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The Long Run Growth Rate of the Kazakhstan's Economy

Aloysius Ajab AMIN[*], **Dariya AINEKOVA**[**]

Abstract

Kazakhstan's economy has performed very well for almost the past decade – growing on an average annual growth rate of 9%. Furthermore, over this period there has been rapid increase in production in all the sectors of the economy. Can this economy continue to grow at such a high growth rate in the long run? The scanty existing literature on the topic suggests that growth is driven by exports from the extractive industry, while growth accounting studies on Kazakhstan's economy reveal little contribution of total factor productivity to growth. In theory, the total factor productivity (TFP) growth rate and long-run growth rate, or the steady state growth rate are equal. Hence, we examine this premise because it is as interesting and useful as policy input.

In investigating the long run growth rate, we used parametric (econometric) methods with extended production functions to include learning by doing through trade (openness). We find the estimates of the TFP steady state growth rate to be around 3 percent. This study gives us better insight into the economic growth of the country, although with transitional economies like Kazakhstan's, there are huge institutional changes.

Keywords: *Economic growth, (total factor) productivity, Kazakhstan, production function and trade*

JEL Code Classifications: *JEL: 040; 050; E60*

[*]Professor of Economics, Economics Department, CSS, KIMEP University Kazakhstan, E-mail: amin@kimep.kz, ajab1@hotmail.com

[**]Senior Lecturer, Economics Department, KIMEP University, E-mail: Dariya@kimep.kz, Darekot@gmail.com

1. Introduction

Before its independence in 1991, Kazakhstan was producing 4% of crude oil and plenty of mineral resources as well as agricultural products, with grain production being the third largest after the Russian Federation and Ukraine in the Soviet Union. Yet there was no flexibility in the economy. Studies (Easterly and Fisher, 1995) show that in the Soviet Union (SU) there was very low elasticity of substitution between labor and capital. The SU stressed extensive growth when the ratio of capital-to-labor was raised. This meant diminishing returns to capital set in faster than in market economies. For the period 1950 – 1987, the marginal product of capital was declining sharply while the growth rate of the total factor productivity was a low constant. This situation was common in the whole Soviet economy.

In the early 1990s, huge oil and gas reserves were discovered in Kazakhstan and at the same time the country was found to be endowed with extensive mineral resources. As the country transforms itself from planned economy to market economy, significant structural and institutional reforms are being made -- the reform process continues. The privatization and price liberalization of the economy, improvement of the business climate, and promotion of the small and medium size enterprises have been crucial as the country integrates into the global economy (Yessentugelov, 2007). Considerable increase in the commodity prices, coupled with the oil boom, has also boosted exports and increased the foreign investment inflow. Thus, per capita income has increased appreciably. The unemployment rate declined from 13.5% in 1999 to 7.3 per cent in 2007, and in the second half of 2011 the unemployment rate was estimated to be 5.3 percent. Furthermore, over this period there has been rapid increase in production and growth in nearly all the sectors of the economy (National Bank of Kazakhstan, 2011; Wandel and Kozbagarova, 2009; Olcott, 2002). The IMF (2007: 4) The report states that:

> Kazakhstan has sustained very strong macroeconomic performance since the start of the last decade. Annual real GDP growth has averaged over 9 percent and per capita incomes have now reached about five times the 1999 level in dollar terms. Employment has expanded steadily and social indicators have improved. The fiscal position has remained very strong, permitting substantial increases in public expenditures, especially social and infrastructure spending, as well as an accumulation of large savings in the National Fund (NFRK) for future generations.

The objective of the paper is, therefore, to estimate the long run growth rate of the economy. The Kazakhstan's economy is the most diversified economy in Central Asian region; thus, the economy has a good base, with great potential for sustainable economic growth. Knowing the long run growth rate could also be a good planning target for the economy. In Section Two, we discuss the issue of long run growth and pattern of growth as experienced in other countries. Section Three brings out the sources of growth and inputs. In Section Four, we specify the model for estimating the long run growth rate. The description of data is carried out in Section Five. We employ the error correction model (for stationarity test) in Section Six. In Section Seven, the empirical results are analyzed, and the conclusion of the paper is drawn in the last section.

