weak policy implications since regional decision makers are usually unable to perceptibly change GVA shares within a short time period. However, the decision makers influence sectoral

GVA growth with the help of industry-specific development programs or taxation.

To put it another way, diversification is not about limiting the size of particular sectors; it is about limiting their contributions in generating (positive and/or negative) regional GVA growth. I use a very simple approach in order to construct a diversification measure that is, unlike the sophisticated and hard-to-implement measures from portfolio theory and input-output analysis, easily computable. The investigation builds on sectoral GVA data for the years 2000 to 2012 provided by the Working Group Regional Accounts VGRdL (2014). The data set contains 402 German districts and urban municipalities. The sectoral disaggregation defines seven industries (see Table 4 in the Appendix). A region is considered perfectly diversified if the absolute impacts on overall regional growth (but not necessarily the GVA shares) are equal for all seven industries. For example, if regional GVA grows (or shrinks) by 7 %, each of the seven industries is expected to provide 1 percentage point; i. e. smaller industries may grow (or shrink) faster than larger ones. The measure Div_r is defined as:

$$Div_r = \frac{\sum_{t=1}^{T} \left(1 / \sum_{i=1}^{n} (S_{i,r,t})^2 \right)}{T} \tag{1}$$

with $S_{i,r,t}$:

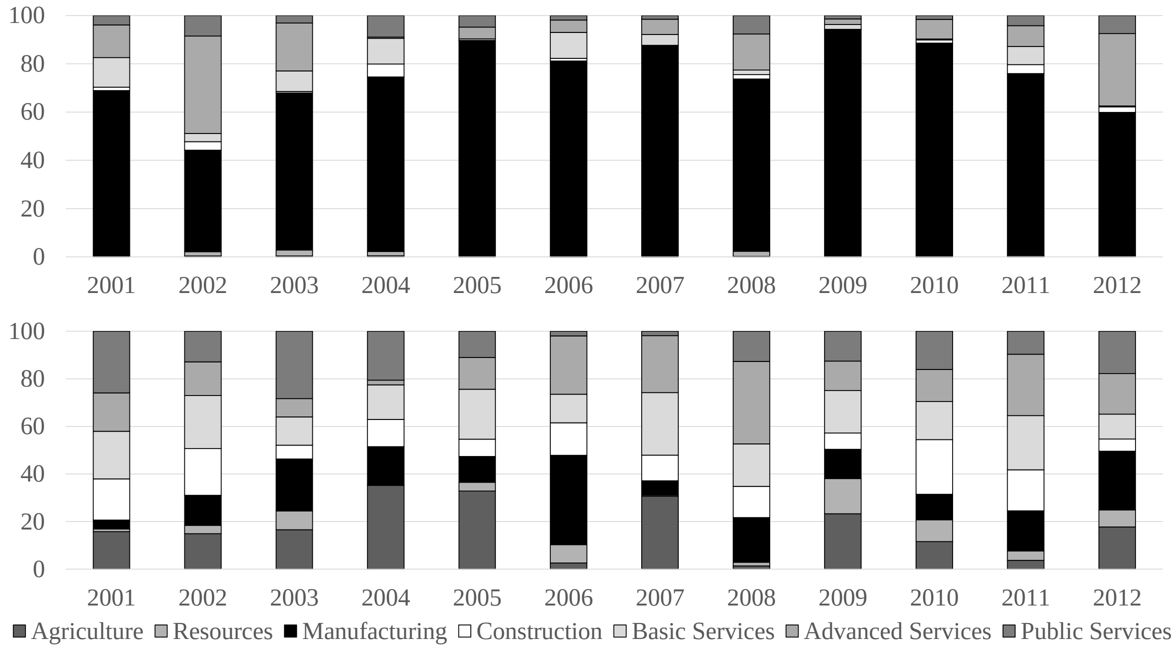
$$S_{i,r,t} = \frac{|\Delta GVA_{i,r,t}|}{\sum_{i=1}^{n} |\Delta GVA_{i,r,t}|} \tag{2}$$

As can be seen from equation 1, the measure is implemented using an inverse Herfindahl index and taking the means over the observed periods T for each region r.[1] Instead of computing this index for GVA shares, I define $S_{i,r,t}$ to be the absolute GVA growth of sector i divided by the sum of the absolute GVA growth over all industries (see equation 2). This gives an idea of how strong certain industries influence overall regional growth. Since GVA growth is used in absolute terms here, the measure treats positive and negative growth the same. This makes sense because only the amplitude (not

[1] Sticking to the well-defined Herfindahl index bears the advantage, that it satisfies the axiomatic requirements for concentration measures (i.e., the non-inverse Herfindahl index; see e.g. Calabrese and Porro (2012)).

the sign) is of interest: A large negative contribution is what regions want to avoid; a large positive contribution might be favorable in the short run, but the mere fact that a single industry is able to dominate regional GVA is what should be alarming. The measure Div_r takes values between 1 (only a single industry contributes to growth) and 7 (all seven industries contribute equally). Figure 1 illustrates this for the least (the upper panel, $Div_r = 1{,}8$) and most (the lower panel, $Div_r = 5{,}2$) diversified region in the data set. Figure 1 shows the stacked values of $S_{i,r,t}$ for the seven industries i and

Figure 1: Stacked values of $S_{i,r,t}$ (in %)



for the years 2001 to 2012. Growth in the least diversified region (the upper panel) is dominated by the manufacturing sector (black) while the remaining industries contribute only a little to the overall development. Thus, this region is, to a large extent, exposed to the fluctuations of its manufacturing sector (although it produces, on average, "only" 45 % of the total GVA). The most diversified region (the lower panel) seems much less dependent on a single industry; the distribution of absolute growth contributions is more equal. The level of regional GVA growth does not influence the diversification measure. The columns for 2009 and 2010 in the upper panel of Figure 1 are almost identical, even though the overall GVA growth rates in this region differed dramatically (-17.9 % in 2009 and +29.2 % in 2010). Nonetheless, the average diversification value in Germany was smaller during the recent economic crisis; however, the average diversification did not decrease due to the negative growth rates but because industries were affected in an unfavorable way. The manufacturing sector, which in most regions was rather large (given its high volatility) even before the crisis, was hit to the greatest extent. Thus, the way into crisis as well as the recovery was mainly driven by manufacturing, which even increased the imbalance in most regions.

