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Converging Wages, Diverging GRP

Directed Technical Change and Endogenous Growth. Empirical Analysis of Growth Patterns across Kazakh regions

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Abstract

The paper analyzes unequal regional development in Kazakhstan. Applying the nonlinear least squares method in presence of spatial correlation we estimate the convergence rate of wages across Kazakh regions for the period 2003–2009. The estimated convergence rate is about 3% which is somewhat higher than estimates obtained for the USA and Europe. At the same time there is slight divergence in the GRP per capita. It is argued that convergence in wages which coincides with divergence in the per capita GRP is consistent with the endogenous growth model where profit maximizing firms choose the capital intensity of the technology. This implies that the inequality between regions will only exacerbate and the central government may wish to invest more in low-growth regions to alleviate disproportional development.

JEL-Classification: O47, P25, P23
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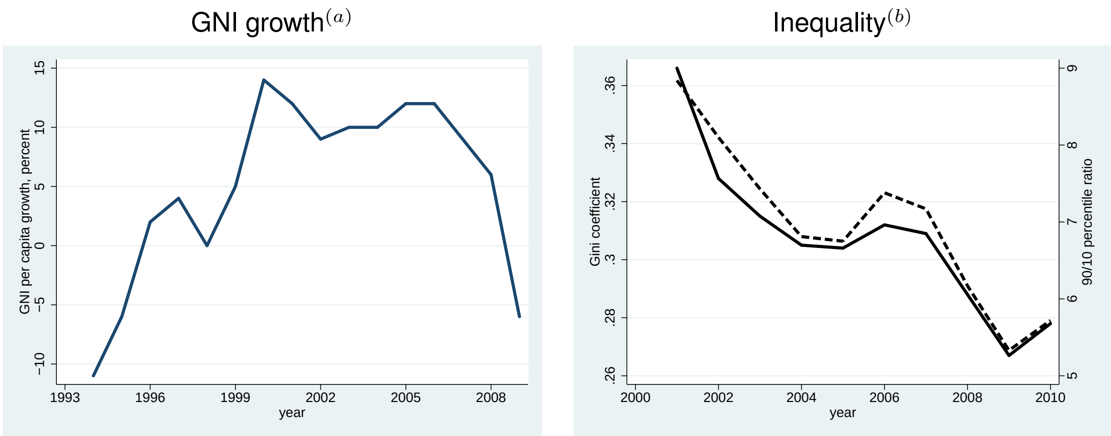
1. Introduction

Having gone through a severe recession after the collapse of the Soviet Union, Kazakhstan has experienced steady economic growth from the end of the 1990s onward. Figure 1 shows that from about 1999 onward the Gross National Income (GNI) per capita has been growing. It peaked in 2000 reaching 14%, then stagnated at around 10% until 2007. Following international financial crisis the growth rates declined to 6% in 2008 and became negative (–9%) in 2009.[1] Remarkably, inequality has continuously declined in Kazakhstan over the 2000s (see Figure 1).



(a) – Annual GNI growth; Source: World Bank

(b) – Solid line – Gini coefficient (income over deciles); Dashed line – ratio of 9^{th} to 1^{st} income decile; Source: Kazakhstan Statistical Agency

Figure 1: **Gross national income growth and inequality**

Oil exports boosted by high oil prices also steered the growth in income levels. The per capita income (in PPP) has doubled over the span of ten years. Several authors highlighted the importance of growth in poverty reduction (Dollar and Kraay, 2002, 2004; Kraay, 2005; Agrawal, 2008). Indeed, poverty depth and severity have substantially declined (see Table A.1) during this period of economic growth.

Compared to other former Soviet economies Kazakhstan is one of the most successful examples of transition from the planned to the market economy. Nevertheless, despite its admirable economic performance, Kazakhstan is going through very uneven regional development: the booming new capital Astana, the financial center and the old capital Almaty, and oil-rich regions at the shores of the Caspian Sea on the one hand, and depressed regions in the north and south on the other. Tables A.2 and A.3 show immense differences in per capita gross regional product (GRP) and wages. Even more so, due to its sheer geographical size (9^{th} largest country in the world) and low popu-

[1] The 2010 GNI growth estimate is roughly 5%.

lation density combined with relatively poor infrastructure uneven regional development might persist.[2]

International Institutions (World Bank, 2004; Kohl *et al.*, 2005) give much emphasis to economic growth as a critical component of poverty alleviation. Moreover, World Bank (2004) argue that policies which promote faster growth are likely to be pro-poor in the long run.[3]

The goal of this paper is the analysis of inequality in regional development in Kazakhstan and possible convergence in incomes in particular. The empirical evidence shows divergence in the Gross Regional Products (GRP) per capita. Using a detailed dataset disaggregated at the *raion* level[4] it is shown that divergence in the per capita GRP goes together with convergence in average wages across regions. It is shown that these results are consistent with endogenous growth models where the production function becomes more capital intensive. Empirical evidence supports this hypothesis. Given this, the gap in the per capita GRP will likely exacerbate over time and redistributional policies should be used to promote more equal regional development.

