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An Institutional Risk Analysis of the Kazakh Economy

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Abstract

This paper investigates the impact of institutions or structural policies on the volatility of income or GDP per capita in transition countries and in Kazakhstan in particular. In the first part of the paper we compare Kazakhstan's institutional framework with other transition economies based on a broad range of indicators. Using factor analytical tools to reduce the dimensionality of the indicator space we find that in general Kazakhstan's institutional quality ranks among the lowest of the 24 transition countries investigated. Reform progress was mainly achieved in infrastructure. In the second part of the paper we employ state-of-the-art Bayesian Model Averaging (BMA) to identify institutional and macroeconomic policy areas that have the strongest impact on output volatility in transition economies. The analysis shows that good legal and administrative institutions can help smooth output volatility. Moreover, we also find that inflation and current account volatility and to a smaller extend exchange rate fluctuations are important determinants of output volatility.

JEL Code: E02, E30, O11, P30.
Keywords: Institutions, output volatility, development, transitions economies, model uncertainty, Bayesian Model Averaging.

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1. Introduction

The recent growth and development literature has emphasized the importance of institutions[2] to explain the large and persistent income per capita differences between developing countries (e.g. Hall and Jones, 1999; Acemoglu et al, 2001). Institutions have also featured prominently in explaining the different performances of transition countries after the fall of the iron curtain (e.g. Roland, 2000; Havrylyshyn and van Rooden, 2003; Beck and Laeven, 2006; Eicher and Schreiber, 2007). Apart from academia, institutions have also received considerable attention in economic policy related circles (e.g. World Bank, 2002; IMF, 2005). Instead of examining the effect on long-run growth, we take a slightly different approach in this paper and investigate the impact that institutions or structural policies have on the *volatility* of income or GDP per capita in transition countries and on Kazakhstan in particular.[3]

The economic consequences of income or GDP volatility are potentially serious. Even if we abstract from the extreme form of economic crisis, adverse effects of volatility will be felt especially strong by the poorest, who may lack wealth or access to credit markets to smooth consumption. Persistent volatility can also translate into slower growth (Ramey and Ramey, 1995) or private investment (Aizenman and Marion, 1999). The quality of institutions may play an important role in explaining output volatility. For instance, greater infighting of political groups or shifts in the balance of power can be associated with economic instability (Acemoglu et al., 2003). In participatory political societies, it may be easier to build a reform consensus in response to an external shock (Rodrik, 2000). Alternatively, inefficient institutions for example in the form of insufficient property rights, may lead foreign investors to allocate capital into sector from which they can redraw their capital quickly, aggravating the effects of crises.

In the first part of this paper, we make use of a broad range of institutional indicators provided by international organizations to characterize the institutional setting of transitions countries. We pay special attention to the Kazakhstan' situation compared to other transition countries and Kazakhstan's development over time. In a first step we reduce the universe of indicators into several important dimensions of the institutional framework using Principal Component Analysis (PCA). In particular we construct composite indicators that cover the following five

[2] We understand institutions as a set of formal rules and informal conventions that provide the framework for human interactions and shape the incentives of members of society (North, 1991).
[3] We use institutions and structural policies interchangeably throughout the paper.

aspects: political/constitutional system, market regulations, legal and administrative system, corruption, and infrastructural reform.

In the second part of the paper we analyze whether and which of these institutional dimensions influence volatility in transition countries. We do so by regressing the institutional composite indicators and other potential determinants of volatility on the standard deviation of average growth over two time periods (1997-2001; 2002-2006). Our estimation approach employs state-of-the art Bayesian Model Averaging (BMA). BMA allows to base interference on a large space of potential models, by averaging over all models and assigning weights according to their model fit. This approach is in sharp contrast to traditional approaches that base statistical significance on one or a few models without accounting for the uncertainty inherent in this model selection process. BMA is also crucial in our context, because it allows us to investigate a long list of potential determinants despite the low number of observations available. Traditional approaches of estimating a full model and judging significance based on p-values are rendered unreliable because of the lack of degrees of freedom. Finally, BMA was shown to exhibit superior predictive performance in a range of simulation experiments (Raftery and Zheng, 2003).

2. Kasakhstans Institutional Setting

A range of international organizations provide assessments of the institutional quality of transition countries in general and Kazakhstan in particular. Table 1 summarizes the institutional indicators for which we have a balanced panel for 24 transition countries over the period 1998-2006.[4] The table also groups the indicators into 5 different institutional dimensions: market regulations, legal/administrative system, corruption, political/constitutional system and infrastructural reform. For each of these institutional dimensions we compute composite indicators using Principal Component Analysis (PCA) to summarize the information content.