This measure satisfies the three requirements: (1) It allows stable industries to be larger than more volatile ones by punishing regions whose economic development is driven by one or a few industries. (2) It takes into account that industries may have region-specific volatilities since the measure for region r is computed with data from region r only. Thus, this measure includes regional heterogeneity that comes from unobservable geographical or historical characteristics or from the sectoral composition at a deeper disaggregation (which in this data set is also unobservable). (3) The measure does not demand sudden and unrealistic rearrangements of economic activity but reveals which industries should be provided with better growth opportunities in order to allocate regional growth to a higher number of contributors.

3 Analytical Framework and Method

3.1 Current State of Research

Although, portfolio theory does not provide meaningful diversification measures (see the previous section), it can serve as an analytical framework. While many of the papers cited simply regress (in)stability measures on various diversification measures, portfolio theory provides the framework for analyzing the interplay of instability, diversification and growth. The issue of growth in particular is often ignored in the literature on this topic. However, recalling the insurance properties of diversification, it seems necessary to jointly analyze the coverage (i.e., stability gains) and the premium (i.e., potential growth losses) of diversification. If the regions are "industrial portfolios" (Conroy (1975, p. 495)) with mean growth rate μ and volatility σ, there should be an efficient frontier that accommodates every efficient combination of μ and σ. Industrial portfolios that are more diversified should be expected to achieve a μ/σ combination on or close to this frontier.

Several authors have tested this logic by investigating how changes in the industrial mix shift regions in the μ/σ space (e.g., Board and Sutcliffe (1991), Gilchrist and St. Louis (1991), Hunt and Sheesley (1994), Lande (1994) or Trendle (2011)).[2] All these works are based on detailed modeling that computes hypothetical efficient portfolios and compares them to the realized ones. In doing so, some authors (e.g., Lande (1994)) impose constraints in order to yield realistic optimal portfolios that are not too distant from the currently achieved industrial structures. Nonetheless, such considerations might be of limited use for regional policy makers who are confronted with settled industrial structures shaped by geographical and historical matters. The policy makers are unable to shift the economic activity in order to achieve optimal portfolios and can only implement policies that eventually move their regions closer to the efficient frontier.

The works closest to the aim of this paper are by Chandra (2002, 2003), Spelman (2006) and Bigerna (2013). Chandra (2002, 2003) uses SFA to estimate the efficient frontier for U.S. states as well as for different administrative areas in Europe. In both cases, he finds a robust convex frontier in μ/σ space as indicated by portfolio theory. Bigerna (2013) finds a similar relationship for Italian regions and Spelman (2006) for U.S. metropolitan areas. Spelman (2006, p. 304) goes one step further and decomposes instability into "baseline" risk, which is the minimum volatility that every region has to take, "assumed" risk, which is justified by additional growth, and "avoidable" risk, which is a measure for regional inefficiency. In the second step, he regresses "avoidable"

[2]St. Louis (1980) also considers the distance in μ/σ space between a region and the efficient frontier. However, he interprets proximity to the efficient frontier as a measure of diversification. This notion bypasses the investigation whether there is a correlation between diversification and inefficiency at all (which is the object of investigation in the paper at hand).

risk on several determinants and finds a significantly negative effect of diversification (measured by the entropy index). Chandra (2002) yields similar results for various diversification measures.

In this paper, I estimate the efficient frontier using a more contemporary version of SFA that estimates an inefficiency term and its determinants within a single stage. This solves a methodological issue regarding the two-stage approach used in Spelman (2006) and Chandra (2002): By estimating the efficient frontier and predicting each region's distance to this frontier, it is implicitly assumed that these distances are identically distributed. By regressing variables on these predicted distances in the second stage, this assumption is violated. The efficient frontier and the inefficiency model should therefore be estimated simultaneously (see e.g. Battese and Coelli (1995)). The estimation approach is presented in detail in the next section.

3.2 Estimation Approach

Consider $g_{r,t}$ to be region r's geometric GVA growth rate (in logs) between *t-1* and t. I then define μ_{r} as the mean of $g_{r,t}$ between 2001 and 2012. The variable σ_{r} is the standard deviation of $g_{r,t}$.[3]

In order to investigate the impact of diversification on regional growth and instability, I proceed in three steps: (1) I estimate the efficient frontier, i.e., the locus of all efficient μ/σ combinations. (2) I determine the positions of the regions in μ/σ space and thus each region's "distance" to the efficient frontier. (3) I investigate whether more diversified regions are closer to this efficient frontier, i.e., whether diversified regions achieve more efficient growth rates, given the volatility they experience.

The functional form of the efficient frontier can be derived from classic portfolio theory

[3]This equals a geometric standard deviation in logs.

as a variance minimization problem (see e.g. Merton (1972); subscript r suppressed):

$$min\ \sigma^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \sigma_{ij} \tag{3}$$

subject to:

$$\sum_{i=1}^{n} w_i = 1 \tag{4}$$

$$\sum_{i=1}^{n} w_i E_i = \mu \tag{5}$$

where w_i are sectoral GVA shares, E_i are sectoral growth rates and σ_{ij} is the covariance for industries i and j. The minimization yields:

$$\sigma^2_{min} = \frac{a\mu^2 - 2b\mu + c}{ac - b^2} \tag{6}$$

where a, b and c are scalars independent of μ and σ. It follows from equation 6 that the efficient frontier is convex in μ. Leaving the scalars aside, the general functional relationship between μ and σ to be estimated reduces to:[4]

$$\sigma = f\{\mu, \beta\} = \beta_0 + \beta_1\mu + \beta_2\mu^2 + \epsilon \tag{7}$$

