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ARMENIAN INFORMATION TECHNOLOGY SECTOR

INDUSTRY GROWTH MODEL

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Preface

This Report has been prepared by the Economy and Values Research Center (www.ev.am) for the Enterprise Incubator Foundation.

The purpose of this paper is to assess key drivers of the Armenian IT industry and develop its growth scenarios in mid-term perspective. EV built econometric models and applied other analytical tools for quantitative assessments. The major building blocks of the Report are:

- analysis of key trends in the global IT market and its implications for Armenia,
- empirical revenue generation model for software and services sectors, which is employed to estimate sector scenarios until 2011. The scenarios are based on estimates of key industry parameters and, specifically, labor supply scenarios,
- development of Internet services sector (ISP) scenarios in 2011,
- development of aggregated Armenia's IT industry growth scenarios until 2011,
- assessment of impact of major cross-cutting factors such as infrastructure, regulatory environment, availability of venture capital, the quality of math and science education, etc.
- identification of three development models for the IT industry, based on experience of other successful countries, and the priorities within each model.

Executive Summary

Key Trends in Global IT Industry

The global outsourcing market is expected to grow substantially both in terms of business revenues, (from $130bln. in 2006 to around $185bln. in 2010 according to Forrester) and jobs, (the United States and the United Kingdom together alone will outsource 885,200 jobs by 2010); the major flow going from advanced to developing countries.

The competition for getting offshore-outsourced contracts among developing countries will become much more intense. As a result of this severe competition, niche markets for specific types of offshore-outsourced services have emerged based on culture/linguistic similarities, favorable regulations of source markets and capability to develop sophisticated products.

The competitive advantages accumulated through early entry, continuous buildup and clear positioning, seem to be hard to match for new entrants, resulting in tough competition in lower-end segments.

In the short-run, the rising salaries of IT specialists in the developing countries as a result of maturing local IT industries will put additional pressure on major countries competing in outsourcing markets.

To stay competitive over time, the quality of IT education is becoming a key factor for major outsourcing destinations to move to new lucrative segments and capture specific niches that are less cost-sensitive.

Armenia's Challenges and Choices

The Armenian IT industry experienced a rapid growth in the last decade and has become one of the most dynamic and internationally competitive sectors of the Armenian economy.

However, the industry, the growth of which was spurred mainly by cost-driven outsourcing ("branch outsourcing"), is currently facing maturity and significant competitive pressures as the local salaries are approaching those of other low cost countries. This may push Armenia into the trap of losing to other destinations over the long-run, if the competitive model is not modified.

The scarce and limited labor supply will be the major constraint for the future growth of the industry. However, additional factors such as the lack of recognition as an outsourcing destination, the poor quality of developed specialized infrastructure and the low level of sophistication of business operations and strategies are considered to be key challenges.

Given the global trends and current challenges of the Armenian IT industry, the development path will be largely dependent on strategic choices that the key industry stakeholders will make now. The choices should be based on the understanding of major factors influencing the growth of the industry and different possible **scenarios**.

Software and Services Revenue Generation Empirical Model

In order to develop the industry's scenarios, we developed an econometric model of the software and services sector. We considered two subsectors (Internet services (ISP) and software and services) separately. The driving forces and key "production factors" are different for the two mentioned sectors.

The empirical revenue generating model for the software and services sector was constructed and applied under different scenarios estimating key industry parameters in 2011 based on supply side factors and company characteristics.

The model used company level cross section data for 2005.

The empirical model reflected the reality of performance differences ingrained in company specific characteristics such as ownership status, market focus, company size, staff qualification. The performance stems not only from pricing mechanisms, but also scale efficiencies, flexibility and adaptability to market conditions, ability to develop sophisticated products, etc.

The logarithmic form of the following function has been estimated in the model:

TR= f (L, S, FO, E, CS)

TR= total annual revenue

L= number of full-time employees

S = skills level

FO= share of foreign ownership

E = share of export in total revenue

CS= Company size

Labor Supply Estimates

Labor Supply Estimates

Since the key endogenous variable in the model is labor supply, we estimated its level under three scenarios in 2011.

The Armenian IT labor market simultaneously experiences both "shortages" and "surpluses", occurring because of skill mismatches, hence the inadequate quality of education in Armenia. Despite the remarkable increase in the number of IT department graduates, the workforce still remains the impeding factor for further industry expansion. The quality of IT education does not comply with internationally recognized standards and even the needs of local companies. It forces companies to make additional investments in the labor force. Highly qualified IT specialists do not consider entering academia as an option, due to the low levels of remuneration. According to our calculations the gap is measured as 1,384,320 USD annually.

Our calculations show that the government's investment in the education of today's IT students will have a certain payoff in just 7 years' time and start to generate net profit thereafter. The government may consider the costs of funding higher education students in the IT field as *investments in human resource development* and the return on investments will take the form of tax payments calculated per employee of the IT sector companies. A three-fold increase in the annual per-student spending (for improvement of the quality of education) will still leave the government with a gain in terms of tax amounts in a 10 year timeframe.

Software and Services Sector Scenarios

Trap of current model scenario assumes that the quality of education in IT departments decreases over time relative to market demand, as government investments and incentives are not sufficient for staff renewal and the aging problem gets more acute. The total IT workforce will only be 6601. Therefore, the industry will develop with the inertia of its early acceleration; no major initiatives will take place to change the competitive model. Even under this

scenario, the industry will continue to grow, however, at a slow pace. The number of companies will grow modestly; takeovers and acquisitions may be observed in selected cases to tap into the limited pool of IT specialists. ***The industry revenue will reach roughly 102 mln. USD in 2011.***

Maneuvering in the niche market scenario assumes that the government spending on education stays the same and the quality of education does not improve significantly, while the private sector's educational initiatives remain rare cases. The IT workforce in 2011 will reach 7187. Armenia will exploit cost-quality characteristics of its IT labor force attracting new foreign players and modestly improving labor quality and supply. New entry will take place faster, takeovers and acquisitions will be marginal, and outsourcing orientation will deepen, especially through establishing branches by foreign companies. ***The industry revenue will reach 150 mln. USD in 2011.***

Strategic positioning scenario assumes that the government will increase the investments in the education sector resulting in a significant increase in the quality and a decrease in the gap between the skill mismatch for the labor demand and supply. The academia will also foster significantly the creation of "employer-led" education, where the representatives of major companies will be responsible for designing, approving and implementing the detailed contents of vocational qualifications. The creation of international-level training and certification centers will be enhanced. The government will recognize the alternative source of recruitment for the IT sector - the graduates from IT related departments. Thus the total IT workforce will reach the high of 8556 in 2011. Concerted efforts of public and private sectors will lead to clear strategic positioning of Armenia's IT industry with unique value proposition, the recognition of "Armenian IT" brand worldwide and clear articulation of Armenia's competitive advantage. The government will undertake targeted FDI promotion to attract IT MNCs into Armenia and will initiate several programs to equip local companies with modern knowledge of marketing, management, and the introduction of international standards. The venture capital industry may take shape through targeted government efforts and support for the industry. ***The industry revenue will reach roughly 221 mln. USD in 2011.***

ISP sector development scenarios

Four key drivers will influence the ISP sector development in 2007-2011:

1. Complete liberalization of the telecom market,
2. Market expansion,
3. Industry re-shuffle through investments, acquisitions and alliances,
4. Expansion of new technologies and transformation of market boundaries.

Stuck in Digital Negligence scenario assumes that the inertia of the recent situation in Internet access and usage by the government, business and society at large will not be overcome and will determine the growth path in the coming 4-5 years. The rural population will be mostly detached from Internet access. Growth will come mainly from advanced businesses, the mobile strata of the urban population and international projects. The demand for Internet will be constrained by slump household income growth, low PC penetration growth rates as well as low levels of investments in infrastructure. ***The industry revenue will reach 12.1 mln. USD in 2011, and the total number of employees in the sector will reach 600.***

Bottleneck Removal scenario assumes that the data transfer market in Armenia will grow significantly in the first two years as a result of demolition of ArmenTel monopoly in this sphere. The growth logic will look similar to removing a bottleneck from the process or fixing the consequences of a traffic

jam. The demand for internet will follow general development trends congruent with average CIS countries track records where there were no significant limitations on competition. ***The industry revenue will reach 21.2 mln. USD in 2011, and the total number of employees in the sector will reach 850.***

E-society Leadership scenario assumes proactive and aggressive strategies employed by the government and business. This implies adoption of an e-society development model supported by rising household incomes. The e-governance strategy backed by significant resource commitments may become a real instrument for breakthrough. The demand for internet will grow at even more rapid paces, as the market demand has been mature for a long time already, without sufficient supply. This will result in greater consumption rates and Armenia will take a leadership position in CIS and closely approach average usage indicators of CEE countries. ***The sector revenue will reach 27.4 mln. USD in 2011, and the total number of employees in the sector will reach 950.***

Impact assessment of cross-cutting factors

The development of the IT sector is also influenced by industry-wide (not company-specific) factors. In particular, we focus our attention on the country level impact of availability of skilled IT specialists, the quality of the political, regulatory, and infrastructural environment, venture capital availability, and the quality of education. The influence of these factors on the growth of the IT sector has been tested through constructing an IT export model based on aggregated, country-level data for major IT exporting countries.

Cross-country IT export empirical model

A rich pool of highly-qualified/ certified IT specialists, high quality of political and regulatory environment and availability of venture capital affects the current level of IT export across the globe However, different results were observed between the digitally developed and underdeveloped world. The availability of a pool of internationally certified IT specialists and venture capital play a significant role in boosting exports from countries with high ITC penetration rate and usage. However, for countries with a lower level of ICT development (including Armenia), the number of certified IT specialists and the quality of political and regulatory environment determines the level of IT exports.

Given the current stage of domestic ICT development, most important enabling factors for the growth of Armenia's IT export and overall IT industry are the supply of quality IT specialists and the general regulatory environment. The number and quality of IT specialists is an absolute necessity for the industry, while stable and improving political and regulatory system is the "framework" or a basic condition that opens the doors of opportunities.

However, as Armenia moves to the next stage of ICT development, it needs to think of different factors that ensure the success of countries in more developed and mature stages. One of the key factors will be the establishment, attraction and effective functioning of venture capital funds and R&D centers (techno parks, technology business incubators), which will fund and support innovative projects in Armenia.

Successful development models and Armenia's choice

Based on the analyses of the experience of countries that succeeded in developing IT industries in relatively short periods of time, we highlighted three competitive development models labeled as follows:

1. ***Platform for regional expansion (e.g. Ireland, Egypt)***
2. ***High tech power center (e.g. Israel)***
3. ***Information society (e.g. Estonia)***

The success of each model rested on a unique set of factors, and the combination of public-private partnership, and government-led programs.

Platform for regional expansion model implies that countries following this model have successfully positioned themselves in the global market as platforms for global players to penetrate into large regional markets. They provided advantages for global companies to serve targeted regional markets more effectively. Through creation of a favorable business environment, provision of highly skilled labor and the development of necessary infrastructure, they managed to become attractive investment destinations for mostly market seeking FDI's in regional markets. This was leveraged by various types of fiscal and financial incentives. Cultural and language similarities have also supported the process.

High tech power center model implies developing advanced technology and science-based clusters and infrastructure. The value proposition to leading technology MNCs includes unique and sophisticated competences for their global value chains. The model, to a large degree, rests on the creation of a highly skilled workforce pool able to develop and design innovative and sophisticated products and services. Creation of world-class science and technology schools, improvement of quality of math and science education in public schools and heavy investments in R&D (both public and private) are the most critical factors determining the success of this model. Government initiatives, such as fiscal and financial incentives for R&D and high-tech export oriented products development, coupled with business development skills through technology incubator programs attract global venture capital to fund risky innovative start-ups. Solid and effective financial markets (especially stock markets) should be in place to support business initiatives and, particularly venture capital exit strategies.

