Constructing the New Growth Model for Uzbekistan's Economy

Nargiza Kayumova[1]

Abstract

During the world-financial crises developed countries have been showing significantly low per-capita income growth rates comparing to emerging economies. This phenomenon can only be explained by endogenous growth theories. In the last decade of the last century new knowledge formations in developing countries occurring faster than those in high-income countries. Therefore, it is an imperative task to analyze current speed of knowledge-stock expansion in Uzbekistan. The research develops open-economy New Growth Model according to which economic growth is stimulated by domestic knowledge production and/or knowledge splits from abroad. Model concludes that the long run steady state per-capita income augmentation rests on growth rates of human capital. Knowledge indices of countries are calculated from normalized values of variables chosen by World Bank. Empirical evidences prove countries with high indices to have high per-capita incomes or vice verse as predicted by the model. Changes in total knowledge stock than those in human capital tend to increase nations' welfare more. Further validations of the model reveal knowledge-flows from abroad to have significant positive impacts. Information and Communication Technologies and Innovation indices possessed big favorable affects on economic well-being of nations in comparison to Economic Incentives and Education indices. Analyses determine all pillar indices to advance at slow rates comparing to other countries of the world. Sharp increase in global knowledge-soar-up competition tends relative knowledge stock of Uzbekistan to decline. Conclusions from the model recommended economic policy implications for Uzbekistan stressing mainly out foreign trade liberalization, domestic business-sphere improvements, area-based development plans, introducing e-government and e-business environments as well as investments in human capital.

Keywords: *economic growth, knowledge, pillars, innovations, ICT, growth theory*

[1] Nargiza Kayumova, PhD in Economics, Associate Professor at Tashkent State University of Economics, Uzbekistan; nora_uz@mail.ru

Özbekistan Ekonomisi İçin Yeni Büyüme Modelinin Oluşturulması

Özet

Küresel finansal kriz süresince gelişmiş ülkeler gelişmekte olan ülkelere nazaran çok daha düşük kişi başı gelir büyüme oranları göstermiştir. Bu olay, sadece içsel büyüme teorileriyle açıklanabilir. Geçtiğimiz yüzyılın son 10 yılında gelişmekte olan ülkelerdeki bilgi birikimi yüksek gelirli ülkelerden daha hızlı gerçekleşmiştir. Bu yüzden, Özbekistan'daki bilgi birikimi büyüme hızının mevcut durumunun analizi zorunlu bir görevdir. Bu araştırma, yerel bilgi üretimi ve/veya yurtdışından farklı bilgi birikimiyle teşvik edilen ekonomik büyümeyi baz alarak açık ekonomiye göre Yeni Büyüme Modeli geliştirmektedir. Model, uzun dönemde ülke kişi başı gelir oranındaki düzenli büyümenin beşeri sermayedeki büyüme oranlarına dayandığı sonucuna varmaktadır. Ülkelerin bilgi endeksleri, Dünya Bankası tarafından seçilen değişkenlerin normalleştirilmiş değerlerinden hesaplanmaktadır. Deneysel bulgular, Modelin de öngördüğü gibi, yüksek endekslere sahip ülkelerin yüksek kişi başı gelire (veya tam tersi) sahip olduğunu göstermektedir. Beşeri sermayeden ziyade toplam bilgi birikimindeki değişmeler ülke refahındaki artışa daha fazla etki etmektedir. Model, yurtdışından bilgi akışının da önemli pozitif etkilerinin olduğunu ortaya çıkarmaktadır. Bilgi ve iletişim teknolojileri endeksleri, ekonomik teşvikler ve eğitim endekslerine kıyasla ülkelerin ekonomik refahında çok daha büyük etkilere sahiptir. Analizler bütün temel endekslerin diğer ülkelere göre daha düşük oranlarda yükseleceğini göstermektedir. Küresel bilgi artışı rekabetindeki keskin yükseliş Özbekistan'ın bilgi birikiminde göreceli düşüşe yol açmaktadır. Model araştırmanın sonuçları, dış ticaretin serbestleştirilmesi, yerel ticaretin geliştirilmesi, alan bazlı iyileştirme planları yapılması, e-hükümet ve e-ticarete geçiş, insan kaynaklarına yatırım yapılması konularında Özbekistan'a ekonomi politikası tavsiyelerinde bulunmaktadır.

Anahtar kelimeler: *ekonomik büyüme, bilgi, temel maddeler, yenilik, ICT, büyüme teorisi*

1. Introduction

Acceptance of knowledge by recent theories as crucial factor of economic growth has made classical phenomenon of factor scarcity, therefore, limited output expansion doubtful. Although formulated growth models have considered labor and capital as given they do not speculate to explain where these two general types of inputs have originated from: what creates capital and what turns people into 'labor'. Knowledge has emerged as the source of innovations, production efficiencies, technological advancements, competitive advantages in international trade and creation of both human and physical capital. While current globalization is taking place through the transmission of countries' economies into knowledge economies, knowledge and technology are playing the roles of heart and mind for this global movement.[2] New Growth Theory can also be called as Knowledge-Based Growth Theory[3] introduces knowledge as the key variable affecting economic well-being of countries[4] in this article, Uzbekistan. It is, therefore, vital to analyze the constituents within the theory and influential degrees of participating variables and draw conclusions about economic and social policies whose target shall be to accelerate the transmission of Uzbek economy into knowledge-economy.[5] In this article are attempt was made to construct a model for Uzbek economy and to assess the formation of the knowledge based economy.

2. The Modelling Background

Origins of classical production functions are built on the monotonic assumption that output is a function of capital and labor which are in turn limited by nature: Y=F(K, L). More specified form of production function was presented by Cobb-Douglas as $Y=AK^{a}L^{a-}$ [6] where A represents technological development and held constant[7] K and L- respectively are

---

[2] World Bank, *Building Knowledge Economics* [online]Available from: http://siteresources.worldbank.org/KFDLP/Resources/ 461197119990709046 4/BuildingKEbook.pdf Accessed: October 26, 2008.

[3] John Cortrigt, *New Growth Theory, Technology and Learning: A practitioner's Guide*, USA: Inpresa Co., 2001.

[4] Center for Economic Research of Uzbekistan. *Knowledge Economics and Its Implication on Uzbekistan*. Tashkent: CER Publishing, 2004.

[5] Bakhodur Eshonov, *Knowledge Economy* [online] 2008. Available from: http://www.un.uz/download.php?type=file&parent=2265&doc=9835 Last Accessed: January 12, 2009

[6] I- investment and s - marginal propensity to save, WIUT 2009.

[7] Gregory Mankew, *Macroeconomics*, The United States: New York, 2003. New Ec.Index Org., *The Knowledge Economy: Knowledge Producers and Knowledge Users* [online] 2007. Available from: http://www.neweconomyindex.org/knowledge.html Last Accessed: January 6, 2009.

capital and labor. Holding the same property, Solow created neo-classical growth model basing on the Keynesian AS-AD cross where I=S (simplified closed economy) generated $S=s*Y=s*Y(K, L)^x$ and stated that economy stays on steady-state output level resulting from capital stock formation.[8] However, Solow's model is not complete in a sense that it takes the level of employment fixed at natural level, thus, unable to explain short run output fluctuations. Model, also, lacks on determining the reasons which shift the economy from one steady-output level to another. To fulfill the classical models, erected the fundamentals for New Growth Theory, opening the new knowledge economics (KE) era according to which output is a function of knowledge: Y=F(K).

3. Explanation of the Model and Its Components

New Growth Theory (NGT) completes classical Cobb-Douglas and Solow models by including knowledge as new factor explaining technological development.[9] Before moving onwards, specifying the characteristics of knowledge as an economic good would be plausible:

Unlike physical products, knowledge is such a good that its use by one cannot prevent the use by another[10] also, divides the knowledge into: codified and tacit. The former meaning knowledge that can be in written form and the latter representing knowledge belonging to special person (acquired by experience, skills etc.). Knowledge is also a public economic good that as new idea, invention are created everyone can benefit from it. Therefore, it can be used unboundedly and possess increasing returns to scale.[11]

Last characteristic of knowledge is crucial to distinguish NGT as input factors in classical models are exposed to diminishing returns. Cortright cites that decreasing returns and increasing marginal costs have been basic 'hands' of classical growth models bringing economies into equilibrium: optimal output-price levels. His microeconomic view of knowledge production implies that once knowledge is created its marginal cost will

[8] M. Gertner, *Macroeconomics*, 2ed. Edenburg: Prentice Hall, 2006.

[9] M. Paul Romer, *Endogenous Technological Change* [online], 1990. The Journal of Political Economy, Available from: http://www.jstor.org/stable/2937632 Accessed: October 26, 2008.

[10] M. Polaniy, *The Tacit Dimension*, New York: Doubleday co., 1967.