In order to estimate the efficient frontier, I use the approach by Battese and Coelli (1995) but adapt it for a cross-sectional setting because the endogenous variable σ can be computed for whole periods only instead of on a year-to-year basis. A workaround might be to replace σ with the *Regional Economic Instability (REI)* index that used to be a common measure (see e.g. Kort (1981)). The index accumulates a region's absolute deviations from its long-term GVA trend and considers regions with higher deviations to be more unstable. Technically, this measure could be used on a year-to-year basis. For the following reasons, however, I refrain from using the measure here: First, the measure depends on the filtering technique chosen and therefore varies

[4]It is common practice to use the standard deviation σ instead of the variance σ^2 (see e.g. Chandra (2002), Chandra (2003) or Bigerna (2013)).

considerably according to the assumptions made; not to mention, that 12 years are a very short period for most of the commonly used filtering methods. Second, even regions with large fluctuations might seem stable in years in which the cyclical figure crosses the trend figure; thus, only the sum of absolute deviations can be interpreted in a meaningful manner. Third, to be in line with the more recent literature, it makes sense to stick with the instability framework derived in this section. The standard estimation equation in Battese and Coelli (1995) looks as follows:

$$Y = \exp\left(f\left\{x, \beta\right\} + V - U\right) \tag{8}$$

with one output Y and inputs x. The estimation error is separated into a term V [$N(0, {\sigma_v}^2)$] and a non-negative term U that captures technical inefficiency and is assumed to follow a truncated normal distribution. This formulation applies to a production function, i.e., Y shall be maximized by the choice of x; technical inefficiency U might reduce Y below its feasible level. In the growth-instability setting at hand, however, instability is minimized in which inefficiency might lead to unnecessarily high levels of instability for any given growth rate. Thus, I transform equation 8 into a cost function according to Kumbhakar and Lovell (2003) by interpreting the GVA growth as the regional output y and economic instability as costs C:[5]

$$C = \exp\left(f\left\{y, \beta\right\} + V + U\right) \tag{9}$$

The inefficiency term U now contributes positively in a cost function. Taking logs and inserting the functional relationship from equation 7 gives the estimation equation:[6]

$$\sigma = \beta_0 + \beta_1\mu + \beta_2\mu^2 + V + U \tag{10}$$

Thus far, industrial diversification is not part of this setting. It now enters as a deter-

[5]Input prices do not apply in this setting.

[6]Recall that σ equals a geometric standard deviation in logs because it was (just like μ) computed using growth rates in logs.

minant of the inefficiency term U:

$$U = \delta_0 + \delta_1 Div + W \tag{11}$$

where Div represents the diversification measure (defined in section 2), and W is another error term whose distributional assumptions follow from equation 11 and the distribution of U (for details, see Battese and Coelli (1995)). Equation 10 in connection with equation 11 gives the final estimation model which consists of two parts: the *stochastic frontier* part and the *inefficiency* part. The two equations are estimated simultaneously using the maximum likelihood method.[7] Thus, the three-step analysis is reduced to a single step that (1) estimates the stochastic frontier, (2) determines each region's "distance" U_r from this frontier and (3) investigates the impact of diversification on U_r.

In addition to diversification as the variable of interest, several control variables are deployed. First, I control for absolute *per-capita GVA* in order to capture differences in economic development stages and the mean *population* to capture size effects. Second, I use a factor variable for *urbanity* (1, urban municipalities, to 4, sparsely populated rural areas). Third, I include political variables in order to control for possible differences in policy making that might have an impact on a region's economic development. Since local voting data come with availability and comparison problems due to different electoral laws at the district level, I use voting data for the federal level[8] (assuming that voters' preferences on district matters are also reflected in federal election outcomes). I compute a Herfindahl index over the regional vote shares of the five largest parties in Germany (plus "others") in order to control for the *concentration of political power*. The larger this measure, the more power is in the hands of one or a few parties (irrespective of their ideology). It can be assumed that powerful politicians have more influence on the economic development of their districts than those who are forced to

[7]The deployed STATA module "sfcross" was developed by Belotti *et al.* (2013).

[8]The voting data stem from the Federal Statistical Office and the statistical Offices of the Länder (2015).

compromise with their competitors, albeit the sign of this effect is not clear. Finally, I introduce spatial aspects. The variable *broader regional GVA share* is defined as a particular region's GVA divided by the overall GVA including all neighboring regions that share a common border. This measure therefore is of economic self-dependence. Hotspot regions that have higher *broader regional GVA shares* are expected to have greater benefits from the region's diversification efforts than regions whose economic development depends mainly on neighboring regions. To check for this, an interaction term (*diversification * broader regional GVA share*) is introduced. Furthermore, I control for the extent to which a region's economy is linked to the neighbors' by including Spearman's rank *correlation* coefficient. According to portfolio theory, a high correlation between two regions might impose additional risk and therefore lead to a less efficient growth-instability combination. Descriptive statistics are shown in Table 5 in the Appendix.