Information society model implies a clear positioning as an ICT enabled tools/applications development or processing center. The IT sphere initially develops as a result of internal infrastructure growth and domestic demand. The main drivers of the model are government-led initiatives such as e-governance, so-called e-society projects, heavy investment in ICT and telecom infrastructure and promotion of ICT use in the country through school connectivity, internet access centers, and computer literacy trainings, etc. Legislative changes are necessary regarding adoption of e-business practices and use of on-line government services (on-line tax filing, on-line public procurement, etc). The increase of local demand drives the future of the IT sector and development of new innovative, ICT-enabled services and products that later are marketed in foreign markets. The general computer literacy and Internet/PC penetration rate of the society determine the level of the success of the model.

Summary of Key Estimated Indicators of the Armenian IT industry

Indicator	Current state 2006	Scenario 1.1. 2011	Scenario 2.2. 2011	Scenario 3.3. 2011
Total industry revenue, million USD	71	115	171	248
Revenue CAGR, 2006-2011		*10.0%*	*19.2%*	*28.3%*
Number of companies	150	172	205	224
Number of companies CAGR, 2006-2011		*2.8%*	*6.4%*	*8.4%*
Number of employees	4 156	7 201	8 037	9 506
Number of employees CAGR, 2006-2011		*11.6%*	*14.1%*	*18.0%*
Taxes, million USD	12	26	33	42
Taxes, CAGR, 2006-2011		*17.0%*	*22.6%*	*29.2%*
Productivity, USD	17 143	15 903	21 303	26 103

CHAPTER 1: GLOBAL IT TRENDS AND ARMENIA'S STANCE

1.1 Key Trends in Global Software and Services Industry

The global outsourcing market is expected to grow substantially, both in terms of business revenues and jobs, the major flow going from advanced to developing countries. According to Forrester the global outsourcing market will grow from $130bln. in 2006 to around $185bln. in 2010 at 7% average annual growth rate. Out of 3.3 million business possessing jobs ($136 billion in terms of wages) outsourced offshore by 2015 in the US, 473,000 are expected to be IT-related jobs. For EU-15 countries the Forrester expects 150,000 IT jobs to go offshore by 2015 (CBI, 2006) (see Appendix 1, Tables 1-3). The United States and the United Kingdom alone will outsource 885,200 jobs by 2010. According to Gartner the European company outsourcing spending is expected to grow by 50% year on year in 2006 and 2007, and globally the number of companies practicing high levels of offshore outsourcing is expected to increase from 13 to 20% in the next 2 years.

The wide spread shortage of skilled IT specialists in the 1990s in North America and Europe, partially curbed through favorable working permits regimes in the most advanced countries, will be further compensated for by offshore outsourcing and moving parts of operations into lower cost destinations. In the 1990s, the developed world was facing the challenges of severe shortages of labor. In Europe alone, it was estimated that the industry was short of around 500,000 employees in 2000. The US and Japan were facing serious shortages as well. To partially curb this problem in the second half of the 1990s and in the early 2000s the number of working permits granted to foreigners, especially IT specialists, in the developed world was growing rapidly. However, in 2004, in the US the ceiling for IT specialist H-1B visas was reduced from 195,000 to 65,000. In France, the number of working permits granted for 2002, reduced dramatically. In 2003, instead of the quota of 20,000, less than 15,000 Green Cards were granted by Germany to IT Specialists. IT-related professions were removed from "occupational shortage list" in late 2002 in the UK (OECD, 2004). The "Software factory" phenomenon was emerging in other locations, in the forms of subsidiaries and offshore outsourcing. In 2003 alone, the United States and the UK outsourced 273,000 IT jobs (Evalueserve, 2004)

The competition for getting offshore outsourced contracts among developing countries will become much more intense. More and more countries are attempting to become attractive outsourcing destinations for large Western multinationals. The rapid growth of the industry and the example of a few highly successful developing countries trigger further interest. Many developing countries are making efforts to be established as low-cost "knowledge factories" for European and North American companies. Eastern Europe, China, and CIS are competing to benefit from their low cost, but under-utilized, software skills to form collaborative links with western companies seeking cheap, "offshore" software expertise.

Niche markets for specific types of offshore outsourced services emerged based on culture/linguistic similarities, favorable regulations of source markets, capability to develop sophisticated products. In Europe the leading outsourcer is the UK. This position in comparison to Germany and France is explained by the labor regulations favoring outsourcing. In 2003 alone, the outsourced market share surpassed $800 million (95% went to India) (*Miller and Codling, 2003*). In 2004, off-shoring was mostly practiced by American

and British companies (internal operations and outsourcing to third parties), particularly in Ireland, Canada and India. Among the factors favoring these locations were employment laws, cultural similarities and knowledge of English. In the case of European Multinational Corporations (MNCs), factors favoring the choice of Eastern and Central European countries were linguistic similarities, geographical and cultural proximity, high levels of technical ability, etc. Nordic countries favor Eastern Europeans and Baltic countries. Morocco and Tunisia are attractive off-shore outsourcing destinations for France due to the knowledge of French. The Czech Republic, Hungary, Poland, Slovakia, Russia, Bulgaria, the Baltic States, Egypt, Morocco and South Africa are potential near-shore destinations for the EU market, because of cultural and linguistic similarities.

Competitive advantage accumulated through early entry, continuous buildup and clear positioning seem to be hard to match for new entrants. The leading destination for outsourcing services is considered to be India, based on cost, availability of IT professionals, and other factors, and this trend will likely continue. India's early and effective focus on outsourcing supported by the abundant and skilled labor pool and extensive contacts through the Indian Diaspora in advanced countries, particularly US and UK, created a strong competitive advantage. India tops A.T. Kearney Global Services Location Index (2005) followed by China, Malaysia, Philippines and Singapore (See Appendix 1, Table 4), and Offshore location map index (2005) developed by NeoIT, followed by Canada and China (See Appendix 1, Figure 1).

The competition will toughen in lower-end segments resulting in cost-based competition and price-cutting practices. According to Meta Group consulting company, it is expected that the prices charged for standard software will reduce by up to 35% by 2008, and additionally by another 15% by 2010. The price pressure will be relatively strong in the low-skills requiring segments of the IT industry. In general NeoIT forecasts a very modest appreciation of offshore IT outsourced services by up to 3% in 2006 which will be achieved due to price dynamics in the higher-end segments.

In the short-run, the rising salaries of IT specialists in the developing countries as a result of maturing local IT industries will put additional pressure on major countries competing in outsourcing markets. The average growth rate of the average IT specialist salary in selected key competing countries in IT outsourcing will increase by 6% (see Appendix 1, Table 5).

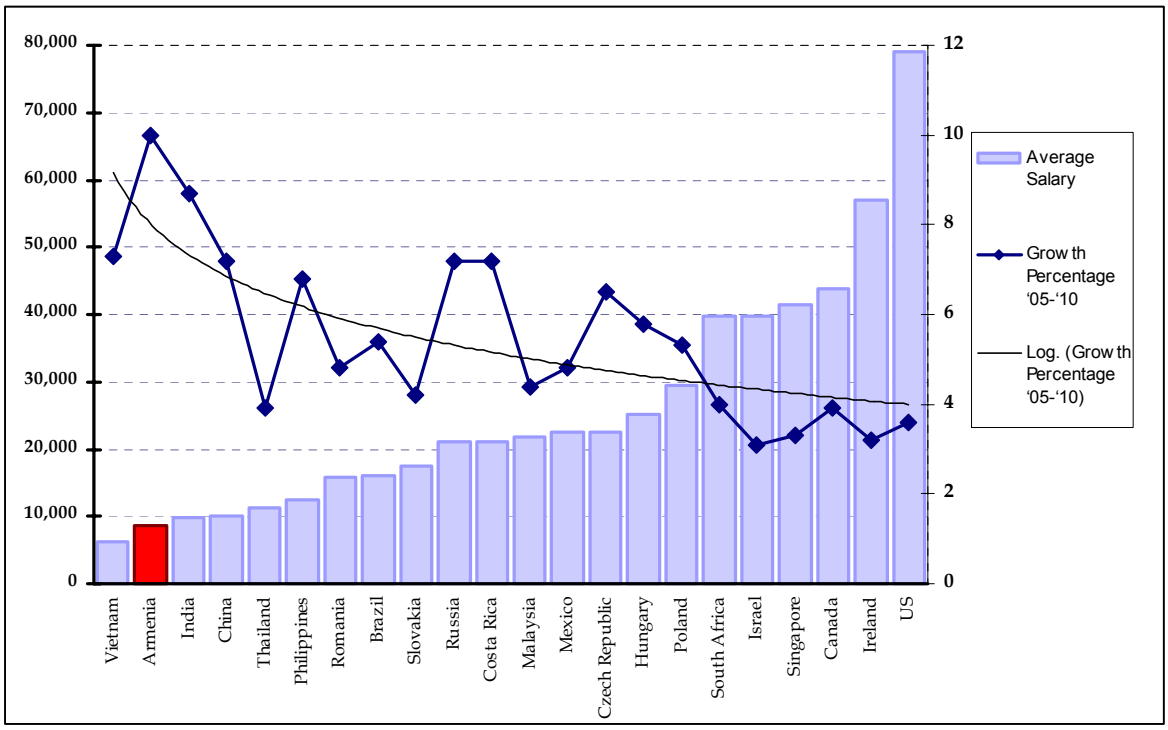
The quality of IT education is becoming a key factor for major outsourcing destinations to move to new lucrative segments and capture specific niches that are less cost-sensitive. Even India, which is competing in the mass outsourcing market, adding 73,000 (Evaluserve, 2004b) new IT graduates annually, is shifting its focus to more specific and high-end segments.

1.2 Challenges and Choices of Armenia

The Armenian IT industry experienced a rapid growth in the last decade and has become one of the most dynamic and internationally competitive sectors of the Armenian economy. According to Enterprise Incubator Foundation (EIF, 2006) the industry revenue CAGR in 1998-2006 was 30%, while the labor force CAGR stood at 19%. Many new start-ups entered the industry; the total number of companies grew by 20%. A few international brands entered the industry, including Synopsis, Lycos, Virage Logic.

The Armenian IT industry, the growth of which was spurred mainly by cost-driven outsourcing, is currently facing maturity and significant competitive pressures. This may put Armenia into a trap of losing to other destinations over the long-run, if the competitive model is not modified. According to EIF estimates, 55% of industry revenue was generated by foreign subsidiaries/branches (established by headquarters), that merely transfer pieces of software or R&D developed in Armenia to headquarters (we may call this "branch outsourcing"). The services sector dominated the domestic IT industry (84%), and the share of services in the total industry exports declined from 61% (2003) to 48%. About 4,200 professionals were employed in the industry (3,000 in 2003), while the CAGR declined from 25% (1998-2003) to 12% (2003-2006). Due to the low cost of the labor force and relatively higher quality, Armenia was chosen as a "branch outsourcing" destination by a few multinationals and foreign companies. The limited supply of highly-educated IT professionals and significant appreciation of Armenian dram put additional pressure on the wages in dollar terms over the last 3 years, resulting in an increase of about 70% in the average salary paid by the employer from 4,500 USD to 7,600 USD. These factors could put Armenia into the trap of losing its business to more cost-quality efficient markets due to the lack of a highly-skilled workforce (both in absolute numbers and in quality) on one hand and rising wages on the other. (See Appendix 1, Table 5).

Figure 1: Salary levels of IT professionals in selected countries, 2005



Source: NeoIT (2006) and EIF (2006)

A scarce and limited labor force supply will be the major constraint for the future growth of the industry. Currently, the supply of high quality programmers and engineers is limited and some specific segments are far below the demand. The inability of educational institutions to supply high quality specialists may become a key obstacle in the short-run.

Lack of recognition as an outsourcing destination impedes growth. Armenia is not well promoted as a major outsourcing destination (e.g. Armenia is not listed in the 40 global outsourcing destinations list published by A.T. Kearney). Diasporan connections and past

experiences of a few multinationals currently operating in Armenia have created good grounds for effective branding.

Time for strategic choice

Given the global trends and current challenges of the Armenian IT industry, the development path will be largely dependent on strategic choices that the key industry stakeholders will make now. The choices should be based on the understanding of major factors influencing the growth of the industry and different possible scenarios. The scenarios developed under different assumptions will help to identify the optimal competitive model for transformation and future expansion of the industry.

