Interaction Effects in Economic Growth and Development:

An Interdisciplinary Analysis

by

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Economic Growth and Development in Central and Eastern European
Countries:
An Interdisciplinary Analysis
Thesis Directed Martin Taschdjian

Abstract

Telecom, financial services, education, health and market liberalization have been

correlated with economic development. The stochastic complexities of the factors that

determine economic growth leave causality as a contentious point. Often a given

variable is necessary but not sufficient for growth. Building on economic growth

models and using a multivariate cross-country time series empirical analysis on

Central and Eastern European countries, this paper tests the interaction effect of

variables on economic growth. The results show the importance of developing

policies bilaterally.

DEDICATION

For Zofia

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For their time and effort in assisting with this thesis, I owe gratitude to Dr. Scott Savage, Dale Hatfield and my supervisor, Dr. Martin Taschdjian.

For the years of love and support, a special thanks to my mom and dad.

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Chapter 1. - Introduction

1.1 Introduction

Telecom, financial services, education, health and market liberalization are threads that make up a country's welfare and economic fabric. Often when the question of what is the best predictor of economic growth is asked, the answer varies from person to person. Research on economic growth or economic development typically studies the effect that a single variable or multiple variables has on an economy. There has been very little reasearch on the effect of variable interactions. The multitude of possible variables and combinations allows for a wide spectrum of explanations. Therefore each variable must be seen as a piece in a larger collection. Testing the contribution of each variable as well as combinations of variables, provides a better understanding of economic growth and development. This thesis reviews the factors generally accepted to effect economies and tests various combinations using panel data from Central and Eastern European countries. Research from cross-sectional, time-series and panel studies are used to inspire additional dimensions of understanding of policy with regards to economic growth and development. This paper does not intend to supersede previous research but rather expand on it.

1.2 Scope

The Central and Eastern European region is one the best areas to study for several reasons. Due to the area's recent economic and political changes, such as the fall of the Berlin Wall and Soviet power, many Central and Eastern European Countries (CEECs) have relatively new economies. The previous economies had been

weakened and/or artificially inflated during Soviet control. When the initial fifteen nations formed and the neighboring countries broke from a socialist form of government, each country was tasked with developing its government and economic structure. This transition period is unique in the scale of change and the availability of data. From the World Bank, International Monetary Fund, United Nations, International Telecommunication Union and the reporting countries, data are available for nearly every time period and country. Analysis begins at the start of this area's independence, 1992, and concludes in 2006. The economic indicators used in this thesis are health, education, telecom/ICT, finance and policy. These variables were chosen based on the large amount of previous economic growth research on the contribution of each of these variables to economic development.[1] Due to the steadily increasing development and transition in this region, new studies can find different results. Earlier studies on the newly formed region had adequate data for a cross sectional approach but the length of time was limited. Before 2000 many countries were in the early stages of development and trends had not been established. Studies before 2004 did not include the recent political changes and restructuring. For instance, since 2004 eight countries have acceded into the European Union, including Bulgaria and Romania, which joined in 2007. Exogenous and un-controllable between-country differences such as climate change or disease epidemics are limited due to the geographic proximities. Other between country differences such as natural resources or war are controlled for with dummy variables. While this thesis does not

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[1] Robert J. Barro's *Determinant of Economic Growth*(1998) included a survey on research on economic growth and noted several studies on health and education among others. To address economic development, research on topics from the U.N's Millenium Development Goals were included as well.

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include the importance of spacial relationships, studies have shown that a country's surroundings are influential in the success of the development.[2] So while the CEEC's are not necessarily homogenous, their geographic proximity and recent economic restructuring provide a similar platform for comparison. This cross-section of similar countries and fourteen year time series provides the dataset necessary to test combinations of factors and determine if certain approaches have resulted in greater development.

1.3 Purpose

The purpose of this thesis is three-fold. The first objective is to provide background on econometric research and show why research on econometric growth and development is important. The second objective is to present a foundation for why it is important to look at the interaction effect of variables. The hypothesis of this paper is to determine if the interaction of variables significantly effects economic growth in the countries of Central and Eastern Europe. By analyzing many variables shown to contribute to economic growth and combining a variety of pairs testing for economic significant, the hypothesis will strive for parsimony. The ultimate intention is for policy makers and stakeholders in developing economies to be able to use this approach in improving social and economic wellbeing.

1.4 Organization

This paper will be segmented into three parts.

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[2] Kobonbaev, Maks. "Spatial Distribution and Analysis of Economic Development and Its Primary Determinants" Paper presented at the annual meeting of the American Political Science Association, Hilton Chicago and the Palmer House Hilton, Chicago, IL, Sep 02, 2004 . This study found developing countries with corruption and weak institutions were clustered together as measured geographically from the three major financial centers, NYC, London and Tokyo.

1. The first section will consist of chapters one and two. The first chapter introduces the purpose and organization of this thesis. The second chapter provides background on economic growth and development.

2. The study of econometrics receives attention from a variety of fields that assert significant roles in growth and development. The second section consists of chapters three, four and five. Chapter three reviews studies on economic growth and development. Chapter four provides an explanation for the data collected. Combining the ideas from the previous chapters, chapter five provides a foundation for the descriptive equations and tests interaction effects.

3. The final section consists of chapter six and seven and presents the results and conclusions. Chapter six presents the results from the testing in chapter five and offers explanations. Chapter seven concludes with guidance for policy decisions and future research ideas.

Chapter 2. - Background

2.1 Introduction

The word economics is derived from the Ancient Greek word, oikonomia, "management of a household, administration."[3] At the beginning of the fourteenth century civilizations around the world were analyzing the management of goods and services. What started as attempts to understand trade and production evolved into a social science orientated to help mankind. Although Adam Smith was not the first economist, he was one of the first to record ideas on economics. In "Wealth of Nations"[4] he set forth the foundation for what is now known as classical economics. Smith's "invisible-hand" analogy, focused on the importance of self-interest in producing income in order to achieve greater social benefits overall, this theory has had many proponents and opponents including Karl Marx, Robert Malthus, John Maynard Keynes, Milton Friedman and Joseph Schumpeter. While each of these men had various economic theories, they all believed in a form of policy, even if it was a policy of little intervention. In modern times policy makers at all levels are determining what sources of growth require attention. One tool for such decisions comes from econometrics which uses mathematical and statistical models to test economic theories.

2.2 Econometrics

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[3] From oikos "house" (cognate with L. vicus "district," vicinus "near;" O.E. wic "dwelling, village;") + nomos "managing," Harper, Douglas (November 2001).
[4] Smith, A. "Wealth of Nations," edited by C. J. Bullock. Vol. X. The Harvard Classics. New York: P.F. Collier & Son, (1909–14)

One of the most often used models is the neo-classical growth model, also known as the Solow-Swan growth model or Solow growth model.[5] The neoclassical model explains the output of production using land, labor and capital as inputs. The model assumes diminishing returns to capital and that rates of saving and population growth are exogenous. The steady state of growth of income per capita across countries is thus attributed to technological change, saving rates and population growth. Therefore when production begins, a finite amount of land is used and the current labor force will be limited by population growth. Hypothetically, each time a unit is produced and the saving rates are equal to 100 percent more capital will be available to produce another unit assuming a one to one ratio of investment to production. Growth will continue until the supply of arable land is no longer available as Malthus[6] predicted. However, there have been countries that have experienced centuries of growth despite a scarcity of land. Therefore technology is attributed to having a significant role in development. To better understand technology's effect, endogenous growth models, also known as new growth models include technology as an endogenous variable.[7] The new growth model attempts to explain the long run growth rate of an economy. The growth comes from technology, saving rates and population growth. Population growth increases the labor variable and improves output, but eventually income per capita growth would cease in the long run due to

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[5] Trevor Swan discovered the model but Robert Solow was the first to publish. Swan's contributions are overshadowed since most of his contribution was verbal and rarely published. Solow received the Nobel Prize for Economics and is the one given credit for the model. For more explanation see (Dimand, Robert W. and Spencer, Barbara J.,2008)

[6] Malthus, Thomas R. An Essay on the Principle of Population J. Johnson, London (1798)

[7] Romer, Paul M. "Endogenous Technological Change" 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. pp. S71-S102 The University of Chicago Press (Oct., 1990), :

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land still being a limiting factor. Technology on the other hand, can be used to utilize land in new ways and increase the productitvity of that variable. Technology can also improve labor productivity without the need for population growth and increase per capita growth that way. These two factors explain how growth can continue at a steady state for centuries. Regardless of the which model is being used, the idea of econometrics is that by using empirical tests, economic theories of growth can be subjected to a moderate level of scientific scrutiny. Yet, there is caution against substantiating a claim with statistical significance alone since results may not necessarily be economically significant, therefore a distinction should be made.[8] While there are shortcomings of econometrics due to the non-experimental nature of the data, the lessons learned from testing formulations and gathering data benefit policy makers.[9]

2.3 Economics of Developing Countries

In a global economy, comparative advantages[10] can be realized anywhere in the world. Thirty years ago India's gross domestic product was largely reliant on agriculture, but in the last two decades the service industry has risen to be the largest value adding sector for the country.[11] Typically economies evolve from emphasis on

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[8] Ziliak, Stephen T. and Deirde N. McCloskey. "Size Matters: The Standard Error of Regressions in the American Economic Review" (August 2004). Did two surveys in 1996 and 2004 on papers submitted to the American Economic Review and found too many papers were falsely using statistical results to explain economic theories.

[9] Pesaran, M. Hashem, "Econometrics", in Eatwell, John; Milgate, Murray; Newman, Peter, The New Palgrave: Econometrics (W. W. Norton and Company New York). P.25-26

[10] Gains of trade can be realized when countries specialize in producing goods (or services) and trade with countries where producing the goods and services is more expensive. In the beginning of the 21st century the cost to produce and transport IT services from India was less than the cost for the US to produce the service in the US. This produced a comparative advantage and it is better for the US to use India for the services. Ricardo used Portugal and England's wine and clothing production costs to illustrate this concept in his book *On the Principles of Political Economy and Taxation* (1821).

[11] World Bank Group.

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agriculture to industry and eventually to services. Jumping from agriculture to service and bypassing a reliance on industrialization is characteristic of the New Economy or Knowledge Based Economy.[12] This transition has led to India becoming one of the fastest growing economies.[13] Reasons for this acceleration have been attributed to technology transfers, a growing working age population, widespread democracy, competitive markets and improved health, education and foreign and domestic investments. Due to the large number of influential factors it is difficult to determine the best individual factor let alone what combination of factors effect economic growth. Even if a single factor was proven to cause India's growth, due to geographical differences there is danger in assuming that what worked for India will work for other developing countries. Similarly, looking at developed countries within the Central and Eastern European region can provide insight into factors for growth, but technological, political, educational, financial, health and temporal differences can cause certain factors to have various effects on developing countries. Countries with high initial output tend to have high target output levels assuming policies and economic behaviors remain the same or improve, which they normally do.14 Countries with lower initial output and higher target output will have higher growth rates assuming their policies improve. Equation 2.1 illustrates this point with a simple formula.

Equation 2.1 Barro Growth Function

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[12] Drucker, P. "The Age of Discontinuity; Guidelines to Our Changing Society." Harper and Row, New York. (1969).

[13] The economy has posted an average growth rate of more than 7% in the decade since 1997. Central Intelligence Agency "The World Fact Book" (December 2008)

[14] Barro, R. Education and Economic Growth. Paris: Organization for Economic Co-operation and Development (OECD).(2000)

$$Dy= f(y, y^*)$$

Dy = Growth (defined as the Change in Output from ne period to the next)
Y = Initial Output
y* = Target Output

Since countries are not intrinsically the same, differences in factors such as education, rule of law, life savings rate make convergence conditional.[15] The Solow model and new growth model have been extended to include technology as well as factors that influence population growth,

2.4 Extending the Solow Model

In the Solow growth model land, labor and the rates of saving are endogenous while population growth and technical change are exogenous. Further extension to this model will be made with regards to technology growth, but for now the capital variable will be explained. The Cobb-Douglas production function with inputs of capital, labor, technology, and output of productivity at time t is written as:

Equation 2.2 Cobb Douglas Production Function

$$Y_t = A_t K_t^{\alpha} L^{1-\alpha}$$

Previously regarded as physical goods, capital was broadened to include such factors as education, on the job experience and health. In 1992 George Mankiw, David Romer and David Weil, henceforth MWR, augmented the Solow model to include

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[15] Barro, Robert J. Determinants of Economic Growth: A Cross-Country Empirical Study Cambridge, MA: MIT Press.(1997)

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human capital.[16] The MWR model was developed to better explain the high capital coefficient in the Solow model. The factor inputs are productivity (A), land (L), and capital (K), and the aggregate output in period (t), is Yt., where the exponents are 0<α < 1. Because empirical estimates of the capital exponent (alpha, α) were high, further investigation into what can be included as capital was made by MRW and included human capital in the above production equation:

Equation 2.3 Extended MRW aggregate Cobb-Douglas production function

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} L^{1-\alpha-\beta}$$

Now with the inclusion of human capital(H), the factor inputs are productivity(A), land(L), and capital(K), and the aggregate output in period t, is Yt, where (α + β) < 1. The above equations are used for cross sectional analysis.