[11] M. Paul Romer, *Endogenous Technological Change* [online], 1990. *The Journal of Political Economy*, Vol. 98, No. 5, Part 2: The Problem of Development: A Conference of the Institute for the Study of Free Enterprise Systems (Oct., 1990), pp. S71-S102. Published by: The University of Chicago Press Available from: http://www.jstor.org/stable/2937632 Accessed: October 26, 2008.

be almost zero. Thus, within knowledge-based growth theory equilibrium analysis shall be different.

Being intangible asset knowledge must be quantified to make yearly and country-based comparisons. Kgomotso[12] states that indigenous knowledge, being key-stream of globalization, can only be measured relatively and no pure measurement scale can be applied. However, World Bank proposed its Knowledge Assessment Methodology (KAM) according to which knowledge-economy index (KEI) is a composite of four key pillars: economic and institutional regime, education and skills, information and communication infrastructure and innovation system. Malhotra[13] founds KAM as strictly relative because of the utilization of normalization process to calculate indices for these four pillars. According to himnormalization from 0 to 10 (from worst to best) does not take individual importance of used variables.

Saisana[14] presents number of methods to create composite indicators that can be used to calculate indices for four pillars of KEI. She emphasizes that "composite indicators are based on sub-indicators that have no common meaningful unit of measurement and there is no obvious way of weighting these sub-indicators." According to her, calculating KEI for Uzbekistan and deriving comparative conclusions may possess following limitations:

• KEI could be misleading and expose non-robust policy messages if poorly constructed

• While making policy suggestions, as a result of KEI analysis, all four pillars and their sub indicators must be taken into account, because, just KEI provides a 'big picture' only.

• KEI calculation within the project is highly dependent on choice of method to construct the indices. Different choices may bring different results.

Desai[15] suggests simple weighted sum method that can be used to generate both.

---

[12] H. Kgomotso, MOAHI, *Globalozation,* Knowledge Economy and imlecation for Inigenouse Knowledge(online), 2006. Available from:http\\www.i-r-i-e\inhalt\007\06-moahi

[13] UN, Round Table report on Knowledge-Based Economy, 2005

[14] Saisana, *Composite Indicators-The Controversy and the way Forward*, European Comission, Joint Research Centre of Ispra, 2005.

[15] Preyas Desai, *Strategic Decentralization and Channel Coordination*, Quantative Marketing and Economics, 2(1) 55-22, 2004.

KEI itself and its pillars using: Index = $\sum_{i=1}^{n} w_i x_i$ and he used this to calculate Human.

Development Index where x_i is sub-indicators and w_i is their respective weights. Saisana[16] suggests multiple regression analysis, principal components analysis and cronbach alpha methods to calculate weight values and gives preference to the first because of its simplicity and making relatively more econometric sense.

4. Models and Theoretical Debates

Romer[17] emphasizes that knowledge input with increasing returns and zero marginal cost creates incentives for unlimited potential growth for all economies. This fact, nowadays worldwide globalization process is making all countries keen to transit from 'resource-based economy' into 'knowledge-based economy'. Current Welfare Improvement Strategy of Uzbekistan outlines government's investment plans in human capital and knowledge expansion programs as fundaments for transition of economy into KE.[18] However, Uzbek economy is performing slow transition speed comparing to other countries: country was on 92nd rank with KEI=3.27 in 2007 but was 95th place with only 0.01 point increase in KEI.[19] Therefore, analyzing individual affects of variables of NGT on Uzbekistan's GDP growth and targeting policies towards the improvement of variables with most influential and statistically significant coefficients is what is needed to improve the speed of country's transition

First research on Knowledge Economics for Uzbekistan was undertaken by Center for Economic Research group of Uzbekistan in 2004. The project concentrated on analyzing role of knowledge in country's economic growth and determined the competitiveness of Uzbekistan within the globalization. Keeping in mind that current development program of our

[16] Saisana, *Composite Indicators-The Controversy and the way Forward*, European Comission, Joint Research Centre of Ispra, 2005.

[17] M. Paul Romer, *Endogenous Technological Change* [online], 1990. *The Journal of Political Economy*, Vol. 98, No. 5, Part 2: The Problem of Development: A Conference of the Institute for the Study of Free Enterprise Systems (Oct., 1990), pp. S71-S102 Published by: The University of Chicago Press Available from: http://www.jstor.org/stable/2937632 Accessed: October 26, 2008.

[18] *Welfare Improvement Strategy Paper for 2008-2010*, Ministry of Economics, Uzbekistan, 2007, WIUT 2009.

[19] World Bank, *Knowledge Economy Index (KEI) 2008* [online], 2008. Available from: http://siteresources.worldbank.org/INTUNIKAM/Resources/KEI2008Highlights_final12052008.pdf Last Accessed: January 17, 2009.

country is to intensify the economy towards knowledge-based-production growth; this research is to be a helpful course testing Uzbekistan's current competitive position in its transition. Project intends to elaborate necessary suggestions in order to increase the speed of transition into knowledge-based economy.

Identifying proper and reasonable method to measure knowledge was tough. As stated in literature review, choice of method would be an important factor affecting comparisons and conclusions of Knowledge-based growth model. Two alternative ways to measure knowledge index were commonly presented in literatures:

1) Fredeunberg[20] in European Union's State of Art Report. Knowledge index can be calculated as sum of products of each variable and their respective weights:

Knowledge Index = $\sum_{i=1}^{n} w_i x_i$ where x_i - variables used to calculate knowledge index and w_i - the weights of corresponding variables. The weights can, in turn, be calculated within knowledge-economy as:

$$GDPPC_i = a_{0i} + a_{1i}x_{1i} + a_{2i}x_{2i} + ... + a_{ni}x_{ni} + u_i$$

Regressing GDP-per-capita on all variables available to calculate knowledge index will provide estimated coefficients for those variables. Coefficients represent affects of each variable on income-per-capita level and, thus, can also be used as weights. This method is reasonable and makes economic sense, hence, can be employed to calculate each pillar of knowledge economy and overall knowledge index of each country.

2) Knowledge Assessment Method of World Bank each time each variable for all countries are set in descending order. The countries are ranked in descending order: 1 for country with highest value on the variables, 2 for next highest and so on. Normalized value of the variable is then calculated as Normalized variable = $10*(1 - N_H / N_C)$ will be between 0 and 10. Each index is then calculated as average of respective variables' normalized values. The second method was preferred to the first because of availability of data, simplicity and easiness of cross-country comparisons. In addition, in the 1st method coefficients of variables are greatly subject to being insignificant when regressed and if more variables are included in the regression the degrees of freedom for the linear model would be eaten-up.

[20] Michael Freudenburg, *Composite Indicators of Country Performanse: A Critical Assessment*, OECD Science, Technology and Industry Working Papers, 2003.

5. Basic Models

Constructing knowledge-based growth model was the extension of closed-economy version of Chen and Kee (2005)[21] model to open economy case: $y=a*m+b*n$ - (a>0) growth of output per-capita in the long run is positively related to human capital growth (m) and population growth (n) rates. Classical Cobb-Douglas output production function was employed for both output and knowledge production sectors of economy: $Y = AK^aL^{1-a}$ where Y-output, A-technological growth, K and L - capital and labor with a and 1 - a respective contributions on output growth. Steady-state condition level of income-per capita growth was then derived by the steps of Solow's growth model: i=s*y that economy is steady-level when depreciation of capital is just equally compensated by investments. As economy was assumed to be open, the net exports (or equivalently net capital outflow) were kept while constructing the complete model.

Realization of the objectives required, mainly, both qualitative and quantitative secondary data be gathered on statistical inferences and economic views on New Growth Theory to explore and evaluate the growth model for Uzbekistan. 83 variables for 134 countries were available in the KAM of World Bank.[22]

Assessing the movement of economy of Uzbekistan towards knowledge-based growth will be based on statistical inferences, thus, secondary data will be used predominantly. Therefore, there was no need for sampling methods to be used to gather primary data for the article.

Following fundamental theories, knowledge-based economic growth model for Uzbekistan will take the look of: $Yt=F(Kt, Lt, Knowledge_t)$ where K and L - amounts of available capital and labor, $knowledge_t$ is the measure of accumulation of knowledge in economy at year t. The model will distinguish from classical ones with three distinct economic characteristics:[23]

1) Concreteness - knowledge is either created or not.

2) Non-excludability - once knowledge is created, it is available for everyone.

[21] Derek H. C. Chen and L. H. Kee, *A Model on Knowledge and Endogenous Growth* [online], 2005. Available from: http://www.worldbank.org/publications Last Accessed: March 27, 2009.