Developing Armenia's IT growth scenarios

The scenarios of Armenia's IT industry are based on the revenue generation econometric model. The model was used to forecast key industry parameters in 2011. The impact of other cross-cutting parameters such as quality of infrastructure, regulatory environment, availability of venture capital and quality of math and science education is assessed through building a cross-country IT export growth model. Three competitive models of the development of the IT industry are identified, based on experience of other successful countries, and priorities within each model are presented.

CHAPTER 2: ARMENIA'S IT GROWTH SCENARIOS

For the purpose of developing growth scenarios for Armenia's IT industry we considered two subsectors (Internet services (ISP) and software and services) separately. The driving forces and key "production factors" are different for the two mentioned sectors.

The ISP sub sector substantially differs from other segments of the industry being more capital intensive and local market oriented. Domestic demand factors are critical for the sector.

For the software and services sector (excluding ISPs) the empirical revenue model will be constructed and applied under different scenarios, thus estimating key industry parameters in 2011. Since labor is one the key parameters in the industry, scenarios of labor supply are constructed which later are input into the model to forecast industry revenues (along with other forecasted parameters).

The overall IT industry scenarios will be constructed based on the combination of results of both software and service and ISP sector scenarios.

As the overall industry dynamics will be also influenced by broader cross-cutting factors such as major infrastructure elements (communication infrastructure, venture capital, technoparks, and the regulatory environment), they will be estimated by constructing a cross-country IT export empirical model.

2.1 Software and Service Sector Revenue Generation Model

The main objective of the model is to build an econometric model that would allow the projection of industry revenues over the mid-term period. Given the absence of industry specific statistics on annual or quarterly bases over a longer-period of time, the use of time-series models was ruled out. The only feasible alternative was to use the company-level cross-section data approach. Therefore a cross-section analysis relying on company-level data for 2005 was applied. The analysis of key trends in the world IT industry showed that the demand factors are less likely to be limiting the growth of Armenia's software and services sector in the short to mid-term perspective. Therefore, the model incorporates mostly supply side factors that will play the main role in further development.

Software economics

In software economics, software development is considered as an economic production process or value creation activity, whereby inputs, most notably the effort of professionals, are converted into outputs (software size), i.e. source line of code (SLOC) (Banker, Chang, and Kemerer, 1994). Therefore software size could be considered as a function of software complexity, functionality, manpower, skills and time (Hu, 1997). However, according to Hu (1997) software development could be considered as a "1-step" production function. Therefore, the production process could be considered as a function of manpower/labor

$$S = f(E)$$

S= software size that is measured in source lines of code (SLOC)
E= efforts measured in man-month

As the output quantities (price per SLOC) are not available and not feasible for using in the model, we will instead be operating with monetary values. This is a common problem for the industries, where the characteristics of products and factor inputs vary considerably across producers (Katayama, Lu, and Tybout, 2003). Data on physical volumes (SLOC) is usually unavailable, so analysts use information on the *values* of production (company-wide total revenues, payrolls, etc.). Mairesse and Jaumandreu (2005) investigated whether there is a difference in the results between when modeling is based on the revenue function or the production function. They used two panel-data samples for which they had both nominal and real output measures and found that estimating the revenue function or the production function makes very little difference for their results. In the end, being a flexible form of the production function, the revenue generating function proposed and estimated in this study provides understanding of software development as a value creation process.

Model Concept

The specified model attempted to capture most of the key characteristics of the Armenian software industry to enable maximum forecasting capacity. The targeted characteristics are those that explain performance differences across individual companies. Cross-cutting factors such as legal environment, (laws/regulations, etc.), the level of higher and primary education (universities, training centers, certifications, the level of math and science classes in schools, etc.), and the level of development of specialized infrastructure (telecom/internet, technoparks, venture capital, etc.) cannot be included in the model as they don't determine the revenue difference across companies. Their impact on total industry performance will be assessed in a separate model (see IT export growth model section).

Taking into account that labor is the main input in the production function for the software industry, performance measures in such models, generally speaking, are indices of revenue per unit input of labor (for the purpose of this model and simplicity, we may call it "labor productivity"). However, potential differences in labor contribution to revenue are influenced by company specific characteristics such as the size of the companies, ownership status (foreign vs. local), training of employees, markets they serve (domestic vs. export), etc.

A general company revenue function can be presented in the following way:

$$TR = f(L, S, FO, E, CS)$$

TR= total annual revenue
L= labor, number of programmers to complete the project in a given period of time
S = skills required to complete the project
FO= share of foreign ownership
E = share of export in total revenue
CS= Company size

The concept of company revenue should be treated carefully as regard to foreign branches who realize outsourced orders of headquarters. The revenue in this case is determined by salaries and overhead costs rather than proceeds from sale of products or services. The pricing mechanisms differ in companies that market packaged software vs. serving outsourcing orders of headquarters, exporting vs. local players. Company performance differs also based on ownership status, market focus, company size and staff qualification. The performance stems not only from pricing mechanisms, but also scale efficiencies,

flexibility and adaptability to market conditions, ability to develop sophisticated products, etc.

Data availability and reliability are major concerns for similar models. The database constructed with the support of EIF included comprehensive data of more than 50 companies. However, after a scrupulous and detailed reliability check, only the data of 34 companies qualified to be used in the model. Moreover, the data that was not consistently reliable for *all* companies was excluded from the model[1].

Function specification

After testing four functional forms: (1) linear, (2) Quadratic, (3) Cobb-Douglas, and (4) Translog, the Cobb-Douglas function was found to be the only model without indicating strong multicolinearity when company level characteristics act as interaction terms affecting the labor productivity (we discuss this issue in detail when we describe the functional form #3. Bhanumurthy K.V. (2002) brings a rather comprehensive discussion about the Cobb-Douglas production function and argues that "various econometric estimation problems, such as serial correlation, heteroscidasticity and multicolinearity can be handled adequately and easily" using this functional form. Other reasons for choosing the Cobb-Douglas function are its ability to capture possible nonlinearities in the relationships and the ease of interpretation of the estimated parameters. This function type has been widely used for production function analysis by many authors. In labor based production, the Cobb-Douglas function has the following form.

$$Y_i = aX_i^{\beta} \exp(e_i) \qquad (1)$$

Where:

Y_i = total annual revenue of the i'th-firm in USD in 2005 or 2006
X_i = number of full-time employees in the i'th-firm for 2005 or 2006
and a and β are parameters to be estimated and e_i is an error term.

Taking logarithms on both sides, we get the linear form of the model, which can be estimated using Ordinary Least Squares (OLS) method

$$\ln(Y_i) = \ln(a) + \beta * \ln X_i + e_i \qquad (2)$$

Where the parameter β represents the labor elasticity of revenue.

The hypothesis is that there may be differences in the extent to which labor contributes to revenue ("labor productivity") between large companies and small medium enterprises (SMEs), between companies with significant foreign ownership and non significant foreign ownership, between companies which provide training to their employees and those which do not have such programs, and between export oriented and local market focused companies.

To account for these potential differences, and to establish an appropriate econometric model for testing these differences, the following slope dummy variables for size,

[1] For example, the number of trained employees or the amounts spent on employee trainings were not reliable for all companies, therefore we preferred to operate with much more reliable indicator of existence/absence of training programs in the company, i.e. whether the company trains employees or not.

ownership, training programs, and export orientation for companies were incorporated into function #2 as interaction terms:

- D_1 = dummy variable for company size. D_1 = 1 for companies with more than 30 employees and D_1 = 0 for otherwise,
- D_2 = dummy variable for trainings provided: D_2 = 1 for companies which train their employees or pay for the training provided by other institutions/companies, and D_2 = 0 for otherwise (as a proxy for skills obtained for completed specific projects)
- D_3 = dummy variable for company ownership: D_3 = 1 for companies with significant foreign ownership, and D_3 = 0 for otherwise,
- D_4 = dummy variable for company's export orientation: D_4 = 1 for companies with share of export equal to or exceeding 80 percent, and D_4 = 0 for otherwise.

The complete model therefore has the following form.

$$\ln Y_i = \alpha_0 + (\beta_0 + \beta_1 * D_1 + \beta_2 * D_2 + \beta_3 * D_3 + \beta_4 * D_4)\ln X_i + e_i \quad (3)$$

We have also used the following encoding of the variables in the model: *trevusd* = *Y*, *emplful* = *X*, *large* = D_1, *trained* = D_2, *sigforown* = D_3, and *exp80* = D_4.

It should be noted that the presence of so many interaction effects may cause multicolinearity in the model. Hence, we paid special attention to checking for possible multicolinearity (see appendix 1) and found that it is not problematic in our model.

Sample Characteristics

We have compared the parameters of the sample that are used in our model with the total IT industry parameters estimated by EIF and can state that our sample can be considered fairly representative for the Armenian software and services industry.

Table 1: Population vs. Sample

Key Parameters	**Population**	**Sample**
Average number of employees per company	27	29
Average number of employees per locally-owned company	19	14
Average number of employees per foreign-owned company	50	50
Share of large companies	20%	29%
Share of foreign companies	35%	44%

Descriptive Statistics of the Variables

The 34 companies presented in the sample employ 1,018 programmers and produce a total of 19,901,938 USD annual revenues. Table 2 shows sample descriptive statistics of the variables used in the revenue generation model. Companies vary significantly in terms of number of workforce and total annual revenue. Specifically, total annual revenue ranges from 8,500 USD to 4,173,000 USD. Number of employees in these companies varies from 2 to 221. About 29 percent of the companies in the sample have more than 30 full time employees. The share of companies with foreign ownership of 50 percent and more is about 44%. Training is quite widespread in the industry. Particularly, roughly 76 percent of the companies provide training to their employees.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
trevusd	34	585351.1	810126.4	8501.387	4173130
emplful	34	29.94118	40.53501	2	221
large	34	0.2941176	0.4624973	0	1
sigforown	34	0.4411765	0.5039947	0	1
trained	34	0.7647059	0.4305615	0	1
exp80	34	0.4705882	0.5066404	0	1

Using the previously mentioned variable coding and opening the parentheses in (3) we get

$$l\_trevusd_i = \alpha_0 + \beta_0 * l\_emplful_i + \beta_1 * l\_emp\_lg_i + \beta_2 * logelp\_for_i + \beta_3 * l\_elp\_trn_i + \beta_4 * l\_emp\_exp_i + e_i \quad (4)$$

The parameter β is the production elasticities for the software production system, i.e. the relative change in production (in terms of total annual revenue) divided by relative change in the amount of the labor input. Differences in labor elasticities for different company characteristics are estimated by adding the parameters of the relevant interaction dummy variables.

Estimated parameters of the model

The model in (3) was estimated using Ordinary Least Squares Analysis (OLS). All estimations and tests were performed using the procedure reg in STATA version 8 SE. The estimated parameters are shown below

l_trevusd = 8.84 + 0.942 * *l_emplful* - 0.196 * *l_emp_lg* +
(22.92)*** (4.43)*** (2.18)*

+ 0.357 * *logelp_for* + 0.296 * *l_elp_trn* - 0.139 * *l_emp_exp* *(5)*
(2.95)** (2.18)** (-1.13)

Observations 34
R-squared 0.89
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

The R-sq value is 0.89 indicating that the independent variables included in the production function explained about 89% of the variations in the annual revenue generated by the companies. The regression does not exhibit problems with heteroscedasticity, omitted variable, multicolinearity, as well as normality of the estimated residual. (for details see Appendix 2)

Model Results

The increase in the number of employees in an average company results in a proportionate growth in the total revenues. On average, a 10% increase in the number of full-time employees will cause a 9.42% of growth in company's total revenue.

The companies that provide training, on average enjoy high rates of return on investment. Those companies that offer formal training programs to their employees boost their labor productivity, resulting in an increase in revenues. If an average company increases its full-time employment by 10% and also offers trainings, the company's total

revenue will increase by 2.96% more, relative to companies that do not have formal training programs.

Foreign companies experience higher increase in the total revenue due to increase in labor force. This phenomenon could be explained by higher productivity rates of employees working for foreign-owned companies. These companies provide training opportunities and attract the best managers to increase the efficiency of operational processes and business practices. On average, a 10% increase in the number of employees in companies with significant foreign ownership will cause a 3.57% higher increase in the total annual revenue relative to those with significant local ownership.