[Table 1 here]

[4] Albania, Armenia, Azerbajan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Moldova, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

The main goal of PCA is to explain the bulk of the information contained in a large number of indicators through a few linear combinations (principal components) of these original indicators. PCA is therefore a data reduction technique that is aimed at reducing the dimensionality of the dataset. This reduction of the dimensionality of the dataset is important for at least three reasons. First it allows to easily summarize the information contained in a large space of indicators. Second, the data reduction is necessary for the following regression analysis, since the number of observations is strongly constrained. Third, it mitigates the multicollinearity problem of the institutional indicators in the regression analysis. Many of the institutional indicators measure similar concepts and are therefore highly collinear. Given the limited number of observations this generally translates into inflated standard errors of regression coefficients and renders most of the variables insignificant.[5]

As described above we perform PCA on each of the five institutional dimensions. If the correlation between the indicators is small it is unlikely that they share common factors. We check the adequacy of the PCA approach by calculating the Kaiser-Meyer-Olkin measure of sample adequacy for each of the five dimensions. In all of these cases did the Kaiser-Meyer-Olkin criterion indicate the use of PCA. Further to identify the number of necessary components to represent the original data we use a standard criterion: We only select those components which have an eigenvalue of greater than one. Intuitively, this means that the component explains more variation than the variation introduced by one original indicator. This procedure suggested that each of the five dimensions can be represented by one single principal component. Finally, to construct the weights of each original indicator in the composite principal component we followed the approach of Nicoletti, Scarpetta and Boyland (2000). According to their methodology the weights correspond to the squared factor loadings. These squared loadings represent the proportion of the variance of the indicator that is explained by the principal component. Figure 1 displays the components and their respective weights in each of the five institutional dimensions. Each of the original indicators and the composite indices are normalized to range from 0 to 100, where a higher value indicates better institutional quality.[6]

[Figure 1 here]

[5] For more detailed information on PCA or more general factor analytical techniques the interested reader is referred to the OECD handbook and composite indicators (OECD, 2008).
[6] For the political/constitutional component this mean a country with a higher score is closer to democracy.

Based on the PCA results we can now turn to the assessment of Kazakhstan's institutional environment. Figure 2 is a first attempt to assess Kazakhstan's institutional development over time. The upper figure shows Kazakhstan's rank in each of the institutional dimensions over time compared to the other 23 transition countries. The lower figure displays the ratio of Kazakhstan's score in each dimension compared to the country with highest score for a specific dimension and year (best practice country).

The component that experienced largest improvement is infrastructure, the improvement was both in absolute terms (better infrastructure compared to previous years) and in relative terms (better infrastructure compared to peers). A small decline in the political system component was also in absolute and relative terms. The remaining components did not display steady trends.

[Figure 2 here]

Additionally, Figure 3 shows the overall areas of progress and regress of Kazakhstan over time. It displays again the ratio of Kazakhstan's score to the best practice country for each dimension at the beginning of the period of observation (1998) and the end (2006).

[Figure 3 here]

3. Alternative Determinants of Volatility

In this section be briefly describe alternative theories that might explain output volatility and that we are going to control for in the regression analysis below. One important strand of the literature stresses *policy mismanagement*, such as misalignment of exchange rates and mismanagement of fiscal and monetary policy, as an important source of economic volatility (e.g. Agenor at al., 2000; Fatas and Mihov, 2004). More generally, the belief that macroeconomic mismanagement leads to economic disarray is the cornerstone of policy prescriptions associated with the Washington Consensus. Given the importance we control for several aspects of macroeconomic policies (see Table 2).

International *trade* can be another important source of economic volatility. In general countries that are more internationally integrated are also more prone to external shocks from abroad. Therefore we include a measure of the overall openness. Moreover, the composition of trade matters for growth. Countries with a very narrow export structure are especially prone

to changes in world prices. Hence we include a measure of the export concentration. Fuel and other primary commodity prices are among the most volatile. In order to control for this effect we include a measure of fuel export intensity and other primary commodity exports.

Other studies have highlighted the role of *geography* (e.g. Malik and Temple, 2009), *ethnolinguistic heterogeneity* or *resource abundance*. We capture these time invariant factors by including country fixed effects in our regression. [7]

4. Estimation Approach

To test our hypothesis that institutions influence volatility econometrically we regress our explanatory variables on the dependent variable using two cross sections of data. These two periods are the five year intervals 1997-2001 and 2002-2006. Our dependent variable is the standard deviation of the average GDP per capita growth for each of these periods. All explanatory variables are also 5-year averages corresponding to the two time periods.
We estimate the following regression equation

$$Y_{i,t} = \alpha + \beta I_{i,t} + \delta Z_{i,t} + \eta_i + \nu_t + \varepsilon_{i,t} \qquad (1)$$

where $Y_{i,t}$ is the GDP volatility in country i and time t, $I_{i,t}$ ist he matrix of institutional composite indicators, $Z_{i,t}$ is a matrix of other control variables, η_i captures country-specific fixed effects, ν_t represents time fixed effects in the form of year dummies, and $\varepsilon_{i,t}$ is a time and country specific error term. The country fixed effects control for variables that do not change over the two time periods considered such as geography, culture, or communist history. The time fixed effect ensures that common time trends are captured and do not bias coefficient estimates.