[22] World Bank, *Knowledge Economy Index (KEI) 2008* [online], 2008. Available from: http://siteresources.worldbank.org/INTUNIKAM/Resources/KEI2008Highlights_final12052008.pdf Last Accessed: January 17, 2009.

[23] Center for Economic Research of Uzbekistan, *Knowledge Economics and Its Implication on Uzbekistan*. Tashkent: CER Publishing, 2008.

3) Non-rivalry - knowledge does not end when someone consumes it because it is information good.

The non-rivalry feature of knowledge makes this input possess increasing returns to scale implying to the possibility that country's economic growth can be unlimited. However, in reality, creation of knowledge is limited by the factors of production of knowledge, in turn. Following assumptions are made:

• There is K and L amount of capital and labor available in country. The labor refers to workers who do not create knowledge, but uses it only.

• H represents the human capital - skilled labor and they are the creators of knowledge in economy.

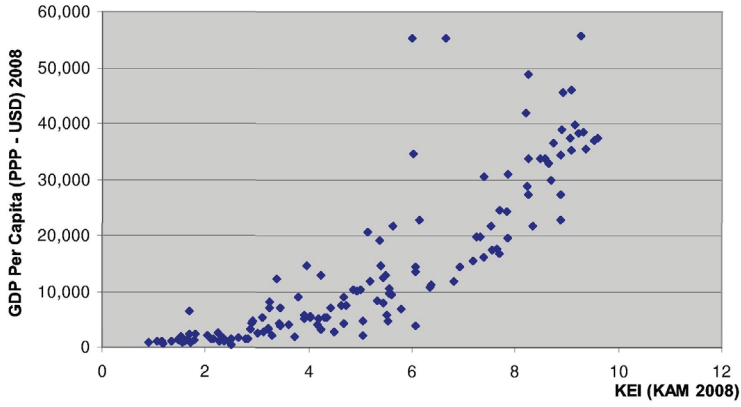
• Economy is divided into two parts: production of goods-services and production of knowledge.

• f - fraction. If, $f_K K$ amount of capital is used in knowledge production, $(1-f_K)K$ amount of capital is used in production of goods and services. Similar intuition applies to L and H.

• Both sector productions follow Cobb-Douglas production function.

6. The Empirical Importance of Knowledge in the Uzbekistan`s Economy

Taking into account the purchasing power parity (PPP), income per capita indicators of 134 countries as of 2008 were scattered against their respective knowledge economy indices generated by the Knowledge Assessment Methodology,[24] **Diagram 1:**

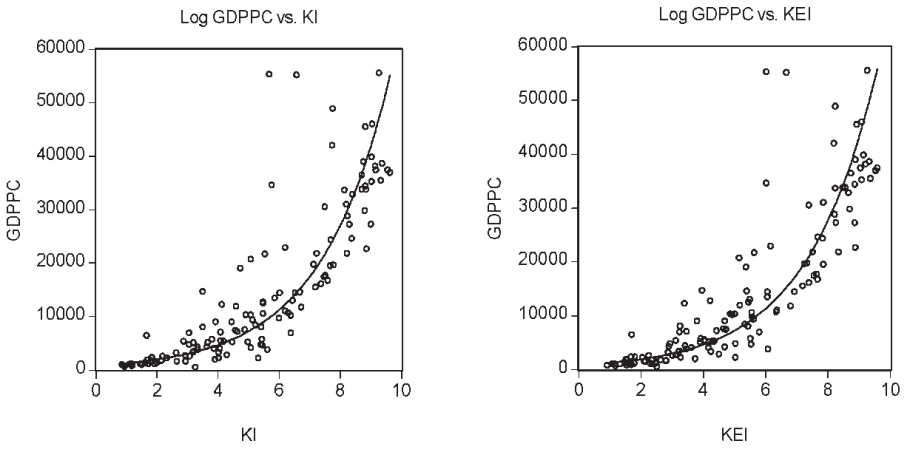


[24] World Bank, *Knowledge Economy Index (KEI) 2008* [online], 2008. Available from: http://siteresources.worldbank.org/INTUNIKAM/Resources/KEI2008Highlights_final12052008.pdf Last Accessed: January 17, 2009.

Analysis showed that for 134 observations average GDP per capita (GDPPC) and KEI was $14345 and 5,16 respectively. The shape of spread of KEI around GDPPC and theoretical propositions of New Growth Theory depicted that log-lin model would best explain the relationship between GDPPC and KEI (or KI):

$$\log(GDPPC_x) = a_0 + a_1 KEI_x + u_x \quad \text{and} \quad \log(GDPPC_x) = f_0 + f_0 KI_x + e_x$$

Diagram 2



Using Eviews4 software, regressions of $\log(GDPPC_t)$ on both KEI_i and KI_t verified the hypothesis that per capita incomes in 134 countries are empirically correlated with the knowledge bases of those countries. Regression results are presented below:

$\log(GDPPC_i) = 6.6447 - 0.4473\ KEI_i + u_i$				$\log(GDPPC_i) = 6.6979 + 0.438\ KI_i + e_i$		
Std.error	(0.1)	(0.0175)		*Std.error*	(0.09)	(0.0172)
t - stat	66.15	25.54		*t - stat*	67.56	25.39
p - value	0	0	*and*	*p - value*	0	0
$R^2 = 0.8317$	*SSR* = 34.18			$R^2 = 0.83$	*SSR* = 34.51	
DW = 1.76	*F - stat* = 652.6 (*p*=0)			*DW* = 1.87	*F - stat* = 644 (*p*=0)	

From this point on, First Pillar - Economic Incentives is assumed to explain the contribution of knowledge flew from abroad to overall knowledge accumulation within an open economy. This assumption is based on the fact that Economic Incentives is composed of factors affecting mostly foreign trade of countries e.g. tariff and non-tariff barriers, trade as % of GDP etc. Following conclusions are drawn from this assumption:

- KEI measures the total knowledge accumulation
- KI measures the knowledge produced within economy

Estimated coefficients of the Log(GDPPC)-KEI and Log(GDPPC)-KI models are statistically significant that t-stats are greater than 2, applying 2-rule-of-thumb (Gujarati, 2004). The same conclusion can be reached as p-values<1%. When KEI and KI are both zero, no knowledge is available, former and latter models estimate the average GDPPC for 134 countries in 2008 to be $e^{6.6447}$=$768,69 and $e^{6.6979}$=$810,7, respectively. When KEI increases by one unit, other factors being constant, income per person grows by 44,73% on average in each country. Whereby, one unit increase in KI brought 43.8% average rise in GDPPC in each country as of 2008. Note that fluctuations of per-capita-income growth rates of 134 countries in 2008 were explained by 83,17% fluctuations of KEI_i and by 83% changes in KI_i.

Testing for serial correlation: H_0 - no serial correlation among u_i's or e_i's DWu=1.611 and DWl=1.637.

As both estimated DW values lie between DW_U=1.611 and 4-DW_U=22.363, H_0 hypothesis is not rejected, thus, no residual-autocorrelation threats appear in both estimated models.

In long run per-capita income growth (gy) is positively related to overall knowledge and human capital growth(m) and negatively correlated with population growth (n).

$$g^*_{Y_i} = \frac{(1-\alpha-\beta)}{(1-\alpha)} g^*_{A_i} + \frac{\beta}{(1-\alpha)} m - \frac{\beta}{(1-\alpha)} n$$

Where α and β-the coefficients of elasticities of K and L.

Following the assumptions in Part C that $A_i = KEI_i$ and $H_i = KI_i$ simultaneous estimations of $\ln(GDPPC_i) = y_0 + y_1 \ln(KEI_i) + y_2 \ln(KI_i) + u_i$ and $\ln(GDPPC_i) = x_0 + x\,n + v_x$ would be sufficient to test the proposed model. Regression results:

$\ln(GDPPC_i) =$	6.152 +	1.3191$\ln(KEI_i)$ +	0.5631$\ln(KI_i) + u_i$
Std.error	(0.281)	(0.405)	(0,377)
t - stat	47.84	3.25	*1.49*
p - value	0	0.0015	*0.1379*
adjusted $- R^2 =$	0.8252	*SSR* = 34.98	
DW = 1.694	*F - stat* = 314 (*p*=0)		

Signs were positive as expected. With no knowledge and human capital growth, on average country would have $e^{6.152}$=$469,6 income-per capita. Any one % rise in overall knowledge level and human capital would increase the GDPPC by 1,31% and 0,56%, on average. However, unlike other estimated coefficients, the one of ln(KIi) was not significant even at 10% level (p=13,79%). At adjusted level, 82,5% changes in GDPPC growth rates were explained by the estimated model with no serial correlation problems (DW=1,69).