2. The long run growth rate

The question is: Can this economy continue to grow at its present high growth rate over the long run? The scanty existing literature shows that the growth is fuelled by the exports on the extractive industry, and growth accounting studies on Kazakhstan's economy reveal little contribution of total factor productivity to growth (Kalyuzhnova et al., 2004; IMF, 2005). In theory, the total factor productivity growth rate and long run growth rate (or the steady state growth rate) are equal. In a steady state all the variables grow at a constant rate – sometimes called *balanced growth equilibrium*. It is interesting and useful as a policy issue to examine this and to investigate the long run or equilibrium growth rate of the economy. An understanding of this could also be a good planning scenario or exercise.

There has been much discussion about East Asia's good economic performance, the contentious issue being whether the actual growth rate can continue into the long run (Kim, 2002). According to Rao et al. (2010), the analyses on East Asian economies did not include the learning-by-doing effects, which they incorporate into their study. They directly estimated the total factor productivity (TFP) and found that the TFP contribution was greater than the previous estimates. Also literature on growth accounting for these East Asian economies shows that the contribution of TFP to their rapid growth has not been as much as the contribution of factor inputs. Evidence on economic growth from other countries particularly from Japan, the US and East Asia shows that sources of growth were highly significant from capital accumulation, rather than from TFP. Furthermore, the growth rate of these countries would tend to gradually diminish to the low growth rate of their TFP.

In the early 1990s the average growth rate of the East Asian countries was 8.8%, while developed economies like the United Kingdom (UK) and the United States (US) had an average of 4%, with estimates of the total factor productivity showing a range between 0 and 1.5%. It is believed that their growth rates would have declined to the level of the growth rate of the TFP of around 1.5% (Rao et al., 2010; Hsieh, 2002). Could the same be true for Kazakhstan's economy? There seems to be a 'natural growth pattern' as countries develop; they go through industrialization; and as the economy grows, the structure of the economy changes with improvement in the TFP (Greiner et al., 2004). According to Kim (2002), contribution of TFP towards growth was quite strong in East Asian countries in comparison to other developing countries.

Lessons drawn from the mid 1970s macroeconomic crises show that countries with good functioning institutions and stable economic environment were more resilient, nor did they retrogress as much as other countries. That is, stable economic environment and good functioning institutions are solid foundations for economic growth. Countries with those attributes can also withstand any global economic crisis (Dowling, 2008; Greiner et al. 2004; Hsieh, 2004). Kazakhstan has experienced relatively stable political and economic environment since independence. The country has been continuously establishing and strengthening the necessary institutions and promoting stable political and economic environment (Kasera and Katz 2007; Yessentugelov, 2007; Daly, 2008; Weitz, 2008). Such performance and stability are good bases for economic growth.

3. Sources of growth and inputs

In estimating the sources of growth, we use the Cob-Douglas production function; and we extend the function to include learning effects beginning from the early 1990s. This is when the country became a Republic and started implementing its own economic policies. Solow (1956, 1957) shows the importance of technological progress for sustained per capita growth over sustained periods of time. As the economy moves towards the long run, diminishing marginal productivity of capital sets in. With endogenous growth models, policy becomes very important, and competition in a market economy also means that firms have to constantly innovate in order to be competitive. As firms invest more, they learn more and innovate, and innovation comes with technological progress. Firms and productive units are motivated to innovate partly because of policies related to trade and competition. Trade and competition also bring about technological progress. Greater technological progress improves economic growth. Technological progress is a catalyst for economic transformation and generates economic growth (Miller, 1997; Greenwood and Seshadri, 2005; Acemoglu and Guerrieri, 2008).