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[16] Mankiw, N. Gregory, David Romer, and David N. Weil. "A Contribution to the Empirics of Economic Growth," Quarterly Journal of Economics, 107, 2 (May 1992)

Section 2

Chapter 3. - Previous Research

3.1 Introduction

Before presenting the interactions, this section provides background on why certain variables were chosen. Previous research inspired the selection of variables and the variation of results suggested that many times a given variable may be necessary but not sufficient. After determining which variables are commonly found to affect economic growth this thesis sought to test different combinations of variables. To determine how those interactions would manifest specifically in the CEEC's, economic studies on the CEE region were also examined.

3.2 Central and Eastern European Countries

For finances to move freely through a society, proper policies must be in place. After the breakup of the Soviet Union the CEECs had to transition from centralized markets with little horizontal, domestic or foreign competition to not only free markets but also a global economy. Grzegorz Kołodko argued that CEEC's should first overcome their "old problems," i.e. finish the reforms of the current socialist economies' inefficiencies and then take steps towards the knowledge-based economy.[17] Others cautioned against delaying policies for transition, since that could widen the gap between the developing and developed countries. Krzysztof Peich argued that policies should address the old problems while attempting to meet the

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[17] Kołodko, G., 'The 'New Economy' and Old Problems. Prospects for Fast Growth in Post socialist Countries', "TIGER Working Paper Series", No.9, Warsaw, (June 2001)

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goals for a knowledge-based economy.[18] Assuming Solow's convergence will take place, it is reasonable to follow Peich's advice and move towards the policies of the developed economies. However, as shown by MWR, Solow's convergence is conditional, therefore policy to address the old economy needs to be made as well.

3.3 Financial Liberalization

Studies by Raymond Goldsmith[19] and Ronald McKinnon[20] showed a causal relationship between financial liberalization and economic development. However, several economists argue that financial development follows economic development[21] and that finance's relationship with economic development is "over-stressed."[22]Joseph Schumpeterwas one of the first to develop theories on the effects of financial services on entrepreneurship and technological innovation. Schumpeter's "creative destruction" is the natural tendency for an innovation to arise when the old ways can be improved. His argument is that financial services are necessary for those innovations to be realized. "The banker ... authorizes people, in the name of society as it were, to ... innovate." (p. 74)   The Grameen Phone story supports Schumpeter's case for financial service for entrepreneurship and show how both can lead to improved economic growth.[23] Henrik Hansen and John Rand analyzed Granger

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[18] Piech, K. The Knowledge-Based Economy in Transition Countries. School of Slavonic and East European Studies University College London. (2004)

[19] Goldsmith, Raymond W., Financial Structure and Development New Haven, CT: Yale University Press, (1969).

[20] McKinnon, Ronald I., Money and Capital in Economic Development Washington, DC: Brookings Institution, (1973).

[21] Robinson, Joan, "The Generalization of the General Theory," in The Rate of Interest and Other Essays London: Macmillan, (1952).

[22] Lucas, Robert E., Jr., "On the Mechanics of Economic Development," Journal of Monetary Economics, XXII (1988), 3-42.

[23] See Appendix A for description of the Grameen Phone story and how technology and financial services helped developing countries.

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causal relationships between FDI and the economy in a cross-country, time series analysis of 30 developing countries.[24] They used a bi-variate vector autoregressive (VAR) model:

Equation 3.1 Hansen and Rand VAR Model[25]

$$x_{it} = \beta_{1i}x_{it-1} + \beta_{2i}x_{it-2} + \beta_{3i}x_{it-3} + \mu_i + \delta_i t + \lambda_t + \epsilon_{it}$$

The results from Hansen and Rand were similar to King and Levine, showing that investment, whether domestic or foreign, has significant long run effects on economic growth. Hansen and Rand attributed these effects to faster knowledge transfer and adoption of new technology.[26]

3.4 Foreign Direct Investment and Liberalization

Both domestic and foreign financial investment is influenced by financial liberalization. David Tswamuno, Scott Pardee and Phanindra V. Wunnava studied liberalization's effect on growth.[27] In their study, South Africa's economy reacted to an increase of capital flows resulting from liberalization, but did not show an

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[24] Hansen, H. and Rand, J. "On the Causal Links between FDI and Growth in Developing Countries". Working Paper Institute of Economics, University of Copenhagen; Development Economics Research Group (DERG), December. 2004

[25] Ibid

[26] de Mello (1997) had found similar results looking at how FDI improved total factor productivity, a variable that has direct effect on the labor variable in the Solow Model. He also stressed the importance of other factors, such as education and technology needing to be in place before full benefits from FDI can be realized whereas King and Levine did not find this.

[27] Tswamuno,D. Pardee, S. and Wunnava, P. Financial Liberalization and Economic Growth: Lessons from the South African Experience International Journal of Applied Economics, 4(2), September 2007, 75-89

economic benefit from liberalization. Similarly Kaminsky and Shmuckler,[28] Baldacci,[29] De Mello[30] and Tornel et. al,[31] found that liberalization leads to increases in capital and brought on shocks to the economy, but long term benefits are not likely through liberalization alone. However, as Aghion, Bacchetta, and Banarjee[32] and Johnston, Darbar and Echeverria[33] suggest developing strong monetary policies first and then introducing partial liberalization over time. This approach lowers risk and still offers favorable growth to developing countries.

3.5 Human Capital

Due to the complexity and variations of economies, when regressing land, labor and capital,studies were showing relatively large capital exponents.[34] . By including human capital with physical capital and raw labor, they reduced the overestimation of the coefficient for capital, saving rates and population growth.[35]

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[28] Kaminsky, G. and S. Schmukler. "Short and Long Run Integration: Do Capital Controls Matter?" Working Paper No.: 2660. World Bank Policy Research Working Paper Series. 2001

[29] Baldacci, E., L. R. de Mello Jr., and M. G. Inchauste Comboni.. "Financial Crises, Poverty and Income Distribution," International Monetary Fund Working Paper. 2002

[30] de Mello, Luiz. Can Fiscal Decentralization Strengthen Social Capital? IMF Working Paper. De Mello studied social capital as a "multidimensional concept of civic virtue, interpersonal trust, social cooperation and cohesiveness." 2000

[31] Aaron Tornell & Frank Westermann & Lorenza Martinez, "The Positive Link Between Financial Liberalization, Growth, and Crises," CESifo Working Paper Series. They found while underdeveloped countries experienced greater shocks from liberalization, in the long run overall growth was greater than countries with less instability. 2004

[32] Aghion, Philippe, Philippe Bachetta, and Abhijit Banerjee "Capital Markets and the Instability of Open Economies," WP, Study Center Gerzensee.-Found Foreign Investment did not destabilize. Monetary policy includes taxes, foreign lending and interest rates. 2000

[33] Johnston, R. Barry, Darbar, Salim M. and Echeverria, Claudia,Sequencing Capital Account Liberalization: Lessons from the Experiences in Chile, Indonesia, Korea, and Thailand(November 1997). IMF Working Paper, Vol. , pp. 1-115, 1997. Available at SSRN: http://ssrn.com/abstract=882738

[34] Ram, R. IQ and Economic Growth: Further Augmentation of Mankiw–Romer–Weil model. Economics Letters Volume 94, Issue 1, Pages 7-11 (January 2007).

[35] Bernanke, B& Refet S. Gurkaynak."Is Growth Exogenous? Taking Mankiw, Romer and Weil Seriously," NBER Working Papers 8365, National Bureau of Economic Research, Inc. (2001) http://www.princeton.edu/~bernanke/exogenous.pdf

Using other models Robert Lucas[36] and Sergio Rebelo[37] both found that education had an important role in economic growth. In Robert Barro and Jong-Wha Lee's *International Comparisons of Educational Attainment*[38] they examined the differences of education across countries. Jess Benhabib and Mark Spiegel[39] and then Barro and Sala-i-Martin[40] used the MRW model and data collected from "*Comparisons*" to illustrate the role education plays in economic growth. They found statistically and economically significant positive educational coefficients explaining the growth and differences in rates of growth between developed and developing countries, thus supporting similar findings of Rebelo and Lucas using a different model. Although research on education's effect on growth preceded MWR's 1992 paper, the use of the MWR model by subsequent studies brought the Solow model back into the realm of modern policy decisions.

3.6 Importance of ICT and Telecom

Telecom and Information and Communication Technology(ICT) contribute to economic growth indirectly through application of the technology and directly as an industry. Telecom and ICT improve equality, education, health and uphold human rights. The 1948 Universal Declaration of Human Rights states that everyone has the right to "receive and impart information and ideas through any media and regardless

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[36] Lucas, Robert E., Jr., "On the Mechanics of Economic Development," Journal of Monetary Economics, 22, 3-43 (June 1988).
[37] Rebelo, Sergio T. Long-Run Policy Analysis and Long-Run Growth," Journal of Political Economy, 99(3), (2001)
[38] Barro, Robert J. and Jong-Wha Lee, "International Data on Educational Attainment: Update and Implications", NBER working paper 7911, (September 2000)
[39] Benhabib, J., Spiegel, M.M. "The role of human capital in economic development: evidence from cross-country data", Journal of Monetary Economics, 34, 143-173. (1994)
[40] Barro, Robert J., N. Gregory Mankiw, and Xavier Sala-i-Martin, "Capital Mobility in Neoclassical Models of Growth", American Economic Review, 85, 103-115.Ch. 5 (March 1995)

of frontiers." The 1982 European Convention for the Protection of Human Rights and Fundamental Freedoms extended the right for information exchange to include the right to communicate and to access information.[41] In 1995 Richard Klugman wrote, "Half of the world's population has never made a phone call." Years later, Kofi Annan and other political figures have used the tag line to convey significance of the digital divide. While this statement may have been used for dramatic effect, recent census data supports that there is a growing disparity of telecommunications access. Many politicians, academics and analysts are attempting to understand what factors are influencing this widening gap. This problem, referred to as the "digital divide" in the early 1990's, comes from the inability to create a globalized network with equal access by all of humanity and is worsened by policies that are creating more access for a select group and leaving other groups behind. At the 2000 UN's Economic and Social Council(ECOSOC) Ministerial meeting, ICTs were agreed "to be central to the creation of the emerging global knowledge based economy and can play an important role in accelerating economic growth to promote sustainable development." As a request of the ECOSOC, the UN formed the ICT Task Force(ICTTF) in 2001. The ICTTF was a consortium of private industry, UN member countries and technical advisors. The mission was to bridge the digital divide by creating policies and governances. The ICTTF organized two significant planning summits in 2001 and 2005. At the World Summit on the Information Society(WSIS) action steps were outlined to "Create new opportunities for accelerated socio-economic catch-up

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[41] UN's DG XIII, Communication, Universal Service for Telecommunications in the Perspective of a Fully Liberalised Environment: An Essential Element of the Information Society, COM(96) 73, 13 March 1996, http://www.ispo.cec.be/infosoc/legreg/9673.html ("DG XIII Universal Service Communication").

processes and help to achieve Millennium Development Goals." Such initiatives helped fund entrepreneurial projects such the Grameen Village Phone Project and village kiosks in rural areas.[42] At a microeconomic level these projects have proven to enhance multiple commercial and social factors including agriculture, education, and healthcare.[43] Due to the importance of telecommunications on commerce, public safety, governance, and overall human development[44] the EU Directives specifically request that transitional countries meet certain universal service and telecom standards. [45,46] However such requirements can have a negative effect on capital investment in telecom. Companies looking to invest and make profit off the new markets in the CEECs have withdrawn funding when asked to develop unprofitable services in order to meet universal service requirements. However, new access technologies, including wireless, fixed wireless, and satellite can meet EU requirements at lower costs than tradition wired services. In 2005 The Committee of Ministers of the Council of Europe set the goal of providing "the availability and access on reasonable terms to adequate facilities for the domestic and international transmission and dissemination of information and ideas."[47] While the people who drafted the words in the original Universal Declaration of Human Rights could not have foreseen the use of the internet or cell phones, it is reasonable to view

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[42] See Appendix A for description of Grameen Phone Project.