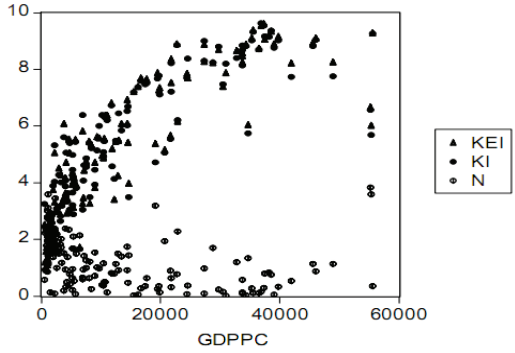
$\ln(GDPPC_i) =$	9.78	-	0.69 n	+ v_i
se	(0.149)		(0.098)	
t - stat	65.34	-	7.018	
p - value	0		0	

R^2 = 0.2717 DW = 1.11

F - stat = 49 (p=0)

One % rise in population would decrease the mean income-per-capita of each country by 69%. With no population growth, countries would enjoy $e^{9.78}$=$17676/person on average. Even though both coefficients are statistically significant, only 27% changes in ln(GDPPC) was caused by changes in population growth rates. Estimated model lacked on positive autocorrelation among v residuals (DW=1,11<DWl=1,61).

Diagram 3



The positive correlated trends of KEI and KI with GDPPC can also be witnessed in the scatter plot.

n - population's growth values concentrate more and more as GDPPC is lowered.

7. Testing the Role of Foreign Trade in Knowledge Accumulation Within Human Capital Growth Model

7.1. First Method: Output Sector

Economic Incentive (EIi) reveals the contribution of foreign trade to domestic knowledge accumulation, thus, economic growth. Model developed was:

Per Capita $g^*_{Y_i} = \chi^* m + n \frac{\varphi_1 (1 - \alpha - \beta) - \beta}{(1 - \alpha)}$ where $\chi^* > 0$ Regression on data:

$\ln(GDPPC_i) =$	5.75	+ 1.981n (KI_i)	+	$0.22\, n_i$ + u_i
Std.error	(0.208)	(0.096)		(0.065)
t - stat	27.6	- 20.66		3.4
p - value	0	0		0.0009
R^2 = 0.8289	*SSR* = 34.74	*adjusted* R^2 = 0.8263		
DW = 1.59	*F – stat* = 317 (p = 0)			

Resulting from one percent increase in the human capital (or equivalently KI), income-per-person will rise by 1.98%. All coefficients are significant at 1% level. However, model does not take knowledge splits from abroad into account. Therefore, Ramsey's RESET Test is utilized to see whether model is statistically mis-specified. The estimated ln(GDPPCi) calculated from above regression was introduced back into the regression in linear form:

$$\ln(GDPPC_i) = a_0 + a \ln(KI,.) + a_2 n_t + a_3 \ln(GDPPC_i) + u_i$$

$$R^2_{new} = 0{,}8673$$

$$F = \frac{(R^2_{new} - R^2_{old}) / \text{number of new regressors}}{(1 - R^2_{new}) / (n - \text{number of parameters in the newmodel})} =$$

$$F = \frac{(0.8673 - 0.8289) / 1}{(1 - 0.8673) / (134 - 4)} = \frac{0.0384}{0.1327 / 130} = 37.61$$

Because calculated F is significant, at 1% level, one can verify that initial model is misspecified. Therefore ln(EI) variable is introduced in the model and regressed: $\ln(GDPPC_i) = 5{,}75 + 1.75\ln(KI_i) + 0{,}18n_i + 0{,}26\ln(EI_i) + v_t$

$\ln(GDPPC_i) =$	5.75	+ 1.751n (KI_i)	+ 0.18n_i	+ $0.261n\,(EI_i)$	+ v_i
Std.error	(0.2)	(0.11)	(0.06)	(0.08)	
t - stat	28.6	15	2.95	3.32	
p - value	0	0	0.0012	0.0038	
R^2 = 0.8423	*SSR* = 32.03		*adjusted* R^2 = 0.8386		
DW = 1.61	*F – stat* = 231 (p = 0)				

Coefficient of added variable was statistically significant (t=3,32>2) and the adjusted-R^2 did also rose from 0,8263 to 0,8386 in the new model. Therefore, the affects of knowledge coming from abroad on countries' GDP per capita are statistically significant.

7.2. Second Method: Knowledge Sector

Knowledge is either created at home (KI) and/or adapted from abroad (EIi). Regressing total knowledge growth on growth of knowledge produced domestically and that of coming from abroad:

$$\ln(KEI_i) = 0.082 + 0.771\ln(KI_i) + 0.181n(EI_i)\ v_i$$

$$p\text{-}value \quad 0 \quad 0 \quad 0$$

$$R^2 = 0.993 \quad SSR = 0.29$$

$$DW = 1.57$$

As of 2008, each country would achieve average 0,77% and 0,18% rise in their overall knowledge base if their KI_i and EI_i were one unit higher than average. The impact of foreign knowledge adoption played, thereof, crucial role.

8. Testing the Individuality of Four Pillars of Knowledge Economy

The importance of each pillar in per-capita GDP growth in 2008 was deducted by linearly regressing countries' GDPPC changes on changes of cross-country pillar indices:

Dependent Variable: LOG(GDPPC) Method: Least Squares

Included observations: 134

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG (EI)	0.235482	0.082585	2.851389	0.0051
LOG (INNOVATION)	0.756480	0.172691	4.380530	0.0000
LOG (ICT)	0.765958	0.147762	5.183725	0.0000
LOG (EDUCATION)	0.098908	0.104302	0.948280	0.3448
C	6.223507	0.128497	48.43304	0.0000
R-squared	0.847815	Mean dependent var		8.951978
Adjusted R-squared	0.843096	S.D. dependent var		1.235993
S.E. of regression	0.489590	Akaike info criterion		1.446104
Sum squared resid	30.92113	Schwarz criterion		1.554232
Log likelihood	-91.88897	F-statistic		179.6631
Durbin-Watson stat	1.652084	Prob (F-statistic)		0.000000

Estimated all coefficients are statistically significant, except education, at 5% confidence level. Other conditions held constant, if EI, Innovation, ICT and Education did not grow at all within 2008, each country on average would have $e^{6.22}$=$502,7 per-person or income-per-capita would show 6,22% increase. One % increase of the Economic Incentives pillar

of any country would stimulate 0,23% increase of its per-person spending rate. The same change in Innovation and Information and Communication Technology Indices caused 0,75% and 0,76% elevation of per-capita income of any country, ceteris paribus.

R^2 was adequately high showing that 84,7% changes of GDP-per-capita from country to country were explained by the estimated log-log model. No serial correlation was reported among unexplained changes of dependent variable, Durbin-Watson=1,65 (with 5% confidence).

Even though, affect of Education pillar did not appear to be empirically significant on crosscountry basis analysis, it is neither sufficient nor proper to conclude that educational level can be omitted from knowledge-based growth model. Note that output-sector model was built on the fact that GDP is a function of both human capital and available stock of knowledge at time t. Henceforth, it is predicted that the coefficient of constant term C=6,22 did sponge-off the affects of available knowledge at the beginning of 2008, thus, the *true* affect of Education index. This was confirmed when GDPPC was regressed on Education pillar alone:

$$\ln(GDPPC_i) = \underset{Std.error}{\underset{p\text{-}value}{7.09\ (0.12)\ (0)}} + \underset{}{\underset{}{0.368\ Education_i\ (0.022)\ (0)}} + u_i$$

$R^2 = 0.6742$ $SSR = 66.18$

$DW = 1.85$ $F - stat = 273\ (p = 0)$

Nevertheless 67% changes in per-capita income were explained by the changes in Education index, coefficient of $\ln(\text{Education}_i)$ was significant with se=0,022 proving existence of cross-sectional relationship between economic growth and education level of 134 countries as of 2008.

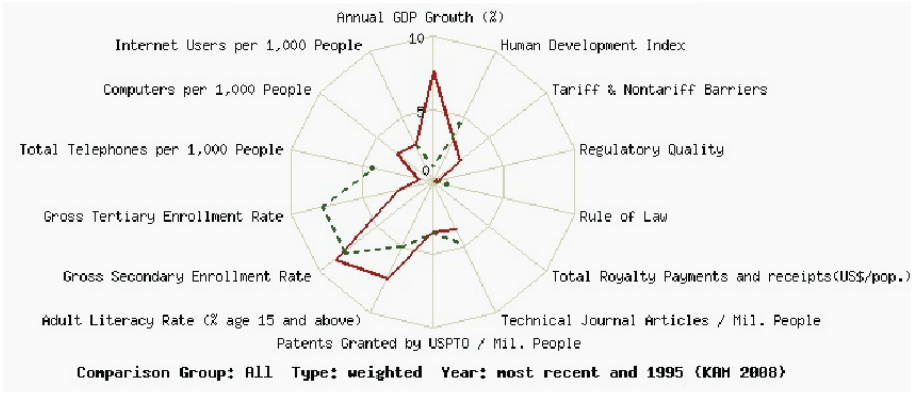
9. Assessing Uzbekistan's Readiness and Competitive Position Within Knowledge-Based Growth Theory

Tools for undertaking the tests are adopted fully or partially from KAM of World Bank and Center for Economic Research of Uzbekistan. Results are purely relative to performance of all countries in transition to knowledge economies. Uzbekistan is compared to one developing country (Kyrgyzstan) and one developed country (The United States of America) on population-weighted-basis in order to eliminate affects of varying population and make precise conclusions.