Barro (1998) breaks down the inputs into quality categories: labor into different quality in terms of educational attainment that could be associated with earnings- and, consequently, income share. As the educational attainment increases with time, such attainment may contribute to economic growth. This can be taken into account to avoid an overestimation of the residual (Solow residual). The capital input is treated similarly: certain categories of capital have a high depreciation rate implying high rental rate (price) than others. Buildings tend to last longer than machinery, and machinery therefore tends to have a higher depreciation rate than buildings. Not taking into account such differences in categories of capital contribution to growth may tend to overestimate the Solow residual (Barro, 1998; Bu, 2004).

According to Lipsey and Carlaw (2000), distinction could be made between technological knowledge and physical and human capital: usually R&D results in accumulated knowledge that can be seen as technological knowledge. Capital goods are produced with the embodiment of such knowledge. People form human capital when they acquire new skills, obtain more education, and when they are formally or informally trained by learning on the job. Similarly, changes could occur in capital (K) when there is depreciation, destruction, obsolescence or new investment is created. Capital wears and tears or can become obsolescent. So too people as human capital as they provide services. Sometimes they may not be needed, they can retire or die, plus young people can be re-trained to become more productive.

There is also difficulty in accounting for the technological progress usually embodied in new capital, when sorting out influence on growth from innovation and from capital accumulation. With output growth, we may not be quite sure whether this is from new and improved capital goods or simply from the capital itself. The relative prices of some capital have been declining partly because of the production of better quality of the capital goods. One can notice the declining price of computers since a decade ago. Also countries usually overestimate capital increases over the years; this poses estimating problems on the TFP. According to Pritchett (2000), this is explained by countries sometimes highly misallocating resources/funds. The Cobb Douglas production function does not take into account the structural differences across countries and over time. Even within the same country there may be differences in sectoral production characteristics. In fact, there is much complexity and changes over time. This is important in Kazakhstan, a country which has just been transformed from planned to a market economy. The structural changes are important.

4. Model Specification

Given the complexities involved, we try to develop a parsimonious model which is able to capture the essentials. The output of goods and services (Q=Y) of the economy is produced by the available inputs (capital-K, labor-L, and natural resources -R) and the productivity of the inputs, at a given state of technology. Technological progress occurs as there is improvement in the state of technology. Human capital (H) could also be included, with H representing skilled and trained labor. It is assumed that the total output of goods and services depends on the inputs (labor, physical capital and human capital) as well as on the state of technology. That is, we posit the relationship between the inputs and the output of goods and services as:

Implicitly $$Q = Y = AF(K, HL, R) \quad (1)$$

Explicitly $$Q = Y = AK^{\alpha}R^{\beta}(HL)^{1-\alpha} \quad (2)$$

Human capital (H) and natural resources (R) are included, but for the time being let us leave them out and see how we can calculate Total Factor Productivity (A):

$$A = Y/(K^{\alpha} L^{1-\alpha}) \quad (3)$$

$$A = (Y/L)/(K/L)^{\alpha} \quad (4)$$

With the appropriate data we can calculate the output per worker (Y/L), output per capital (Y/K), and the capital-labor (K/L) ratio. The data give the share of capital in output (α), hence A can be estimated.

The three main sources of output growth (Amin, 2002) here are:

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \varepsilon_K \frac{\Delta K}{K} + \varepsilon_L \frac{\Delta L}{L} \qquad (5)$$

Output growth rate = total factor productivity growth rate+ ε_K*capital growth rate + ε_L*labor growth rate

ε_K is output elasticity with respect to capital (percentage change in output resulting from percentage change in capital).
and
ε_L is output elasticity with respect to labor (percentage increase in output due to percentage change in labor).

Generally as an economy grows, it creates new investment, such as in new buildings and machines, which leads to capital accumulation and continuously opens up to competitive international trade. This process promotes more efficient methods of production, and knowledge is also accumulated and applied. In other words, we are assuming that innovation, knowledge and technological progress are embodied in the "A" term. For simplicity, we suppress the time subscript in the equations. The initial stock of knowledge and technological progress can be designed as A_0, and we can assume that the knowledge and technological progress grow at a constant rate 'g' and that 't' is the effects of trend variables affecting TFP. That is $A = A_0e^{gt}$

Thus, the aggregate production can then be written as:

$$Y = A_0e^{gt}K^{\alpha}L^{1-\alpha}U \qquad (6)$$

U is the error term and it is assumed to be $u \approx N(0, \sigma^2)$

Transforming equation 6 by taking logs it becomes:

$$\ln Y = A_0 + gt + \alpha \ln K + (1-\alpha)\ln L + \ln U \qquad (7)$$

Kazakhstan's economy is exposed to competitive international trade, so that trade openness is supposed to generate positive spillover effects, such as learning by doing and improves efficiency in production of goods and services.