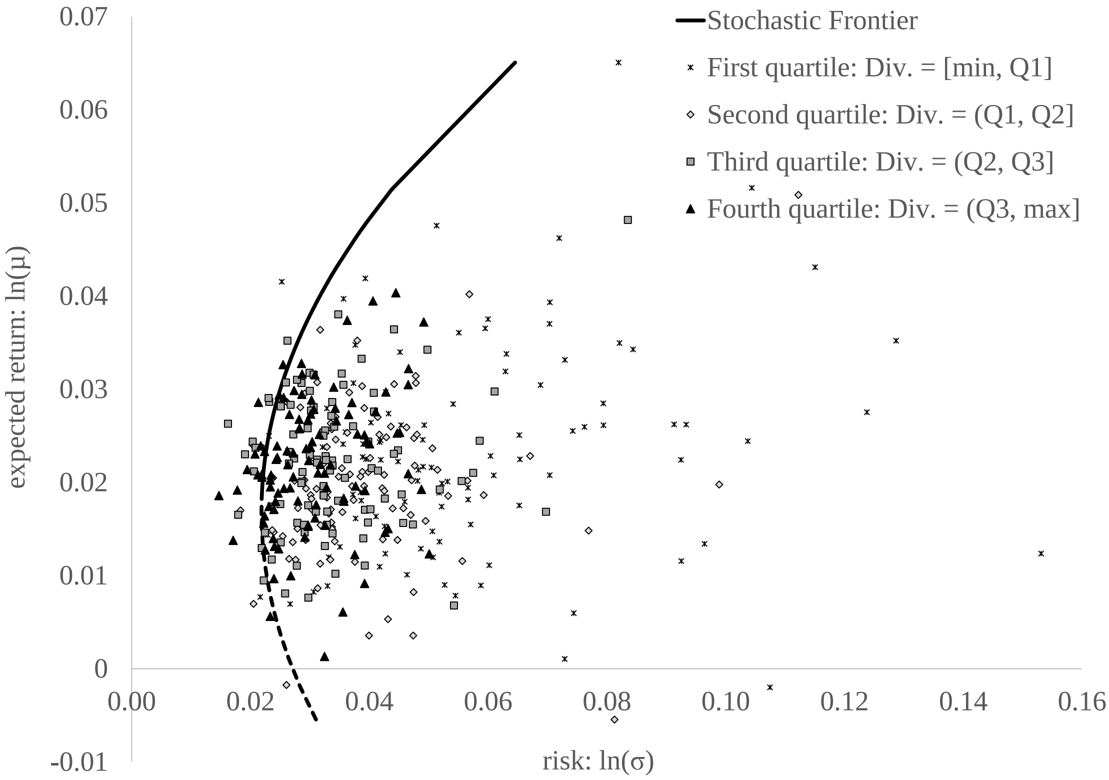
All of these control variables enter the estimation equation in the inefficiency term (equation 11) rather than in the stochastic frontier part (equation 10). The reason is that the frontier has been derived from portfolio theory and should not be subject to arbitrary modifications as they might alter the position of the frontier and, thus the benchmark for measuring efficiency. The only exception I make is to introduce an indicator variable for the 16 German federal states and therefore capture unobserved differences in political and geographical conditions that might influence a region's "production technology."

4 Results

4.1 Basic Results

The estimation results are presented in Table 1; a representation of the efficient frontier is given in Figure 2. The solid curve depicts the frontier as estimated using specification 1; the upper branch of this curve depicts the efficient μ/σ combinations. As expected, a convex relationship between μ and σ can be observed. The coefficient for μ is significantly negative while the squared term is significantly positive. The fact that this central prediction of portfolio theory holds in a regional context lends support to the notion that regions can be seen as portfolios of industries and therefore allow the adaption of portfolio theory (see e.g. Chandra (2003)). The symbols depict the 402 regions by quartiles in terms of the diversification measure.[9] At first glance, the most diversified regions (triangles) are generally located closer to the upper part of the frontier than the least diversified ones (asterisks). This could be the first indication that the level of diversification plays a role in regional inefficiency.

Figure 2: Efficient frontier



Before the determinants of inefficiency are considered in detail, it should be checked whether inefficiency influences the results or whether an OLS estimation (not shown) would have been sufficient. For this purpose, attention should be paid to the bottom

[9]Note that regions can be located left of the frontier because of the idiosyncratic error term V.

Table 1: Maximum-Likelihood Estimation Results

Specification	(1)	(2)	(3)
Dependent Variable	Instability (σ)	Instability (σ)	Instability (σ)
Efficient cost frontier model			
Growth rate (μ)	-0.621***	-0.243	-0.211
	(0.194)	(0.191)	(0.192)
Growth rate (μ^2)	18.39***	9.862**	8.641**
	(4.335)	(4.251)	(4.311)
State Dummies	*yes*	*yes*	*yes*
Constant	0.0271***	0.0237***	0.0239***
	(0.00276)	(0.00267)	(0.00266)
Dependent Variable	Inefficiency (U)	Inefficiency (U)	Inefficiency (U)
Inefficiency model			
Diversification		-0.0738***	-0.0619***
		(0.0102)	(0.00983)
Per-capita GVA		-4.58e-07*	-5.56e-07
		(2.65e-07)	(3.67e-07)
Population		-1.86e-05	-8.76e-06
		(2.05e-05)	(2.09e-05)
Urbanity			
Urban municipalities (1)		.	.
		.	.
Urban districts (2)		0.00379	0.00456
		(0.00760)	(0.00763)
Rural districts with agglom. Trends (3)		0.0169**	0.0158*
		(0.00831)	(0.00820)
Rural districts (4)		0.0327***	0.0313***
		(0.00956)	(0.00942)
Concentration of political power		-0.161**	-0.166**
		(0.0667)	(0.0658)
Broader regional GVA share			0.00162*
			(0.000864)
Diversification * Broader regional GVA share			-0.000598**
			(0.000281)
Correlation			-0.00992
			(0.00837)
Constant	-22.05	0.289***	0.263***
	(48.66)	(0.0419)	(0.0404)
Standard deviation of U	0.5889358	0.0214412	0.0209746
Standard deviation of V	0.0037232	0.0039731	0.003967
H0: No inefficiency component	z = 16.120		
	(P>=z = 0.000)		
Observations	402	402	402

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

of Table 1: First, the constant of U (-22.05) is not significantly different from zero, indicating that the inefficiency bias might be small. However, the variance of U is much larger than the variance of the idiosyncratic error term V; in fact, the overall error variance is almost entirely induced by U. In addition to these contradictory indications, there is a decisive test for inefficiency, proposed by Coelli (1995) and presented at the bottom of Table 1: It indicates that there is considerable inefficiency; i.e., the error terms of an OLS regression are biased.