Checking for Readiness:

Three key variables that best represent each pillar are used to construct the Score Card which demonstrates the readiness of Uzbekistan's transition to knowledge economy.

Diagram 4. Basic Score Card of Uzbekistan



Data used in score card are provided in Appendix II. Decline in value of any normalized variable can be the result of either absolute decrease in the real value or because Uzbekistan has developed at relatively lower speed than average of all countries. Overall economic condition in Uzbekistan has improved: yearly income growth rate has much overlapped that of 1995, nonetheless, Human Development Index progress rate has been sluggish. Adult literacy and gross secondary enrollment rates as well as computer per 1000 person variables have demonstrated absolute advancements. Considerable erosions were observed in total telephones per 1000 and gross tertiary enrollment variables within 1995-2008. Only Economic Incentive index has improved in Uzbekistan from 1995 to KAM 2008. Innovation, Education and ICT pillars have been slower than that of average world levels. Therefore, when normalized their values as of KAM 2008 was lower than those recorded for the year 1995.

10. Evaluation of Knowledge-Economic Competitiveness of Uzbekistan

Uzbekistans KEI illustrate Uzbekistan's overall competitive position in global transition to knowledge-economy. Country's KEI=3,28 has declined by 0,53 points moving from 1995 to 2008 and is at lower level than average KEI=4,1 of Lower Middle Income group where Uzbekistan

belongs to. Although Kyrgyzstan and the United States possessed higher 3,74 and 9,08 KE indices, respectively, as of 2008, both countries in line with Uzbekistan deteriorated their KEI by 0,12 and 0,42 points, in that order comparing to 1995. Europe and Central Asia group – Uzbekistan's geographical location - exposed knowledge economy indices that are 3,07 and 2.25 points larger than those of Uzbekistan in 2008 and 1995, respectively.

The USA dominated almost all variables of four knowledge economy pillars and, therefore, possessed highest Human Development and KE indices. ICT and Education pillars as well as Human Development Index are on, average, same levels in both developing countries. Economic Incentives index consisted of rue of law, regulatory quality and tariff-nontariff barrier variables are noticeably high in Kyrgyzstan 0,79; 2,14 and 6,81 comparing to Uzbekistan 0,36; 0,29 and 2,44 respectively. Leaning on the conclusions and assumptions of Knowledge-Base Growth Model constructed, the foreign trade of Kyrgyzstan is much more liberalized in comparison to that of Uzbekistan. Freely flowing Knowledge from abroad, in terms of imports, has been the reason why Kyrgyzstan is on 89th rank with 3,74 KEI while Uzbekistan is on 95th with 3,28 KEI in Appendix II.

11. Basis Policy Implications for the Republic of Uzbekistan

Constructed Knowledge-Based Growth Model proposed the long run stable income growth and socio-economic well-being of population of Uzbekistan to be in positive relationship with domestic knowledge accumulation or equivalently human capital development. The conclusive theory of the model did in fact comply with fundamental predictions of Endogenous Growth Theory originated by Romer and initiated the extension of endogenous growth model of Chen and Kee to open economy case.

When knowledge indices calculated as of KAM 2008 plotted against per-capita incomes of all countries (under Purchasing Price Parity assumption) in 2008, countries with high knowledge levels tend to have higher per-person incomes. For instance, Denmark (1st rank with KEI=9,8) and Taiwan (17th rank with KEI=8,2) had $37400 and $42000 GDPPCs, respectively (see Appendix II). On the other side, nations with relatively low knowledge stocks were subject to small GDPPC levels e.g. Uzbekistan (95th rank with KEI=3,28) and Tajikistan (107th rank with KEI=2,79) encountered $2200 and $1600 per-person annual expenditures. High knowledge, therefore, was associated with high incomes and higher standards of living.

Both KEI and KI demonstrated positive and statistically significant affects on income-per capita growth rates when tested on empirical cross-country data. One point increase in KEI of Uzbekistan would cause country's per-capita-GDP by 45%, on average. In other words, taking GDPPC of Uzbekistan $2200 at PPP level, if government maintains to increase overall knowledge accumulation level by one-normalized-unit within the framework of KAM (WB), each person in Uzbekistan would have ~$990 more to spend annually. Equal increase in Knowledge Index of Uzbekistan, would expand yearly per-capita-income by 43% or ~$940, stating $ at PPP level. Finally, estimated model indicated that if both KEI and KI diminish to zero for Uzbekistan, per capita income stays at around $800 that is one third of one person spending each year today, on average. Therefore, transition of Uzbek economy towards knowledge-based growth by means of encouraging knowledge accumulation has been set as one of the top tasks of Welfare Improvement Strategy of Uzbekistan until 2015.

Implication of the developed Knowledge-Based Growth Model determined the differentiated impacts of overall knowledge base from that of human capital generation on economic growth of Uzbekistan. Not surprisingly, if available human capital stays unchanged from its current level in Uzbekistan i.e. no-more skilled labor graduate from universities, no-more experience is attained etc. and no-more innovations and discoveries take place, GDPPC will be ~$450 that is, on average, each inhabitant will have 5 times less money to spend yearly, in the long run. Encouraging 1% rise of current KEI=3,28 and KI=4,03 (by 0,033 or 0,04 normalized points, respectively) would rise current GDPPC by $29 (1,31%) and $13 (0,56%) as for Uzbekistan, in line with other countries.

If everything else stays constant and population of Uzbekistan continues to grow at current 1,71% rate annually, each year GDPPC is forecasted to diminish by 1,2% on average. This relationship was significant at 10% level. Ceteris paribus does not happen to be true in reality, however. Because 'two head is better than one', more population creates higher probabilities for both human capital growth and faster knowledge accumulations (perfect example would be China). Testing this intuition extracted expected outcomes: 1% population growth, when regressed together with human capital growth, on average had positive and significant affect on economic growth, GDPPC rose by 0,22%. Keeping in mind, human capital growth is

always a fraction of population growth in Uzbekistan, basing on the CER report (2004)[25], if human capital growth is about 1,4% of workforce within the country, GDP/person is estimated by the constructed model to grow at 1,4*1,98=2,78% annually. Thereof, in order to achieve stable 7% per-capita GDP growth rates in the long run as aimed by, according to constructed Human-Capital Growth Model growth of human capital should be -3%, at 1,75% population growth rate. In fact, Uzbek government has initiated policies to 'train highly qualified workers with abilities to reproduce knowledge... increase number of working-age population with university degrees, primarily in engineering and with a technical education'. Subject areas such as economic, physics, chemistry, medicine, programming, and engineering where innovations mostly emerge should be under greater interest of government's human-capital expansion policies.

Human Capital Growth Model outlaid affects of human capital and domestic population growth rates on GDPPC changes without considering accumulative affects of knowledge that may flow into Uzbekistan from abroad though. Prevailing instinct about inter-country knowledge splits created inducement to utilize Ramsey's RESET test to check whether or not model is subject to mis-specification error of omitting relevant variable. Economic Incentive index was presumed to represent knowledge flows from abroad as it consisted of variables such as trade and gross capital formation as % GDP, tariff-nontariff barriers unlike other pillars. Ramsey's test found the model omitting a relevant variable - EI. Re-assessing the Human Capital Growth Model introducing EI, one percent rise of EI index would expand GDPPC by average 0,26%. The empirical relationship between economic well being and foreign trade, thus, was more significant than that between the former and population growth. The inflow of knowledge from abroad is due to imports. Government of Uzbekistan should, henceforth, continue trade liberalization policies and gradually avoid import-substitution policies by eliminating tariffs and other import barriers. Before investing into innovations and R&D sector, opportunity costs of the capital in terms of availability of thoseinnovations and R&D purposes in international markets must be strongly assessed. In other words, if it is cheaper to import the bicycle than re-inventing it, bicycle should be imported after trading-off long-term social costs and benefits. R&D investments should be undertaken after collecting all possible knowledge-splits

[25] Center for Economic Research of Uzbekistan, *Knowledge Economics and Its Implication on Uzbekistan*, Tashkent: CER Publishing, 2004.

from the world into Uzbekistan. Regressing total knowledge accumulation on domestic knowledge creation and foreign-knowledge inflows extracted that average 77% of new knowledge in 134 countries, is created within the country and mean 18% is due to knowledge coming from abroad. The results were highly significant. In 2008, approximately 75% knowledge was created in Uzbekistan while 25% was adopted from abroad[26]. This is the fact that country has more opportunities and capabilities than world's average to adopt more knowledge from abroad.