With the trade openness (T), the extended production function becomes:

$$Y = A_0 e^{(g_1 + g_2 T)t} K^{\alpha} L^{1-\alpha} u \qquad (8)$$

If we transform equation 8 in terms of per worker and take logs it becomes:

$$\text{Ln } y = \ln A_0 + (g_1 + g_2T)\, t + \alpha \ln k + \ln u \qquad (9)$$

And the steady state growth rate is equal = $g_1 + g_2T + n$, with n being the labor force growth rate.

We are interested in the short run as well as in the long run. The above equations estimate the effects of changes in TFP and inputs on the output, and more importantly, we focus on the growth of TFP. The production function models the long run relationship between the inputs and the output levels.

Much care must be taken to avoid the risk of having a spurious regression resulting from non-stationary variables. We address this by employing the error correction model as discussed below.

5. Description of Data

We use data from the publications of Statistical Agency's of the Republic of Kazakhstan for the period 1991 to 2011. We observe that the real GDP rose sharply from 1999 to 2008, and declined in 2008 and up to the third quarter of 2009 due to the World Financial Crisis. The financial crisis tended to reduce the speed of the economic growth. However, the economic growth picked up in 2010 and 2011 to almost the previous level of around nine (9) percent growth rate.

5.1. Capital

The Statistical Agency provides us with information on fixed capital at initial cost in its statistical compendium "Kazakhstan in years of Independence 1991-2011". The data available for the fixed capital at initial cost may not reflect the actual capital. This is because of the transitional and economic reform period involving privatization of previously government owned fixed assets and the difficulty of evaluating capital at its market value. However, the value of fixed capital at initial cost includes all the actual costs incurred for the construction or acquisition of fixed assets. We use estimates of fixed capital stock value from Perpetual Inventory Model, which is:

$$K_t = K_{t-1} - \delta K_{t-1} + I_t = (1-\delta)\, K_{t-1} + I_t \qquad (10)$$

Where K_t is the value of fixed capital stock available in year t, K_0 would refer to fixed capital stock available in Kazakhstani economy in the initial year 1992, δ is aggregate depreciation rate. I_t represents investments in fixed assets made in year t.

5.2. Labor

The number of workers employed in the economy is available for both private and public sectors. This number includes the self-employed. The data for the population is also available from Statistical Agency of the Republic of Kazakhstan, "Kazakhstan in years of Independence 1991-2011". In the first decade of independence from 1992-2002, due to the massive emigration and declining marriage and birth rates as well as rising mortality rates, the population growth rate was almost negative. As from 2000, the situation of the labor force has improved.

5.3. Trade Openness

To estimate the parameter "T" for trade openness, we added exports to imports and divided the total by the gross domestic product. We used data for Kazakhstan's exports and imports obtained from Statistical Agency of the Republic of Kazakhstan: "Kazakhstan in years of Independence 1991-2011". The composition of commodity exported is dominated by primary commodities such as mineral products, precious and non-precious metals. Starting from 1995, the share of oil and gas in total exports increased sharply from 29% in 1995 to 74% in 2009, with much foreign direct investment (FDI) flowing into the primary commodities sector. Data from The National Bank of Kazakhstan (1995-2011) shows that extraction of oil and gas attracts the highest amount of foreign direct investment (FDI).

6. Data Specification Model

We adopt the vector auto-regression (VAR) approach to estimate the effect of capital, labor and openness on GDP (or output) growth. This approach allows us to identify the long term effect by considering the long term dynamic feedback between real GDP (output) growth and variables that affect growth. Differencing simplifies the interpretation of results, since the first difference of the logarithms of the original variables represents the growth rate of the original variables.