[43] Hajela, S. Use of ICT for achieving MDGs South & Southwest Asia Conference on the follow up to WSIS Kathmandu, 1-3 March 2005

[44] See chapter 2, UNDP Report, supra, note 2; ITU Report, supra, note 7

[45] The universal service obligation requires Member States to ensure that all persons reasonably requesting it can obtain a connection to the fixed public telephone network at an affordable price.

[46] United Nations Development Programme (UNDP) New York Oxford Oxford University Press 1999 *http://hdr.undp.org/en/media/hdr_1999_en.pdf*

[47]http://www.coe.int/t/e/legal_affairs/legal_cooperation/fight_against_terrorism/2_adopted_texts/Declaration%20freedom%20and%20media%202005%20E%20pdf.pdf

telecommunications as a tool that can enable the rights they intended everyone to have. Within Target 18 of the UN's Millennium Development Goals, ICT will "Deliver educational and literacy programs specifically targeted to poor girls and women using appropriate technologies."[48] The World Health Organization claims that "40 percent of health is exchanging information."[49] ICTs can have an impact on a nation's health by enabling those who seek and provide healthcare to communicate with each other rapidly over increased distances.[50] ICT's can reduce the space and time barriers to education and information poorer men and women in some cultures may have. Developing policies to improve ICT and Telecom dispersion, while maintaining quality and investment interest, can have a full range of benefits for the economy and mankind's wellbeing.

3.7 Telecom Research

The importance and influence of telecom with respect to knowledge and the economy has been the subject of many studies. A recent search in the RePEc[51] database on "ICT" returned over 1,800 results for journal articles, working papers, and books. Research has shown that information and communication technologies, specifically telecommunication technologies, can reduce poverty and inequality[52] and

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[48] Marker, P. McNamara, K and Wallace, L. "The significance of information and communication technologies for reducing poverty." Department for International Development (United Kingdom) 2002.
[49] Sachs Jeffrey D. Macroeconomics and Health: Investing in Health for Economic Development. World Health Organization. Geneva, 2001.
[50]Micevska, M. Telecommunications, Public Health, and Demand for Health-Related Information and InfrastructureInformation Technologies and International Development, 2005, vol. 2, issue 3, pages 57-72
[51] Research Papers in Economics is a decentralized database of working papers, journal articles and software components to enhance the dissemination of research in economics. Found at http://repec.org/
[52] Forestier, E., Grace, J., Kenny, C. (2002), "Can information and telecommunications technologies be pro-poor?", Telecommunications Policy, Vol. 26 No.11, pp.623-46.]

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increase productivity and economic growth.[53,54] Telecom can contribute to economic growth directly through employment and investment and indirectly through a variety of applications in health, education and finance. It plays an important role as a primary industry and a supporting one. Similar to the variables used to explain growth by finance, health, education and policy, telecom is not sufficient for growth but necessary. It should be viewed as a tool for growth not the engine. It has been is generally accepted that there is a positive correlation between teledensity and gross domestic product per capital, but some argue the casual relationship flows in the opposite direction. Hypothetically, either direction of cause and effect is possible, but this thesis accepts the popular opinion of the last two decades that ICT's effect on economic development is significant.

3.8 The ICT Sector

When analyzing ICT's effect on the economy, the contribution of ICT as an industry is important, but the application of ICT tends to effect the economy more. For example, Russia's ICT sector is 1/10th the size of the US', yet the application of ICT contributed to Russia's labor productivity twice as much.[55] In Estonia, Teet Rajasalu found that due to subcontracting and transfer pricing, the production of ICT has little effect on overall growth.[56] Because the effects vary for ICT as a sector the OECD cautioned against ICT production promoting policies. Nevertheless, the

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[53] Madden G, Savage S (1998) CEE Telecommunications Investment and Economics Growth. Information Economics and Policy 10(2): 173-95

[54] Jungmittag, Andre and Welfens, Paul J.J.,Telecommunications Dynamics, Output and Employment(October 2006). IZA Discussion Paper No. 2379. Available at SSRN: http://ssrn.com/abstract=941114

[55] www.itu.int/osg/spu/presentations/2006/ponder-ICTsEconGrowth.ppt

[56] Rajasalu, T and Laur A. Contribution of the "New Economy" to Estonia's Economic Growth and Convergence with the European Economy. The New Economy and Transformation, M. Piatkowski (ed.). Warsaw: WSPiZ, 103-127

argument over production or use is a waste of time since they are one of the same. That is to say, an ICT industry supports ICT use and simultaneously the ICT industry is supported by the use of technology. This scenario has increased growth in countries such as the US, Ireland and India where the dispersion of technology can be attributed to Silicon Valley, Dublin and Bangalor but these sites rely on ICT's to produce the service. Therefore to reduce the digital gap, several conclusions can be made. First, the ICT sector and ICT using sectors benefit from ICT, therefore policies to improve ICT use and production should be made. Secondly, the success of ICT use is dependent on other variables such as investment and training therefore synergistic policies to improve such things should be made. From the second meeting at the WSIS, it was agreed that international involvement is important to development, but "There is no unified public policy applicable for each country without exception." The exception is to develop bilateral policies that can improve economic growth. Research thus far has analyzed the effect a given variable has on GDP per capita, this thesis analyzes the effect of combined variables on GDP. While causality is difficult to measure, it is generally accepted that the investment in and use of ICTs is a contributing factor to increased productivity and economic growth.[57] Despite overcoming a recession from market transitions, the growth in GDP in the CEECs from 1992-2000 was greater than the European average.[58] This initial period of growth can be attributed to the fall of the Soviet Union and the introduction of more efficient privatized companies, but technology transfers not available under the

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[57] Nadiri, I. and Nadi, B. Telecommunications and Infrastructure and Economic Development Working Paper. 2003
[58] Piatkowski, M. 2003. "The Contribution of ICT Investment to Economic Growth and Labor Productivity in Poland 1995-2000," Development and Comp Systems 0308002, EconWPA

COCOM restrictions[59] became available and ICT capital investment rose. This catch up in growth supports Solow's convergence idea and at least in the short run ICT investment in developing countries led to greater benefits from development.

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[59] COCOM (Coordinating Committee) restrictions enforced by NATO, prevented the import of civilian-military high-tech equipment to the member countries of the Warsaw military pact. These restrictions were lifted in 1991.

Chapter 4. - Data

4.1 Introduction

This chapter will describe the data used in the descriptive model of variable interaction. The variables and their respective descriptions and sources are listed in table 4.1

Table 4.1 Variables

GDP Per Capita	Standard Measure of Economy. Constant US$ for year 2005	The World Bank Group 2008
Foreign Direct Investment	Physical investment in domestic operations by a foreign company	The World Bank Group 2008
Secondary School Enrollment	The percentage of children of official school age based on the International Standard Classification of Education 1997 who are enrolled in school to the population of the corresponding official school age.	The World Bank Group 2008
Telecom Liberalization	The level of government control over telecommunication service operations.	International Telecommunications Union 2008
Financial Liberalization	Index of 10 factors of economic freedom.[60]	The Heritage Foundation's Index of Economic Freedom.[61]
Life Expectancy	Number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	The World Bank Group 2008
Teledensity	Fixed line and mobile phone subscribers per 100 people.	The World Bank Group 2008
Worker Remittance	Money (US$) sent back to home countries from work abroad.	The World Bank Group 2008

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[60] See Table 4.2 for description of variables used to measure financial freedom.

4.2 Determination of Variables

Each of the variables in table 4.1 was chosen for a specific reason. The CEE region has received attention in recent years due to the high rates of growth and data have become more available. Since the countries in this region have similar characteristics, each variable was chosen for two reasons. Most important was finding complete data for all time periods and all countries. Next important was using the results from previous studies to determine which variables are most likely tocontribute to the growth of an economy.

4.3 Human Capital

As seen in the MWR model, the definition of capital was expanded to include human capital which consisted of education and health. Education can be measured by school attainment,[62]proficiency scores or IQ.[63] Each measure is often correlated with the other and the majority of studies agree school attainment is a sufficient tool to measure education. School attainment can be measured through completion or enrollment rates. Data for secondary school enrollment was available for all countries and it implies completion of primary education, therefore it serves as a good measure for education. Health has been measured a multiple ways, including disease

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[62] Wolf and E.G. West would argue this measure ignores the quality of education. E.G. West Argues specifically against state run compulsorily education and data collected on attendance is often based on state educational systems.

[63] Ram, R. IQ and Economic Growth: Further Augmentation of Mankiw–Romer–Weil model. Economics Letters Volume 94, Issue 1, Pages 7-11 (January 2007) Used IQ scores, thus taking variability of education quality out, however data on such a measure is still not available in many countries.

immunization, such as tuberculosis and malaria. Other studies look at fertility rates and life expectancy. A less direct measure is health care expenditure often measured as a percentage of GDP per capita[64]. Again these measures are often correlated therefore the best measure is often the one that is most accurate and available. In this model life expectancy is used.

4.4 Drawbacks of Human Capital Data

Acemoglu and Johnson caution against using evidence on education and health from cross-sectional studies in order to support a macroeconomic conclusion.[65] To avoid these criticisms, the within country differences are controlled using panel data. The scaling problem is a question of correlation and unknown effects. These issues are reduced by including several factors and assuming correlation. That is to say, the model includes exogenous factors that correlate with the individual effects. If the effects are either microeconomic or macroeconomic the included factors will represent most of them. Other criticisms come from the actual measure of education. Alison Wolf criticizes the pro-economic case for education and how it has been incorrectrly correlated with status and competency. She suggests that after middle school or high school everyone take exams which provide a clear ranking of population. "How much less productive would the economy, and most of these

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[64] Heshmati's HCE has a positive effect on the economic growth and the speed of convergence of 32 countries in the Organization for Economic Co-operation and Development (OECD)(2001)
[65] Acemoglu, D and Johnson S., "Disease and Development: The Effect of Life Expectancy on Economic Growth," Journal of Political Economy, December 2007, 115 (6), 925—985. Since microeconomic units do not necessarily scale to macroeconomic levels and this can result in omitted variable bias and false causal relationships.

people, then be?"(p.30)[66] While she presents an interesting argument for not focusing on education for reasons of economic development, she admits education at some level is necessary. Wolf's suggestion is to send children through at least a secondary education level and this thesis uses secondary enrollment to measure education. Also since combined effects are considered, the strength of one factor is compared with synergistic effects of health or ICT, which Wolf does not address.

4.5 Measuring Finance as Foreign Direct Investment

The variables from King and Levine's 1993 study addressed the financial segment from multiple angles.[67] They used four financial indicators to measure financial depth, distribution and development. These variables were the ratio of domestic deposit money bank assets to overall bank assets, the amount of currency held outside the banking system plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries, the amount of credit allocated to private enterprises and the amount of claims on the nonfinancial private sector. Their findings supported that countries with stronger financial infrastructures had better growth. Unfortunately, while these indicators provide a relatively comprehensive idea of the financial situation of a country, many of the CEECs do not have data on these variables, therefore this study is limited to use other measures in order to arrive at similar results. Foreign direct investment (FDI) is a suitable financial indicator since

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[66] Wolf, A. Does Education Matter? Myths about Education and Economic Growth? London: Penguin Books Ltd, (2002).
[67] Levine, Ross and King, Robert G. "Finance and Growth: Schumpeter Might be Right," The Quarterly Journal of Economics, Vol. 108, No. 3, (Aug., 1993), pp. 717-737

transnational companies will use financial indicators, among other variables, to determine their investments.

4.6 Measuring Policy and Liberalization

To measure liberalization as an observable policy change, this thesis uses The Heritage Foundation's Index of Economic Freedom. Each country receives a cumulative index score based on ten specific economic freedoms.[68] Telecom liberalization is also included. Many of the CEEC's have allowed foreign investment and privatization of telecom operations and experienced better rates of dispersion and technology advancement. Therefore, by including a factor for liberalization specific to telecom this thesis also tested the effect of specific kind of liberalization, improving the accuracy of policy decisions.

4.7 Measuring Telecom and ICT

To determine if telecom liberalization and ICT effect the economy a variable for ICT and Telecom was necessary. So far this thesis has used information and communication technology and telecom often interchangeably. Recent studies have referred to ICT as a broader category for all knowledge based development and telecom is typically measured as one segment of ICT. ICT may include media services, televisions, computers, medical equipment and other business services, but often in developing countries, these variables are not available and telecom is the most available measure of ICT. When ICT includes more variables, telecom will

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[68] Business Freedom, Trade Freedom , Fiscal Freedom, Government Size, Monetary Freedom, Investment Freedom, Financial Freedom, Property Rights, Freedom from Corruption, Labor Freedom

have similar patterns of changes and effects.[69]   This study uses teledensity as the measure for ICT. One drawback of using teledensity as a measure for telecom and ICT is the evolution of what is being measured. In transition countries where technology transfers from developed countries have taken place, often the traditional measure of the number of twisted-pair copper wires per 100 people does not account for newer technologies such as wireless or satellite phone service.[70] For this reason teledensity is measured in this study as both fixed line and wireless. We omit services over fiber optic or coaxial cable since these technologies are not present in most residences or commercial buildings.