On average SMEs experience higher percentage increase in total revenues due to increase in the number of employees than large companies. This trend reflects the dual nature of the Armenian IT industry. In the case of an increase in the number of their full-time employees, large companies (mainly branches/subsidiaries of foreign companies) serving orders from headquarters, will receive compensation/remuneration proportionate to the number of new employees. The SMEs involved in development of their own/customized products or outsourcing, can charge price premiums, thus experiencing higher growth rates in the total revenues, relative to large companies. On average, a 10% increase in the number of full time employees will cause a 1.96% higher increase in the total annual revenue for SMEs (local and foreign-owned non-branch/subsidiaries) relative to larger companies.

The estimated size of the Armenian software and services sector in 2006 is 62.3 mln. USD. We have assumed that EIF estimates of total employment and total number of companies (with foreign and domestic ownership distribution) are accurate and input them into the model. The discrepancy with EIF estimate of software sector revenues is 11.4 mln. USD (EIF estimate is 77.2 mln. USD).

Box 1: Labor Productivity Prospects

Labor productivity analysis based on sample data shows the following trends.

IT sector company productivity varies across companies. According to sample data, the number of full-time employees of thirty-four companies amounted to 1,018. Total output of the sample amounted to 19.9 million USD. Sample-wide productivity was 19,550 USD, while average company productivity (calculated based on average of averages) was 18,020 USD.

Productivity figures reflect the dual nature of Armenian IT industry. Firms with foreign ownership were at least twice as productive as their local counterparts. The same trend was observed across all IT industry sub-sectors.

A few local companies can surpass the performance of foreign counterparts. Sub-sector market leaders recorded high productivity levels.

Companies involved in customized software development are the most productive. The price premium charged for final products makes these companies even more productive than several foreign counterparts that mainly serve the orders of headquarters (branches/subsidiaries).

Management maturity level significantly determines the level of productivity. The highest level of productivity was observed in the case of companies involved in customized software development and outsourcing that requires high levels of

companies operating in other sub-sectors of the IT industry also apply modern SW management processes; invest in training of project managers, etc.

Table 3: Sample Productivity

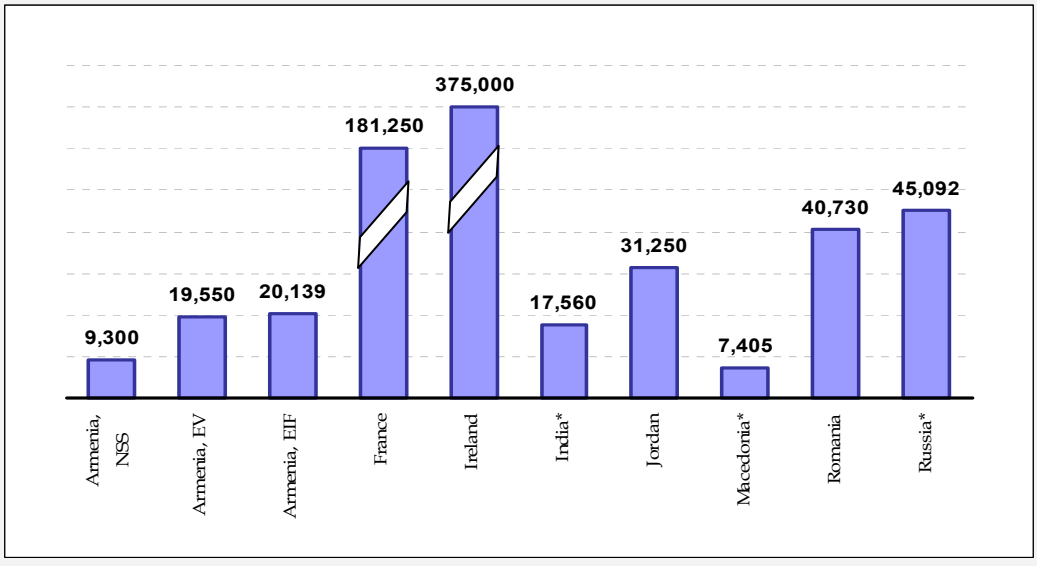
	Revenue	Number of Employees	Productivity (based on sample total figures)	Productivity (Average of Averages)	Number of companies
Sample	19 901 938	1 018	19 550	18 020	34
Companies with foreign ownership	17 059 686	750	22 746	29 707	15
Companies with local ownership	2 842 253	268	10 605	8 794	19
Chip design	3 200 000	146	21 918	23 043	2
Customized software & outsourcing	6 298 501	244	25 814	28 773	10
Customized software & outsourcing (foreign)	6 000 000	205	29 268	38 333	7
Customized software & outsourcing (local)	298 501	39	7 654	6 465	3
MIS/Database	4 991 957	316	15 797	14 402	12
MIS/Database (foreign)	2 986 555	143	20 885	23 075	4
MIS/Database (local)	2 005 402	173	11 592	10 066	8
Internet Application and Multimedia	5 411 480	312	17 344	10 605	10
Internet Application and Multimedia (foreign)	4 873 130	256	19 036	19 441	2
Internet Application and Multimedia (local)	538 349	56	9 613	8 395	8

Source: EIF; Authors' own calculations

Cross-Country Productivity Comparisons

Armenia's IT productivity data reinforces the argument for the need to re-focus on more sophisticated and lucrative market segments. In terms of productivity, Armenia generally lags behind well positioned, special niche competitors serving off-shore outsourcer, however beats mass market low-end players such as India.

Figure 2. Selected Country Productivity Data, 2006



* EV estimates, estimates for 2005/2006 for India,
** Macedonia (2004), Armenia, NSS, EV (2005), Jordan (2005),
** Source: NSS, EIF, NASSCOM, Russoft, APKIT, INT@J, MASIT, Romanian Business Digest, IDA, Syntec Informatique, WB-WDI Online

Productivity differences are explained by a very long list of cross-cutting and country specific factors. The broader factors are as follows:

Russia's relatively strong performance at large is a result of leverage of its strong scientific base, traditions of sophisticated R&D especially in the military sphere, a large and well educated labor pool, a large internal market and its focus on R&D and niche segments. Romania has a clear strategic focus on outsourcing and attempts at becoming a key development center for multinationals. Jordan chose a regional positioning as an "ideal gateway to MENA countries", and succeeded in attracting several "first-tier" multinationals such as Microsoft, Intel, Cisco Systems, etc. At the same time, emerging countries with unclear positioning such as Macedonia or with mass service market focus such as India have lower overall productivity.

Basic Factors Negatively Affecting Productivity of Armenian IT

Key Company-Specific Factors:

1. *Weak branding*. Weak brand recognition constraints Armenian companies to charge premium prices and leads to substantial discounts. "Armenian IT brand" is not well established yet.
2. *Small and unsophisticated domestic market*. Small and unsophisticated domestic demand impedes achievement of scale efficiencies and specializations of companies.
3. *Skill gap*. Armenian IT companies are on the track of upgrading skills, however the gap with more advanced countries still exists. The skill gap chain starts in educational institutions and in many cases narrows at company level.
4. *Management quality.* Management at strategic and project management levels is also in great need of upgrade.

Key Cross-Cutting Factors:

1. *Small number of globally competitive MNCs*. Although a couple of MNCs are present in Armenia, the critical mass is not formed to shape large cross-industry spill-over effects. MNCs increase productivity not only through more efficient business processes, training of employees and other production-specific factors, but also by investing and using complex technological tools (eg. expensive and special software tools for chip design).
2. *Underdeveloped specialized infrastructure and related industries.* Armenian companies suffer from a lack of technoparks, venture capital funds and underdeveloped telecom infrastructures which eventually increase costs and, hence, decrease value per employee. Foreign rivals in more advanced countries enjoy the support of related industries such as various high tech industries, R&D institutes and military units which enhance technological and human resources.
3. *Lack of specialized institutions preparing software companies for international accreditation/certification.* There is a lack of specialized institutions preparing and assisting local companies to qualify for CMMI accreditation/certification, thus enabling them to compete for global off-shoring contracts. Certification at CMMI level 3 is becoming a basic requirement for entry into the Western European market. The direct effect of such accreditation will be an increase in productivity and performance of Armenian IT companies. According to survey results conducted by Carnegie Mellon Software Engineering Institute (2006) the median productivity increase was 62% after CMMI certification.

2.2 Labor Force Supply Scenarios in Software and Services

Current situation

The IT labor market in Armenia simultaneously experiences both "shortages" and "surpluses". This occurs because of skill mismatches, hence the inadequate quality of education in Armenia. After its sharp rise in the 1998-2003, growth in the IT workforce has slowed down in recent years. Despite the remarkable increase in numbers of IT department graduates, the workforce still remains the impeding factor for further industry expansion. Currently software and IT services sector employees in Armenia total about 4200 people, of which only 2700 are IT specialists. This is a very modest pool in comparison to other outsourcing destinations.

One of the key developments in this field is the active engagement of private companies, especially MNC's, into the educational sector. Joint educational projects support the development of required knowledge and skill sets by students who will later on work in those companies. However, the quality of IT education does not comply with internationally recognized standards or even the needs of local companies. It forces companies to make additional investments in the labor force. Moreover, mandatory military service is yet another important issue. This creates a two-year time gap between graduation and employment which certainly downgrades the quality of males in the workforce.

Currently 206 lecturers are engaged as faculty members of the IT departments in main universities providing IT education. Research reveals problems of aging and insufficient levels of competence in faculty (USAID CAPS, 2006). Inadequate salary levels are the main deterrents to the inflow of fresh, qualified specialists. There is a huge gap between the salary levels of lecturers and IT sector companies. The monthly average salary of the faculty members is about 200 USD, while the average salary of a professional specialist (e.g. experienced programmer) in IT companies is about 760 USD. According to our calculations the gap is measured as 1,384,320 USD annually.

Bases for estimates

Currently the main sources of the labor force supply are the graduates of the institutions of higher education. The total number of graduates in 2006 was 1021 (USAID CAPS, 2006). Based on the expert opinion of the relevant department heads in the leading institutions of higher education, the average annual growth rate of the graduates will be 6%. This rate is reasonable, based on demographic factors and analysis of the past development trends of the number of graduates. The number of graduates will thus reach only 1366 in 2011.

The employment rate for the IT sector specialists in their specialties three years after graduation is only **55.4**% (UNDP and MoES, 2005). Almost 15% of the graduates are employed in areas other than their specialties. Thus, assuming that about 10% of the graduates would choose not to work in their field of specialty, **20**% of the total number of annual graduates does not find a suitable job because of the quality mismatch. The mismatch is a result of the inadequate state of the education infrastructure (the quality of faculty members, the lack of equipment, the curricula, etc). This creates an unutilized pool of labor force which can be estimated to reach 1202 by the year 2011.

The graduates of IT related departments should be considered as alternative sources for the expansion of the IT labor force supply. In order to ensure the compliance of the graduates, an intensive 1 year retraining course for the respective graduates must be designed. The annual costs for the organization of the trainings are estimated at 720 000 AMD per student (the average competitive rate based on the Lycos and Virage Logic training costs). The number of graduates from IT related departments in 2006 is 779, this number has a relatively stable character, and thus significant changes are less likely to happen. If the number of graduates doesn't change in the coming 5 years, there will be ***3895*** graduates by 2011, a reasonable part of which potentially could enter the IT industry after intensive training.

Development scenarios for labor force

The development paths of the IT workforce can vary significantly depending on numerous factors. Global IT market development trends and changes of costs for labor in Armenia, as mentioned earlier, will compel the companies to focus on high value-added products which will increase the qualification requirements for hiring new specialists. This means that, if the quality of education do not change significantly, then less and less graduates will have a chance to get jobs in the IT sector.