In order to analyze the co-integration between real output (Y), capital (K), labor (L) and openness (T), we specify the following multivariate VAR model: Y = f (K, L, T)

Where Y is real gross domestic product, K is capital stock, L is labor stock, and T is the trade variable, which is openness to world trade. With the exception of T, the rest of the variables are expressed in logarithms. If these variables share a common stochastic trend and their first differences are stationary, then they can be co-integrated. We use the augmented Dickey-Fuller unit root test to analyze multivariate time series that include stochastic trend. This is done to provide evidence of co-integration among these variables.

6.1. Unit Root Test

First, we examine the time series properties of the data to determine whether the data are stationary (unit roots) and the order of integration. We use the Augmented Dickey-Fuller (ADF) test. This is equivalent to running the following set of regressions for each of the variables.

$$\Delta y_t = \beta + \lambda t + \alpha y_{t-1} + \sum_{i=1}^{l} \delta \Delta y_{t-1} + \varepsilon_t$$

Where y_t is the relevant time series, β is a constant, λ_t is time trend and ε is the residual error term. The test is performed separately for each level variable as well as on its difference with the aim of establishing the order of integration. The lag length (l) in the ADF regression is selected using the Schwartz criterion. The results indicate that all the variables are stationary with the exception of the y that has unit roots. But the variables are all integrated of order one and are all stationary at first difference.

The Johansen co-integration test was conducted with the assumption of linear deterministic trend in the data series. The test showed that the variables are integrated of order one. The trace test indicates one co-integration equation, and the maximum eigenvalue test indicates that one co-integration equation at 5 percent levels.

6.2. Error Correction model

With co-intergration and error correction specification, we are able to obtain the equilibrium relationship within the non-stationary series and incorporate short run as well as long run considerations into the same model. In doing this, we do not lose information resulting from differencing the non-stationary series. Our estimates show that the error correction term has a positive sign and is statistically significant at 5% level.

7. Empirical results

From the estimates of the error correction model and its analyses as discussed in Section Six above, we estimated Equation 7 and Equation 9. The results are shown in Table 1 below.

Table1: OLS Estimates of Production Function

Annual data for period 1990-2011: No. of observations: 22

Parameters\Equations	**(7) column 1**	**(9) column2**
A_0	0. 019018 [0.3261]	0.012225 [0.0000]
g	0.022484 [0.0139]	
g_1		0.002457 [0.0947]
g_2		0.027756 [0.0243]
α	0.561173 [0.0101]	0.284367 [0.0298]
1- α	0.214329 [0.0260]	
R-squared	0.879615	0.874963
Adjusted R-squared	0.876217	0.870790
Log likelihood	33.11540	83.94058
F-statistic	288.3336	233.6431
Prob(F-statistic)	0.000000	0.000000
Durbin-Watson stat	1.72330	1.682559

Note: p-values are in brackets.

It is observed from the adjusted R-squared that the right hand variables (labor, capital and trend (time) explain about 88 percent of the variation in real output (Y) in the two models (equations 7 and 9). The F-statistic and prob (F-statistic) indicate that, overall, the two models are significant. From the p-values the coefficients are all significant. The D-W statistics show that there is no autocorrelation as we do not reject the Ho: p=0. The estimates were made after differencing.

The estimates of equation 7 (column 1) show that the coefficients (g, α, and 1- α) are highly significant. Capital share is .561; this is almost two-thirds while the labor share is .214, which is slightly less than one-third. The interesting coefficient is 'g', which is 0.02248; that is, the growth rate of total factor productivity is 2.25%.

The results of equation 9 (column 2) are in per capita. The coefficients (α, g1, g2) are significant. The capital per labor coefficient is 0.284, which can be interpreted in terms of elasticity. The elasticity of output with respect to capital per labor is 0.284. That is if capital per labor were increased by 1%, output per labor would increase by 0.284%. In other words, the share of capital per labor in the total output per labor is about 0.28.