We estimate equation (1) using recently developed Bayesian Model Averaging (BMA). One of the major advantages of this approach in our context is that we are able to control for a range of potential volatility determinants despite the low number of observations, thereby reducing possible omitted variable bias. It also correctly accounts for the uncertainty inherent in the model selection process, that traditional approaches neglect. If the uncertainty about the

[7] Other studies have highlighted the development of domestic financial markets for economic volatility. We would have liked to control for this fact, however, proxies for financial market development are only available for a limited number of countries in our sample, further reducing the already small sample size.

true model specification is not accounted for in the econometric method, the precision of estimates is overestimated.

4.1 Bayesian Model Averaging

In this section we briefly explain the crucial intuition behind our BMA estimation methodology. For more extensive introductions the interested reader is referred to Raftery (1995), Raftery, Madigan and Hoeting (1997) or Hoeting et al. (1999).[8] An advantage of Bayesian Model Averaging over other approaches to deal with model uncertainty, such as extreme bounds analysis (Leamer, 1983, Levine and Renelt, 1992), is that BMA is soundly based on statistical theory with all results directly following from elementary probability theory, notably the definition of conditional probability, Bayes' theorem and the law of total probability. Intuitively: BMA asks the researcher to specify candidate regressors that are clearly linked to distinct theories. Bayesian Model Averaging then allows for any subset of regressors to appear in a given model. Given the data, BMA first estimates a posterior distribution of each regressor coefficient for every model that includes the regressor. It then combines all posterior distributions into a weighted average posterior distribution, with weights given by the posterior model probabilities.

For notational convenience we integrate the matrices $I_{i,t}$ and $Z_{i,t}$ as well as the country and time fixed effects from above into a comprehensive $n \times k$ matrix X. Then, consider a regression model, where the dependent variable per capita GDP volatilty, *y*, is regressed on an intercept, α, and candidate regressors chosen from a set of *k* variables in the design matrix *X* of dimension $n \times k$. Further define β as the full *k*-dimensional vector of regression coefficients. Now suppose we have an $n \times k_j$ submatrix of variables in X denoted by X_j. Then denote by M_j the model with regressors grouped in X_j, such that

$$y = \alpha + X_j \beta_j + \varepsilon, \qquad (2)$$

where $\beta_j \in \Re^{k_j}$ $\left(0 \le k_j \le k\right)$ groups regression coefficients corresponding to the submatrix X_j. The exclusion of any given regressor in a particular model implies that the corresponding element in β is zero.

[8] For a more general introduction to Bayesian econometrics see e.g. Koop (2003).

Since Bayesian Model Averaging allows for any subset of variables in *X* to appear in any model M_j, there are 2^k possible sampling models. BMA specifies that the posterior distribution of the slope coefficients β is the weighted posterior distribution under each of the models, $P(\beta \mid y, M_j)$, with the weights given by each model's posterior model probability $P(M_j \mid y)$. The posterior distribution given the data can then be expressed as

$$P(\beta \mid y) = \sum_{j=1}^{2^k} P(\beta \mid y, M_j) P(M_j \mid y). \qquad (3)$$

Equation (3) is the fundamental equation of BMA. It states that the posterior distribution of the quantity of interest is only conditional on the data and *not* on a particular model. Inference based on the posterior distribution incorporates information across all possible models. The posterior model probability itself is given by

$$P(M_j \mid y) = \frac{l_y(M_j)}{\sum_{h=1}^{2^k} l_y(M_h)}, \qquad (4)$$

where $l_y(M_j)$, is the marginal (or integrated) likelihood of model M_j.[9] Thus, the posterior model probability can be viewed as a measure of the relative data fit.

Based on these fundamental equations, BMA allows to compute several important summary statistics. For instance, the posterior mean and the posterior standard deviation of a particular coefficient are given by:

$$E(\beta_i / y) = \sum_{j=1}^{2^k} E(\beta_{ij} / y, M_j) P(M_j / y), \qquad (5)$$

$$Var(\beta_i / y) = \sum \left(Var(\beta_{ij} / y, M_j) + (E(\beta_{ij} / y, M_j))^2 \right) P(M_j / y) - E(\beta_i / y)^2 \qquad (6)$$

In addition, by summing over all models that contain a particulat regressor , $P(\beta_i \neq 0 / y)$, the *posterior inclusion probability* of that regressor can be obtained. This statistic provides a probability measure of how important a rgeressor is to explain the dependent variable.