Key factors for development of IT labor force during the timeframe under observation will be the following:

- Increase the quality of education, hence the efficiency of "output" of universities (share of graduates entering industry)
- Utilization of available pool of "semi qualified" specialists

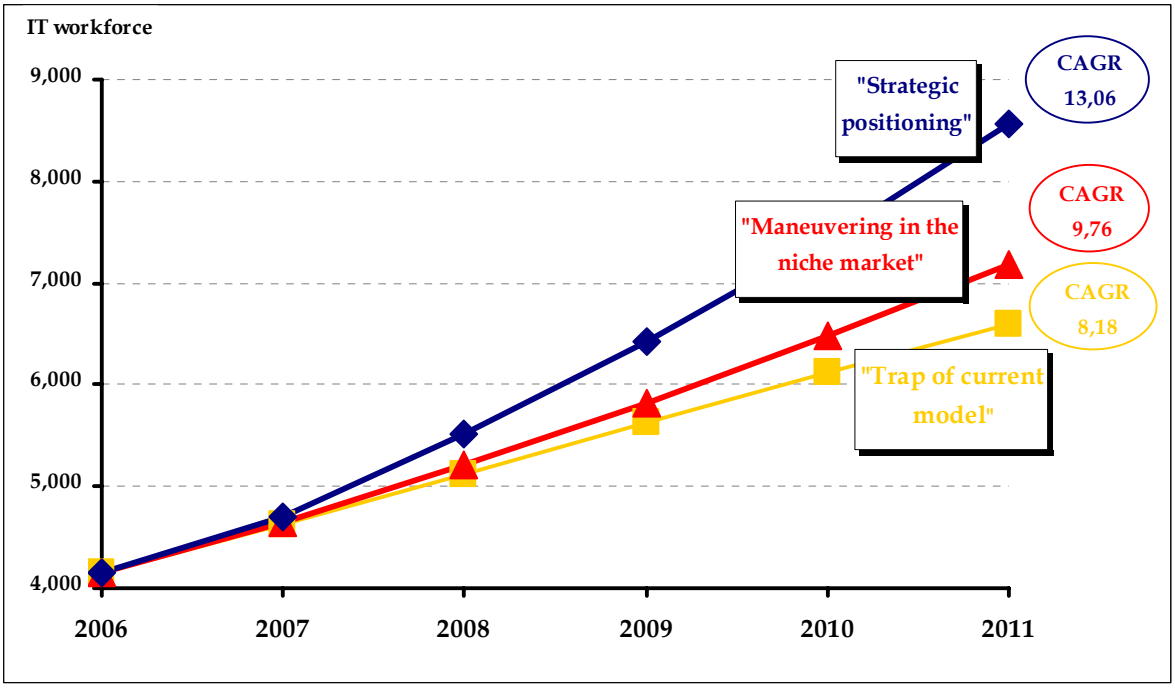
Based on our assessment we indicate 3 development scenarios for workforce development. They are presented in the Table 4

Table 4: The development scenarios for workforce development for software and IT service sector (ISPs excluded)

Scenario	Description	Assumptions
Scenario 1		
Trap of current model	This scenario assumes that the ***education quality of the IT departments decreases over time, relative to market demand***, as government investments and incentives are not sufficient for staff renewal and the aging problem gets more acute. The potential of graduates from IT related departments is not being explored and used, thus eventually decreasing the labor force enlargement. The labor force will grow at CAGR 8.18% during 2007-2011.	The share of graduates to be employed in three years after graduation gradually decreases reaching 40% in 2011. The total IT workforce will only be ***6601*** in 2011.
Scenario 2		
Maneuvering in the niche market	This scenario assumes that government spending on education stays the same and the ***quality of education does not improve significantly***. Private sector's educational initiatives remain rare cases, which allow satisfying their own needs for new employees. The CAGR is calculated as 9. 76%.	The share of graduates to be employed in three years after graduation stays relatively stable, increasing to only 58% in 2011. In this case, the total IT workforce in 2011 will reach ***7187***.

Scenario 3		
Strategic positioning	This scenario is based on the assumption that the ***government will increase investments in the education sector,*** resulting in a significant increase in the quality and a decrease in the gap between the skill mismatch for the labor demand and supply. The academia will also foster significantly the creation of ***"employer-led" education,*** where the representatives of major companies will be responsible for designing, approving and implementing the detailed contents of the vocational qualifications. Special incentives will be provided to the companies for encouraging investment in the educational sector. The ***creation of international level training and certification centers*** will be enhanced. The government will undertake targeted ***FDI promotion*** to attract IT MNC-s into Armenia. The government will recognize the alternative source of recruitment for IT sector - the graduates from IT related departments. The labor force will grow at CAGR 13.6% during 2007-2011.	The ratio of employed in the total number of graduates after three years of graduation increases, peaking at 80% in 2011. The workforce is increased by the 20% of the annual graduates of the IT related departments. As the number of new entrants increases, the administrative staff grows in sync with the IT staff. Thus the total IT workforce will reach the high of ***8556*** in 2011.

Figure 3: Workforce development scenarios for software and IT service sector (ISP excl.)



Box 2: Government investment in IT education

As human resource has come to be seen as the most important form of capital in the IT sector, traditional investment criteria, profitability, and rates-of-return principles can be applied in determining the efficiency of investments in the education sector carried out by the government.

The government may consider the costs of funding the higher education students in the IT field as *investments in human resource development* and the return on investments will take the form of tax payments calculated per employee of the IT sector companies.

Underlying Data
The share of IT students who receive state funding is almost 50% of the total number. The funding is provided based on the performance criteria, which means that in general, state funded students excel others. Therefore we can assume that the share of the state funded graduates in the total employed is fairly high.

We implemented an appraisal of the described investment project with the following input information:
Based on our calculations, government annual spending per student is equal to 232,608 AMD. This means that to prepare a bachelor degree graduate an investment to the amount of 930,000 AMD (about 2550 USD) is needed and a masters degree graduate 1,395,000 AMD (about 3800 USD)[2]. This amount is comprised of two components: provision of graduate and postgraduate education (total amount in the state budget: 991.1 million AMD; number of beneficiaries: 5906) and scholarship (total amount in the state budget: 660,000; number of beneficiaries: 10,182).

Based on publicly available data provided by the Tax Inspectorate of RA, we have calculated the amount of paid taxes generated by one employee. The assessment was done for 9 software companies which employ 989 people totally.

Assumptions
These companies paid taxes in total to the amount of 1,039,521 million AMD during 2006 meaning that one IT employee generated 1,051,000 AMD taxes.

The investment time-horizon was assumed at 10 years. The future values used are discounted to bring to net present values using 10% discount rate (an average rate for state T-bills and private bank deposits). The forecast of the increase in both government spending and the tax amounts are estimated at annual rate of 10%, based on the natural growth trends in productivity of the sector, salary levels, as well as inflation rates.

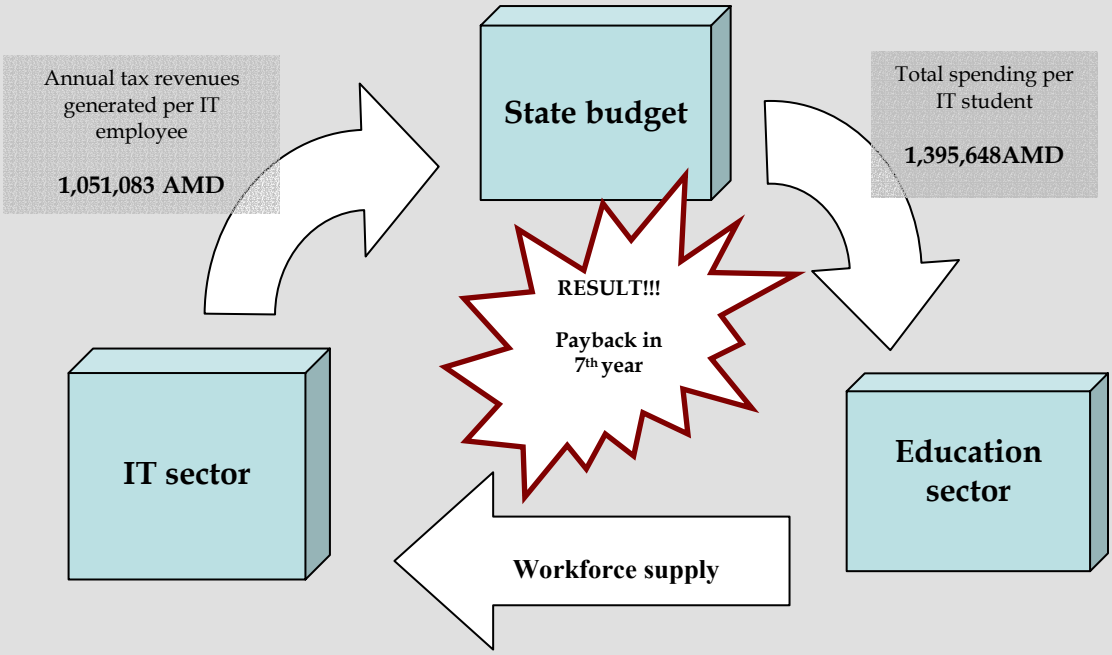
Results
Based on the afore-mentioned data, the investment analysis produced the following results:

The payback period or the timing that the benefits start to accrue is 5-7 years (depending on the degree differences)[3]. The net present value of total spending of 1,051,083 AMD during 6 years of University education of an average State funded student will be 1,833,507 AMD of net benefit in 10 years timeframe. The general NPV evaluation suggests that the project is attractive from a business point of view.

The investment in today's IT students will have a certain payoff in just 7 years time (see

the diagram below)

Figure 4: Government expenses-revenue flow

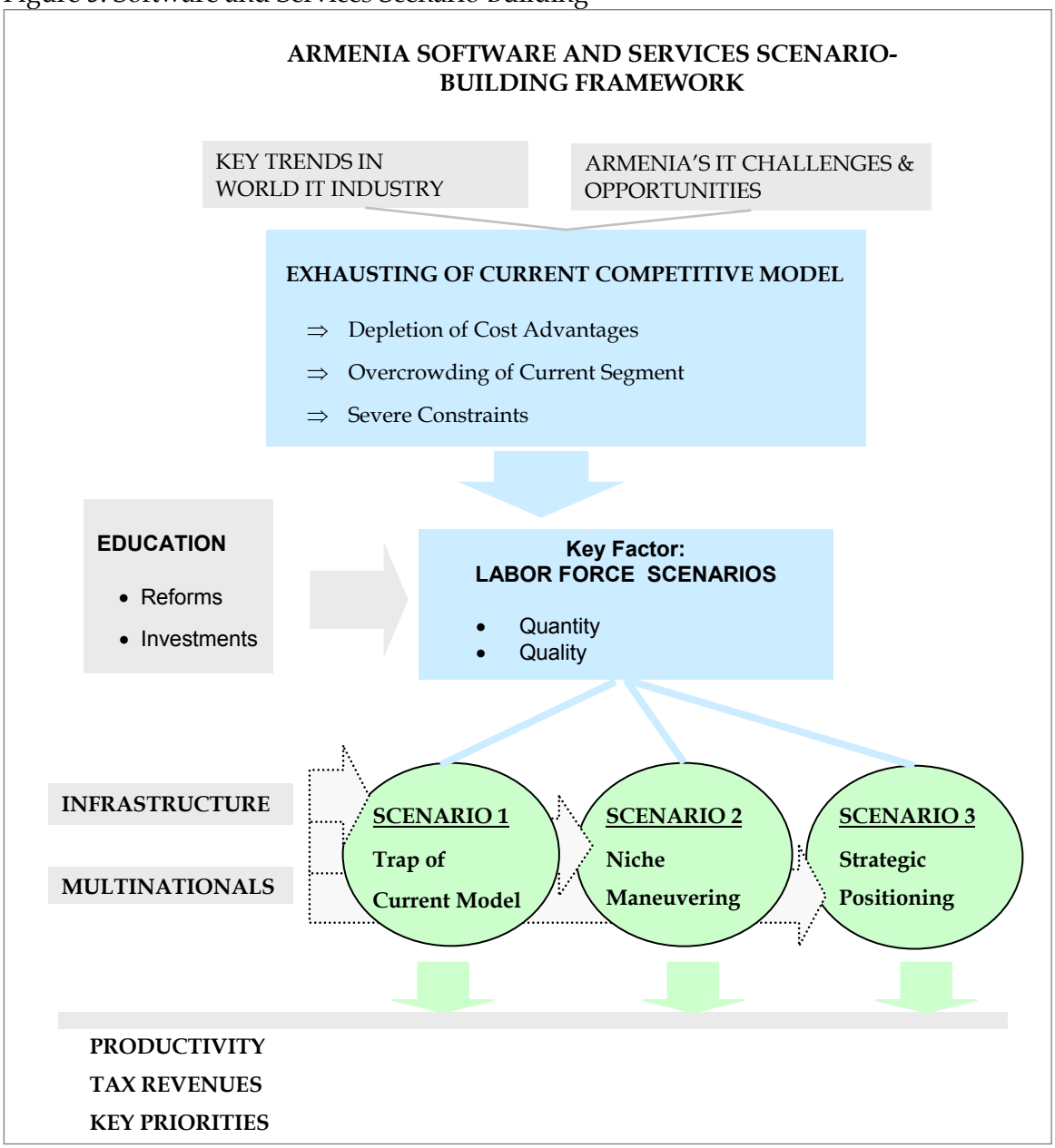


It is noteworthy that investment in education brings about numerous other benefits of social value, the measurement of which is not easy to implement, but the availability of which cannot be denied. Thus it is judicious to increase the amount of government spending on human resource development. According to our analysis a 3-fold increase in annual per student spending will still leave the government with a gain in terms of tax amounts within the 10 years timeframe.