By now it is a fact that more and faster knowledge accumulation improves, at least in the long run, welfare of Uzbek nation. In order to rationalize faltering about knowledge-formation within Uzbekistan, affects of each knowledge economics' pillar was estimated. Changes in Economic Incentives, Innovation and Information and Communication Technology indices did have statistically significant (at 1% confidence) and positive affects on per-capita income growth trends from the experiences of 134 countries analyzed. Affect of ICT was the largest among them that 1% improvement in that pillar-index would cause per-capita income to go up by 0,77%, on average, for all countries including Uzbekistan. In the same manner, next largest impact was of Innovation index with 0,76% affect on GDPPC changes followed by Economic Incentives whose mean influential degree was 0,24%. Note that coefficient of EI has been similar around 0,20-0,25% in all regressions making the conclusions of the models consistent with each other. The reason why ICT and Innovations appeared with considerably larger affects in comparison to EI and Education indices is that, once I&C Technology is developed/introduced or any innovation is created/privileged they are immediately added to available knowledge stock or they create direct favorable affects on knowledge-producing sector of economy. On the other hand, the fact that number of people with education increases or amount of imports rises does not necessarily mean that each educated person creates some new knowledge or each imported good brings together all the knowledge used in its production into Uzbekistan. Henceforth, government of Uzbekistan should prioritize the pillars of knowledge economy in following order while preparing long-term transition plans towards knowledge-based economy (recommendations are as of 83 variables in Appendix I):

[26] 25 Author's approximated calculation using simple weighting method: KEI=3,28, Economic Incentives=1,03 with w weight and Knowledge Index=4,03 with 1-w weight, thus, w=0,25 or 25% for Economic Incentives as of 2008 for Uzbekistan.

1. First Priority - ICT. In creation, adoption, improvement and spreading knowledge both inter-countries and intra-Uzbekistan role of information and communication technologies is vital. The development and wide scale use of modern digital information systems in order to create effective mechanisms for generating and disseminating information, knowledge, research and technical process' is the core factor that is to accelerate the speed of Uzbekistan's transition into knowledge based one. Government's specific tasks in utilizing modern ITC should include:

• Encouraging domestic competition among both mobile service providers and main telephone service providers to ensure competitive prices and high quality services (as this variable has very low 1,07 normalized value comparing to the USA).

• Internet usage opportunities should be widened especially within secondary educational system. This variable is one third of USA's as of KAM normalization.

• Electronic Government system should be implemented in order to ensure efficiency within the sphere (Variable is NA within KAM).

• Projects should be initiated to inform domestic businesses about the benefits of ebusiness and usage of internet in both domestic and international markets.

2. Second Priority - Innovations. Establishing both government and private innovation institutions is a must for new knowledge to be created. The former can be used to undertake state-sponsored R&D projects. While private innovations should be encouraged by providing strict copyrights and trade marks. Those institutions must also serve to gather scientists and skilled human capital. Specific tasks should be:

• Exports of (high-tech) manufactured goods should be encouraged by subsidies, so that, domestic producers are encouraged towards international competitions.

• Investing in R&D must be paid special attention by government. Because local companies are afraid of achieving nothing out-of R&D's.

• University-Government and University-Businesses collaboration trends should be granted as universities are 'creators' of human capital released into economy.

3. Third Priority - Economic Incentives. Government's foreign tra-

de liberalization should target reorientation of exports from raw-goods (cotton) and low-priced agricultural products to high value added. Import restrictions on should be gradually removed, before protected industries turns to 'sleeping babies' of the government - they sleep unless disturbed. Specific task recommended:

• Banks operating in Uzbekistan should be freed of government deep intervention (respective normalized variable in KAM is 0,56 - to low than average).

4. Fourth Priority - Education. Regression results showed education index to be statistically insignificant (p-value=0,34) referring, once again, to the fact that having one % more educated people does not mean 1% increase in knowledge level. Education index of Uzbekistan has been highest among the four pillars in 1995 and 2008 (Diagram 4). However, its affect on GDPPC growth rates was the lowest of all. Therefore, following reformations are recommended to Uzbek government within education system:

• Specialization of students should be more favored - policies ought to ensure specialization from early schooling in certain areas of interest so that specialized experts will have more probabilities to create innovations and new knowledge.

• Improve current teaching qualities of universities.

Because employed assessment methodology of knowledge was relative measure, competitiveness of Uzbekistan in its transition to knowledge-based economy was also evaluated relatively. Kyrgyzstan with similar income and geographical opportunities as of Uzbekistan and the United States, one of the most developed countries, were chose to be benchmarks. To eliminate the bias from significant affects of countries' population differences (see above), all knowledge economy indices were weighted relative to populations. Relative readiness of Uzbekistan for full adjustment to knowledge-based growth was checked by score card: overall economic improvements were represented by real GDP growth rate and human development index which outlaid noticeable increase and decrease, respectively, in comparison to 1995. Lower human-development index, however, was because of Uzbekistan's slow speed of advancements within the variable relative to others. More developments can be achieved in overall economic welfare by developing plans that cover all regions of the Republic

as huge differences persist. One option would be to make effective use of existing recourses in each region 'linked with local employment creation' and SME promotions.

Competitive position of the country was mainly drawn back by lethargic improvements of Economic Incentives and Regime variables such as tariff-non tariffs, regulatory quality, rule of law, political stability and SME developments comparing to the USA. These unfavorable factors have strongly distracted domestic and, mostly, foreign knowledge adaptations into Uzbekistan.

Encouraging foreign direct investments, giving tax/subsidy privileges for SME's and ease-upping current account convertibility to help importers should be prioritized government tasks.

Further analysis showed that transitions into knowledge-based economy have been strongly competitive among all countries, income and geographical groups worldwide.To stay in the competition and achieve faster globalization, increasing both private and public savings must be maintained. Government and private investments into both human capital and R&D can be increased through increasing savings rate (Solow's model). Implications of the created model will result in estimated outcomes, if and only if free market hypothesis apply to the knowledge accumulation of reality.

BIBLIOGRAPHY

Adams, D. James. *Fundamental Stocks of Knowledge and Productivity Growth* [online], 1990. *The Journal of Political Economy*, Vol. 98, No: 4 (August 1990), pp. 673-702 Published by: The University of Chicago Press Available from: http://www.jstor.org/stable/2937764 Accessed: October 25, 2008.

Center for Economic Research of Uzbekistan. *Knowledge Economics and Its Implication on Uzbekistan*. Tashkent: CER Publishing, 2004.

Chen, Derek H.C. and L. H. Kee. *A Model on Knowledge and Endogenous Growth* [online], 2005. Available from: http://www.worldbank.org/publications Last Accessed: March 27, 2009

Cortrigt, John. *New Growth Theory, Technology and Learning: A practitioner's Guide*. USA: Inpresa Co., 2001.

Desai, Preyas. *Strategic Decentralization and Channel Coordination, Quantative*

Marketing and Economics, 2(1) 55-22, 2004.

Eshonov, Bakhodur. *Knowledge Economy* [online] 2008. Available from: http://www.un.uz/download.php?type=file&parent=2265&doc=9835 Last Accessed: January 12, 2009

Freudenburg, Michael. *Composite Indicators of Country Performanse: A Critical Assessment,* OECD Science, Technology and Industry Working Papers, 2003.

Gertner, M. *Macroeconomics,* 2ed. Edenburg: Prentice Hall, 2006.

Jones, A. *Macroeconomic Analysis: Endogenous Growth: Romer Model* [online], 2002. Available from: www.hull.ac.uk/php/ecskrb/M_ANALYSES/Romer-model-6.ppt Last Accessed: October 25, 2008.

Kamilov, Ildus. *Cer, WIS process in Uzbekistan: building framework for partnership and cooperation* [online], 2008. Available from: http://www.google.com/search?client=opera&rls=en&q=W.I.S+of+Uzbekistan&sourceid=opera&ie=utf-8&oe=utf-8 Last Accessed: January 12, 2009

Kgomotso, H, MOAHI. *Globalozation, Knowledge Economy and imlecation for Inigenouse Knowledge* [online], 2006. Available from:http\\www.i-r-i-e\inhalt\007\06-moahi:pdf

Mankew, Gregory. *Macroeconomics*. The United States: New York, 2003.

New Ec.Index Org. *The Knowledge Economy: Knowledge Producers and Knowledge Users* [online], 2007. Available from: http://www.neweconomyindex.org/knowledge.html Last Accessed: January 6, 2009.