[9] Note that equation (6) assumes a uniform prior over the model space, which is standard in the literature (see e.g. Fernadez, Ley and Steel 2001). Computation of the marginal likelihood also requires the choice of parameter priors. Here we follow Raftery (1995) and Hoeting et al. (1999) and assume the diffuse Unit Information Prior (UIP) which allows for a simple approximation of the marginal likelihood with the Bayesian Information Criterion (BIC).

To judge the effectiveness of a regressor in explaining growth we refer in the following to a rule of thumb proposed by Jeffreys (1961) and refined by Kass and Raftery (1995). According to this rule, the evidence of a regressor having an effect is *weak, positive, strong, or decisive* if the posterior inclusion probabilities lie between 50-75%, 75%-95%, 95%-99% and greater 99%, respectively. Thus we refer to an "effective" regressor if the posterior inclusion probability exceeds 50%.

4.2 BMA Results

In this section we report the estimation results of our BMA analysis. Table 3 displays the results. We find that the legal and administrative composite indicator is indeed robustly related to the volatility of GDP p.c., receiving a posterior inclusion probability that exceeds our effectiveness threshold of 50%. The indicator has also the predicted sign, i.e. a better legal and administrative environment leads to a reduction in output volatility as indicated by the negative sign of the posterior mean. We do not find any robust evidence that any of the other institutional aspects robustly influences volatility.

[Table 3 here]

Turning to the other regressors, we find very strong evidence that inflation and current account variability positively influence GDP volatility. Additionally, albeit somewhat weaker, we find that the exchange rate variations also impact output volatility. Taken together these findings confirm previous studies that highlight the important role of macroeconomic policies.

Apart from the influence of institutions and macroeconomic policies our results also suggest that the variability of GDP per capita has overall declined in the second period under analysis (2002-2006), as indicated by the posterior inclusion probability of the time dummy which exceeds 50%. Interestingly, we also find strong support for the inclusion of the Kazakhstan dummy. This suggests that there are unobserved time invariant characteristics, such as geographic location, culture or ethno-linguistic heterogeneity that – all else being equal – induce Kazakhstan's economy to experience on average higher output volatility.

5. Policy conclusions

The previous section has highlighted the importance of good legal and administrative institutions as well as stable macroeconomic policies to reduce output volatility. The data

shows that there has been an slight improvement along several dimensions (2006 compared to 1998). Specifically, the following components experienced improvement: property rights, government effectiveness and rule of law. However, two components deteriorated – the regulatory quality and judicial framework and independence. It must be noted that part of this deterioration is due to decline in the relative level of quality of these institutions, i.e. on average these institutions were improved faster in other countries within the dataset.

[Figure 4 here]

Finally, while volatility of real economic growth in the long-term is affected by the underlying institutions, there are also short-term factors that must be taken into consideration. Specifically, large current-account fluctuations may result in currency volatility which is detrimental to stable economic growth. In addition to that, high dependency on imported goods can lead to sudden bursts of inflation and rapid changes in living standards, as demonstrated by a commodity bubble in 2007-8. Therefore, in the short- and medium-term installing appropriate macroeconomic policies is important for ensuring a smooth transition to stable-growth path.

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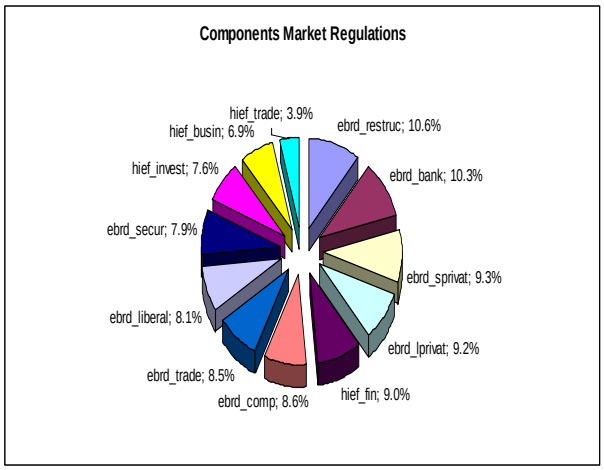
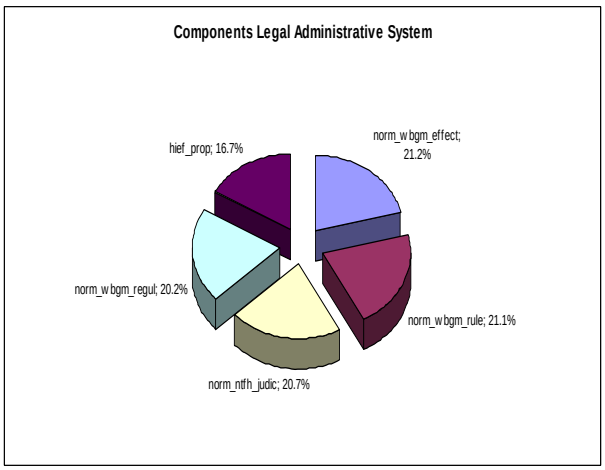
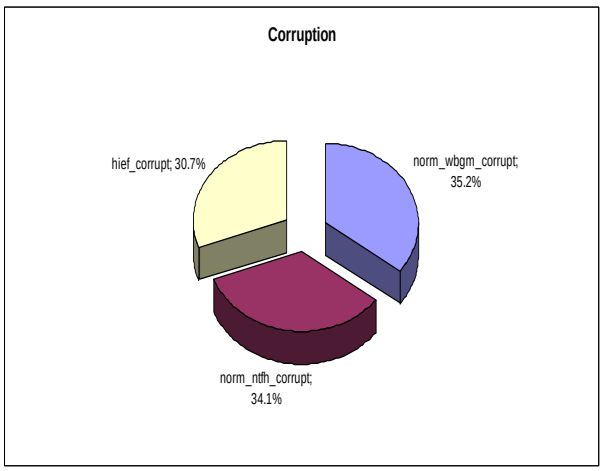
Table 1: Institutional and Structural Reform Indices