2.3 Software and Services Industry Scenarios

The graph below depicts the logic of the framework that was applied to construct scenarios for software and services sector.

Figure 5: Software and Services Scenario Building



Scenario 1: Trap of current model

This worst-case scenario suggests that the industry will develop with the inertia of early acceleration; no major initiatives will take place to change the competitive model. Even under this scenario the industry will continue to grow, however, at a slow pace. The number of companies will grow modestly; takeovers and acquisitions may be observed in selected cases to tap into limited pool of IT specialists.

The dichotomy between local and foreign companies in the industry will continue to expand. Some takeovers may be observed to survive tough conditions in the local market. Local start-ups will be mainly focused on off-shore-outsourcing to escape the pressure of the limited size of the domestic market. The number of locally-owned companies will increase slightly.

The brightest students will be hired mainly by foreign companies. However, the poor quality and limited number of IT graduates will put additional pressure on foreign-owned companies either to increase the salaries of IT specialists or to move to other locations. Modest growth of new entrants is expected.

The industry revenue will reach roughly 102 mln. USD in 2011.

Scenario 1: Industry snapshot in 2011

Number of companies	160
Number of employees	6601
Share of foreign owned companies	35%
Share of large companies	44%
Share of companies doing training	80%
Average number of employees per company	41
Taxes*	23 323 810
Industry Total Revenue	102 330 767

Note: * The amount of taxes is estimated upon the historical data by the State Tax Registry of the RA. The calculations are based on two main indicators- the average share of taxes in the total revenue and taxes generated per employee

Scenario 2: Maneuvering in the niche market

Under this scenario, Armenia will exploit cost-quality characteristics of its IT labor force attracting new foreign players and modestly improving labor quality and supply. New entry will take place faster, takeovers and acquisitions will be marginal, and outsourcing orientation will deepen, especially through establishing branches by foreign companies.

The number of locally owned companies will grow faster; spin-offs from foreign companies may drive the process. A growing number of local IT companies will try to find their place in the global off-shore outsourcing world.

The growing number of IT graduates will stimulate several foreign companies to choose Armenia as an alternative destination. Medium-sized firms and companies with employment ranging 35-40 will be the main group of players. The share of companies offering formal trainings to their employees will increase.

The industry revenue will reach 150 mln. USD in 2011

Scenario 2: Industry snapshot in 2011

Number of companies	193
Number of employees	7187
Share of foreign owned companies	48%
Share of large companies	38%
Share of companies providing training	90%
Average number of employees per company	37
Taxes	28 286 397
Industry Total Revenue	149 969 421

Scenario 3: Strategic positioning

Concerted efforts of public and private sectors will lead to clear strategic positioning of Armenia's IT industry with unique value proposition, recognition of "Armenian IT" brand worldwide and clear articulation of Armenia's competitive advantage.

Significant investment in the educational sector will take place through close trilateral partnerships (government-business-academia). The government will initiate training programs for IT related graduates and will build strategic alliances with companies to ensure the production of high-quality IT graduates according to business needs. Government investments, in the form of scholarships, will increase the current labor pool.

Targeted efforts will foster positioning of Armenia as a unique destination for MNCs based on investments in developing sophisticated skills. "Armenian IT" branding strategies will foster the entry of large global players, which could have spillover effects by attracting other companies from Eastern Europe. This may lead to growth of average company size.

The government will also initiate several programs to equip local companies with modern knowledge of marketing, management and introduction of international standards (e.g. CMMI). The venture capital industry may take shape through targeted government efforts and support. This may lead to an increase in numbers of start-ups.

"E-Society" initiatives will boost the local demand for the usage of IT services, hence creating new market opportunities for local companies. However, this factor hasn't been considered as a major driver of the industry as the government will face resource allocation trade-offs between demand creation ("e-society model") vs. supply support ("R&D or outsourcing-driven models") alternatives.

Industry revenue will reach roughly 221 mln. USD in 2011

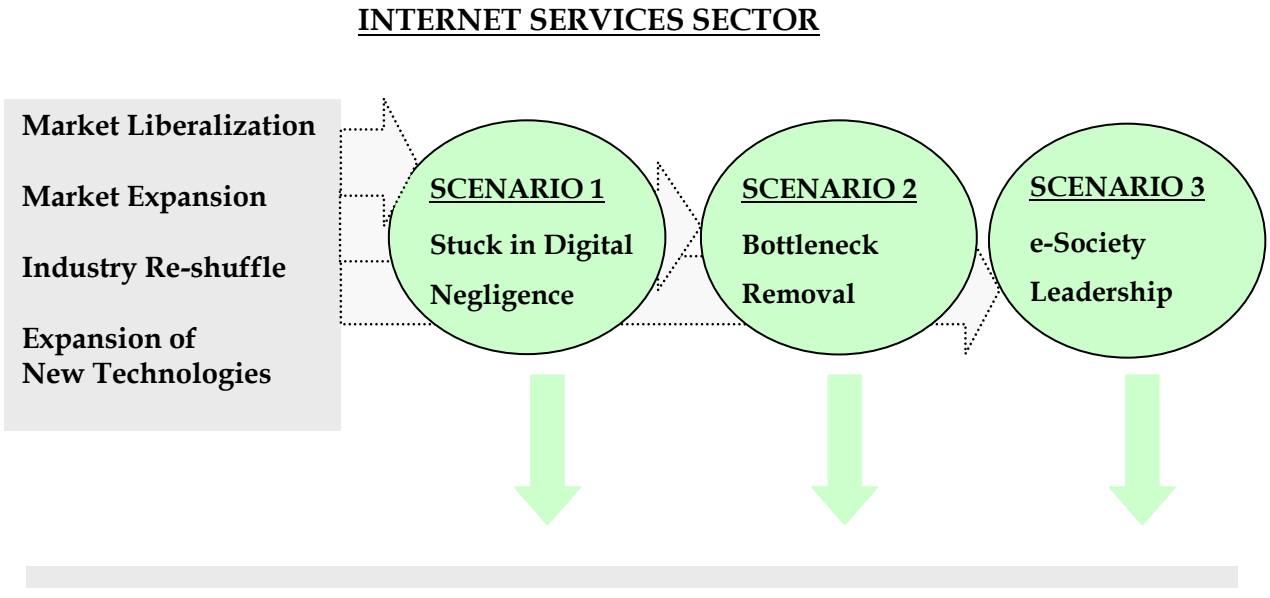
Scenario 3: Industry snapshot in 2011

Number of companies	212
Number of employees	8556
Share of foreign owned companies	50%
Share of large companies	40%
Share of companies providing training	100%
Average number of employees per company	40
Taxes	36 840 007
Industry Total Revenue	220 725 358

2.4 ISP Sector Development Scenarios

The following graph shows the general framework that has been applied to estimate the growth patterns of the Internet services sector in Armenia.

Figure 6: ISP Sector Forecasts Framework



Key Industry Drivers

The Internet services sub-sector is a relatively underdeveloped segment of Armenian IT industry and it is lagging behind many peer countries. The development of Internet services was sluggish in Armenia due to the monopoly granted to ArmenTel in the telecommunication sector. However, recent developments in this area, and particularly the liberalization of the Internet services market (ISPs can uplink avoiding ArmenTel) will remove the bottleneck in the sector and its rapid development is expected.

Four Key Drivers That Will Influence the ISP Sector Development in 2007-2011:

1. Complete liberalization of the market expected in March, 2007
2. Market Expansion
3. Industry re-shuffle through investments, acquisitions and alliances
4. Expansion of new technologies and transformation of market boundaries

Driver 1. Market Liberalization

After the sale of 90% of stake in ArmenTel, the new owner Russian Vimpelcom waived its monopoly rights on Uplink communication outside of Armenia, which in the past created two layers in the market. The first layer included 10 main ISPs that received Internet directly via ArmenTel satellite channels, which in its turn used Teleglobe. The second layer was comprised of about 85 licensed ISPs companies competing in the secondary market. The control of the internet market by ArmenTel resulted in inefficient market structure and high prices on Internet connections, and, hence, in a very low level of Internet usage in

Armenia. The Internet penetration rate in Armenia in 2005 was 4.9% of the population, while CIS average stood at 8.2% and CEE average at 19.6%.

According to industry experts and key industry players, the liberalization is expected to bring on average up to 50% drop in Internet prices starting in summer, 2007 assuming an adjustment period of 3-4 months for ISPs to find new partners, purchase and install equipments and make necessary technological changes. However, the expected regulations (e.g. about x% increase of license fee) may impede the downward price trend.

Driver 2. Market Expansion

Reason 1: Plunge in Internet prices

The sharp decrease in Internet prices is expected to lead to expansion of the Internet market by attracting new users and motivate the existing customers to move to broadband services. However, in the case of new entrants this expansion will not happen automatically as the lack of infrastructure (PCs, digital lines, access points, etc.) will still impede it.

Reason 2: Average growth of prosperity

Armenia's GDP per capita has been growing at CAGR 12% during 2003-2006 and is expected to continue this aggressive growth pattern in the coming 4-5 years. Moreover, as the growth is concentrated mainly in Yerevan where almost 90% of existing ISP infrastructure is located, this will spur the Internet market. Internet services comprise a specific element in the consumer basket, its usage substantially rises when a threshold income level (usually when a household buys a home PC) is surpassed. Though difficult to estimate, Armenia's overall economic metrics and the track record of other more advanced countries suggest that Armenia's average prosperity is approaching that level.

Reason 3: Expansion of telecommunication infrastructure

Currently, one of the key constraints of ISP market is the lack of developed infrastructure. Though the ISP market is quite concentrated (three leading companies control over 70% of the market), the second tier is very fragmented. The small size of the market led to underinvestment in infrastructure and technologies even by leading companies. As the technologies are developing rapidly and switching costs are quite high, the Armenian ISPs face a tough choice regarding technologies and corresponding infrastructure as targets for investments. Several ISPs are expected to launch aggressive Internet accessibility infrastructure programs which will make Internet available to new segments and consumers. However, the pace of expansion will be dependent on many factors, including future acquisitions, alliances, etc.

Reason 4: E-governance initiatives

The Internet market may also be affected by future e-governance initiatives planned by the government and international donors. As Armenia is starting from a very low base (Armenia ranked 86th in the Global IT Report's Network Readiness Index, and specifically 101st in Usage Sub-index), this may lead to high growth rates in Internet usage in the early stages. However, this may be stalled by lack of political will, necessary resources and insufficient coordination.

Driver 3. Industry Re-shuffle through Investments, Acquisition and Alliances

Market liberalization and expansion will attract new capital into the sector. The future technological platform of the Internet infrastructure will be based on the choices between competing technologies (DSL, WiFi, WiMax, fiber optics, etc.) and the size of investments by the largest, key incumbent companies and possible future resourceful entrants. The complementaring features between currently competing technologies may lead to alliances and partnerships to gain dominance, market power and eventually customer lock-in.

Currently, key ISPs are considering large investment plans to expand their technological base and create loyal customer bases. Some foreign capital will also flow into the sector. The competitive landscape will be re-shuffled in the coming two years, leading to the emergence of distinct market leaders.