[2] For example, regional poverty rates varied from 2% to 32% in 2002 (World Bank, 2004)

[3] Given a large share of growth driven by the oil sector there are doubts whether the growth will indeed be pro-poor.

[4] Equivalent to the European NUTS-3 level.

2. Literature Review

Beginning with the Solow (1956) seminal paper the neoclassical growth model with decreasing returns to capital has been very popular among the economists. In its simplest form the production function is assumed to be Cobb-Douglas with the constant returns to scale property: $Y = K^{\alpha}L^{1-\alpha}$ with $\alpha < 1$ ensuring decreasing returns to factors of production. Given the same structural variables the model implied faster growth for countries with lower initial GDP per capita. It was shown (see Barro and Sala-i-Martin, 1990, 1991; King and Rebelo, 1993) that the neoclassical growth model can be approximated as:

$$(1/T)\log(y_{it}/y_{i,t-T}) = x_i^* + \log(\hat{y}_i^*/\hat{y}_{i,t-T})(1 - e^{-\beta T})/T + u_{it}, \quad (1)$$

where y_{it} is per capita output at time t in a country i, x_i^* is the steady-state per capita growth rate, $\hat{y}_i^*$ - the steady-state level of output per effective worker, T is the length of the observation period, β is the rate of convergence, and u_{it} is the error term.[5] As $\hat{y}_i^*$ is unobserved an empirical version of Equation 1 becomes[6]:

$$(1/t)\log(y_{it}/y_{i,0}) = a + x_i - (1 - e^{-\beta t})\log y_{i0}/t + \epsilon_{it}, \quad (2)$$

with a being the common intercept, x_i are the cross-sectional fixed effects which correspond to possibly different steady-states. If $\beta > 0$ then regions with lowest per capita output grow at a higher rate. This is what is called β-convergence. If x_i are insignificant it implies absolute convergence. Differences in regional specific steady-states (which can be due to differences in skill composition of the labor force across regions) implies that each region converges to its own steady-state level and β coefficient would thus show the convergence rate *within* a region.

A different empirical measure of convergence is the so-called σ-convergence. It measures cross-sectional variation in a variable of interest (for example the output or the GDP per capita) over time. The σ-convergence is usually measured by coefficient of variation (cross-sectional standard deviation of the variable of interest normalized by the mean). Although closely linked, the two concepts (β and σ-convergence) are different. Whereas in a standard neoclassical growth model the β-convergence is implied by diminishing returns to factors of production, σ-convergence could be driven by external shocks to the production function (see Barro and Sala-i-Martin, 1991).

Much empirical work on growth was based on regression of the GDP growth rates on the initial levels of the GDP (Equation 2) and estimation of the β coefficient. Barro and Sala-i-Martin (1991) analyzed convergence across states in America and NUTS-2 regions in Europe. The results of the authors suggest that poorer regions both in the United States and in Europe grow faster than the rich ones, so the β-convergence is observed. Moreover,

[5] For an empirical specification which includes human capital see Mankiw *et al.* (1992).

[6] Barro and Sala-i-Martin (1991)

the estimates indicate that the average rate of convergence is about 2 percent a year both in the USA and in Europe implying that the gap between the poor and rich regions shrinks at 2% a year.

Marinelli and Signorelli (2010) estimated the growth model on European data on NUTS-3 level and found convergence between the transition European countries. On the other hand, the authors showed that within each country divergence prevailed, so that certain regions with high initial GRP per capita grew faster than the rest of the country. Regional divergence in Central European countries has been documented by several authors (Huber, 2007; Römisch, 2003; Solanko, 2003). The data show that variation in wages and GRP per capita has been rising in the Central European countries. The growth patterns for different post-communist European economies suggest convergence of agricultural regions although shares of employment in agriculture have negative impact on growth (Huber, 2007, and citations therein).