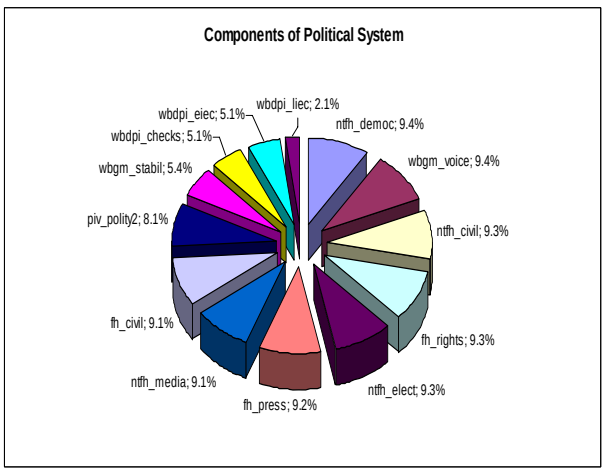
Variable	Description	Source
Market Regulations		
EBRD_Lprivat	Large scale privatisation	European Bank for Reconstruction and Development (EBRD)
EBRD_Sprivat	Small scale privatisation	EBRD
EBRD_Restruc	Governance and enterprise restructuring	EBRD
EBRD_Liberal	Price liberalization	EBRD
EBRD_Trade	Trade and foreign exchange system	EBRD
EBRD_Comp	Competition policy	EBRD
EBRD_Bank	Banking reform and interest rate liberalization	EBRD
EBRD_Secur	Securities markets and non-bank financial institutions	EBRD
HIEF_Busin	Business freedom	Heritage Foundation
HIEF_Trade	Trade freedom	Heritage Foundation
HIEF_Invest	Investment freedom	Heritage Foundation
HIEF_Finan	Financial freedom	Heritage Foundation
HIEF_Labor	Labor freedom	Heritage Foundation
Legal/Administrative System		
HIEF_Prop	Property rights	Heritage Foundation
NTFH_Judic	Judicial framework and independence	Freedom House: Nations in Transit
WBGM_Rule	Rule of law	World Bank: Governance Matters (WBGM)
WBGM_Regul	Regulatory quality	WBGM
WBGM_Effect	Government effectiveness	WBGM
Corruption		
HIEF_Corrupt	Freedom from corruption	Heritage Foundation
NTFH_Corrupt	Freedom from corruption	Freedom House: Nations in Transit
WBGM_Corrupt	Freedom from corruption	WBGM
Political/Constitutional System		
FH_Rights	Political rights	Freedom House
FH_Civil	Civil liberties	Freedom House
FH_Press	Freedom of the press	Freedom House
NTFH_Elect	Electoral process	Freedom House: Nations in Transit
NTFH_Civil	Civil society	Freedom House: Nations in Transit
NTFH_Media	Independent media	Freedom House: Nations in Transit
NTFH_Democ	Democracy	Freedom House: Nations in Transit
WBGM_Voice	Voice and accountability	WBGM
WBGM_Stabil	Political stability	WBGM
PIV_Polity2	Measure of Democracy and Autocracy	Polity IV Project
WBDPI_Liec	Legislative index of electoral competitiveness	World Bank Database for Political Institutions (DPI)
WBDPI_Eiec	Executive index of electoral competitiveness	DPI
WBDPI_Checks	Checks and balances	DPI
Infrastructural Reform		
EBRD_Telec	Telecommunications	EBRD
EBRD_Rail	Railways	EBRD
EBRD_Electr	Electric power	EBRD
EBRD_Roads	Roads	EBRD
EBRD_Water	Water and waste water	EBRD