Constant, capital per worker, and trend spillover effects from trade openness are highly significant and positive as expected. That may imply that productivity growth is also based upon commodities' export growth.

7.1. Steady State estimates

The theory states that the total factor productivity growth rate is equal to the long run growth rate at steady state. The steady state growth rate (SGR) in this paper is $g_1 + g_2T$.

From equation 9 (column 2) we have SGR = $g_1 + g_2$ = 0.25%+ 2.80% =3.05 %

Other studies (Rao et al., 2010; Hsieh, 2002; Kim, 2002) have shown the growth rate of the total factor productivity of other countries including East Asian countries (Asian Tigers) in the long run to 3.5%. For developed economies the TFP growth has been shown to be much lower between 1.5 % and 2.8% (Hulten, 2009; Greenwood and Seshadri, 2005). For Kazakhstan, the long run total factor productivity growth rate is around 3 percent. If we rely on the data, then the steady state growth rate around 3 per cent would imply that the growth rate of the economy may continue to be high before tapering down to around 3 per cent.

7. Conclusion

We estimate the long run growth rate of the total factor productivity. The estimates of steady state growth rate are found to be around three per cent, implying that the growth rate of the economy may continue to be high before tapering down to around three (3) per cent. The results show the contribution of trade openness. Examining the data, it is observed that export from extractive industry (boosted by commodity high prices) sharply increased from 29 percent in 1995 to 74 per cent in 2009, thus making the oil and gas exports a strong driving force of the TFP. The technology involved in the production and exportation of the extractive industry may be absorbed by the local labor force and economic system. At the same time, the resources including the financial resources obtained from exploitation and exports could be well utilized in the country's development. It is important as the government puts emphasis on infrastructural development and continuous diversification of the economy. This has long run development implications. Hence, the main challenge is managing the economy (particularly the resources from these exports) in such a way that it achieves broad-based sustainable growth with development. The policy issues may include incentives for investments, particularly those that tend to improve factor productivity with technological advances.

References

Acemoglu, Daron and Veronica Guerrieri (2008), "Capital Deepening and Nonbalanced Economic Growth" Journal of Political Economy, University of Chicago Press, 116 (3):467-498

Aghion Philippe and Peter Howitt (2007), "Capital, Innovation, and Growth Accounting" Oxford Review of Economic Policy, 23 (1): 79-93

Amin, Aloysius Ajab (2002), "An Examination of Sources of Economic Growth in Cameroon, Nairobi": African Economic Research Consortium (AERC)

Chen, Qiang "R&D, learning and long run growth" http://wise.xmu.edu.cn/Master/News/NewsPic/200821812754564.pdf (Accessed May 9, 2011).

Barro, Robert J. (1998), "Notes on Growth Accounting" NBER Working Paper 6654, http://www.nber.org/papers/w6654 (Accessed May 30, 2011).

Bosworth, Barry and Susan M. Collins (2008), "Accounting for Growth: Comparing China and India" Journal of Economic Perspectives, 22 (1): 45-66.

Bosworth, Barry and Susan M. Collins (2003) "The Empirics of Economic Growth: An update." Brookings Papers on Economic Activity: 113-206

Bu, Yisheng (2004), "Fixed Capital Stock Depreciation in Developing Countries: Some Evidence from Firm Level Data." www.iub.edu/~econdept/conference/Bupaper.pdf (Accessed May 23, 2011).

Daly, John C. K (2008), "Kazakhstan's Emerging Middle Class" Central Asia-Caucasus Institute & Silk Road Studies Program –A Joint Transatlantic Research and Policy Center

Dowling, John Malcolm (2008), Future Perspectives on the Economic Development of Asia, Portland: World Scientific Publishing Co.

Easterly, W. and S. Fisher (1995), "The Soviet Economic Decline." World Bank Economic Review 9 (3): 341-371

Ericsson Neil R. and James G. Mackinnon (2002), "Distributions of Error Correction Tests for cointegration" Econometrics Journal, 5(4): 285–318.