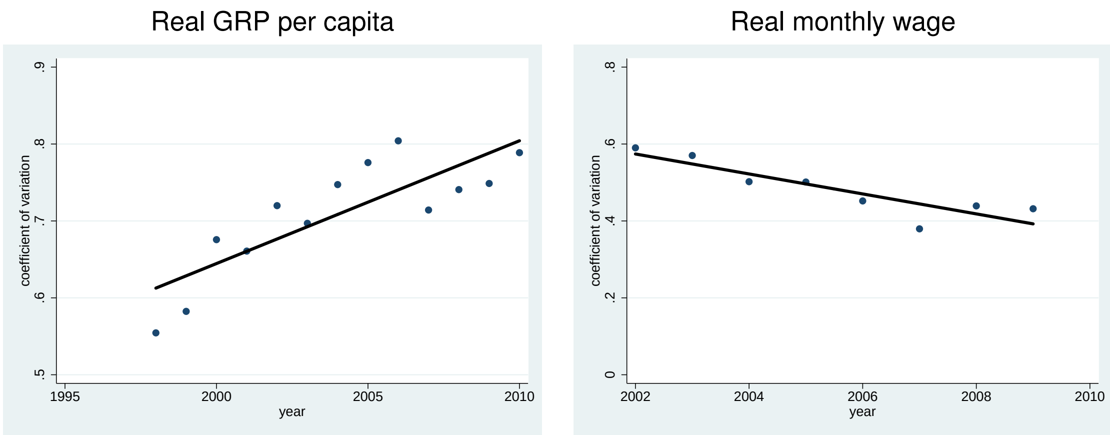
As it was mentioned before several authors stressed the role of growth in poverty alleviation (Dollar and Kraay, 2002, 2004; Kraay, 2005). One of the few empirical results on growth in Kazakhstan can be found in Agrawal (2008). The author uses a panel of Kazakh *oblasts*[7] to analyze the effect of growth on poverty. The results suggest that economic growth plays an important role in reducing poverty.[8]

[7] Equivalent to the European NUTS-1 or NUTS-2 level.

[8] One has to note that three-year panel of 16 regions is too short for a fixed effect model used by the author.

3. Descriptive Statistics

Kazakhstan has vast territory spanning over about 2.7 million sq. km. Administratively the country is divided into 14 regions (*oblasts*) and 2 cities (the new capital Astana and the old capital Almaty).[9] Each *oblast* is further divided into *raions*.[10] The data of the National Statistical Agency of Kazakhstan on *oblast* level reveals huge differences in such indicators as the GRP per capita and the nominal monthly wage. The GRP per capita and the monthly wage in 2009 spreads from the lowest 336.3 and 44.0 thousand Tenge[11] respectively in Zhambyl *oblast* (a region in the South of Kazakhstan) to the highest 3381.6 and 129.0 thousand Tenge in Atyrau (a region at the shores of the Caspian Sea).[12]



(a) coefficient of variation is defined as the standard deviation divided by the mean; Own calculations based on Kazakhstan Statistical Agency data

Figure 2: **Variation in real wage and real GRP per capita**$^{(a)}$

Tables A.2 and A.3 show the Gross Regional Product (on *oblast* level of aggregation) per capita and the average monthly wage in Tenge. One could see that despite steady growth in the GRP and wages inequality in both indicators persists over time across *oblasts*. The highest GRP and wages are traced for Atyrau and Mangistau (oil-rich regions at the shores of the Caspian Sea) and two major cities Almaty and Astana. It is difficult to see, however, from the raw data whether the gap between the rich and the poor regions has been narrowing or not. A quick glance at the coefficient of variation in the GRP per capita and wages (the so-called σ-convergence approach) can shed more light on this issue. The GRP σ-convergence would imply that the variation of the per capita GRP across regions declines over time. Using the data of the Statistical Agency of Kazakhstan

[9] Equivalent to the European NUTS-1 or NUTS-2 level of aggregation.

[10] Equivalent to the European NUTS-3 level.

[11] in 2011, 1 USD is worth roughly 145 Tenge

[12] see Tables A.2 and A.3

on *oblast* level the coefficients of variation of per capita GRP and monthly wages has been constructed. Remarkably, as one could see in Figure 2 there is the σ-divergence in the GRP which is accompanied by the σ-convergence in monthly wages.

One has to note here that the σ-convergence need not necessarily imply the β-convergence. In other words, the σ-divergence in the per capita GRP could still be in line with the basic Solow growth model if β-convergence is observed at the same time. It is possible that due to diminishing returns to capital poorer regions grow faster (hence β-convergence) but due to external shocks to the production function (the error term in Equation 2) the variation in the GRP per capita increases over time (Barro and Sala-i-Martin, 1991).

4. Econometric Methods

To test the β-convergence hypothesis one could estimate Equation 2. One has to note that this model is nonlinear in parameters. However, for a nonlinear model $y = x(\beta) + u$, the moment condition is $\mathbf{X}'(\beta)(y - x(\beta)) = 0$, with $\mathbf{X}(\beta)$ being a matrix containing the first derivatives of the regressor matrix, x, with respect to the parameter vector β evaluated at x. The parameter vector estimated given this moment restriction is the nonlinear least squares (NLS) estimator and is close to the method of moments estimator (see Davidson and MacKinnon, 1993).