Driver 4. New Technologies and Transformation of Market Boundaries

Turbulent developments in telecommunication technologies make decisions hard for companies. Considerations of accessibility and affordability will significantly affect such decisions. On the other hand, they will open new opportunities through converging technologies. e.g. triple play features available through broadband (particularly fiber optics) may lead to inter and intra-penetration of data transmission, media and telephone services industries. Consumers can get access to Internet, phone (VoIP) and TV/video through a single access infrastructure. These opportunities are attracting the attention of Armenian ISPs and may lead to strategic investments with long-term planning horizons surpassing current market capacities to offer high returns on investments.

Sector Development Scenarios

The development paths can vary significantly dependent on numerous factors. They have been grouped into three general scenarios titled:

Scenario 1 – Stuck in Digital Negligence

Scenario 2 – Bottleneck Removal

Scenario 3 – E-society Leadership

Table 5: ISP Sector Growth Scenarios

SCENARIO	DESCRIPTION	ASSUMPTIONS
Scenario 1		
Stuck in Digital Negligence	This scenario assumes that the inertia of the recent situation in Internet access and usage by the government, business and society at large will not be overcome and will determine the growth path in the coming 4-5 years. The rural population will be mostly detached from Internet access; growth will come mainly from advanced businesses, mobile strata of urban population and international projects. The demand for Internet will be constrained by slump household income growth, low PC penetration growth rates as well as low levels of investments in infrastructure. The market will grow at CAGR 10% during 2007-2011.	CAGR of Internet users will be **10%**, (13% in CIS countries; 5%? in CEE countries) rising to 10.0 users per 100 inhabitants in 2011 (17.4 - in CIS countries, 22.4 – in CEE countries).

Scenario 2		
Bottleneck Removal	Under this scenario the data transfer market in Armenia will grow significantly in the first two years as a result of the removal of the ArmenTel monopoly in this sphere. The growth logic will look similar to removing a bottleneck from the process or fixing the consequences of a traffic jam. The demand for internet will follow general development trends congruent with average CIS countries track where there were no significant limitations on competition. The market will grow at CAGR 18% during 2007-2011.	CAGR of Internet users will be **17**%, (13% in CIS countries; 5% in CEE countries) rising to 17.4 users per 100 inhabitants in 2011 (17.4 - in CIS countries, 22.4 – in CEE countries).
Scenario 3		
E-society Leadership	This scenario assumes proactive and aggressive strategies employed by the government and business. This implies adoption of e-society development model supported by rising household incomes. The e-governance strategy backed by significant resource commitments may become a real instrument for breakthrough. The demand for internet will grow at even more rapid paces, as the market demand has been mature for a long time already, without a sufficient supply. This will result in higher consumption rates and Armenia will take a leadership position in CIS and closely approach average usage indicators of CEE countries. The ISP market will grow at CAGR 20.5% during 2007-2011.	CAGR of Internet users will be **20**%, (13% in CIS countries; 5% in CEE countries) rising to 22.4 users per 100 inhabitants in 2011 (17.4 per 100 inhabitants in CIS countries, 22.4 – in CEE countries).

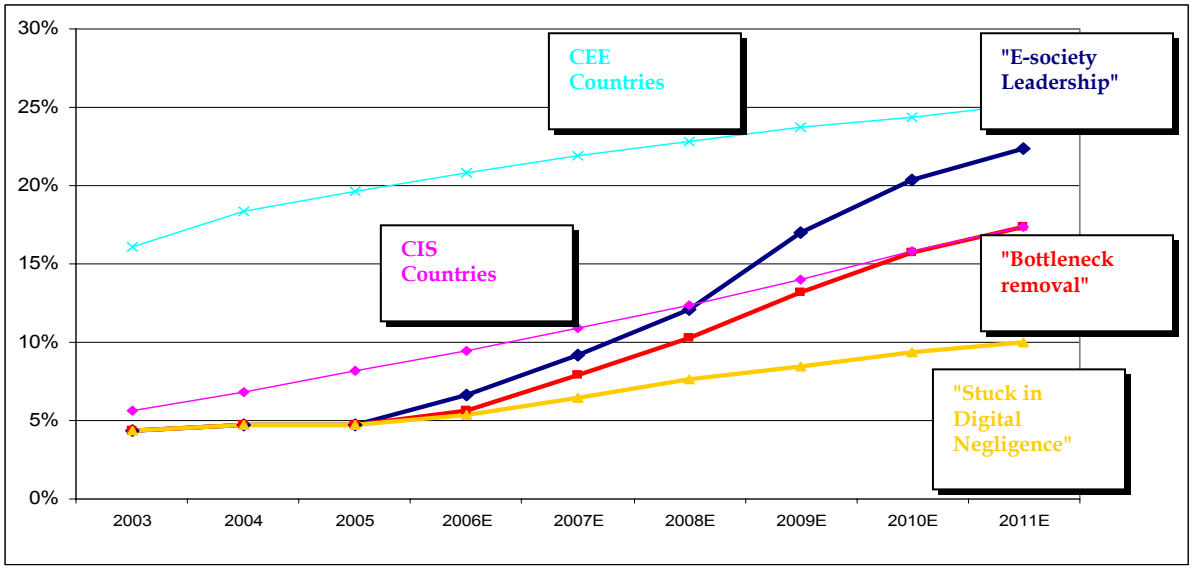
General Assumptions:
In 2006 Internet prices are expected to drop by 30% on average; traffic usage on average will increase by about 20%. The annual revenue per user (ARPU) will stay relatively stable (40 USD) during the forecasted period. The annual average exchange rate will stay constant (1USD=357AMD).

The following graph shows the dynamics of Internet penetration in Armenia for the period of 2003 – 2011. The historical data for the period of 2003-2005 is based on International Telecommunication Union. The forecasted estimates are given according to the developed scenarios.

The 20% CAGR estimates under "E-society leadership" scenario will eventually bring the level of Internet penetration of Armenia very close to that of the average CEE countries' rate.

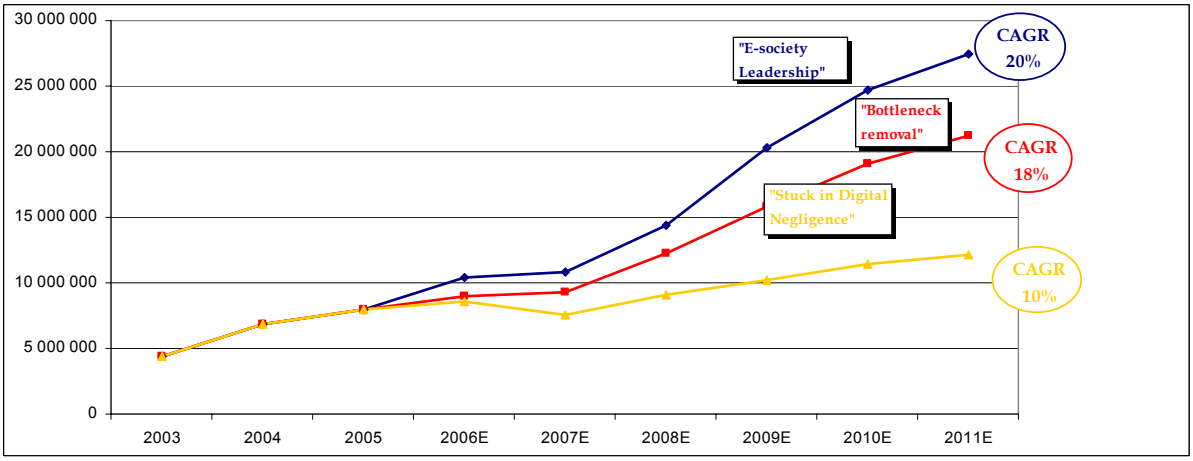
The "Bottleneck removal" scenario suggests that the share of Internet users in Armenia will reach the average level of CIS countries soon with CAGR of 17%.
The third possible development path ("Stuck in digital negligence" scenario) suggests that by 2011 Armenia will lag behind CIS countries by almost 7% less usage of Internet. CAGR is estimated at 10%.

Figure 7: Internet penetration rate dynamics



The possible dynamics of the ISP market size is shown in the following graph. The forecasts are estimated based on the assumption that the revenue per user will decline by 25%, as a result of a significant price drop expected in 2007. The CAGR for the total revenue is calculated as 10; 18 and 20 in scenarios 1; 2 and 3 respectively.

Figure 8: Internet Market Size, USD



The forecasts of the tax amounts are based on analysis of the historical data published by the State Tax Service of Armenia. The forecasted taxes generated by the ISP sector companies in 2011 are displayed in Table 6. The Table contains the forecasts on workforce figures in 2011. The workforce of ISP companies is currently comprised of 378 employees. The CAGR of the workforce is estimated to be proportionate to that of the ISP market size.

Table 6: Forecasts on taxes and workforce of ISP companies for the year 2011

	Total tax amounts; USD	**Total number of employees**
Scenario 1: Stuck in Digital Negligence		
	2 437 977	600
Scenario 2: Bottleneck Removal		
	4 248 723	850
Scenario 3: E-society Leadership		
	5 481 305	950

2.5 Armenia's IT Industry Scenarios

As the development of ISP and software and services sectors are relatively independent, different combined scenarios are presented in Figure 8.

Figure 9: Armenia's IT Industry Scenarios Matrix

INTERNET SERVICES SECTOR SCENARIOS	SOFTWARE AND SERVICES SECTOR SCENARIOS: Trap of Current Model	Niche Maneuvering	Strategic Positioning
Stuck in Digital Negligence	SCENARIO 1.1 Revenue: $114.5 mln. Employment: 7 201 Taxes: $25.8 mln.	SCENARIO 1.2 Revenue: $162.2 mln. Employment: 7 787 Taxes: $30.7 mln.	SCENARIO 1.3 Revenue: $232.9 mln. Employment: 9 156 Taxes: $39.2 mln.
Bottleneck Removal	SCENARIO 2.1 Revenue: $123.6 mln. Employment: 7 451 Taxes: $27.6 mln.	SCENARIO 2.2 Revenue: $171.2 mln. Employment: 8 037 Taxes: $32.5 mln.	SCENARIO 2.3 Revenue: $242 mln. Employment: 9 406 Taxes: $41.1 mln.
e-Society Leadership	SCENARIO 3.1 Revenue: $129.7 mln. Employment: 7 551 Taxes: $28.8 mln.	SCENARIO 3.2 Revenue: $177.4 mln. Employment: 8 137 Taxes: $33.8 mln.	SCENARIO 3.3 Revenue: $248.1 mln. Employment: 9 506 Taxes: $42.3 mln.

CHAPTER 3: ASSESSMENT OF OTHER CROSS-CUTTING FACTORS

The development of the IT sector is influenced also by industry wide (not company-specific) factors. In particular, we focus our attention on the impact of availability of skilled IT specialists, the quality of political and regulatory, and infrastructure environment; venture capital availability, and quality of education. The influence of these factors on the growth of the IT sector has been tested through constructing an IT export model based on aggregated, country-level data for major IT exporting countries.

Within the model, we have developed a number of hypotheses regarding the functional relationships between the factors that could be tested quantitatively on a cross-country basis. The model allows measuring and testing the impact of cross-cutting factors on IT such as regulatory environment and infrastructure which could not be measured and tested in the revenue model**.**

3.1 The Cross-Country IT Export Model

Hypotheses

We have developed a set of hypotheses, which are partially based on the main success factors of "software-export followers" (Hicks and Nicholson, 2004) such as supply factors (human capital, finance) and infrastructure.

Hypothesis 1: Available pool of internationally certified specialists positively affects the IT export growth.

Availability of internationally certified/qualified specialists will allow the country to enhance its exporting potential and specifically compete in high-quality products/services segments.

Hypothesis 2: Political and regulatory environment positively affects the IT export growth.

A favorable political and regulatory environment (intellectual property protection, property rights, competitions in the ISP sector, efficiency of legal framework, etc.) enhances local companies' capacity to be more productive and compete globally. The government initiatives and regulatory changes send positive signals to MNCs to choose a particular destination, thus boosting the IT export growth.

Hypothesis 3: IT growth favoring infrastructure positively affects the IT export growth.

Reliability of electricity supply, secure internet hosts, etc. boost the productivity of local companies, enhancing their potential to compete globally. These changes will attract MNCs, hence increasing the IT export volumes.