Thus, it makes sense to search for the determinants of this inefficiency. Specification 2 includes the diversification measure and the non-spatial control variables. The coefficient for the diversification measure is negative and significant; *diversification* is strongly correlated with more efficient growth-instability combinations. This is the central result of this paper. Obviously, diversification works like insurance against economic instability as it allows regions to be located closer to the efficient frontier. On average, the 10 % most diversified regions achieve μ_r of only 81 % compared to those achieved by the 10 % least diversified regions; this is the insurance premium. However, their average σ_r is only 41 % compared to the 10 % least diversified regions; this can be interpreted as the insurance coverage. Furthermore, regions with high *per-capita GVA* are located significantly closer to the efficient frontier. More *urban* regions perform better than more *rural* ones. As expected, the effect of the *concentration of political power* is significant; the negative sign indicates that higher political power is correlated with higher efficiency. The reason might be that powerful politicians can react quicker to economic developments than those who have to negotiate compromises with their competitors. Furthermore, such compromises might contain contradictory policies, especially when different ideologies are involved.

The spatial controls are included in specification 3. Although the results are qualitatively unchanged compared to specification 2, the coefficient for the *broader regional GVA share*, which is positive and significant, cannot be interpreted without the corresponding interaction term (*diversification * broader regional GVA share*). Since the coefficient for this interaction term is negative and significant, it can be concluded that the efficiency-enhancing impact of diversification is stronger the higher a region's *broader regional GVA share*. The marginal effect becomes insignificant only for very high *broader regional GVA shares*, certainly due to a declining number of observations. The only regions without significant marginal effects are large cities like Berlin or Hamburg that account for more than 70 % of their broader regional GVA. Generally, however, regions with a high degree of self-dependence, i.e., regions that generate the majority of the respective broader regional GVA, benefit more from diversification than others. Accordingly, regions with very low shares of broader regional GVA (the minimum is less than 2 %) may have efficiency-enhancing effects from diversification, but these effects are smaller because these region's economic ups and downs are mainly driven by strong neighboring regions.

4.2 Alternative Results

In this section, the above-mentioned effects are investigated over time. As discussed in section 3.2, panel approaches are not feasible since there is no meaningful instability measure on a year-to-year basis. However, to involve the temporal perspective, I disassemble the overall observation period into subsequent, overlapping four-year periods. This gives 4,020 observations that can be analyzed using the cross-sectional methods presented. Year dummies are included in the efficient frontier part of the estimation equation in order to capture unobserved time-related effects. The results are shown in Table 2.

Most of the results are qualitatively the same as in section 4.1. The efficient frontier is convex in μ, and the coefficients for *diversification* and for the interaction term with *broader regional GVA share* are significantly negative. The results for *urbanity* remain qualitatively unchanged. The result for the *political power* variable does not change much as well. The effect of *population* is now stronger and significant; the coefficient

Table 2: Alternative Estimation Results (Maximum-Likelihood) - A

Specification	(1)	(2)	(3)
Dependent Variable	Instability (σ)	Instability (σ)	Instability (σ)
Efficient cost frontier model			
Growth rate (μ)	-0.238***	-0.177***	-0.180***
	(0.0215)	(0.0213)	(0.0211)
Growth rate (μ^2)	3.843***	2.409***	2.414***
	(0.315)	(0.336)	(0.333)
State Dummies	*yes*	*yes*	*yes*
Year Dummies	*yes*	*yes*	*yes*
Constant	0.0108***	0.0132***	0.0132***
	(0.00108)	(0.00104)	(0.00102)
Dependent Variable	Inefficiency (U)	Inefficiency (U)	Inefficiency (U)
Inefficiency model			
Diversification		-0.135***	-0.100***
		(0.0119)	(0.00945)
Per-capita GVA		2.46e-07	3.92e-07
		(2.46e-07)	(3.05e-07)
Population		-4.72e-05**	-3.32e-05*
		(2.13e-05)	(1.97e-05)
Urbanity			
Urban municipalities (1)		.	.
		.	.
Urban districts (2)		0.0112	0.00123
		(0.00826)	(0.00741)
Rural districts with agglom. Trends (3)		0.0270***	0.0159**
		(0.00897)	(0.00797)
Rural districts (4)		0.0625***	0.0484***
		(0.0107)	(0.00920)
Concentration of political power		-0.319***	-0.274***
		(0.0542)	(0.0467)
Broader regional GVA share			0.00210***
			(0.000628)
Diversification * Broader regional GVA share			-0.000975***
			(0.000224)
Correlation			0.0195***
			(0.00386)
Constant	-30.99	0.408***	0.316***
	(30.44)	(0.0357)	(0.0293)
Standard deviation of U	0.8316346	0.0517383	0.0483159
Standard deviation of V	0.0080378	0.0087557	0.0084326
H0: No inefficiency component	z = 64.175		
	(P>=z = 0.000)		
Observations	4,020	4,020	4,020