Polaniy, M. *The Tacit Dimension*. New York: Doubleday co., 1967.

Romer, M. Paul. *Endogenous Technological Change* [online], 1990. *The Journal of Political Economy*, Vol. 98, No. 5, Part 2: The Problem of Development: A Conference of the Institute for the Study of Free Enterprise Systems (Oct., 1990), pp. S71-S102 Published by: The University of Chicago Press Available from: http://www.jstor.org/stable/2937632 Accessed: October 26, 2008.

Romer, M. Paul. *Ideas and Thins: the Concept of Production is Being Retooled* [online], 1993. The Economist. (September 11, 1993) F70(3) Available from: www.theeconomist.com/search&romer%growththeory1993archive. Accessed: October 24, 2008.

Saisana. *Composite Indicators-The Controversy and the way Forward,* European

Comission, Joint Research Centre of Ispra, 2005.

Shodiyev, Tursun. *Bilimlar İqtisodiyotining Nazariy Asoslari, Tamoyillari va O'zbekistonda Shakllanishi*, Tashkent: WIUT (WIUT Conference: May 21, 2008).

Statistics Org. *Knowledge Economy Index Indicators* [online], 2008. Available from: http://kei.publicstatistics.net/KEI%20D5_1.pdf Last Accessed: January 6, 2009

Tsutomu, Sh. *Japan, Moving toward a More Advanced Knowledge Economy - Lessons for developing countries-*. Vietnam: World Bank publishing, 2007. Available from: http://www.ficci.com/media-room/speeches-presentations/2004/oct/gfbi/session1/oct15-gfbi-saurabh.ppt Accessed: October 25, 2008

UN. *Round Table report on Knowledge-Based Economy,* 2005.

Wikipedia Org. *Knowledge Economics* [online], 2008. Available from: www.wikipedia.org/economics/knowledge-basedeconomics/ Accessed: October 25, 2008.

World Bank. *Building Knowledge Economics* [online], Available from: http://siteresources.worldbank.org/KFDLP/Resources/461197119907090464/BuildingKEbook.pdf Accessed: October 26, 2008.

World Bank. *Key Variables Used to Calculate Knowledge Economy İndex* [online], 2008. Available from: http://web.worldbank.org/WBSITE/EXTERNAL/WBI/WBIPROGRAMS/KFDLP/EXTUNIKAM/0,,contentMDK:20588132~menuPK:1453369~pagePK:64168445~piPK:64168309~theSitePK:1414721,00.html Last Accessed: January 12, 2009.

World Bank. *Knowledge Assessment Methodology and Knowledge Economy Index Knowledge for Development Program* [online], 2008. Available from: http://siteresources.worldbank.org/INTUNIKAM/Resources/KAM_v4.pdf Last Accessed: January 15, 2009.

World Bank. *Knowledge Economy Index (KEI) 2008* [online], 2008. Available from: http://siteresources.worldbank.org/INTUNIKAM/Resources/KEI-2008Highlights_final12052008.pdf Last Accessed: January 17, 2009.

World Bank. *Towards a Knowledge Economy in Central Asia* [online], 2008. Available from: http://www.wiut.uz/wp/wpcontent/uploads/2008/05/Knowledge%20Eco%20conference%20(May%2015,%202008)%20_%20Eng.pdf Last Accessed: January 12, 2009.

APPENDIX I

Country Cross Sectional Normalized Values of KEI, KI and Four Pillars of Knowledge Economy as of 2008 KAM

Country	GDP Per Capita (PPP USD)	KEI	KI	Econ, Incentive	Innovation	Education	ICT	Population Growh
Denmark	37.400	9,58	9,55	9,66	9,57	9,8	9,28	0,3
Sweden	36.900	9,52	9,63	9,18	9,79	9,4	9,69	0,16
Finland	35.500	9,37	9,33	9,47	9,66	9,78	8,56	0,11
Netherlands	38.600	9,32	9,36	9,18	9,48	9,26	9,36	0,75
Norway	55.600	9,27	9,27	9,25	9,06	9,6	9,16	0,35
Canada	38.200	9,21	9,14	9,42	9,43	9,26	8,74	0,83
Switzerland	39.800	9,15	9,03	9,5	9,89	7,69	9,52	0,33
United Kingdom	35.300	9,09	9,03	9,28	9,18	8,54	9,38	0,28
United States	46.000	9,08	9,05	9,16	9,45	8,77	8,93	0,88
Australia	37.500	9,05	9,17	8,66	8,72	9,64	9,16	0,8
Ireland	45.600	8,92	8,82	9,23	9,04	9,08	8,33	1,13
Austria	39.000	8,89	8,76	9,3	8,9	8,53	8,85	0,06
Iceland	22.700	8,88	8,87	8,92	7,98	9,44	9,18	0,78
Germany	34.400	8,87	8,83	8,99	9	8,46	9,04	0,04
New Zealand	27.300	8,87	9	8,48	8,65	9,79	8,56	0,97
Belgium	36.500	8,73	8,7	8,82	8,96	9,14	8,02	0,11
Taiwan, China	29.800	8,69	8,8	8,35	9,24	7,91	9,26	0,24
Luxembourg	32.800	8,65	8,4	9,42	8,91	6,66	9,62	1,19
Japan	33.800	8,56	8,84	7,71	9,15	8,71	8,66	0,14
France	33.800	8,47	8,69	7,82	8,61	9,08	8,38	0,57
Estonia	21.800	8,34	8,22	8,68	7,49	8,27	8,9	0,63
Slovenia	27.300	8,25	8,29	8,11	8,31	8,24	8,33	0,09
Spain	33.700	8,24	8,13	8,58	8,14	8,21	8,04	0,1
Singapore	48.900	8,24	7,75	9,71	9,56	5,19	8,5	1,14
Israel	28.800	8,22	8,24	8,16	9,34	6,72	8,03	1,71
Hong Kong, China	42.000	8,2	7,73	9,6	8,64	5,3	9,26	0,53
Italy	31.000	7,86	8,19	6,84	8,04	7,86	8,68	0,02
Hungary	19.500	7,85	7,67	8,39	8,14	7,62	7,25	0,25
Czech Republic	24.400	7,83	7,7	8,23	7,6	8,11	7,39	0,08

Lithuania	16.700	7,68	7,6	7,94	6,59	8,36	7,84	0,28
Korea, Rep,	24.600	7,68	8,38	5,57	8,47	7,97	8,71	0,37
Latvia	17.700	7,64	7,51	8,04	6,4	8,41	7,73	0,63
Cyprus	17.500	7,55	7,47	7,77	7,65	6,45	8,32	0,36
Portugal	21.800	7,52	7,22	8,44	7,43	6,83	7,39	0,31
Greece	30.500	7,38	7,48	7,08	7,63	8,2	6,62	0,15
Poland	16.200	7,38	7,37	7,39	6,92	7,94	7,25	0,05
Slovak Republic	19.800	7,33	7,12	7,99	6,86	6,98	7,51	0,14
Barbados	19.700	7,25	7,78	5,66	7,51	8,4	7,44	0,36
Croatia	15.500	7,19	7,19	7,16	7,54	6,44	7,61	0,04
Chile	14.400	6,92	6,53	8,11	6,81	6,31	6,46	0,91
Bulgaria	11.800	6,8	6,73	7,01	6,43	7,42	6,33	0,81
United Arab Emirates	55.200	6,66	6,57	6,95	6,74	4,78	8,18	3,83
Romania	11.100	6,37	6,2	6,87	5,66	6,3	6,63	0,14
Uruguay	10.700	6,35	6,31	6,49	5,26	7,18	6,48	0,49
Qatar	22.900	6,15	6,2	5,99	5,77	5,29	7,56	2,28
Dominica	3.800	6,07	5,61	7,46	3,76	6,24	6,82	0,2
Costa Rica	13.500	6,06	5,85	6,7	6,24	5,01	6,3	1,39
Malaysia	14.400	6,06	6,02	6,18	6,83	4,14	7,08	1,74
Bahrain	34.700	6,02	5,75	6,84	4,2	5,82	7,22	1,34
Kuwait	55.300	6,01	5,68	7,01	5,05	4,87	7,13	3,59
Ukraine	6.900	5,8	6,38	4,06	5,77	7,91	5,45	0,65
Trinidad and Tobago	21.700	5,64	5,54	7,02	5,67	4,38	5,38	1,01
Turkey	9.400	5,61	5,14	4,3	6,07	5,84	6,08	0,98
Brazil	9.700	5,57	6	5,81	6,92	4,51	4,98	0,5
South Africa	10.600	5,55	5,47	5,77	5,66	5,49	5,21	2,34
Jordan	4.700	5,53	5,46	5,71	6,17	6,32	3,84	0,08
Armenia	5.700	5,51	5,44	2,63	6,85	6,49	5,98	0,92
Argentina	13.000	5,49	6,44	5,38	5,82	4,85	5,77	1,14
Mexico	12.500	5,45	5,48	5,51	5,98	5,27	5	0,64
Thailand	8.000	5,44	5,41	1,55	6,89	7,09	6,08	0,47
Russian Federation	14.600	5,4	6,69	5,61	4,76	4,87	6,06	0,26
Oman	19.100	5,37	4,72	6,95	3,7	4,09	5,96	0,8
Macedonia, FYR	8.400	5,33	5,23	5,39	4,04	4,87	6,29	1,95
Mauritius	11.900	5,18	4,58	3,99	5,36	4,1	6,74	0,78