4.8 Countries

While this study does intend to help policy makers in developing countries, not all of the countries included are considered to be developing or underdeveloped. However, many CEECs were recently considered to be in the developing stages and some still are. However, there is not a concise definition for what constitutes a developed, developing, underdeveloped or least developed country(LDC).[71, 72] The crude method of classification compares the standard of living to the Western-style and countries below this standard are considered developing or underdeveloped. The alternative is to use data and objective measurements to categorize a country. The

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[69] Jorgenson , Dale W. and Vu, Khuong,Information Technology and the World Economy. Scandinavian Journal of Economics, Vol. 107, No. 4, pp. 631-650, December 2005. Available at SSRN: http://ssrn.com/abstract=870661

[70] H.G. Thompson Jr., C. Garbacz / Information Economics and Policy 19 (2007) 189–214 195

71 The World Trade Organization allows countries to define their status and other countries can contest.

72 The main criteria used by the International Monetary Fund to classify "advanced and emerging economies are (1) per capita income level, (2) export diversification—so oil exporters that have high per capita GDP would not make the advanced classification and (3) degree of integration into the global financial system. However these criteria are flexible to allow for special cases.

International Monetary Fund uses economic factors such as export diversification and GDP per capita to determine their list of "developing or emerging countries."[73] This list includes all CEECs except Slovenia.[74] A similar method used by the United Nations is the Human Development Index (HDI) which uses the gross domestic product per capita, school enrolment rates, literacy rates and life expectancy to rank 177 countries.[75] Table 4.3 Shows the CEECs in order of ranking by the HDI. Countries are given high, medium or low rankings based on attaining a certain aggregated index score. Using HDI's classification, sixteen CEECs are in the high ranking and ten are in the medium group. The sixteen countries with highscores have seen a gradual increase since 1992.Yet, the rate of improvement for the medium HDI group is far slower or in some cases decreasing. Excluding Russia, the ten medium ranked countries make up fifty percent of the total Central and Eastern European region's population; therefore understanding why these countries are falling behind the high ranked countries is important. The variation of HDI rankings between countries with similar backgrounds and geographical qualities has been investigated by several studies, but conclusions are generally country specific and require a complex set of explanations for growth.[76] The difference between developing and developed country economic growth has more to do with the starting level of certain variables and capital. Depending on these levels, growth rates exhibit conditional

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73 IMF. World Economic and Financial Surveys World Economic Outlook Database—WEO Groups and Aggregates Information(2008) Available at
http://www.imf.org/external/pubs/ft/weo/2008/01/weodata/groups.htm#oem
74 Slovenia is considered a developed country.
75 http://hdr.undp.org/en/media/hdr_20072008_tech_note_1.pdf
[76] Piech, K. Development of ICT in Transition Countries: Cross-Country Comparison. ICT as Drivers of Development in Transition Economies, Warsaw 14th (May 2004)

convergence of growth rates.[77] Throughout this paper economic growth and development will be used. Typically growth refers to the increase of GDP per capita in developed countries and development is used to refer to GDP per capita growth in developing countries. For simplicity sake, both terms will be used interchangeably unless noted otherwise. Countries are not specifically separated based on any definition of development, but between country differences are included.

4.9 Central and Eastern European Countries

The CEE region has seen several armed conflicts before and after 1992 and these have caused much stress to the area's economies. Countries considered to be in an "armed conflict" during the time period measured were separated. Also, some countries have net natural resources that contribute to their GDP. While management of these resources is likely enhanced with the variables used in this thesis, in an initial visual analysis of correlations, countries with net resources tended to be isolated.[78] The variance in output in the Eastern European countries can be attributed to oil revenues, where a country with a smaller population but greater amounts of natural resources will show inflated production per capita. This study tested the interaction effects before and after removing countries with significant net natural resources. Table 4.4 lists the The Central and Eastern European countries and their respective gross domestic product per capital for each time period used in this study.

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[77] Conditional convergence holds that "poorer countries grow faster per capita once one holds constant measures of government policy, initial levels of human capital, and so on." Growth rate depends on the relation between the initial level of output and its target position. Barro, Robert J. "Determinants of Economic Growth: A Cross-Country Empirical Study," NBER Working Papers 5698, National Bureau of Economic Research, Inc (1996).
[78] See correlation matrices in Appendix.

Table 4.4 List of Countries and GDP Per Capita 1992-2006

Country	GDP Per Capita (Current US Dollar)			
	1992	1995	2000	2006
Albania	216.9319	769.6922	1196.938	2868.036
Armenia	368.7819	455.0131	620.2348	2122.152
Azerbaijan	676.1515	397.1981	655.1027	2473.041
Belarus	1666.228	1370.673	1273.049	3796.077
Bosnia and Herzegovina	*	560.1753	1445.076	3247.185
Bulgaria	1214.508	1560.343	1563.2	4115.173
Croatia	2290.967	4027.454	4092.23	9665.072
Czech Republic	2903.083	5348.664	5521.189	13926.98
Estonia	2600.532	3013.673	4106.134	12363.38
Georgia	692.2781	535.2602	647.7572	1747.615
Hungary	3592.751	4323.406	4695.308	11211.96
Kazakhstan	1515.104	1288.239	1229.004	5291.534
Kyrgyz Republic	509.5826	361.8856	278.6589	542.7081
Latvia	1841.967	2081.797	3302.305	8719.364
Lithuania	2314.138	2098.217	3262.848	8769.964
Macedonia, FYR	1197.707	2266.058	1785.173	3129.635
Moldova	525.8059	400.2919	310.8044	889.3068
Poland	2197.995	3604.655	4455.196	8962.179
Romania	1100.983	1564.175	1650.966	5633.268
Russian Federation	3095.087	2669.946	1775.141	6951.417
Serbia	*	*	1192.511	4287.803
Slovak Republic	2215.515	3675.583	3780.987	10357.81
Slovenia	6272.163	10329.38	9854.564	19032.94
Tajikistan	345.9707	213.3471	158.7623	423.3719
Turkey	3872.801	3967.577	3963.344	7261.828
Turkmenistan	823.8463	591.9964	645.1737	2142.376
Ukraine	1417.87	935.9681	635.709	2303.019
Uzbekistan	603.9349	585.932	558.2302	643.0199

*Data not available for countries during these years.

Source: The World Bank Group ©2008

Chapter 5. - Testing

5.1 Introduction

As seen, previous research has used a given variable to test effects on economic growth. This thesis tests the interaction effect of those variables. Equation 5.1 is similar to previous cross-sectional growth equations, but includes time and country variables for each term.

Equation 5.1 Regression Form for Panel Data

$$y_{it} = \beta_0 + \gamma y_{i,t-1} + \gamma y_{i,t-2} + \gamma y_{i,t-3} + \sum_i \beta_n X_{it}^x + \epsilon_{it}$$

where y_{it} is the GDP per capita, γ is the change of GDP at time t-1, and ϵ_{it} is the error term at time (t) country (i) assumed to be correlated with the endogenous factors of X. Equation 5.2 is based on 5.1 but includes the interaction term.

Equation 5.2 Regression Form for Panel Data with Interaction Term

$$y_{it} = \gamma y_{i,t-1} + \beta_0 + \beta_1 X_{i,t}^{x1} + \beta_2 X_{i,t}^{x2} + \beta_3 \left(X_{i,t}^{x1} \times X_{i,t}^{x2} \right) + \epsilon_{it}$$

5.2 ICT and Education

Using the variables of school enrolment and teledensity, this equation will test the combined effect of ICT and educaiton. Access to education can be improved with ICT via virtual classrooms and through such programs as the $100 laptop. Likewise,

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education is necessary for ICT adoption and increasing dispersion. Educating people on how to use ICTs can lead to more education. Since education and ICT are both considered pro-economic growth factors, the combination of the two would be assumed to produce a greater effect on growth. However this was not true in CEECs.

Equation 5.3 Regression of GDP Per Capita with Telecom, Education and Both

$$y_{it} = \gamma y_{i,t-1} + \beta_0 + \beta_1 h_{i,t}^{tel} + \beta_2 h_{i,t}^e + \beta_3 (h_{i,t}^{tel} \times h_{i,t}^e) + \epsilon_{it}$$

5.3 ICT and FDI

Foreign direct investment is often used to improve infrastructure. In at least the last forty years Telecom and ICT have been considered important in a country's infrastructure. Conversely, when companies look to invest in a foreign country, ICT development is a factor they look at. Such is the case in Romania wheere the French telecom company, Orange has improved Romania's teledensity greatly over the last several years and improving the attractiveness of Romania to other investors. Some CEEC's do not receive significant amounts of FDI in relation to their GDP thus the interaction effect is not significant. Therefore, a calculation was made for countries where FDI was at least 5% of GDP.

Equation 5.4 Regression of GDP Per Capita with Telecom, FDI and Both

$$y_{it} = \gamma y_{i,t-1} + \beta_0 + \beta_1 h_{i,t}^{tel} + \beta_2 h_{i,t}^{fdi} + \beta_3 (h_{i,t}^{tel} \times h_{i,t}^{fdi}) + \epsilon_{it}$$

5.4 ICT and Telecom Liberalization

Instead of testing general economic liberalization as was done in equation 5.5, this equation focuses on the liberalization of the telecommunications sector. This will test if liberalization of telecom combined with the increased diffusion of telecom has a significant effect on the economy. While the answer could be assumed yes since deregulation spurs new entrants into the market and competition can increase penetration, this assumption is not always true since the level of technology can be as important as the dispersion.[79] The deregulation of telecom in the CEEC's has been slow for some and rapid for others. The Czech Republic and Slovenia embraced full deregulation by 2004 and coincidently saw greater development and growth compared to countries like Tajikistan and Bulgaria which were slower to liberalize.

Equation 5.5 Regression of GDP Per Capita with Telecom, Liberalization and Both

$$y_{it} = \gamma y_{i,t-1} + \beta_0 + \beta_1 h_{i,t}^{tel} + \beta_2 h_{i,t}^{p} + \beta_3 (h_{i,t}^{tel} \times h_{i,t}^{p}) + \epsilon_{it}$$

5.5 ICT and Worker Remitance

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[79] Kinksy, C and Potzl, J CEE Technology Index: Estonia ahead of Slovenia and the Czech Republic. Roland Berger Strategy Consltants. 2007 "Our study does not show any clear connection between how technologically advanced a country's telecommunications sector is and how deregulated it is." However the model is only concerned with penetration, the level of technology, while interesting is not included.

This equation tested if telecom improved worker remittances and if together they increased economic growth as suggested by the anecdotal evidence.[80]

Equation 5.6 Regression of GDP Per Capita with ICT, Worker Remittance and Both

$$y_{it} = \gamma y_{i,t-1} + \beta_0 + \beta_{it} h_{i,t}^{tel} + \beta_{it} h_{i,t}^{wrkr} + \beta_{it}(h_{i,t}^{tel} \times h_{i,t}^{wrkr}) + \epsilon_{it}$$

5.6 Health and Education

The two variables in the human capital term of the MRW model have been shown to have complementary effects. In chapter three and four of this thesis, previous research has used both of these variables to explain economic growth. This equation combines the two variables and tests if if one variable is more effective individually or when combined.

Equation 5.7 Regression of GDP Per Capita with Health, Education and Both
$$y_{it} = \gamma y_{i,t-1} + \beta_0 + \beta_{it} h_{i,t}^{e} + \beta_{it} h_{i,t}^{h} + \beta_{it}(h_{i,t}^{h} \times h_{i,t}^{e}) + \epsilon_{it}$$

5.7 FDI and Liberalization

If currency cannot flow freely through a country FDI will be low. A comparison between Tajikistan and Macedonia illustrates how two landlocked countries can gain their independence at the same time, but experience different rates of growth. Neither

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[80] See Appendix A and B for stories on how phone service helped worker negotiate exchange rates and transfer fees in the order to send money back to their families.

country is considered an oil country and has had to rely on worker remittance and foreign aid during the first decade of independence. However, Macedonia has made several policies to create competition and create a free market whereas Tajikistan has made efforts to block privatization. Currently Macedonia is ranked 12th globally for "Easiest Places to Start a Business" and Tajikistan is 168th out of 188.[81] This ranking is based on the procedures, time, cost and paid-in minimum capital for starting a business. Table 5.1 lists a comparison for each of the variables and the growth of GDP per capita from 1992 to 2006.