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

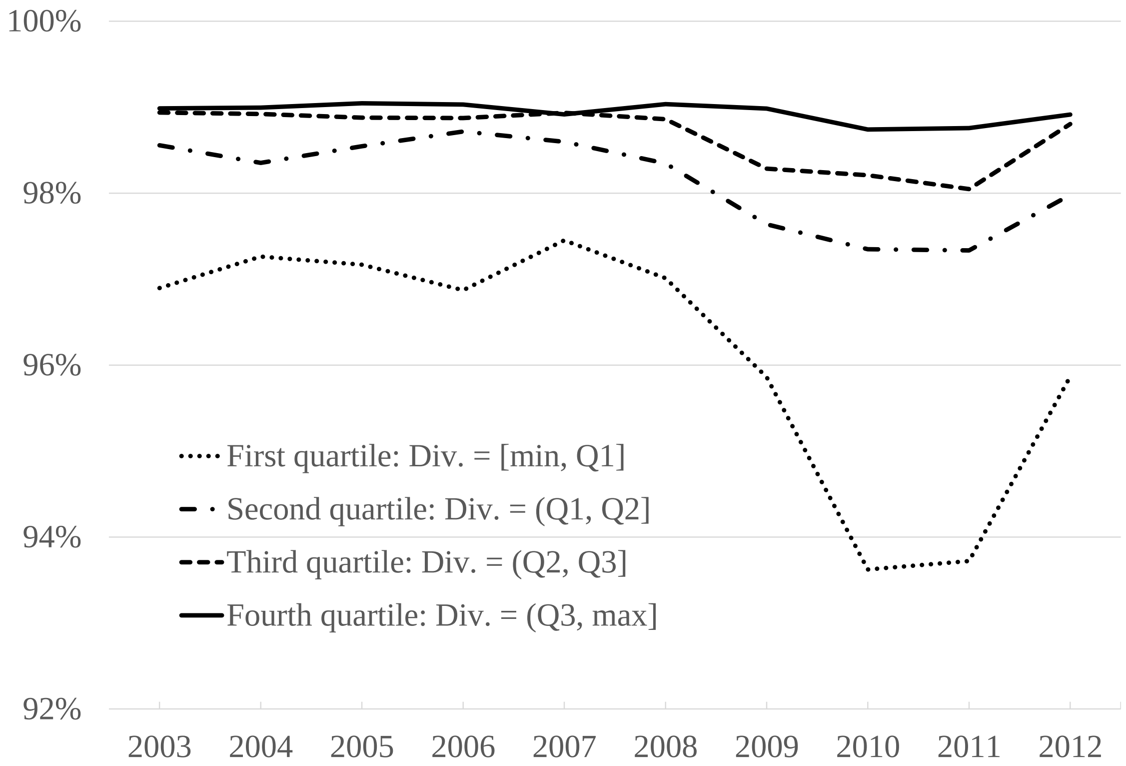
for *per-capita GVA* turns insignificant. The variable *correlation* (which before was insignificant) now yields the expected result. The higher the correlation of a region's growth rates and those of the surrounding regions, the less efficient the μ/σ combination due to the additional risk that comes with such regional alignment.

In order to observe the extent to which regions have shifted away from the efficient frontier during the economic crisis in 2009, it is helpful to compute each region's efficiency level according to the following formula (see e.g. Kumbhakar and Lovell (2003, p. 139)):

$$Efficiency_{\mathrm{r,t}} = exp(-U_{\mathrm{r,t}}) \tag{12}$$

The development of the efficiency levels over time is shown in Figure 3. The x-axis depicts the respective last year of a particular four-year period; the y-axis depicts efficiency levels between 92 % and 100 % for the diversification quartiles.

Figure 3: Efficiency levels over time



Obviously, the efficiency levels dropped with the outbreak of the international economic crisis in 2009 but quickly recovered. During the period from 2009 to 2012, most regions approached their pre-crisis efficiency levels from 2005 to 2008. Obviously, the drop was much larger for the less diversified regions (dotted line) and almost negligible for the upper quartile. This leads to the conjecture that diversification even helped dampen the shock of the severe economic crisis. To gain insight into this issue, the year dummies can be included in the inefficiency part of the estimation equation and interacted with *diversification* and the *broader regional GVA share*. The results are reported in Table 3. The marginal effect of *diversification* is (irrespective of the level of *broader regional GVA share*) significantly negative in every year which indicates the efficiency-enhancing effect. However, the effects are somewhat smaller during the economic crisis. In fact, the interaction term *year * diversification* is significantly positive for the periods ending in 2009, 2010 and 2011 (see boldface in Table 3); i.e., *diversification* was less effective in these years. Nonetheless, the effect of diversification itself stays significant. This might be because regions were affected to varying extents (38 districts even achieved positive GVA growth rates in 2009). Furthermore, even the export-oriented industries in Germany, which should have been expected to suffer considerably from the international crisis, absorbed the shock pretty well (at least in terms of employment; see e.g. Möller (2010)). Thus, although the opportunities to diversify were slightly smaller than in the years before and after the crisis, the efficiency-enhancing effect of diversification remained.

Table 3: Alternative Estimation Results (Maximum-Likelihood) - B

Dependent Variable	Instability (σ)	Dependent Variable	Instability (σ)
	Efficient cost frontier model - suppressed		
Inefficiency model		*Inefficiency model*	
Diversification (Div)	**-0.0752*** **	*continued*	
	(0.0140)		
Broader regional GVA share (BRGS)	0.00223	**BRGS stands for**	
	(0.00139)	**"Broader regional**	
DIV * BRGS	-0.000798	**GVA share."**	
	(0.000493)		
Year 2003	.	Year 2003 * BRGS	.
	.		.
Year 2004	-0.0242	Year 2004 * BRGS	-1.33e-05
	(0.0575)		(0.00194)
Year 2005	0.0272	Year 2005 * BRGS	-0.00124
	(0.0555)		(0.00195)
Year 2006	-0.0457	Year 2006 * BRGS	0.000690
	(0.0534)		(0.00203)
Year 2007	-0.0852	Year 2007 * BRGS	-0.000104
	(0.0552)		(0.00206)
Year 2008	-0.0574	Year 2008 * BRGS	0.00140
	(0.0571)		(0.00238)
Year 2009	-0.0360	Year 2009 * BRGS	-0.00163
	(0.0469)		(0.00174)
Year 2010	-0.0255	Year 2010 * BRGS	0.000788
	(0.0454)		(0.00165)
Year 2011	-0.0165	Year 2011 * BRGS	-0.000819
	(0.0445)		(0.00155)
Year 2012	0.0493	Year 2012 * BRGS	-0.00214
	(0.0508)		(0.00177)
Year 2003 * DIV	.	Year 2003 * DIV * BRGS	.
	.		.
Year 2004 * DIV	0.00499	Year 2004 * DIV * BRGS	-0.000138
	(0.0185)		(0.000714)
Year 2005 * DIV	-0.0129	Year 2005 * DIV * BRGS	0.000218
	(0.0185)		(0.000737)
Year 2006 * DIV	0.0136	Year 2006 * DIV * BRGS	-0.000445
	(0.0176)		(0.000767)
Year 2007 * DIV	0.0239	Year 2007 * DIV * BRGS	-3.60e-05
	(0.0177)		(0.000735)
Year 2008 * DIV	0.0184	Year 2008 * DIV * BRGS	-0.000617
	(0.0185)		(0.000839)
Year 2009 * DIV	**0.0305** **	Year 2009 * DIV * BRGS	0.000480
	(0.0150)		(0.000597)
Year 2010 * DIV	**0.0281***	Year 2010 * DIV * BRGS	-0.000264
	(0.0148)		(0.000581)
Year 2011 * DIV	**0.0278***	Year 2011 * DIV * BRGS	0.000146
	(0.0145)		(0.000550)
Year 2012 * DIV	-0.0211	Year 2012 * DIV * BRGS	0.000557
	(0.0171)		(0.000658)
	Further controls - suppressed		
		Observations	4,020
		Standard errors in parentheses	
		*** p<0.01, ** p<0.05, * p<0.1	