Figure 1: Components of Institutional Composite Indicators









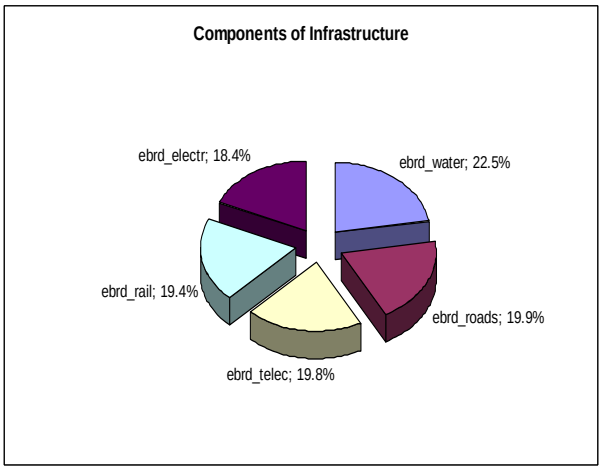


Figure 2: Kazakhstan's institutional performance over time

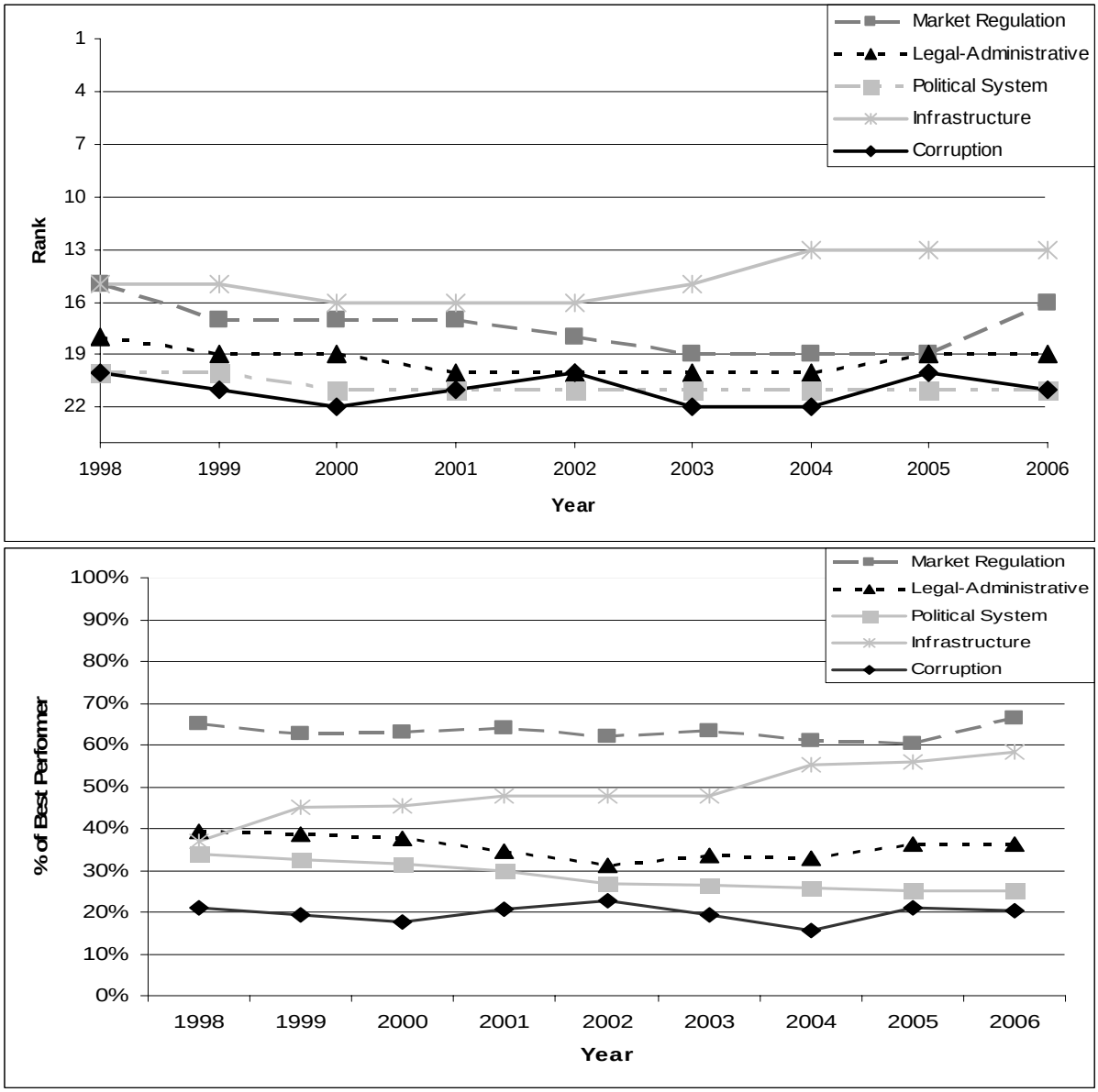


Figure 3: Kazakhstan's areas of progress and regress

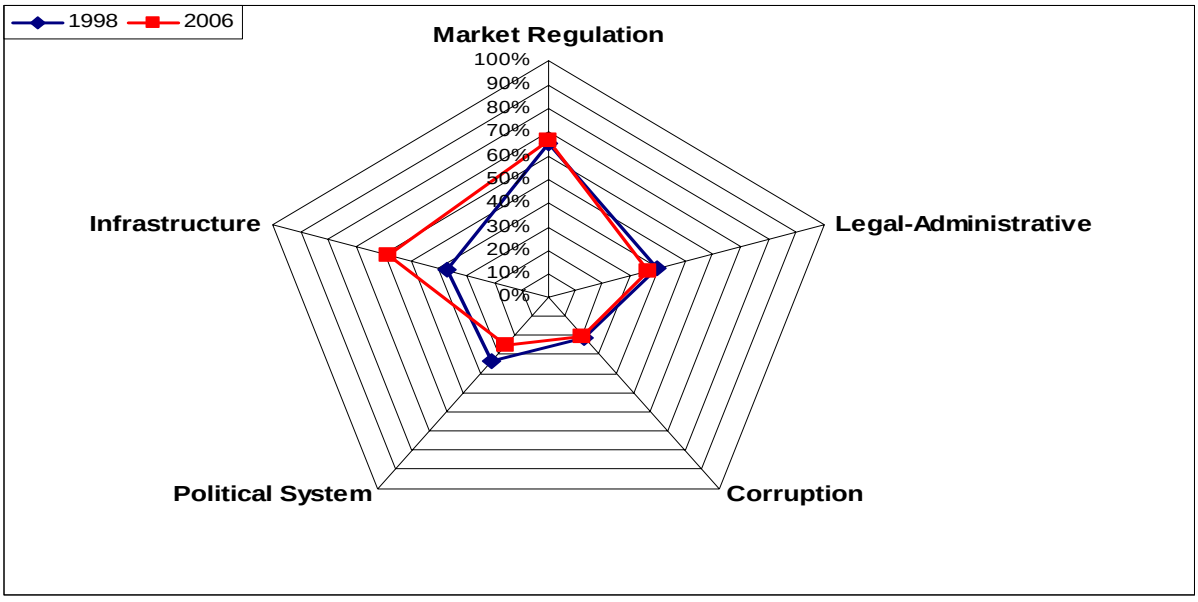


Table 2: Dataset for BMA Analysis

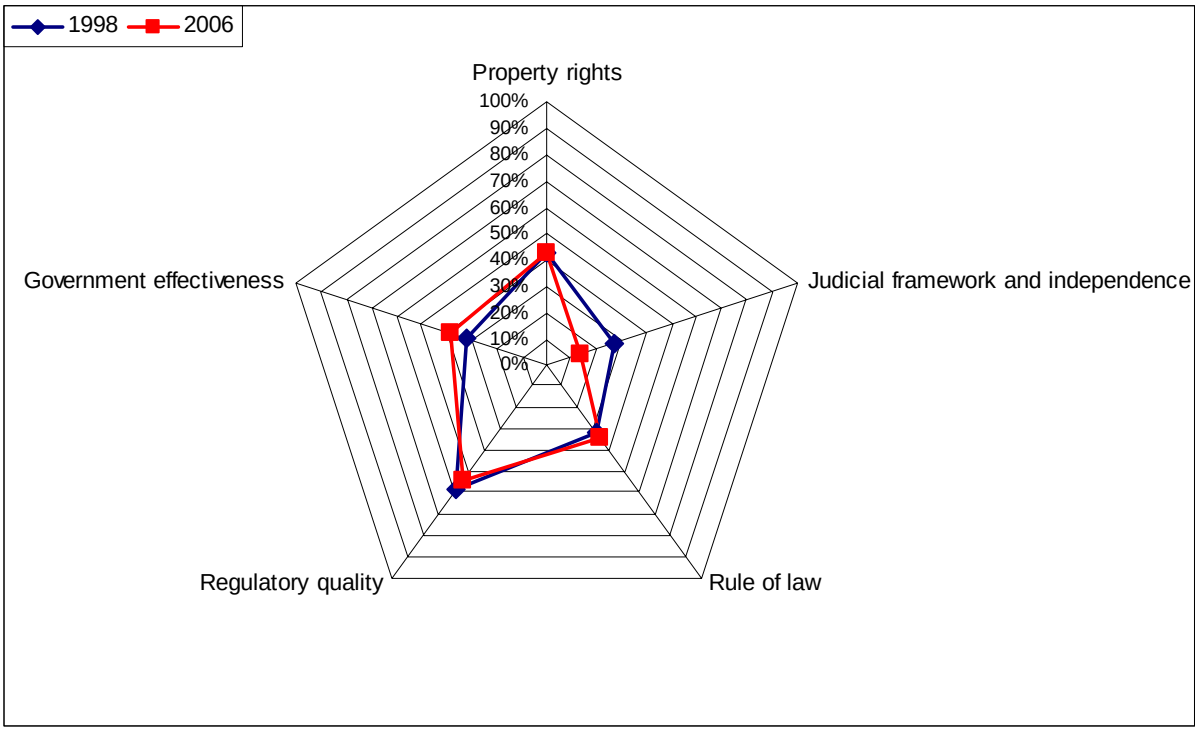
Variable	Description	Source
Dependent Variable		
Vol	Standard deviation of annual growth of real GDP per capita	European Bank for Reconstruction and Development (EBRD)
Institutional Quality and Structural Reform		
market_comp	Composite Indicator of Market Regulations (1-100(best))	own calculation and EBRD
legal_comp	Composite Indicator of Legal and Administrative System (1-100(best))	own calculation and EBRD
politic_comp	Composite Indicator of Political and Constitutional System (1-100(best))	own calculation and EBRD
corr_comp	Composite Indicator of Corruption (1-100(best))	own calculation and EBRD
infrastr_comp	Composite Indicator of Infrastructural Reform (1-100(best))	own calculation and EBRD