Table 5.1 Ease of Business

Ease of Business Variable	Macedonia	Tajikistan
#of Procedures to start a business	7	13
Time to start a business(days)	9	49
#of Procedures to obtain construction permits	21	32
Time to obtain permits(days)	198	351
Cost to export across borders (US$ per container)	1315	3150
Cost to import across borders(US$per container)	1325	4550
GDP Per Capita Growth 1992-2006	61.7%	18%

The final row indicates the most important variable for this study. There is a significant difference between the two countries GDP per capita growth and this is significantly correlated with the ease of business in each country. A more

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[81] World Bank, "Doing Business in Landlocked Economies 2009" Washington D.C. The International Bank for Reconstruction and Development / The World Bank 2008

35

comprehensive comparison on pro-competition policy and reform can be found in the "Doing Business" report. This study uses the Heritage Index of Economic Freedom as an estimate for the countries' level of overall liberalization and policy. The combined effect variable of FDI and policy will test whether FDI contributed more to growth when policy was set for liberalization. Similar to the previous equations, controls are used to separate oil, natural gas, coal and war countries. An empirical analysis of policy and finance is made to explain the importance of both.[82] Equation 5.5 will test the combined effects of foreign direct investment and financial liberalization.

Equation 5.8 Regression of GDP Per Capita with Liberalization, FDI and Both

$$y_{it} = \gamma y_{i,t-1} + \beta_0 + \beta_1 \log S_{i,t}^{FDI} + \beta_2 \log S_{i,t}^{P} + \beta_3 (\log S_{i,t}^{FDI} \times \log S_{i,t}^{P}) + \epsilon_{it}$$

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[82] See Grameen Phone Story in Appendix A

Chapter 6. - Results

6.1 Introduction

The equations in chapter 5 tested different variables to determine if important interaction effects existed. Overall the results did not provide much support for interaction effects, but for a few equations the hypothesis was supported. While only one of the equations supported the hypothesis that combined effects are greater than isolated variables, each result has several reasonable explanations. Following in order from the chapter above the next paragraphs present the results and offer explanations

6.2 ICT and Education, ICT and FDI

Testing equations 5.3 and 5.4 resulted in no significant benefits from combined effects. This was to be expected since FDI and enrolment rates are not significant contributing factors on their own. While ICT did improve the statistical significance of both variables through combined effects, the economic significance was not there.

Insert Tables 6.1, 6.2 and 6.3 Here

6.3 ICT and Telecom Liberalization

The combination of teledensity and telecom liberalization produced economically significant effects on the economy. A single unit of increase in teledensity contributes an average $25 US dollars to GDP per capita annually. An increase in telecom liberalization saw an average increase of $13 US dollars. Combining the two variables resulted in an average of $27 US dollars increase per person. While the contribution of liberalization is not as significant as teledensity,

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liberalization is important to realizing greater benefits from teledensity. This is likely

the result of improved technology and utilization when telecom is liberalized.

Insert Table 6.4 Here

6.4 ICT and Worker Remittance

This specific model tested to see if telecom improved worker remittances and

if together they increased economic growth as suggested by the anecdotal evidence.

From Table 6.5 the results were surprisingly contrary to the idea that telecom can

have a benefit to worker remittances since the combined effect was economically

insignificant. Although worker remittance makes up less than one percent of some

countries' GDP, when analyzing countries with at least five percent of their GDP

coming from worker remittance the effect was still insignificant.

Insert Table 6.5 Here

6.5 FDI and Liberalization

The results show that overall the combination of liberalization and foreign

direct investment did not have an economically significant effect on the change in

gross domestic product per capita. This can be the result of several factors. At the turn

of the century, select CEE countries were receiving unprecedented amounts of

investments from transnational corporations (TNCs). In terms of the size of their

economies, Estonia, Hungary and the Czech Republic were the region´s leading FDI

recipients. In 1999 their FDI stock in relation to their GDPs reached 41.5%, 39.6%

and 30.6%, respectively with the majority of that money coming from European Union TNCs. These three countries coincidently were going through liberalization earlier than most of the other CEECs. However, the majority of the CEECs did not benefit from FDI and liberalization, likely caused by lowered investments after the first couple of years brought on by short term instability. Further research on the long run effects of FDI and liberalization will possibly show a better interaction effect.

Insert Table 6.6 Here

6.6 Health and Education

Using Equation 5.7 with fixed effects the results showed that an increase of life expectancy by one year had a significant positive effect on growth, while health measured as mortality or fertility rates had similar results. Unlike studies in OECD countries, [83,84] education as measured by secondary or primary school enrolment rates did not have economic significance, with many countries showing high GDP per capita despite having low school enrollment levels. Removing countries with high oil, coal and natural gas exports did very little to adjust the effect of enrollment on the economy. This result could be explained by Edwin West who criticizes education by the state,[85] which most of the CEE countries have. Therefore the amount of schooling

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[83] Barro, Robert J., and Jong-Wha Lee "International Measures of Schooling Years and Schooling Quality" *American Economic Review* 86(2): 218-223.(1996)

[84] Levine, Ross and King, Robert G. "Finance and Growth: Schumpeter Might Be Right," The Quarterly Journal of Economics, MIT Press, vol. 108(3), pages 717-37, (August 1993)

[85] West, Edwin G. Education and the State. London : The Institute of Economic Affairs, (1970)

is less important than the quality, a claim also made by Barro.[86] Further research on this should be done once data for proficiency scores over several years become available for the CEECs.

Insert Table 6.7 Here

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[86] Barro, Robert J., and Jong-Wha Lee (1996) "International Measures of Schooling Years and Schooling Quality" American Economic Review 86(2): 218-223. King, Robert G & Levine, Ross, 1993.

Chapter 7. - Conclusion

7.1 Introduction

This paper studied the empirical link between a range of economic growth predictors from finance, policy, health and telecommunications. The findings are that (1) indicators used in this study of capital, saving and policy were not all economically significant in Central and Eastern European Countries as expected. (2) The level of financial liberalization should be increased regardless of risks to short term volatility. Spillover benefits from increased investment and liberalization are strongly and robustly correlated with long run growth. (3) Of the variables tested, ICT has the greatest contribution to the increased economic growth. The results are consistent with the view that financial and technology services stimulate economic growth by increasing productivity and rate of capital accumulation. In a 2001 email to the Asian Pacific Network Information Centre, Sarbuland Khan, the Director for ECOSOC Support and Coordination, United Nations captured this view best,

> "Of course social and economic development is dependent on various
> factors -political stability, macroeconomic governance, transparency,
> education and health care systems, infrastructure etc. These factors
> should be addressed through an overall development strategy. ICT is
> by no means a panacea for the developing world's problems. However,
> the integration of ICT can help to facilitate implementation, expand
> the scope and coverage, and increase the results of an overall national

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development plan. ICT has the potential of bringing unprecedented economic and social development to the world's poorest nations."[87]

It is not sufficient to raise one tile. To achieve the momentum building critical mass, the entire floor needs to be elevated. The parameters of one sector can provide greater adoption for another sector and therefore order and prioritization is important. The models presented in this paper explained that growth is greatest when telecom, health, education, investment and policy variables reach a synergistic level, but until all the variables are contributing at a significant level; these benefits will go unrecognized economically.

7.2 Beyond Economic Evidence

It is important to address the philosophical and moral foundation behind seeking to improve economic well being through improved health, education, technology, policy and financial support. Currently poor health conditions trouble people of all ages, genders, races and socioeconomic levels. The quality of life benefits from improved health and education vary from person to person. However, it is unanimous that severe health problems have the greatest impact on the developing countries. This is largely to do a lack of resources that could be used to confront the problems. These resources can be obtained through investment, education and technology. Yet, there is caution against prioritizing economic growth for fear of

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[87] Kahn, S. Q and A with Mr. Sarbuland Khan about the UN ICT Task Force. Email. Available at: http://www.apnic.net/mailing-lists/s-asia-it/archive/2002/10/msg00000.html

removing consideration for the well being of mankind.[88] While the importance of
income production can be debated the model of this thesis inherently offers a
response to such criticisms by including two factors directly related to quality of life.
Health and education provide monetary and non-monetary benefits.

7.3 Conclusion for CEECs

As other studies found, when an economy is liberalized, foreign direct
investment will generally increase, but such an influx of capital can cause financial
fragility in the short run.[89]However, looking at the subsequent time periods after the
liberalization, GDP eventually stabilized and saw greater growth once the economies
recovered. The growth for the countries that liberalized earlier exceeded the growth
of the non-liberalized or later liberalized countries. Another reason why the
combination did not cause the GDP per capita to increase is that some countries with
liberalized economies did not have FDI contributing to their GDP with any economic
significance. It can be determined that FDI does not play as important a role in
economic development as liberalization, but liberalization can increase FDI which
can improve productivity and knowledge transfer in the short run and economic
growth in the long run.[90]

7.4 Policy

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[88] Marx and Engels, The Communist Manifesto, introduction by Martin Malia New York: Penguin group, 1998

[89] Tornell A. Westermann, F. and Martinez L., "The Positive Link Between Financial Liberalization, Growth, and Crises," CESifo Working Paper Series (2004).

[90] de Mello, L. "Foreign direct investment-led growth: Evidence from time series and panel data", *Oxford Economic Papers*, 51, 133-151. (1999).

In order to address the old problems associated with state enterprises and communistic governments, CEECs need to promote the entrance of foreign investment into the market while simultaneously developing domestic infrastructure. The effect of introducing competition is gaining competitive advantages quicker. In the CEEC's many new businesses are difficult to start since the licensor is the competition. However once policy affords more competition vis a vis license and permit acquisition, the incumbent companies are forced to improve efficiency or parish, either way the market benefits. Reforms to encourage foreign investment include removing steps in the filing process, reducing paperwork and lowering administrative fees. Automated systems or e-filings can reduce time, cost and procedures for the creation and operation of a business thus supporting the case for technologies role in policy decisions. However, many of these reforms can be enacted within a year and do not require new technology.

7.5 Policy Suggestions

Only by measuring and testing economic theories can policies be executed with confidence. Going into a future with unforeseen unintended consequences is unavoidable; however risks can be mitigated with proper analysis. This thesis did not intend to offer policy makers a list of variables or combination of variables that contain the secret to economic growth. Rather the intention was to test whether or not variables had significant synergistic effects. While this proved to be false for several of the tests, there were benefits to combining variables. Therefore policy makers should consider multiple areas of focus each time. Specific policies should be aimed

at liberalization of capital funding institutions and the telecom sector. In the CEE region, many countries are growing without ICTs and liberalized markets, but their growth is less than that of other countries. Such policies to change this would include deregulating interest rates, opening trade restrictions, allowing for foreign and domestic competition in the ICT industry, including telecom.

7.6 Obstacles to Development

Developing infrastructure for energy, manufacturing, trade and telecommunication investment can be difficult. As the rise of Silicon Valley and fiber optics were revolutionizing ICT in the US, CEECs were struggling to develop nationwide networks. The networks that did exist had been neglected and offered poor quality.[91] To add insult to injury, the inefficiency of the centralized planning caused a long waiting period to receive the service.[92] The small customers that waited and could afford the services were wealthier and concentrated in urban settings. CEE businesses were unable to realize the technological benefits other European companies had. These problems were largely the fault of the state run telecommunication companies' failures to invest in new technologies.[93] Investment in the newest technologies was often out of reach for developing countries and these centralized phone companies failed to upgrade to mobile phones, fiber optics or DSL modems. Investment in these technologies was not seen until the telecommunications industry was opened to competition and foreign investment. As more companies

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[91] Welfens, P.J.J., Telecommunications and Transition in Central and Eastern Europe. Telecommunications Policy 19, 561–577.(1995)

[92] ITU, Telecommunication Indicators for Economies in Transition. Geneva, ITU.(1994)

[93] Muller, J., Nyevrikel, E. Closing the Capacity and Technology Gaps in Central and Eastern European Telecommunications. In: B.Wellenius and P.A. Stern (Eds.), Implementing Reforms in the Telecommunications Sector: Lessons from Experience, Ashgate Publishing, Aldershot, pp. 353–374. (1996)

entered the market, the price per unit went down and the value of the network increased,[94] thus supporting the case for telecom liberalization. Unfortunately, many new telecom companies were met with high connection costs, license fees, construction fees, slow permitting processes and other bureaucratic obstacles that made running a business difficult. These obstacles were often intentionally set in place by the regulatory body which shared duties as the incumbent phone company.