5 Conclusion

In this paper, I have examined the extent to which sectoral diversification can help stabilize region's economic performance. In spite of good arguments in favor of specialization, e.g., agglomeration economies or comparative advantages, a highly specialized region might be more vulnerable to industry-specific downturns. The focus of this paper, therefore, was whether a district's diversification efforts can be seen as a type of insurance.

I considered regions to be portfolios of industries with annual GVA growth rates and their standard deviation as a measure of instability, and I used *Stochastic Frontier Analysis* in order to estimate the efficient frontier, i.e., the locus of all efficient growth-instability combinations. Furthermore, I defined a comprehensive diversification measure that is based on sectoral contributions to overall growth instead of on the commonly used sectoral GVA shares. I then estimate whether regions whose growth rates are not driven by a single industry but by a variety of industries achieve more efficient growth-instability combinations, i.e., greater stability at given levels of economic growth.

The results show that more diversified regions are closer to the efficient frontier; i.e., they experience a more appropriate volatility given the achieved GVA growth rates. Such effects are larger for hotspot regions that determine the economic development of a broader region. This also means that regions whose fluctuations are mainly induced by their economically strong neighbors have much smaller benefits from own diversification strategies. The impact of diversification was smaller but still significant during the recent economic crisis.

This study could be enhanced in several ways. For example, a sectorally more disaggregated database would provide better insights into the interdependencies of industries. An even longer time series or monthly data would help to investigate more sophisticated instability concepts instead of fluctuations over time (e. g. vulnerability to shocks, resilience properties etc.). In addition, with a longer time series, different instability measures (e.g., the *regional economic instability (REI)* index) and panel approaches could be used.

Appendix

Table 4: Classification of Economic Activities
according to the Federal Statistical Office Germany (2008)

Abbr.	**Content**
A	Agriculture; Forestry; Fishing
B,D,E	Mining & Quarrying; Electricity, Gas, Steam and Air Conditioning Supply; Water Supply, Sewerage, Waste Management and Remediation Activities
C	Manufacturing
F	Construction
GJ	Wholesale & Retail Trade; Repair of Motor Vehicles & Motorcycles; Transportation & Storage; Accommodation & Food Service Activities; Information & Communication
KN	Financial & Insurance Activities; Real Estate Activities; Professional, Scientific & Technical Activities; Administrative & Support Service Activities
OT	Public Administration & Defence; Compulsory Social Security; Education; Human Health & Social Work Activities; Arts, Entertainment & Recreation; Other Service Activities; Activities of Households as Employers, Undifferentiated Goods- and Service-Producing Activities of Households for own Use

Table 5: Descriptive Statistics

Variable	**Mean**	**s.d.**	**Min**	**Max**
Instability (σ)	0.04039	0.01876	0.01470	0.15312
Growth rate (μ)	0.02183	0.00865	-0.00545	0.06507
Diversification (inv. Herf. index)	3.52514	0.53450	1.75244	5.24363
Per-capita GVA (in Euros)	23,805.27	9,604.67	11,566.67	71,961.37
Population (in 1.000)	204.472	229.000	34.937	3,418.801
Urbanity				
Urban municipalities (1)	0.16667	-	0	1
Urban districts (2)	0.34080	-	0	1
Rural districts with agglom. Trends (3)	0.25124	-	0	1
Rural districts (4)	0.24129	-	0	1
Concentration of political power (Herf. index)	0.31930	0.04558	0.20381	0.48697
Broader regional GVA share (in %)	18.31955	14.70477	1.97825	74.74499
Correlation	0.45635	0.26372	-0.35664	0.96504

References

Baldwin, J. R. and Brown, W. M. (2004). Regional manufacturing employment volatility in Canada: The effects of specialisation and trade. *Papers in Regional Science*, **83** (3), 519–541.

Battese, G. E. and Coelli, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics*, **20** (2), 325–332.

Beaudry, C. and Schiffauerova, A. (2009). Who's right, Marshall or Jacobs? The localization versus urbanization debate. *Research Policy*, **38** (2), 318–337.

Becker, G. S. and Ehrlich, I. (1972). Market insurance, self-insurance, and self-protection. *The Journal of Political Economy*, **80** (4), 623–648.

Belotti, F., Daidone, S., Atella, V. and Ilardi, G. (2013). sfcross: Stata module for cross-sectional stochastic frontier models estimation. *Statistical Software Components*, **S457635**.

Bigerna, S. (2013). The regional growth-instability frontier in Italy. *Atlantic Economic Journal*, **41** (4), 463–464.

Board, J. and Sutcliffe, C. (1991). Risk and income tradeoffs in regional policy: A portfolio theoretic approach. *Journal of Regional Science*, **31** (2), 191–210.

Brewer, H. (1985). Measures of diversification: Predictors of regional economic instability. *Journal of Regional Science*, **25** (3), 463–470.