Macroeconomic Policies		
sd_inflation	Standard deviation of log inflation rate	EBRD
sd_govbal	Standard deviation of government balance (% of GDP)	EBRD
sd_accbal	Standard deviation of current account balance (% of GDP)	EBRD
sd_xrate	Standard deviation of exchange rate (against US$, annual average)	EBRD
ext_debt	External debt/GDP (in %)	EBRD
Trade		
exp_concentr	Export concentration index	UNCTAD
trade_open	Trade openness, ratio real exports plus imports over GDP	Penn World Tables 6.2
fuel_exp	Fuel export intensity, ratio of fuel exports over total exports	UNCTAD
primcom_exp	Primary commodities intensity, ratio of primary commodity exports (excl. fuels) over total exports	UNCTAD

Table 3: BMA Results

Variable	Posterior Incl. Probability	Posterior Mean	Posterior Standard Deviation
sd_inflation	**100**	**2.07**	**0.49**
sd_accbal	**100**	**0.49**	**0.16**
legal_comp	**74.4**	**-0.08**	**0.07**
sd_xrate	**58.1**	**0.00**	**0.00**
politic_comp	48.7	0.04	0.05
exp_concentr	48.6	-3.71	4.57
market_comp	17.8	0.03	0.09
ext_debt	16.4	-0.01	0.02
trade_open	13.8	0.00	0.01
infrastr_comp	13.3	0.01	0.02