7.7 Overcoming Obstacles

As discussed in the first section, foreign investments and technical aide came from other European countries and development organizations such as the UN, ITU, European Bank for Reconstruction and Development (EBRD) and the World Bank. This assistance enabled the spread of telecom to areas normally deemed unprofitable and brought more people onto the network which provided extrinsic and intrinsic benefits to the economy as a whole. Such benefits included increased productivity, lowered transaction costs and social well-being.[95] Leonard Waverman, Meloria Meschi and Melvyn Fuss found that the variation of economic growth rates between countries can be explained, at least partially by the spread of mobile cellular technology.[96] If a country fails to implement ICTs initially there is still incentive to invest. Due to transfer of technology and reduced costs many countries experience large rates of growth and are able to catch up to more developed countries in less

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[94] Piatkowski, M. "The Contribution of ICT Investment to Economic Growth and Labor Productivity in Poland 1995-2000," Development and Comp Systems 0308002, EconWPA (2003)

[95] Zolkiewski, Z and Kolasa, M. "Total Factor Productivity and its Determinants in Poland - Evidence from Manufacturing Industries. The Role of ICT" TIGER Working Paper Series No. 64 Warsaw, September 2004

[96] Waverman, L. Meschi, M and Fuss, M. Mobile Telecommunications and Economic Growth PPT.(2005) available at: arnic.info/workshop05/Waverman.ppt

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time. Impact of investment, infrastructure development and use on the population of developing countries can occur in a shorter amount of time.[97]

7.8 Future Research

The initial aim of this paper was a mile wide and a mile deep. Having to narrow and simplify the focus repeatedly has resulted in a long list of topics that should be developed further. The majority of these topics are contingent on increasing the accuracy and breadth of data on countries. The World Bank, UN and IMF have pooled a good share of data from developed countries, but many countries in the CEE region are not reporting data. Fortunately one requirement by the EU for accession is to prove financial stability and better records are being kept for this reason. Assuming the data improves, future research topics can include a more comprehensive model which will include social benefits as well as economic. Until then, a similar test can be done with OECD countries, where health, education, financial and telecom factors are well measured and at higher levels. Also, using a systems approach where more endogenous variables are considered and the initial direction of casual relationships is less important than the continual feedback cycle can provide a larger conceptual framework. Such an approach would be less likely to result in a concise result, but rather model interactions often overlooked by policy makers. As mentioned before, a single approach is not sufficient and the tools and access to information is available for those individuals wanting to explore multifaceted approaches. There can be no better goal than sharing wealth gained from the dissemination of knowledge.

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[97] Jipp, A., 1963. Wealth of nations and telephone density. Telecommunications Journal July, 199–201.

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<center>**Appendix**</center>

<center>**Case Studies**</center>

A.1 The Grameen Phone Story

The UN's *Fourth annual report of the Information and Communication Technologies Task Force* stipulated that the challenge of bringing information and communication technologies in developing countries in line to converge with developed countries "Is not a challenge that governments can overcome alone; the private sector and civil society bring unique assets to the table."[98] Private sector development (PSD) has been effective in enabling growth in economically poor countries. One example is the Grameen Telecom's Village Phone or Polli Phone program in rural Bangladesh. As table 3.1 illustrates, when the project started, Bangladesh was one of the least connected countries in the world.

Table A.1 Telephone Main Lines per 100 Inhabitants, 2000

Country	Main Lines per 100 People
Bangladesh	0.34
Pakistan	2.22
India	3.2
Sri Lanka	4.06

<center>Source: ITU Telecommunication Indicators, 2000</center>

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[98] United Nations, "Fourth annual report to Information and Communication and Technologies Task Force" Geneva (May 5 2006). Available at: http://www.unicttaskforce.org/perl/documents.pl?id=1594

<center>54</center>

97% of the country's homes and rural villages were without phone or internet service. This ICT isolation was the result of several factors. Bangladesh has the world's 11th highest population density and much of Bangladesh is rural with two-thirds of the country working in the agriculture sector.[99]Similar to CEECs, the rural population had very little money for basic necessities let alone phone service. Because the cost of running copper lines to these communities was too expensive and the people using the service would be unable to pay for the cost, the monopolistic government provider, Bangladesh Telegraph and Telephone Board, BTTB had little incentive to bring those areas onto the network. It took innovation in finance, information and communication technology and policy to combat these obstacles. Grameen had to overcome several barriers simultaneously.

A.2 Telecom, Finance and Policy

In order to provide phone service in Bangladesh, Grameen had to secure one of the countries four nationwide GSM cellular phone operating licenses. Next Grameen needed to sell services in urban areas to offset the losses incurred by providing rural areas with discounted service. Obtaining the license and selling services in the urban areas was not easy due to the government also being the competition. Grameen overcame the first two obstacles by securing nationwide spectrum licenses. This allowed them to build towers and offer service anywhere in the country. They also secured a national operating license and could use revenue

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[99] United Nations World Population Prospects (2005 revision). Available at http://esa.un.org/unpp

from their urban operations and offset their costs elsewhere. With regulatory protection and faster and less expensive services than BTTB, who had a $450 installation fee and 10 year wait list, Grameen quickly gained a share in the national markets.[100] Taking advantage of the dense geography, Grameen secured long term leases with Bangladesh Railways and within a year had their own nationwide fiber backbone. With the infrastructure in place Grameen began identifying locations for network coverage in each of the rural villages. With GSM wireless technology, a single tower is capable of providing 15 to 20 kilometers of coverage so Grameen had to be selective on where towers were built and what villages would be involved. The implementation would involve gathering potential entrepreneurs, many of which were women, and teach them how to operate the cell phones and how to run a phone service business. These entrepreneurs would then receive loans to purchase the phone and set up businesses in their village. To ensure the entrepreneurs can afford payment on their loans, Grameen has business cadres each payment cycle. At these meetings, Grameen assists anyone who is struggling. From the macroeconomic to microeconomic level, Grameen worked with the regulatory groups to obtain licenses and worked with individuals to ensure sustainable business opportunities.

A.3 Drawbacks of the Village Phone

The two major drawbacks to the Village Phone program are the GSM technology and the high transaction costs charged by BTTB. GSM is more expensive and has half the tower coverage range than the competitors' wireless local loop

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[100] Richardson, D., Ramirez, R. Haw,M. "Grameen Telecom's Village Phone Programme in Rural Bangladesh: a Multi-Media Case Study." Guelph, Ontario: TeleCommons Development Group (2000)

(WLL) technologies. The other problem is the high connection costs. BTTB charged

five times the average amount for transaction costs in order to connect incoming calls

to their local service. Instead of paying this cost Grameen and other wireless

providers were forced to only offer cell to cell calling plans. While this limits calls to

BTTB subscribers, over time this has encouraged the competing wireless providers to

work together and build plans for call to other carriers, thus cutting BTTB out of a

large share of the phone calls. Despite these setbacks the program is considered a

success. In ten years, the program has far exceeded its initial goal of employing

40,000 Village Phone operators and currently has 260,000 Village Phone operators in

over 50,000 villages in the country and 95% of all loans have been repaid. Referring

back to table 4.1, while Bangladesh still trails in teledensity, the growth from 2000 to

2005 is one of the highest in the world. The operators' income from the phones makes

up 24-40% of the household income. In a masculine dominated society, the ability for

women to contribute financially and socially has helped balance gender

empowerment. Policy, technology and finance worked alongside each other at all

levels to make the Grameen case a success.

A.4 Grameen Conclusion

While a GSM phone is not an innovation for most of the developed world, in

underdeveloped countries the use of such a technology is enabling a variety of

opportunities for innovative entrepreneurship. This program serves as a case study for

successful universal service, micro lending, bridging of the digital divide, reducing

gender inequalities and other economic and social benefits. Because these new

business opportunities contribute to the growth of the economy and overall health of

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the area Grameen Telecom's Village Phone program has since been replicated in a number of countries including Uganda and Rwanda.

A.5 Universal Application

While the Grameen story focuses on Bangladesh, the enabling factors in this story are present in other developing countries. As mentioned above, a phone call used to require traveling miles to a neighboring city which is estimated to cost 2 to 8 times the cost of a phone call. This results in saving the rural farmers between $2.70 to $10 USD per call. For the farmers in Bangladesh, the phones have improved their market knowledge and improved their effectiveness in pricing. Having knowledge of exchange rates and real time information on farm prices enables the predominantly agricultural communities to be more competitive while avoiding high transaction costs of having to travel two days to use the neighboring village's phone. In CEECs like Moldova, where agriculture contributes up to 68% of the country's GDP, this savings could contribute to the countries overall economic growth. The majority of the phone calls are business related and often made to coordinate remittance being sent back from family working in other countries. Because many people in Bangladesh work in the neighboring Gulf States, phones are used to reduce the risk involved in remittance transfers. Also because of the high amount of worker remittance into many of CEECs, such calls would improve these transactions as well and have a positive effect at the national level.

A.6 Health and Education

There is a correlation between health and education.[101] There is also a correlation between education and economic growth and health and economic growth. Since significant health and education improvements are made in the area of child development these correlations are not always present unless lag effects are considered. That is to say, a child will grow up with improved health due to increases in health care expenditure or another intervention, but this child's impact on education won't be realized for 5 to 10 years and his or her impact on the economy will not be realized until he or she enters the work force 15 to 20 years after their birth.[102] In order for health to be included as human capital, education must be as well due to the reasons explained above. Without education, health can have a capital shallowing effect and any returns to capital, including human capital, will suffer. A policy to reduce infant mortality rates will increase the number of children therefore, a policy must also be made to educate and employ the next generation. With both policies in place human capital will continue to grow in the long run and countries will converge at a steady state of human capital growth as well as economic.

A.7 Health

The Commission on Macroeconomics and Health places health as one of the most important determinants of a country's economic success.[103] The *World*

[101] Barro, R. "Determinants of Economic Growth: A Cross-Country Empirical Study," NBER Working Papers 5698, National Bureau of Economic Research, Inc (1996).

[102] Bleakley, Hoyt, "Disease and Development: Evidence from Hookworm Eradication in the American South," Quarterly Journal of Economics, February 2007a, 122 (1), 73—117. The study found that children who grow up in a more favorable health environment had higher IQs and lower prevalence of chronic disease and could perform better as students and workers since healthier children are better able to take advantage of schooling through reduced absenteeism and greater mental alertness while at school.

[103] Sachs Jeffrey D. Macroeconomics and Health: Investing in Health for Economic Development. World Health Organization. Geneva, (2001)

Development Report 1993 emphasized that improved health in developing countries, as well as directly improving welfare, is potentially important in boosting productivity and growth.[104] However, there are studies that found an increased life expectancy can have little or even a negative effect on economic growth.[105] As people live longer and more children are born, the population grows. This increase in population hurts growth in two ways. Most obviously since GDP per capita is a measure of earnings per person, as the population increases, productivity and capital must also grow to meet or exceed the population growth or else GDP per capita will decrease. Aside from an increase in numbers, the increase in life expectancy and number of children creates a greater ratio of an unemployed population since most children and elderly do not work. This again puts more burden on the working population to increase productivity. However, these similar studies found that when education was combined with improved health there was a productivity increasing effect. Education can have a population reducing effect since female school attainment has an inverse relationship with fertility rates. Education also provides information on family-planning options.