— and Moomaw, R. L. (1985). A note on population size, industrial diversification, and regional economic instability. *Urban Studies*, **22** (4), 349–354.

Brown, C. C. (2012). The impact of changing diversification on stability and growth in a regional economy. *Research in Business & Economics Journal*, **5**, 1–10.

Calabrese, R. and Porro, F. (2012). *Single-name concentration risk in credit portfolios: a comparison of concentration indices*. University College Dublin, Geary Institute, Discussion Paper Series.

Chandra, S. (2002). A test of the regional growth-instability frontier using state data. *Land Economics*, **78** (3), 442–462.

— (2003). Regional economy size and the growth–instability frontier: Evidence from Europe. *Journal of Regional Science*, **43** (1), 95–122.

Coelli, T. (1995). Estimators and hypothesis tests for a stochastic frontier function: A Monte Carlo analysis. *Journal of Productivity Analysis*, **6** (3), 247–268.

Conroy, M. E. (1974). Alternative strategies for regional industrial diversification. *Journal of Regional Science*, **14** (1), 31–46.

— (1975). The concept and measurement of regional industrial diversification. *Southern Economic Journal*, **41** (3), 492–505.

Dissart, J. C. (2003). Regional economic diversity and regional economic stability: Research results and agenda. *International Regional Science Review*, **26** (4), 423–446.

Eckles, D. L., Kam, C. D., Maestas, C. L. and Schaffner, B. F. (2014). Risk attitudes and the incumbency advantage. *Political Behavior*, **36** (4), 731–749.

Essletzbichler, J. (2007). Diversity, stability and regional growth in the United States, 1975–2002. In K. Frenken (ed.), *Applied Evolutionary Economics and Economic Geography*, Edward Elgar Publishing, Cheltenham, pp. 203–229.

Ezcurra, R. (2011). Unemployment volatility and regional specialization in the European Union. *Regional Studies*, **45** (8), 1121–1137.

Federal Statistical Office and the statistical Offices of the Länder (2015). *Regional elections: Eligible voters, voter turnout and valid votes by party.* Date: August 10, 2015, Düsseldorf.

Federal Statistical Office Germany (2008). *Classification of Economic Activities, Edition 2008 (WZ 2008).* Wiesbaden.

Gilchrist, D. A. and St. Louis, L. V. (1991). Directions for diversification with an application to Saskatchewan. *Journal of Regional Science*, **31** (3), 273–289.

Hunt, G. L. and Sheesley, T. J. (1994). Specification and econometric improvements in regional portfolio diversification analysis. *Journal of Regional Science*, **34** (2), 217–235.

Jackson, R. W. (1984). An evaluation of alternative measures of regional industrial diversification. *Regional Studies*, **18** (2), 103–112.

Kam, C. D. and Simas, E. N. (2012). Risk attitudes, candidate characteristics, and vote choice. *Public Opinion Quarterly*, **76** (4), 747–760.

Kort, J. R. (1981). Regional economic instability and industrial diversification in the US. *Land Economics*, **57** (4), 596–608.

Kumbhakar, S. C. and Lovell, C. K. (2003). *Stochastic Frontier Analysis*. Cambridge University Press.

Kurre, J. A. and Weller, B. R. (1989). Regional cyclical instability: An empirical examination of wage, hours and employment adjustments, and an application of the portfolio variance technique. *Regional Studies*, **23** (4), 315–329.

Lande, P. S. (1994). Regional industrial structure and economic growth and instability. *Journal of Regional Science*, **34** (3), 343–360.

Malizia, E. E. and Ke, S. (1993). The influence of economic diversity on unemployment and stability. *Journal of Regional Science*, **33** (2), 221–235.

Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, **7** (1), 77–91.

Marshall, A. (1890). *Principles of Economics*. MacMillan, London.

McLaughlin, G. E. (1930). Industrial diversification in American cities. *The Quarterly Journal of Economics*, **45** (1), 131–149.

Merton, R. C. (1972). An analytic derivation of the efficient portfolio frontier. *Journal of Financial and Quantitative Analysis*, **7** (4), 1851–1872.

Möller, J. (2010). Germany's job miracle in the world recession - shock-absorbing institutions in the manufacturing sector. *Applied Economics Quarterly (formerly: Konjunkturpolitik)*, **61** (Supplement), 9–28.

Sherwood-Call, C. (1990). Assessing regional economic stability: A portfolio approach. *Economic Review. Federal Reserve Bank of San Francisco*, **Winter** (1), 17–26.

Siegel, P. B., Johnson, T. G. and Alwang, J. (1995). Regional economic diversity and diversification. *Growth and Change*, **26** (2), 261–284.

Spelman, W. (2006). Growth, stability, and the urban portfolio. *Economic Development Quarterly*, **20** (4), 299–316.

St. Louis, L. V. (1980). A measure of regional diversification and efficiency. *The Annals of Regional Science*, **14** (1), 21–30.

Trendle, B. (2006). Regional economic instability: The role of industrial diversification and spatial spillovers. *The Annals of Regional Science*, **40** (4), 767–778.

— (2011). An analysis of diversification strategies in regional Queensland using a two-region, portfolio selection model. *The Australasian Journal of Regional Studies*, **17** (2), 102.

Tress, R. C. (1938). Unemployment and the diversification of industry. *The Manchester School*, **9** (2), 140–152.

Wagner, J. E. and Deller, S. (1998). Measuring the effects of economic diversity on growth and stability. *Land Economics*, **74** (4), 541–556.

Working Group Regional Accounts VGRdL (2014). *Gross domestic product, gross value added in Germany on NUTS3-Level 1992, 1994 to 2012*. Date of calculation: August 2013, Stuttgart.

Wundt, B. D. and Martin, L. R. (1993). Minimizing employment instability: A model of industrial expansion with input-output considerations. *Regional Science Perspectives*, **23** (1), 81–93.

Yakovlev, P. A. (2011). In uncertainty we trust: A median voter model with risk aversion. *Financial Theory and Practice*, **35** (4), 465–477.

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