corr_comp	12.7	0.00	0.02
sd_govbal	11.6	0.03	0.14
fuel_exp	4.9	-0.11	1.07
primcom_exp	3.1	0.02	0.59
t_dummy	**66.6**	**-0.72**	**0.78**
d_Alb	13.3	0.20	0.68
d_Arm	21.1	-0.48	1.08
d_Azer	20.3	-1.09	2.49
d_Bel	8.4	0.21	0.87
d_Bul	99	-3.72	1.20
d_Croat	0.7	0.00	0.09
d_Czech	14.3	-0.27	0.78
d_Est	**59.4**	**1.29**	**1.31**
d_Geor	1.8	-0.01	0.26
d_Hung	4.7	-0.05	0.34
d_Kaz	**83.2**	**2.78**	**1.76**
d_Kyrg	1.9	-0.01	0.25
d_Lat	6.7	0.07	0.49
d_Lith	1.9	0.01	0.24
d_Mold	1.7	0.00	0.17
d_Pol	8.7	0.17	0.69
d_Rom	3.8	0.05	0.34
d_Rus	23.2	0.39	0.99
d_Slk	0.9	0.00	0.10
d_Slov	13.7	0.44	1.25
d_Taj	**63.2**	**2.07**	**1.95**
d_Turk	13.4	0.33	1.23
d_Ukr	2.1	0.01	0.20

Notes:Dependent variable is the standard deviation of GDP p.c. growth. Entries in **boldface** represent variables with posterior inclusion probability greater than 50%. Intercept included in all regressions but not reported. Number of observations = 48.

Figure 4: Relative (to best practice country) component scores of Kazakhstan in the legal composite indicator



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