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[104] World Bank, World Development Report, pp. 17-21.(1993)
[105] Ashraf, Quamrul, Lester, Ashley and Weil, David N.,When Does Improving Health Raise GDP?(October 2008). NBER Working Paper No. W14449. Available at SSRN: http://ssrn.com/abstract=1294124

**Graph 1 Correlation of GDP Per Capita and Predictors Variables**
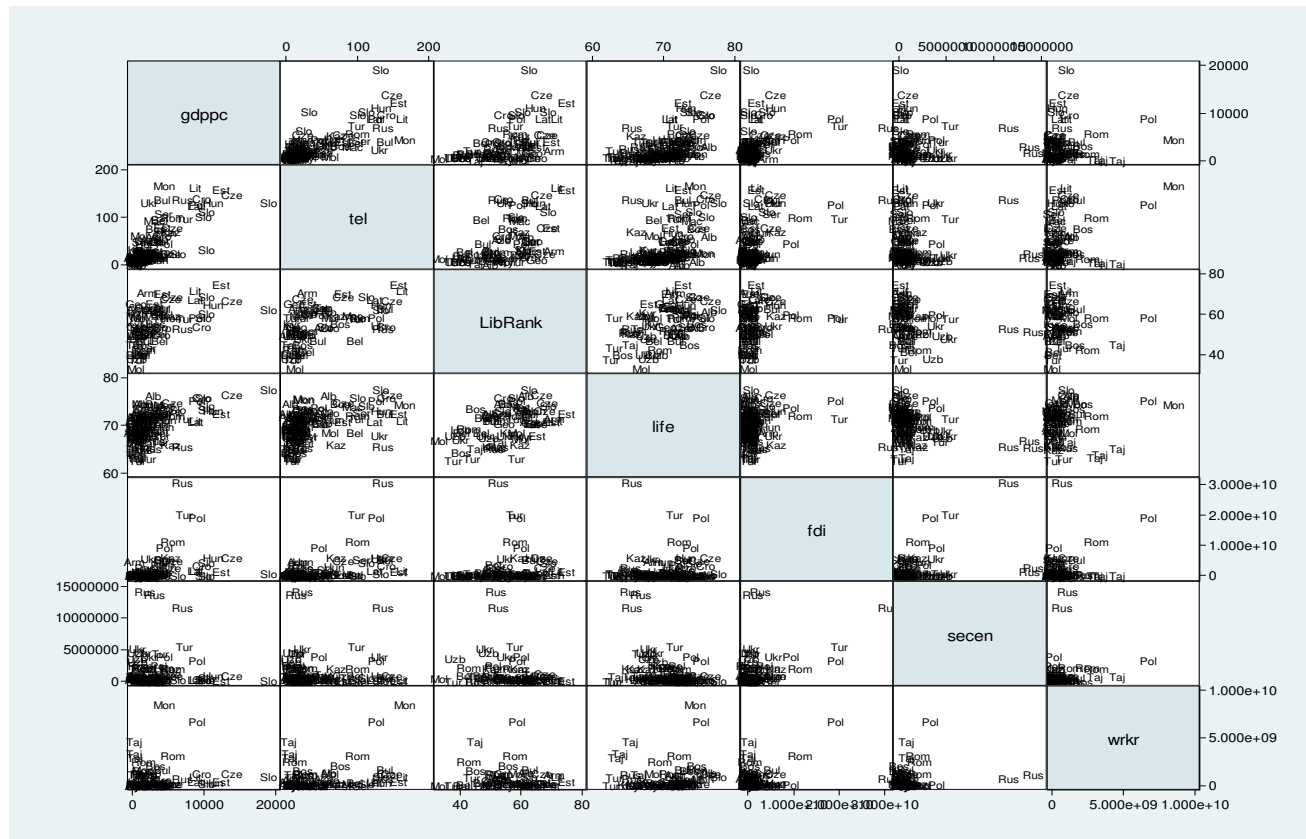
Graph 2 Correlation of GDP Per Capita and Predictors Variables Non-Oil/Gas/Coal Net Countries
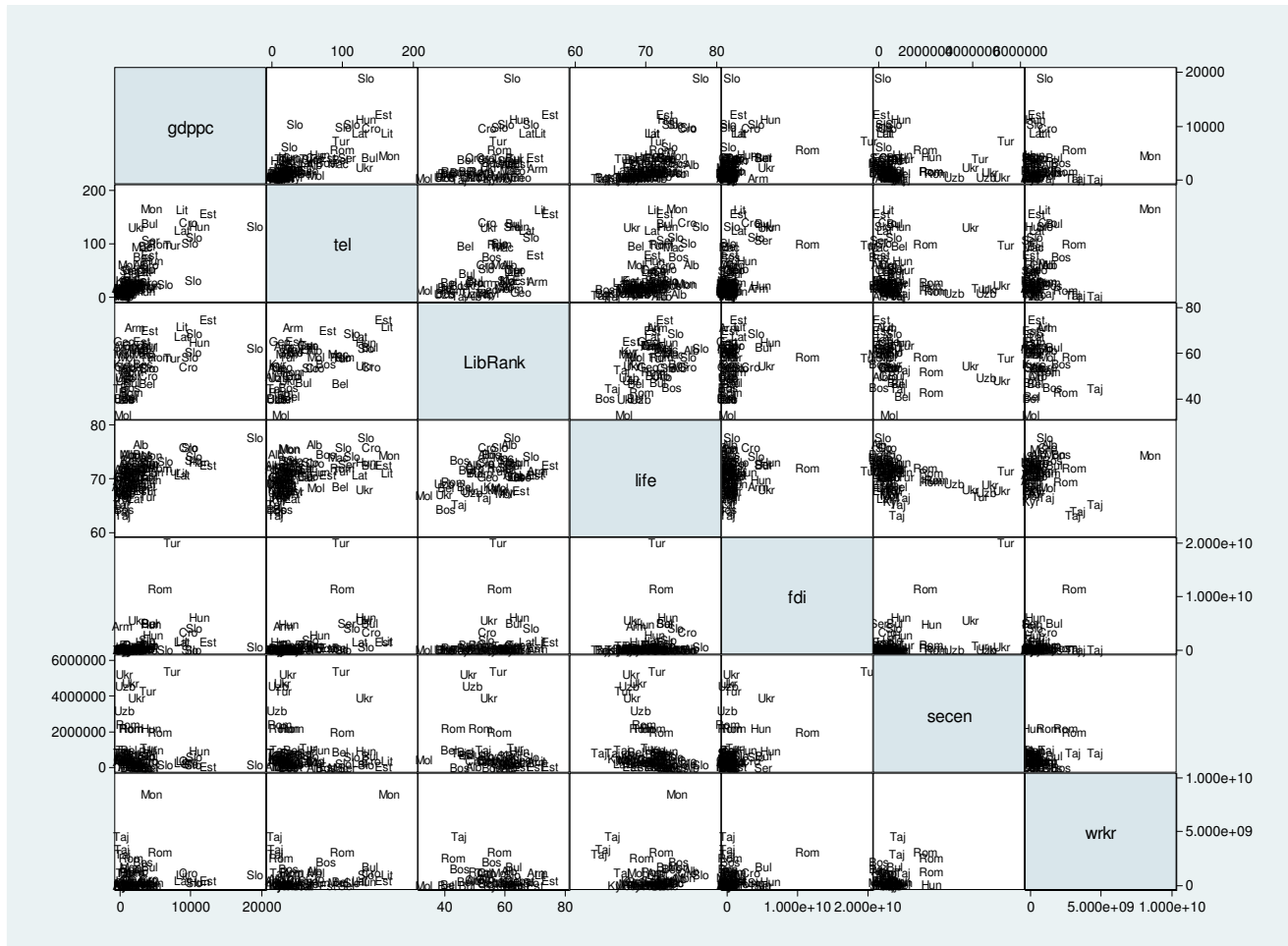
Graph 3 Correlation of GDP Per Capita and Predictors Variables Non-War Countries
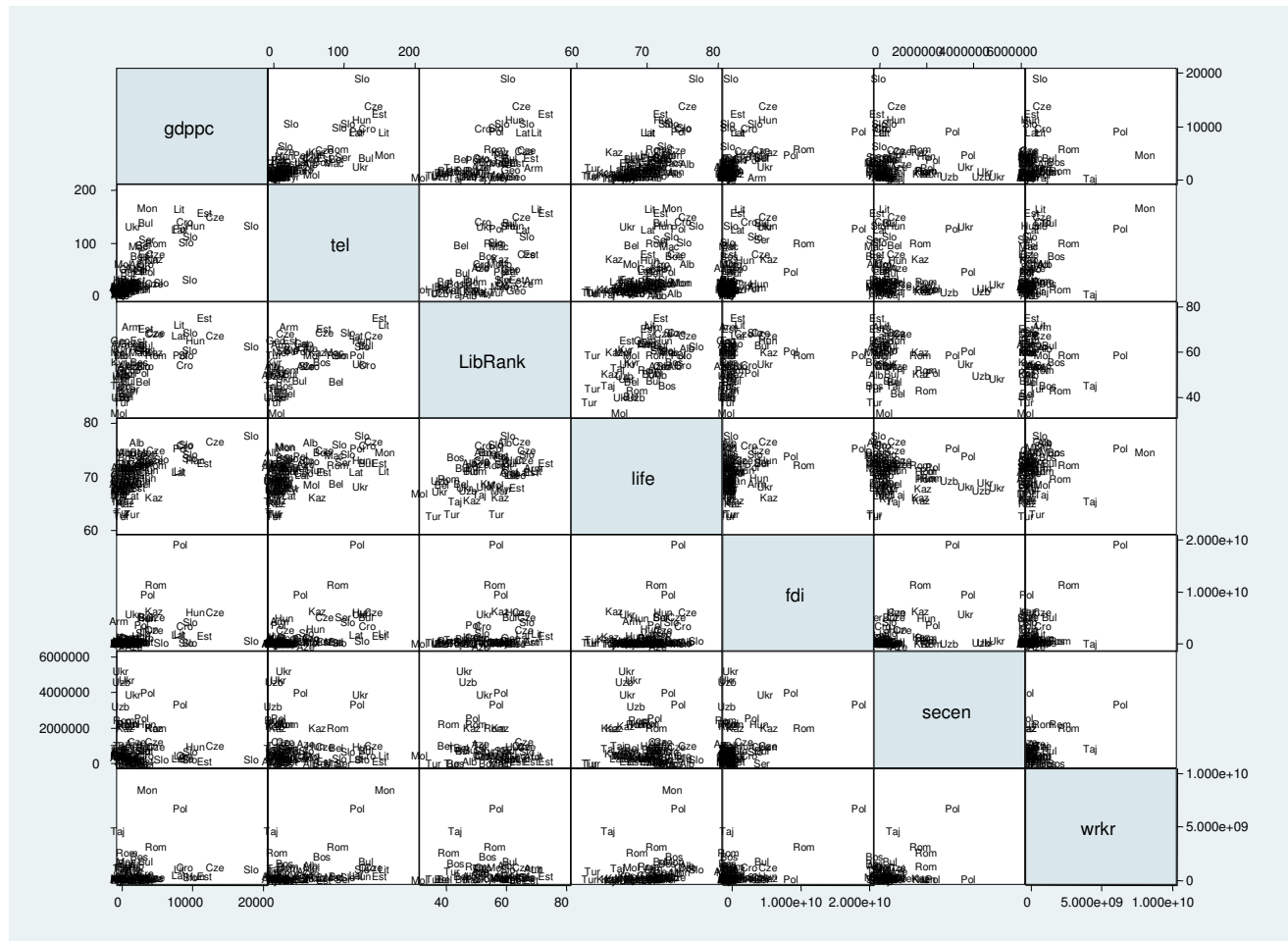
Table 4.2 Heritage Foundation Index of Economic Freedoms

Business freedom	The ability to create, operate, and close an enterprise quickly and easily. Burdensome, redundant regulatory rules are the most harmful barriers to business freedom.
Trade freedom	A composite measure of the absence of tariff and non-tariff barriers that affect imports and exports of goods and services.
Fiscal freedom	A measure of the burden of government from the revenue side. It includes both the tax burden in terms of the top tax rate on income (individual and corporate separately) and the overall amount of tax revenue as a portion of gross domestic product(GDP).
Government size	Defined to include all government expenditures, including consumption and transfers. Ideally, the state will provide only true public goods, with an absolute minimum of expenditure.
Monetary freedom	Combines a measure of price stability with an assessment of price controls. Both inflation and price controls distort market activity. Price stability without microeconomic intervention is the ideal state for the free market.
Investment freedom	An assessment of the free flow of capital, especially foreign capital.
Financial freedom	A measure of banking security as well as independence from government control. State ownership of banks and other financial institutions such as insurer and capital markets is an inefficient burden, and political favoritism has no place in a free capital market.
Property rights	An assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state.
Freedom from corruption	Based on quantitative data that assess the perception of corruption in the business environment, including levels of governmental legal, judicial, and administrative corruption.
Labor freedom	A composite measure of the ability of workers and businesses to interact without restriction by the state.