Saudi Arabia	20.700	5,15	5,07	4,19	4,39	6,4	5,17	0,09
Jamaica	4.800	5,04	5,4	4,82	3,77	7,21	4,25	0,37
Moldova	2.200	5,04	5,32	0,55	5,54	8	5,63	0,39
Kazakhstan	10.400	5,01	5,08	4,7	4,69	4,76	5,27	1,15
Belarus	10.200	4,93	6,39	5,26	4,58	4,1	5	0,99
Lebanon	10.400	4,86	4,91	5,39	5,45	4,86	3,04	1,53
Tunisia	7.500	4,73	4,56	3,54	5,38	5,97	3,85	0,33
Panama	9.000	4,69	4,45	3,98	3,88	5,57	5,12	1,26
Georgia	4.200	4,69	5,07	5,18	2,06	6,31	4,46	1,49
Peru	7.600	4,64	4,86	3,83	4,26	4,79	4,8	1,41
Mongolia	2.900	4,5	4,28	4,01	5,12	4,11	4,16	0,63
Colombia	7.200	4,42	4,62	2,33	4,47	5,8	4,64	0,21
China	5.300	4,35	4,46	4,95	3,63	4,76	3,66	1,73
Guyana	5.300	4,31	4,97	0,51	5,73	5,27	5,41	1,5
Philippines	3.300	4,25	4,02	7,14	3,3	2,57	3,74	0,95
Venezuela, RB	12.800	4,23	5,47	4,44	4,44	4,91	2,85	0,94
Namibia	5.200	4,19	3,2	3,91	3,1	4,94	4,2	0,54
Sri Lanka	4.100	4,16	4,07	3,57	4,55	4,35	3,66	1,68
Albania	5.500	4,04	4,08	5,34	4,34	2,58	3,59	1,43
Egypt, Arab Rep,	5.400	4,03	4,19	4,24	2,91	4,11	4,42	1,5
Botswana	14.700	3,96	3,5	4,7	3,19	3,26	4,5	1,68
Dominican Rep.	5.800	3,92	3,81	3,25	2,7	6,25	2,75	1,38
El Salvador	5.200	3,91	3,65	2,87	3,47	4,2	3,93	2,39
Azerbaijan	9.000	3,81	3,93	1,58	3,55	3,77	4,93	0,94
Kyrgyz Rep,	2.000	3,74	3,9	3,8	3,67	2	4,32	1,51
Paraguay	4.000	3,62	3,87	2,78	3,05	4,76	3,09	1,38
Ecuador	7.100	3,46	4,08	1,18	3,02	3,89	5,48	0,79
Morocco	3.800	3,45	3,33	1,03	3,51	6,17	2,4	1,75
Bolivia	4.400	3,42	3,63	2,53	3,48	3,64	3,37	1,21
Iran Islamic Rep,	12.300	3,39	4,13	3,36	3,32	3,42	2,82	1,18
Uzbekistan	2.200	3,28	4,03	3,3	3,3	3,17	3,06	2,02
Algeria	8.100	3,25	3,5	3,67	3,97	2,26	2,59	1,58
Cape Verde	7.000	3,24	3,05	3,81	2,25	2,96	3,96	0,6
Indonesia	3.400	3,23	3,19	3,36	3,32	3,42	3,82	1,18
Honduras	3.300	3,21	3,18	3,3	3,3	3,17	3,06	2,02
India	2.700	3,12	2,94	3,67	3,97	2,26	2,59	1,58
Guatemala	5.400	3,11	2,88	3,78	2,47	2,21	3,97	2,11

Vietnam	2.600	3,02	3,08	2,85	2,83	3,32	3,08	0,99
Swaziland	4.800	2,93	3,05	2,56	4,55	1,73	2,88	0,41
Syria	4.300	2,9	3,34	1,55	3,44	2,91	3,68	0,5
Nicaragua	3.200	2,87	2,64	3,57	1,99	2,93	3,02	1,83
Kenya	1.600	2,82	2,65	3,31	3,87	1,49	2,6	2,76
Tajikistan	1.600	2,79	2,93	2,37	2,33	5,34	1,1	1,89
Senegal	1.700	2,63	2,15	4,07	2,77	0,92	2,75	2,58
Zimbabwe	500	2,51	3,25	0,29	4,09	2,38	3,29	0,57
Ghana	1.400	2,5	2	3,97	2,08	1,8	2,13	1,93
Uganda	1.100	2,46	1,93	4,04	2,72	1,16	1,92	3,6
Madagascar	1.000	2,37	1,51	4,93	2,54	0,76	1,25	3,01
Mauritania	1.800	2,35	1,83	3,89	1,75	0,94	2,8	2,85
Tanzania	1.100	2,28	1,72	3,98	2,39	1,05	1,7	2,07
Pakistan	2.600	2,24	2,18	2,43	2,75	1,07	2,72	1,81
Lesotho	1.500	2,15	1,99	2,65	2,7	1,73	1,53	0,13
Benin	1.500	2,1	1,8	3	2,33	1,14	1,93	2,62
Nigeria	2.200	2,04	2,33	1,16	2,72	1,87	2,41	2,38
Yemen	2.400	1,8	1,83	1,72	1,68	1,83	1,99	3,46
Mali	1.200	1,78	1,18	3,58	1,69	0,66	1,19	2,73
Mozambique	900	1,71	1,2	3,24	1,86	0,33	1,41	1,79
Angola	6.500	1,7	1,67	1,76	2,44	0,88	1,7	2,14
Cameroon	2.300	1,69	1,85	1,2	2,49	1,36	1,7	2,22
Burkina Faso	1.200	1,64	1,11	3,24	2,15	0,26	0,93	3,11
Nepal	1.100	1,61	1,46	2,06	2,04	1,5	0,84	2,1
Malawi	800	1,55	1,17	2,71	2,11	0,87	0,53	2,39
Lao PDR	1.900	1,53	1,68	1,08	1,43	2,01	1,59	2,34
Bangladesh	1.400	1,49	1,63	1,1	1,71	1,52	1,66	2,02
Myanmar	1.200	1,48	1,52	1,35	1,17	2,58	0,82	1,7
Rwanda	1.000	1,34	0,85	2,8	1,47	0,35	0,74	2,78
Ethiopia	700	1,18	0,93	1,95	1,57	0,73	0,48	2,23
Djibouti	1.000	1,15	1,14	1,19	1,29	0,49	1,63	1,95
Eritrea	1.000	1,07	1,2	0,68	1,56	0,81	1,22	2,45
Sierra Leone	800	0,91	0,92	0,87	1,7	0,67	0,39	2,28

APPENDIX II

	KAM 2008		1995	
SROCE CARD Data of Uzbekistan	(Group: All)		(Group: All)	
Variables	actual	normalized	actual	normalized
Annual GDP Growth (%), 2002-2006	6,04	7,63	-0,3	1,15
Human Development Index, 2005	0,7	3,26	0,71	4,43
Tariff & Nontariff Barriers, 2008	68,4	2,44	n/a	n/a
Regulatory Quality, 2006	-1,66	0,29	-1,78	0,21
Rule of Law, 2006	-1,44	0,36	-0,99	1,07
Total Royalty Payments and receipts(US$/pop.) 2006	n/a	n/a	n/a	n/a
Scientific and Technical Journal Articles / Mil. People, 2005	6	3,6	12,95	4,75
Patents Granted by USPTO / Mil. People, avg 2002-2006	0,03	3,43	0,03	3,57
Adult Literacy Rate (% age 15 and above), 2007	99,3	7,34	86,4	4,89
Gross Secondary Enrollment Rate, 2006	102,41	8,68	94,47	7,84
Gross Tertiary Enrollment Rate, 2006	9,8	2,48	35,79	7,83
Total Telephones per 1,000 People, 2006	100	1,07	68	4,29
Computers per 1,000 People, 2005	30	3,19	n/a	n/a
Internet Users per 1000 People, 2006	60	2,93	0	2,86