One has to bear in mind that regions are not isolated units and hence interact with each other. Regional spill-over effects[13] can result in correlation of regression residuals across spatial units (see Anselin, 2000). The standard errors could be corrected for cross-sectional correlation using the method of Driscoll and Kraay (1998). The method is in principle an extension of the GMM estimator of Newey and West (1987). In a simple univariate model $y_{it} = x_{it} + \epsilon_{it}$ with spatial but no time dependence, the identifying moment restriction is: $E(x_{it}\epsilon_{it}) = 0$. Driscoll and Kraay (1998) show that the variance matrix is given by:

$$\mathbf{Var} = (\mathbf{X}'\mathbf{X})^{-1} S_T (\mathbf{X}'\mathbf{X})^{-1}, \tag{3}$$

where $S_T = \frac{1}{T}\sum_{t=1}^{T}\sum_{i=1}^{N}\sum_{j=1}^{N} E(x_{it}\epsilon_{it}x_{jt}\epsilon_{jt})$ (see also Hoechle, 2007). The method works, however, in the linear case. To correct standard errors in the nonlinear model one could run a linear artificial regression:

$$r(\hat{\beta}) = \mathbf{X}(\hat{\beta})b + res, \tag{4}$$

where $r(\hat{\beta})$ are residuals from the NLS regression evaluated at the estimated parameter value $\hat{\beta}$, $\mathbf{X}(\hat{\beta})$ is the matrix of first derivatives of x evaluated at the estimated parameter value $\hat{\beta}$ and b is the coefficient vector and res is the residual which have no further interpretation (see Davidson and MacKinnon, 2000). The estimated covariance matrix of b is an estimator of the covariance matrix of β. Applying the method of Driscoll and Kraay (1998) on the linear regression in Equation 4 gives the consistent estimator of the covariance matrix of β (see also Aldashev, 2009).

Equation 2 has been estimated using the yearly panel of *raions* of Kazakhstan using the NLS method described above. Unfortunately the data on the GRP is unavailable at this level of aggregation. For this reason the monthly wage was chosen as a proxy for the per capita income. Nominal wages were converted into real wages using the CPI estimates

[13] For example, growth of income in one region increases demand and thus may increase output and income in another region. Furthermore, differences in incomes generate migration flows which affect income differentials.

of the Statistical Agency of Kazakhstan on *oblast* level. The time dimension of the panel is 8 years (2002–2009) but given that we estimate the growth rate or changes it leaves us with 7 periods and 1386 observations.

5. Results

Estimation results of Equation 2 are presented in Table 1. Columns 2 and 3 contain the parameter and standard error estimates from Equation 1 excluding the *oblast* fixed effects thereby imposing absolute convergence restriction. Columns 4 and 5 contain the parameter and standard error estimates of the same model but including the *oblast*-specific fixed effects and thus implying that each *oblast* may converge to its own steady state monthly wage.

Table 1: **β-convergence estimation; Dependent variable – monthly wage growth. NUTS3 level in 2003–2009**

variable	coefficient	st.error$^{(a)}$	coefficient	st.error$^{(a)}$
$\beta^{(b)}$	0.03	0.01	0.03	0.01
a	0.40	0.05	0.41	0.06
oblast dummies	no		yes	
R^2	0.12		0.23	
N	1386		1386	

(a) – standard errors are corrected for spatial correlation

(b) – rate of convergence as specified in Equation 2

The results reveal that inclusion of *oblast* dummies did not change the estimate of the rate of convergence.[14] The estimate of $\beta = 0.03$ implies that the convergence rate is 3 percent per year which is higher than estimates for the USA and Europe (Barro and Sala-i-Martin, 1991, report 2 percent rate of convergence). According to this estimate half of the initial wage gap disappears in about 23 years and it will take some 46 years to eliminate 75% of the gap.

Further the Equation 2 has been estimated with the GRP growth as a dependent variable. Due to its unavailability on *raion* level, the *oblast* level of aggregation was chosen. The panel of 16 *oblasts* for the period 2003–2009 was estimated using the same econometric methods described in the previous section both for the GRP growth rates as well as the wage growth rates. The results are summarized in TableA.4. Interestingly, the estimated rate of absolute convergence using aggregated data is twice as small as using disaggregated data. A possible interpretation could be that the rate of convergence *between* the *oblasts* is much smaller than convergence *within* them. The negative coefficient of the β coefficient in the GRP regression (albeit statistically insignificant) implies divergence in the Gross Regional Products. This is consistent with the results of Frey and Wieslhuber (2011) who point at a slight divergence in the GRP per capita at the *oblast* level.

[14] Regional dummies appear to be statistically significant. Estimates for the dummy variables are not reported but are available from the author upon request.

The results of the β-convergence analysis are qualitatively similar to the results of the σ-convergence and hence, the question remains: Why do we observe convergence in monthly wages and no convergence (or slight divergence) in the per capita GRP? Different authors stress the role migration plays as the regional adjustment mechanism (for example Barro and Sala-i-Martin, 1991; Blanchard and Katz, 1992). If labor is mobile one could expect workers to migrate from low income to high income areas thereby equalizing wages in the long run.