*Each of the 10 indicators is given equal weighting 1-10 and contribute to the overall score of 1-100. Data is collected per anum, but such indicators as monetary freedom consist of weighted averages over three years. For a complete list of sources used to develop index consult the Methodology: Measuring the 10 Economic Freedoms available at: http://www.heritage.org/research/features/index/chapters/pdf/Index2008_Chap4.pdf

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Table 4.3 Human Development Ranking

Human Development Report 2007/2008										
		HDI Trends				**Population, total (millions)**			**Population, annual growth rate(%)**	
HDI Rank	Country	1990	1995	2000	2005	1975	2005	2015b	1975-2005	2005-15b
High Human Development										
27	Slovenia	0.851	0.857	0.891	0.917	1.7	2	2	0.5	(.)
32	Czech Republic	0.845	0.854	0.866	0.891	10	10.2	10.1	0.1	-0.1
36	Hungary	0.813	0.817	0.845	0.874	10.5	10.1	9.8	-0.1	-0.3
37	Poland	0.806	0.822	0.852	0.87	34	38.2	37.6	0.4	-0.2
42	Slovakia	..	..	..	0.863	4.7	5.4	5.4	0.4	(.)
43	Lithuania	0.827	0.791	0.831	0.862	3.3	3.4	3.3	0.1	-0.5
44	Estonia	0.813	0.792	0.829	0.86	1.4	1.3	1.3	-0.2	-0.3
45	Latvia	0.804	0.771	0.817	0.855	2.5	2.3	2.2	-0.2	-0.5
47	Croatia	0.812	0.805	0.828	0.85	4.3	4.6	4.5	0.2	-0.2
53	Bulgaria	0.794	0.785	0.8	0.824	8.7	7.7	7.2	-0.4	-0.8
60	Romania	0.777	0.772	0.78	0.813	21.2	21.6	20.6	0.1	-0.5
64	Belarus	0.79	0.755	0.778	0.804	9.4	9.8	9.3	0.1	-0.6
66	Bosnia and Herzegovina	..	..	..	0.803	3.7	3.9	3.9	0.1	(.)
67	Russian Federation	0.815	0.771	0.782	0.802	134.2	144	136.5	0.2	-0.5
68	Albania	0.704	0.705	0.746	0.801	2.4	3.2	3.3	0.9	0.6
69	Macedonia (TFYR)	..	..	..	0.801	1.7	2	2	0.6	(.)
	Averages	**0.803923**	**0.792077**	**0.818846**	**0.843125**	Total excluding Russia	**125.7**	**122.5**	**2.8**	**-3.9**
	Percent Increase (1992-2005)(%)	**4.65%**								

Table 4.3-Continued

Medium Human Development										
73	Kazakhstan	0.771	0.724	0.738	0.794	14.1	15.2	16.3	0.2	0.7
76	Ukraine	0.809	0.756	0.761	0.788	49	46.9	43.4	-0.1	-0.8
83	Armenia	0.737	0.701	0.738	0.775	2.8	3	3	0.2	-0.1
96	Georgia	..	..	..	0.754	4.9	4.5	4.2	-0.3	-0.7
98	Azerbaijan	..	..	..	0.746	5.7	8.4	9	1.3	0.8
109	Turkmenistan	..	..	..	0.713	2.5	4.8	5.5	2.2	1.3
111	Moldova	0.74	0.684	0.683	0.708	3.8	3.9	3.6	(.)	-0.6
113	Uzbekistan	0.704	0.683	0.691	0.702	14	26.6	30.6	2.1	1.4
116	Kyrgyzstan	..	..	..	0.696	3.3	5.2	5.8	1.5	1.1
122	Tajikistan	0.703	0.638	0.64	0.673	3.4	6.6	7.7	2.1	1.6
	Averages	**0.744**	**0.697667**	**0.7085**	**0.7349**					
	Percent Increase (1992-2005) (%)	**-1.24%**				**Total**	**125.1**	**129.1**	**9.2**	**4.7**

Notes:

a.The HDI rank is determined using HDI values to the sixth decimal point.

b.Data refer to medium-variant projections.

Source: :UN (United Nations). 2007e. World Population Prospects 1950-2050: The 2006 Revision. Database. Department of Economic and Social Affairs, Population Division. New York. Accessed July 2007.

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Table 4.4 Variables and data sources New Economy Indicators

Factor	Variable	Source
1. Quality of regulations and contract enforcement	Sum of World Bank Regulatory Quality and Rule of Law Indicator*	Kaufmann et al. (2003)
2. Infrastructure	Sum of total number of telephone lines (main and cellular) and PCs per 1000 persons	WDI 2003
3. Trade openness	Share of trade in GDP (in %)	WDI 2003
4. Development of financial markets	Domestic credit to private sector (% of GDP)	WDI 2003
5. R&D spending	Annual R&D spending (% of GDP)	Eurostat 2003
6. Quality of human capital	Public spending on education (% of GDP)	Eurostat 2003
7. Labour market flexibility	Unemployment rate (in %)	WDI 2003
8. Product market flexibility	Product market regulation indicator (Nicoletti et al. 2000)**	EBRD 2003
9. Openness to foreign investment	FDI (% of GDP)	WDI 2003
10. Macroeconomic stability	Inflation (CPI) (in %)	WDI 2003

*Regulatory Quality and Rule of Law are available for 1996, 1998, 2000 and 2002. 1995 was assumed to equal 1996; 1997, 1999 and 2001 were calculated as averages of 1996-98, 1998-2000 and 2000-02, respectively.

** The indicator to Slovakia is assumed to equal the Czech Republic's, while Slovenia's score equals the value for Hungary. Indicators for Bulgaria, Romania, and Russia are based on the score for Poland multiplied by 1.20 on the basis of the "Competition Indicator" from EBRD 2003.

Table 4.5 Discussion of ICT indicators used by the World Bank in KAM (2002)

	Indicator	Pro	Contra	Decision	Weight
1.	telephones (both telephone mainlines and mobile phones)	very universal and important	contains two next indicators	eliminate in favour of next indicators	0
2.	telephone mainlines	still important	indicator no. 3 more important for ICT	May be used	0,75
3.	mobile phones	very important	Lack of data for least developed countries	Use with higher weight	1.5
4.	computers	very important	Relatively "old" invention (PCs of 1980s)	May be used	1.0
5.	TV sets	Important, especially for developing countries	Old invention, its importance decreases	Use with smaller weight	0.25
6.	radios		"old" economy invention; not important nowadays, better use internet radios	Eliminate	0
7.	daily newspapers	Describes information society	"old" economy invention, old data (of 1996), (better would be e.g. no. of internet portals)	Eliminate	0
8.	investment in telecom	Important, shows catching-up process	Ambiguous results (see fig. 2); better use ICT expenditures; doubts on quality of source*	Eliminate	0
9.	rating of computer processing power	Shows development of computers (not by their number, as indicator no. 4, but by their power)	Very high concentration in the U.S.; rarely used in other methodologies; strongly biased by size of population – contrary to the level of computerisation of economy; lack of data	Use with very small weight or eliminate	0
10.	internet hosts	Very important	Problems with counting	Higher weight	1.75
11.	international telecommunications, cost of call to US	Important	Shows competition on telecom market and state regulation (more proper for category of regulations); favours U.S. neighbours	Use with smaller weight	0.5
12.	information society index	Important for KBE	Society-related index, rather ICT one (more proper for category of KBE foundations)	Eliminate	0
13.	e-government	Very important, shows gov. approach to ICT	View of government websites from the firm (not personal usage) point of view	Use with higher weight	1.25
14.	ICT expenditure	Extremely important		Use with higher weight	2.0

Notes:

* Data according to IMD obtained from Siemens International Telecom Statistics and from national sources present state-owned and private company.

Table 6.1 Telecom and Education Regression

	Telecom and Education		
Independent Variable	Estimated Coefficients		
	Regression(i)All	Regression(ii) Non-oil/gas/coal	Regression(iii) Non-war
Teledensity	59.82	67.6	73.31
	[8.47]	[10.25]	[10.96]
Secondary Enrolment	0.00007	0.00059	0.00037
	[0.00009]	[0.00020]	[0.00015]
Combination of Telecom and Enrolment	0	0	0
	[0.00]	[0.00]	[0.00]
Constant	750.12	138.61	222.5
	[245.03]	[330.49]	[304.45]
Observations	94	71	77
R-squared	0.64	0.61	0.65

Robust standard errors in brackets
Source: 2008 The World Bank Group

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Table 6.2 Telecom and Foreign Direct Investment Regression

Independent Variable	Telecom and Foreign Direct Investment		
	Estimated Coefficients		
	Regression(i) All	Regression(ii) Non-oil/gas/coal	Regression(iii) Non-war
Teledensity	61.34	62.65	62.69
	[10.13]	[11.87]	[11.48]
Foreign Direct Investment	0	0	0
	[0.00000]	[0.00000]	[0.00000]
Combination of Telecom and Foreign Direct Investment	0	0	0
	[0.00]	[0.00]	[0.00]
Constant	872.06	709.37	747.75
	[204.35]	[270.55]	[208.61]
Observations	104	78	85
R-squared	0.65	0.61	0.64

Robust standard errors in brackets
Source: 2008 The World Bank Group

Table 6.3 Telecom and Foreign Direct Investment Regression Where FDI > 5% of GDP

Independent Variable	Telecom and Foreign Direct Investment		
	Estimated Coefficients		
	Regression(i) All	Regression(ii) Non-oil/gas/coal	Regression(iii) Non-war
Teledensity	105.93	120.34	104.93
	[14.81]	[15.57]	[14.90]
Foreign Direct Investment	0	0	0
	[0.00000]	[0.00000]	[0.00000]
Combination of Telecom and Foreign Direct Investment	0	0	0
	[0.00]	[0.00]	[0.00]
Constant	-3930.82	-5968.1	-3744.79
	[1160.87]	[2392.14]	[1145.62]
Observations	33	27	32
R-squared	0.76	0.76	0.74

Robust standard errors in brackets

Source: 2008 The World Bank Group

Table 6.4 Telecom and Liberalization Regression

Independent Variable	Telecom and Liberalization		
	Estimated Coefficients		
	Regression(i) All	Regression(ii) Non-oil/gas/coal	Regression(iii) Non-war
Teledensity	25.97	23.82	23.82
	[9.82]	[10.77]	[10.77]
Liberalization	14.51249	11.25457	11.25457
	[21.15556]	[24.04048]	[24.04048]
Combination of Telecom and Liberalization	25.06	28.59	28.59
	[8.82]	[9.11]	[9.11]
Constant	1,107.17	1,284.62	1,284.62
	[1,006.81]	[1,101.67]	[1,101.67]
Observations	71	59	59
R-squared	0.63	0.54	0.61

Robust standard errors in brackets

Source: 2008 The World Bank Group

Table 6.5 Telecom and Worker Remittance Regression

Independent Variable	Telecom and Worker Remittance		
	Estimated Coefficients		
	Regression(i) All	Regression(ii) Non-oil/gas/coal	Regression(iii) Non-war
Teledensity	69.51	80.1	67.44
	[10.60]	[13.61]	[10.44]
Worker Remittance	0	0	0
	[0.00000]	[0.00000]	[0.00000]
Combination of Telecom and Worker Remittance	0	0	0
	[0.00]	[0.00]	[0.00]
Constant	[259.16]	[315.16]	[342.26]
	94.69	-115.35	-41.68
Observations	[315.97]	[304.87]	[542.81]
R-squared	0.70	0.69	0.71

Robust standard errors in brackets

Source: 2008 The World Bank Group

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Table 6.6 FDI and Liberalization Regression

Independent Variable	FDI and Liberalization		
	Estimated Coefficients		
	Regression(i)All	Regression(ii) Non-oil/gas/coal	Regression(iii) Non-war
	GDP Per Capita	GDP Per Capita	GDP Per Capita
Foreign Direct Investment	0	0	0
	[0.00]	[0.00]	[0.00]
Liberalization Score	34.9252	-10.13558	-19.78292
	[24.87298]	[23.68531]	[26.81648]
Combination of FDI and Liberalization	0	0	0
	[0.00]	[0.00]	[0.00]
time00	-2,507.31	-2,819.76	-2,569.76
	[689.37]	[718.08]	[900.07]
time95	-2,337.24	-2,530.64	-2,976.50
	[808.09]	[838.70]	[1,083.91]
Constant	2,721.75	5,311.51	6,150.31
	[1,651.47]	[1,697.97]	[2,490.06]
Observations	71	59	52
Overall R-Square	0.39	0.36	0.29

Robust standard errors in brackets
Source: 2008 The World Bank Group

Table 6.7 Health and Education Regression

Independent Variable	Health and Education		
	Estimated Coefficients		
	Regression(i)All	Regression(ii) Non-oil/gas/coal	Regression(iii) Non-war
	GDP Per Capita	GDP Per Capita	GDP Per Capita
Life expectancy	632.13	846.94	663.2
	[165.26]	[303.62]	[226.09]
Secondary Enrolment	0.00018	0.00804	-0.00565
	[0.00010]	[0.00688]	[0.00603]
Combination of Life and Enrolment	0	0	0
	[0.00]	[0.00]	[0.00]
Constant	-42,634.96	-57,859.96	-45,115.49
	[11,486.98]	[21,243.05]	[15,762.01]
Observations	93	70	76
Overall R-Square	0.47	0.44	0.49

Robust standard errors in brackets
Source: 2008 The World Bank Group