Greenwood, Jeremy and Ananth Seshadri (2005), "Technological Progress and Economic Transformation" in Hand Book of Economic Growth, Vol 1B edited by Philippe Aghion and Steven N. Durlauf: Elsevier Publishing: 1225-1263.

Greiner, A., W. Semler, G. Gong (2004), The Forces of Economic growth: A Time Series Perspective. Princeton: Princeton University Press.

Hoff Ayoe (2004), "The Linear Approximation of the CES Function with n input variables." Marine Resource Economics, 19 (4): 295–306

Hsieh, Chang-Tai (2002), "What Explains the Industrial Revolution in East Asia? Evidence from Factor Markets." American Economic Review, 92 (3): 502-526

Hulten, CharlesR. (2009), “Growth Accounting” NBER Working Paper 15341, http://www.nber.org/papers/w15341 (Accessed April 28, 2011).

IMF (2007). Republic of Kazakhstan Country Report No. 07/235

IMF (2005). Republic of Kazakhstan: Selected Issues, IMF Country Report No. 05/240

Kalyuzhnova,Y., J. Pemberton and B. Mukhamedieyev (2004), “Economic Growth in Kazakhstan” in G. Ofer and R. Pomfret (Ed.), The Economic prospects of the CIS, London: Edward Elgar: 63-88

Kasera, Saurav and Barbara Katz (2007), “Kazakhstan: Economic Policies Before and After the 1998 Russian Financial Crisis”, Research Paper, Stern School of Business, New York University

Kim, Jong-il (2002), “Total Factor Productivity Growth in East: Implications for the Future.” Asian Economic Papers 1 (2): 50-70

Lipsey, Richard G, and Kenneth Carlaw (2000), “What does Total Factor Productivity Measure?” International Productivity Monitor (1): 31-40.

MacKinnon, J.G. (1991), “Critical Values for Cointegration Tests”, in Long-Run Economic Relationships: Readings in Cointegration, eds. R.F. Engle and C.W.J. Granger, Oxford: Oxford University Press: 267-276.

MacKinnon, James G., Alfred Haug, and Leo Michelis (1999), "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration" Journal of Applied Econometrics, 14(5): 563-577.

Miller, Preston J. (1997), “ Breaking Down the Barriers to Technology Progress” USA Federal Reserve System Annual Reports.

National Bank of Kazakhstan (1993-2011), External Sector Statistics. www.nationalbank.kz.

Nehru, Vikram and Ashok Dhareshwar (1994), “New Estimates of Total Factor Productivity Growth for Developing and Industrial Countries.” World Bank Policy Research working paper: 1313.

Olcott, Mrtha Brill (2002), Kazakhstan Unfulfilled Promise, Washington, DC.

Pritchett, L. (2000), “The Tyranny of Concepts: CUDIE (Cumulated, Depreciated, investment Effort) Is not Capital.” Journal of Economic Growth 5 (4): 361-384

Rao, bhaskara B., Artur Tamazian and Rup Singh (2010), “What is the long run growth rate of the East Asian Tigers.” EERI (Economics and Econometrics Research Institute) Working Paper 04/2010

Solow, R. (1956), “A Contribution to the Theory of Economic Growth.” Quarterly Journal of Economics, 70 (1): 65-94

Solow, R. (1957) “Technical Change and Aggregate Production Function.” Review of economics and Statistics, 39 (3): 312-320

Stigler, George J. (1976), “The Xistence of X-Efficiency.” American Economic Review, 66 (1): 213-216

Wandel, Jurgen and Botagoz Kozbagarova (2009) Kazakhstan: Economic Transformation and Autocratic Power” Mercatus Center- George Mason University County Brief 4.

Weitz, Richard (2008) Kazakhstan and the New International Politics of Eurasia Central Asia-Caucasus, Institute & Silk Road Studies Program–A Joint Transatlantic Research and Policy Center

Yessentugelov A. (2007) “Economics of independent Kazakhstan: History of Market Reforms” Almaty: Center of Research and Monitoring of Economy of Kazakhstan