To test this hypothesis the growth rate of labor supply has been regressed on the deviation of regional wage from the national average. Table 2 summarizes these results. Columns 2–5 show the estimates from regressing the labor supply growth rate on the wage deviation and columns 6–9 – from regressing the labor supply growth rate on the lagged wage deviation. One could see that indeed in regions with higher wages supply of labor grows at a faster rate. This is consistent with labor mobility working as an adjustment mechanism causing wages to converge. Table 4 shows that employment growth is also higher in regions with higher wages.

Nevertheless, given the diminishing returns to factor assumption, increase in labor supply in regions with high wages would cause a decline in the output per capita and hence convergence in the per capita GRP should translate into convergence in wages.

Table 2: **Effect of the wage gap on labor supply growth**

variable	co-efficient	st. error$^{(a)}$	co-efficient	st. error$^{(a)}$	co-efficient	st. error$^{(a)}$	co-efficient	st. error$^{(a)}$
wage deviation$^{(b)}$	0.31	0.10	0.31	0.12	—	—	—	—
lag wage dev.$^{(c)}$	—	—	—	—	0.26	0.04	0.28	0.04
cons	1.58	0.54	1.47	0.51	1.16	0.25	1.09	0.24
oblast dummies	No		Yes		No		Yes	
R2	0.01		0.03		0.03		0.08	
N	1378		1378		1180		1180	

(a) – standard errors are corrected for spatial correlation

(b) – wage deviation is defined as $w^d_{it} = \ln(w_{it}/\bar{w}_t)$, where $\bar{w}_t$ is the national average wage in the respective year.

(c) – lag wage deviation is defined as w^d_{it-1}.

One possible explanation of this discrepancy could be the measurement of wages and the GRP per capita. The GRP per capita is measured as the Gross Regional Product per resident of the region whereas the wage is measured as the average wage per *working* individual. Consider a standard neoclassical Cobb-Douglas production function $Y = K^\alpha L^{1-\alpha}$ with $\alpha < 1$. This production function has the property of constant returns to scale and diminishing returns to a factor. Population consists of working population, L and nonworking, NW. If L remains constant but population grows because of the increasing size of the nonworking population then total output and the wage rate do not change but the GRP measured as the output per capita will decline. However, if we measure the GRP as the GRP per *worker*, that is $y = Y/L$ (this can also be interpreted as average productivity), it should unambiguously decline with the labor supply increase. Consequently, convergence in wages should go together with convergence in average productivities.

To check the robustness of the results the growth in the GRP per employed person (call it y) has been regressed on the initial GRP per employed person. The results are presented in Table 3.

Table 3: **Convergence in GRP per laborer; Panel of 16 regions in 2003–2009**

	All employed individuals		Excluding self-employed	
variable	coefficient	st. error$^{(a)}$	coefficient	st. error$^{(a)}$
a	–0.073	0.086	–0.156	0.117
β	–0.030	0.013	–0.036	0.016
R^2	0.10		0.08	
N	96		96	

(a) – standard errors are corrected for spatial correlation

The results are qualitatively unchanged: wages are converging across Kazakh regions but the GRP per worker, Y/L, are diverging. This implies that the parameter α in the production function has to increase when the economy grows, that is the economy switches to more capital intensive (or labor saving) technologies the more capital it accumulates. The next section gives an overview of an endogenous growth model where the production technology is endogenous. It is shown that in such a model convergence in wages can be accompanied by divergence in the per capita output.

6. Endogenous Growth

Assume an economy consisting of identical firms with the Cobb-Douglas production function having the usual properties of diminishing returns to factors and constant returns to scale:

$$Y = K^{\alpha} L^{1-\alpha}. \tag{5}$$

The markets are competitive and firms may choose different technologies. The choice of the technology is reflected in the value of α in equation 5. It is assumed that a firm may switch to a more capital intensive technology by investing in research and development (see for example Peretto and Seater, 2006). Moreover, more capital intensive technologies are more costly to develop. For convenience assume that the cost of research is $-\ln(1-\alpha)$ so that the technology that uses only raw labor is costless.[15] It follows that the firms maximize profits by simultaneously choosing employment levels of capital and labor and technology level (α). Setting the price level to 1 for simplicity it follows:

$$\pi = K^{\alpha} L^{1-\alpha} - wL - rK + \ln(1-\alpha), \tag{6}$$

where π is the profit level, w is the real wage rate, and r is the real price of capital.

Maximizing equation 6 with respect to α gives:

$$k^{\alpha} = \frac{L}{(1-\alpha)\ln k}, \tag{7}$$

where k is the capital to labor ratio. One can check that α grows with k approaching unity in the limit.

The capital stock grows as long as investment exceeds depreciation:

$$\dot{K}_t = sK_t^{\alpha-1} - \delta, \tag{8}$$

where $\dot{K}$ is the growth rate of capital, δ is the depreciation rate and s is the exogenous saving rate.[16]

It follows from the model that as long as capital replacement exceeds depreciation, the capital stock increases over time and as a result firms switch to more and more capital intensive technologies. Note that $y = Y/L = k^{\alpha}$ and hence as the capital stock increases (at the same time α grows as well) the growth rate increases as well. Consequently, one will observe divergence in the output per capita as regions with higher capital stock switch to more capital intensive technologies. At the same time as α grows wages ($w = (1-$

[15] See for example Zuleta (2008).

[16] For endogenous saving one could see Zuleta (2008) where individuals maximize the present value of lifetime consumption. However, the qualitative results presented here are similar to the ones obtained in Zuleta (2008).

$\alpha)k^{\alpha}$) will decline. Hence, in this type of endogenous growth or directed growth model divergence in the per capita output goes together with convergence in wages. This model also implies that the share of labor falls in fast growing regions. Hence, if divergence in the GRP per capita is driven by the shift to a more capital intensive technology in fast growing regions then we would observe positive correlation between the change in α and the GRP growth rate. Given the production function in equation 5 the share of labor in national income is given by the ratio of the wage rate to the per capita GRP and α is thus one minus the share of labor.[17] Table A.5 summarizes shares of non-labor income in the GRP. The highest shares are observed for oil-extracting regions Atyrau and Mangistau and two major cities Almaty and Astana. The lowest shares are found in Southern regions of Zhambyl and South Kazakhstan. On average the share of capital in 2009 was 60 percent which is much larger than what is typically observed for developed countries (usually about 30 percent). Plotting the growth rates or changes in the share of capital, α, against the GRP growth rate reveals strong positive correlation between these two variables (see figure 3). This is consistent with the endogenous growth model described above where regions change the technology of production in favor of more capital intensity the more capital they accumulate.

Table 4: **Effect of the wage gap on employment growth**

variable	co-efficient	st. error$^{(a)}$	co-efficient	st. error$^{(a)}$	co-efficient	st. error$^{(a)}$	co-efficient	st. error$^{(a)}$
wage deviation	0.02	0.00	0.01	0.00	—	—	—	—
lag wage dev.	—	—	—	—	0.03	0.00	0.01	0.00
cons	0.03	0.00	0.03	0.01	0.03	0.00	0.02	0.00
oblast dummies	No		Yes		No		Yes	
R^2	0.04		0.03		0.07		0.30	
N	1378		1378		1180		1180	

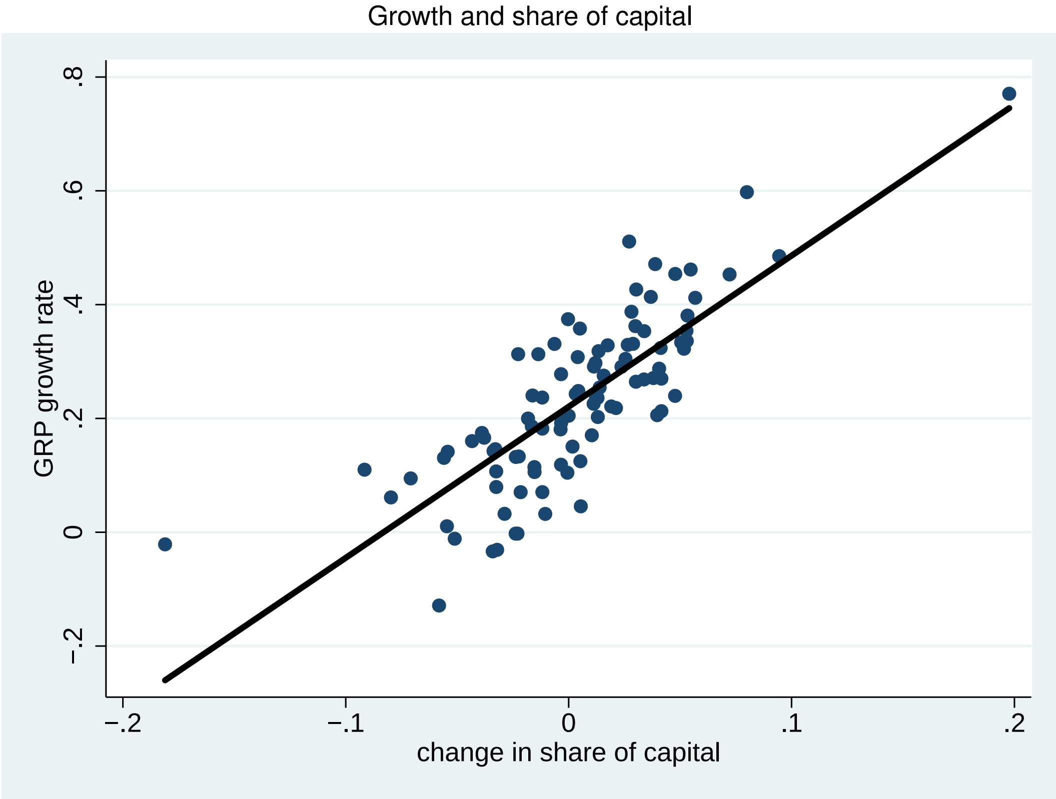
(a) – standard errors are corrected for spatial correlation

(b) – wage deviation is defined as $w^d_{it} = \ln(w_{it}/\bar{w}_t)$, where $\bar{w}_t$ is the national average wage in the respective year.

(c) – lag wage deviation is defined as w^d_{it-1}.

From what it follows, the results are inconsistent with an exogenous growth model. However, divergence in the per capita GRP which goes together with convergence in wages are in line with the endogenous growth model where firms choose capital intensity of the technology (α) to maximize profits. The model implies that despite convergence in wages the gap in the per capita GRP across regions will only exacerbate. One way to alleviate inequality and disproportionality in regional development is to resort to redistributional policies and invest more heavily in capital stock of underdeveloped regions.

[17] This measure is imperfect (Krueger, 1999) but given data limitations no better estimate is available.



(a) – solid line – linear regression line; Own calculations based on Kazakhstan Statistical Agency data

Figure 3: **Growth, share of capital and investment**

7. Conclusion

In this paper we analyzed convergence of wages and the GRP per capita in Kazakhstan. Using a panel of regions (*raion* level) for a period 2003–2009 the rate of convergence in monthly wages has been estimated. The estimated rate of convergence is about 3 percent per year which is higher than the estimates for the USA and Europe reported by Barro and Sala-i-Martin (1991) implying that half of the gap between regions is reduced in about 23 years.

The results of the paper also point at slight divergence in the GRP per capita across regions which goes together with convergence in wages. It is argued that this observation is inconsistent with the exogenous growth model *à la* Solow. However, it can be explained by an endogenous growth model with directed change in technology, that is profit maximizing firms increase the capital intensity of the technology in response to the increase in the capital stock. Empirical results show that the share of capital in the regional product indeed increases faster in regions with high growth of the GRP per capita. All these results show that inequality in the output per capita across regions is likely to exacerbate with regions relying on more labor-intensive technologies lagging behind the regions with industrial mix shifting in favor of more capital intensity despite convergence in wages. The central government could then mitigate regional inequality by investing more in the capital stock of underdeveloped regions to promote faster capital accumulation and growth.

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A. Appendix

A.1. Tables

Table A.1: **GNI and poverty measures**

year	GNI per capita[a]	poverty depth[b]	poverty severity[c]
1998	3990		
1999	4120		
2000	4460		
2001	5260	14.8	6.5
2002	5930	13.3	5.5
2003	6530	10.2	3.9
2004	7230	8.3	2.9
2005	7830	7.5	2.5
2006	8690	3.9	1.3
2007	9590	2.4	0.8
2008	9750	2.3	0.7
2009	10320	1.3	0.3

a – Gross national income per capita in current US dollars (PPP adjusted); Source: World Bank

b – Deviation of income of persons living below the subsistence level from the subsistence level; Source: National Statistical Agency of Kazakhstan

c – Inequality among the poor: deviation of incomes of persons living below the subsistence level from the average income of the poor; Source: National Statistical Agency of Kazakhstan

Table A.2: **Nominal GRP, thousand Tenge**

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Kazakhstan	108.8	135.1	174.7	218.8	254.1	309.3	391.0	501.1	667.2	829.9	1,024.2	1,068.0
Akmola	53.8	96.1	105.3	140.6	155.2	189.1	222.1	263.4	340.0	543.2	641.4	709.3
Aktobe	122.3	136.7	175.2	219.7	268.7	353.2	438.1	604.9	748.1	970.5	1,231.1	1,193.1
Almaty	55.7	63.8	80.1	102.1	119.2	147.3	163.5	202.1	253.5	337.4	409.2	460.3
Atyrau	226.6	314.7	554.5	658.4	866.0	1,065.0	1,389.5	1,727.3	2,296.2	2,541.7	3,626.0	3,881.6
West Kazakhstan	87.4	124.4	195.5	249.5	296.7	333.1	589.8	659.8	838.6	1,006.2	1,339.4	1,324.2
Zhambyl	46.7	50.3	58.7	71.2	84.7	121.6	138.8	169.1	191.2	262.8	316.9	336.3
Karaganda	131.7	168.0	217.7	249.3	276.7	333.6	382.3	509.9	690.1	853.5	1,088.4	1,123.5
Kostanai	109.5	135.8	163.1	181.2	199.6	256.5	299.1	356.5	429.5	624.5	789.7	815.3
Kyzyl Orda	60.7	64.4	96.3	122.2	170.2	224.6	294.9	394.0	585.2	794.7	1,075.9	937.4
Mangistau	191.2	263.2	407.9	455.0	599.3	633.4	831.6	1,174.2	1,552.9	1,896.2	2,631.0	2,542.5
South Kazakhstan	48.9	62.0	88.3	114.1	117.1	145.8	142.7	161.7	187.6	265.2	310.4	384.8
Pavlodar	153.2	156.1	214.4	266.2	286.9	359.7	449.0	516.6	621.3	793.9	1,153.6	1,150.8
North Kazakhstan	86.4	102.9	100.4	141.7	162.2	207.1	226.7	277.9	357.8	487.4	619.0	625.5
East Kazakhstan	116.1	139.0	158.4	188.2	199.0	228.9	270.6	325.4	430.8	563.4	627.9	693.6
Astana city	186.8	262.2	328.6	438.1	463.8	596.8	901.7	1,318.0	1,701.8	1,927.0	2,080.2	2,075.2
Almaty city	265.1	319.8	367.5	504.9	603.3	695.8	924.4	1,218.6	1,792.9	2,048.9	2,193.2	2,293.1

Source: National Statistical Agency

Table A.3: **Average nominal monthly wage, Tenge**

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Kazakhstan	23,128	28,329	34,060	40,790	52,479	60,805	67,333	77,611
Akmola	14,954	18,706	22,740	27,687	36,540	41,944	47,794	54,557
Aktobe	23,848	29,482	34,851	40,905	50,271	56,090	60,375	69,726
Almaty	15,933	20,180	24,436	29,779	39,483	44,327	49,715	58,430
Atyrau	48,338	53,472	65,195	74,682	94,373	111,023	129,009	148,310
West Kazakhstan	29,876	31,868	36,145	40,198	50,242	59,362	69,455	80,101
Zhambyl	14,779	19,131	22,542	26,750	33,996	37,546	43,951	51,340
Karaganda	19,962	24,772	28,440	34,612	44,236	53,472	57,611	66,539
Kostanai	16,803	20,693	24,431	29,249	37,584	43,903	49,130	57,268
Kyzyl Orda	19,928	26,400	30,948	36,116	46,859	53,333	60,227	69,753
Mangistau	44,369	53,832	63,959	72,086	82,055	98,743	112,907	133,148
South Kazakhstan	15,309	19,386	22,854	27,586	36,707	41,679	48,610	57,545
Pavlodar	21,801	26,872	31,062	36,882	46,297	52,227	56,113	64,955
North Kazakhstan	15,245	19,166	23,011	27,182	34,522	39,790	45,755	51,689
East Kazakhstan	20,099	23,846	27,688	33,101	42,137	48,293	53,496	61,388
Astana city	33,002	41,921	51,001	63,001	79,210	89,631	98,864	110,838
Almaty city	32,622	39,614	49,201	59,240	78,021	90,239	95,139	106,597

Source: National Statistical Agency

Table A.4: β**-convergence estimation. Panel of 16 regions in 2003–2009**

	dep. variable: GRP growth		dep. variable: wage growth	
variable	coefficient	st.error$^{(a)}$	coefficient	st.error$^{(a)}$
a	0.097	0.056	0.246	0.082
β	–0.008	0.01	0.014	0.008
R^2	0.005		0.065	
N	96		96	

(a) – standard errors are corrected for spatial correlation

Table A.5: **Capital Share**$^{(a)}$

	2003	2004	2005	2006	2007	2008	2009
Akmola	0.53	0.49	0.47	0.50	0.58	0.57	0.56
Aktobe	0.62	0.60	0.66	0.67	0.68	0.72	0.68
Almaty	0.40	0.31	0.32	0.34	0.33	0.37	0.38
Atyrau	0.77	0.79	0.80	0.82	0.79	0.82	0.81
West Kazakhstan	0.49	0.69	0.69	0.72	0.71	0.73	0.68
Zhambyl	0.31	0.26	0.28	0.23	0.22	0.26	0.18
Karaganda	0.64	0.61	0.66	0.69	0.68	0.69	0.68
Kostanai	0.58	0.54	0.53	0.53	0.58	0.61	0.58
Kyzyl Orda	0.55	0.53	0.58	0.68	0.68	0.73	0.68
Mangistau	0.65	0.64	0.70	0.75	0.77	0.80	0.76
South Kazakhstan	0.49	0.30	0.28	0.24	0.28	0.29	0.33
Pavlodar	0.63	0.64	0.64	0.64	0.63	0.71	0.68
North Kazakhstan	0.51	0.44	0.46	0.50	0.53	0.57	0.51
East Kazakhstan	0.50	0.49	0.50	0.55	0.55	0.53	0.53
Astana city	0.69	0.71	0.77	0.78	0.76	0.72	0.70
Almaty city	0.75	0.76	0.78	0.82	0.78	0.76	0.77

(a) – Own calculations based on Kazakhstan Statistical Agency dataCapital share, α can be found as 1 minus labor share. The share of labor, $1 - \alpha = w/y$, where w is the average wage and y is the GRP per capita.