Hypothesis 4: Availability of venture capital positively affects the IT Exports growth.

Availability of venture capital funds both from local and foreign sources attracts start-ups to undertake the development of innovative and globally competitive products, thus boosting the IT export growth.

Hypothesis 5: Quality of math and science education positively affects the skills of the IT specialist, thus boosting the export growth of the country.

Quality of math and science education develops the abstract and analytical thinking of IT graduates to make them more innovative to produce globally competitive products/ services, thus enhancing exporting potential of companies to compete in high-quality products/services segments.

Model Specifications and Variables Used

We define our model as:

Export = f (*certified IT specialists; political and regulatory environment; infrastructure environment; venture capital availability; quality of math and science education*)

Dependent variable
export04 = IT export data for 2004. As a proxy, the team uses export data for computer and related services (Source: UNCTAD)

Independent variables

ncer05 = A proxy of number of internationally certified specialists in each country. As a proxy, the team uses the number of certifications completed on-line from May 1, 2004 to April 30, 2005 via Brainbench's online skills certification site (Source: Global Skills Report, 2005).

pol0506 = political and regulatory environment. A composite index, ranging from -1.70 to 1.97 (standardized with a mean of 0, being distributed above and below the mean score of zero), that is constructed by incorporating the following variables: effectiveness of law making bodies (2005); laws relating to ICT (2005); judicial independence (2005), intellectual property protection (2005); efficiency of the legal framework (2005), property rights; quality of competition in the ISP sector (2005) (Source: Global Information Technology Report 2005-2006)[4].

inf0506 = infrastructure environment. A composite index, ranging from -0.84 to 4.29 (standardized with a mean of 0, being distributed above and below the mean score of zero) that is constructed by incorporating the following variables: telephone lines (2003); secure internet servers (2004); internet hosts (2003); electricity production (2002) (Source: Global Information Technology Report 2005-2006). All data are hard data published by the World Bank, ITU.

vent0506 = Availability of venture capital in each country in 2005 (Source: Global Competitiveness Report 2005-2006). This variable has score-based values, ranging from 1 to 7.

qms0506 = Quality of math and science education in 2005 (Source: Global Competitiveness Report 2005-2006). This variable has score-based values, ranging from 1 to 7.

Descriptive Statistics of the Variables

Table 6 provides descriptive statistics of the variables included in the IT export model. The model includes 68 countries, together exporting 84.1 billion USD, which account for about 90% of the world IT export. The average value of the IT export was 1.27 billion USD in 2004 with standard deviation of 3.2 billion USD. There is an enormous difference in the volume of IT export and the number of certifications received among the countries. Specifically, Paraguay (0.4) and Ireland (18,316.5) have the lowest and the highest levels of IT export.

The number of certifications received ranges from 3 (Mozambique) to 125,722 (United States). The political and regulatory environment, the infrastructure environment, venture capital availability, and the quality of math and science education are variables describing the level of the country in a specific field. The scores of the political and regulatory environment and the infrastructure environment can take negative values. These two variables have mean values of 0.279 and 0.280 respectively.

Table 7: Descriptive Statistics of the Dataset

Variable	Obs	Mean	Std. Dev.	Min	Max
export04	68	1,269,789,000	3,170,602,000	400,000	18,316,500,000
ncer05	68	4216.176	16873.68	3	125722
pol0506	68	0.2786765	1.05017	-1.68	1.96
inf0506	68	0.2808824	1.101179	-0.84	4.29
vent0506	68	3.526618	1.01896	1.74	5.89
qms0506	68	4.393971	1.002265	2.31	6.5

Hamilton (1992) notes, that non-normal distributions of error term often result from badly skewed Y and/or X distributions. We also have tested the variables for the normality of distribution and found that we reject the null hypothesis of normal distribution for many them. The natural logarithms of our variables, however, have better-behaved normal distributions (See Appendix 3). To avoid violation of the OLS assumption of a normally distributed error term and to be able to capture the nonlinear relationships between the exogenous factors and the IT service export, we decided to use the natural logarithms of the variables.

Hence, the model will have this form. The modified set of the variables is the following: *l_ex = ln(export04); l_nc = ln(ncer05); l_pl = ln(pol0506); l_inf 0506=ln(inf 0506); l_vc = ln(vent0506); and l_qms = ln(qms0506)* (See appendix 3 model specification and diagnostics).

$$l\_ex = a_0 + a_1 * l\_nc + a_2 * l\_pl + a_3 * l\_inf0506 + a_4 * l\_vc + a_5 * l\_qms + \text{error} \quad (1)$$

The literature (UNCTAD, Information Economy Report, 2006) shows that developed and developing countries are rather different from each other in terms of the effect of the mentioned factors on the level of the IT export. We have grouped these countries based on the Digital Opportunity Index, 2004/2005 (*digop0405*), which ranges from 0 to 1. The cutoff point for grouping is 0.5, the average score of the index (see Appendix 1). *This cutoff point logically separates countries in terms of the level of development of the ICT infrastructure and its usage (affordability).*

Results of Estimation

Estimation #1: For All Major IT Exporting Countries (Without Outliers: India and Malta)
(Number of oservations equals to 66, R-squared equals to 0.7)

$$l\_ex = -1.82 + 0.30 * l\_nc + 1.53848 * l\_pl + 0.672 * l\_inf0506 + 3.00 * l\_vc - 0.40 * l\_qms \quad (2)$$
*(1.24) (2.98)*** (2.39)** (0.90) (2.02)** (0.40)*

Estimation #2: For Countries with Digital Opportunity Index greater than 0.5 (Without Outliers: Luxembourg)
(Number of observations equals 35, R-squared equals 0.59)

$$l\_ex = -4.38 + 0.40 * l\_nc + 2.58331 * l\_pl - 2.06 * l\_inf0506 + 6.09 * l\_vc - 0.91 * l\_qms \quad (3)$$
(1.51) *(2.14)** (1.49) (1.67) (2.64)** (0.57)*

Estimation #3: For Countries with Digital Opportunity Index less than 0.5 (Without Outliers: India)
(Number of observations equals 31, R-squared equals 0.56)

$$l\_ex = \underset{(0.68)}{-1.37} + \underset{(2.32)**}{0.32} * l\_nc + \underset{(2.06)**}{1.54864} * l\_pl + \underset{(1.13)}{2.46} * l\_inf0506 + \underset{(0.62)}{1.28} * l\_vc \underset{(0.08)}{-0.13} * l\_qms \quad (4)$$

Note: Absolute value of t statistics in parentheses
* *significant at 10%;*
** *significant at 5%;*
*** *significant at 1%*

3.2 Model Results and Implications for Armenia

The IT Export across the Globe

The rich pool of highly-qualified/ certified IT specialists, the high quality of political and regulatory environment and the availability of venture capital affect the current level of the IT export across the globe. The ICT favoring regulatory environment creates positive incentives for both multinationals and local companies, boosting the IT export of a given country. On average across the globe, a 1% improvement in a country's score of political and regulatory index would cause a 1.54% increase in the volume of the IT export. And the increase of internationally certified, i.e. high quality IT specialists by 1% percent would cause a 0.3% increase in IT export. The highest magnitude is observed in the case of the availability of venture capital funds that enable start-ups to initiate innovative but risky projects, to design new products and services. The 1% improvement of the score would cause a 3% increase in the IT exports.

The quality of infrastructure and math and science education does not have a statistically identifiable impact on the IT export growth export across the globe. The developed world enjoys a high quality infrastructure; the developing world enjoys low-cost labor force availability that partially or fully offsets the effects of poor quality and high cost of the domestic infrastructure. Moreover, the lion's share in the IT export is software and services that are less dependant on such factors as the number of telephone lines, secure internet hosts or stability of electricity production. The high quality of math and science education enables IT specialists to qualify for certifications, thus increasing the volume of the IT exports. However, in our sample these 2 variables don't behave in the same way, and the correlation is very low (0.13). For instance, in the case of the United States, the quality of math and science education in schools is quite low in comparison to leaders (Western European countries); however the US enjoys the largest pool of certified IT specialists, which could reflect the migration factor. The reverse scenario is observed in developing countries, where the quality is relatively high; however, the brain drain reduces the available stock of internationally qualified specialists. This phenomenon explains why the quality of math and science education doesn't have any impact on the IT export across the globe.

Group 1. Countries with a High Level of ICT Penetration and Usage

Availability of the pool of internationally certified IT specialists and venture capital play a significant role in boosting the export from countries with a high ICT penetration rate and usage. The highly-skilled labor stock of IT specialists is more innovative, and can

design and develop sophisticated applications and programs to be globally competitive, thus increasing the IT export volumes across the countries with high digital opportunities. This productivity is also reflected in the coefficient of this variable. On average, a 1% increase of the number of IT certified specialists would cause a 0.4% increase in the IT exports across these countries. This innovative environment attracts and is supported by venture capital. The 1 % improvement of the score will cause the highest, 6.09%, increase in the IT exports.

Group 2. Countries with a Lower Level of ICT Penetration and Usage

For countries with a lower level of ICT development (including Armenia), the number of certified IT specialists and the quality of political and regulatory environment determines the level of the IT exports. The available stock of highly qualified IT specialists will allow local companies and the multinationals to offer high-quality products at a comparatively low cost thus boosting the export growth, which could be based on best practices, not on unique value proposition. This fact is reflected in a comparatively low coefficient of this variable in comparison to the value of the countries with a high ICT penetration rate and usage. On average, the 1% increase of the number of IT certified specialists would cause a 0.32% increase in the IT exports across these countries. Both locals and multinationals operating in these countries with a relatively low ICT penetration level and usage are very sensitive to the policy and regulation changes that the government is initiating or implementing. These positive signals attract MNCs, thus boosting the IT export growth. On average across these countries, a 1% improvement of the score of the political and regulatory index would cause a 1.55% increase in the IT export.

Implications for Armenia

1. *Current Stage.* In the current stage of domestic ICT development, for the growth of IT export and overall IT industry, the most important enabling factors that Armenia needs to get concentrated are the supply of high quality IT specialists and the general regulatory environment. The sufficient supply of high quality IT specialists is an absolute necessity for the industry, while a stable and improving political and regulatory system is the "framework" or a basic condition that opens the doors of opportunities.

2. *Move to the Next Stage.* As Armenia moves to the next stage of ICT development, it needs to think of different factors that ensure the success of countries in more developed and mature stages. One of the key factors will be the establishment, attraction and effective functioning of venture capital funds which will fund innovative projects in Armenia.

CHAPTER 4: DEVELOPMENT MODELS AND KEY PRIORITIES

4.1 Three Development Models

The Armenian IT sector is facing a strategic choice of a future model for development. As the industry is maturing, the future growth is becoming harder to achieve. The mere increase of supply of IT specialists is not enough to sustain the growth. The competitive advantage and Armenia's value proposition need to be clearly articulated. The value proposition will have to go beyond mere supply of teams of high quality engineers and programmers who are ingrained in selected elements of global value chains of multinationals. The transformation needs to entail a shift from competitive advantage resting on low cost programmers to competitive advantage based on ability to produce high value added products and solutions. Armenia is hardly able to compete with massive low cost off-shoring destinations, such as India, China, Vietnam, etc. Regardless of the choice of the model (discussed below) Armenia's positioning requires well-thought strategies, and coordination of actions among all stakeholders of the IT industry.

Governments are fiercely competing in offering better environments for IT businesses. The competitive tools include creating specific cutting edge infrastructures (technoparks, science parks, incubators, venture and innovation funds, telecommunication infrastructure, etc.), providing lucrative tax incentives, grants, cost-sharing instruments, investing in education and other actions, etc. The Armenian government needs to consider applying and developing the right mix of the instruments within a consistent framework.

Clear positioning of the industry requires a compatible and unambiguous branding strategy. The branding concept should directly follow the positioning and competitive model and reflect the key value proposition of the industry. Armenia can strive to capture its "niche" based on an attractive positioning clearly comprehensible by global players.

Based on the analyses of the experience of countries that succeeded in developing IT industries in relatively short periods of time (see Boxes 3-5), as well as the results of the model, we highlighted three competitive development models labeled as follows:

1. Platform for regional expansion (Ireland, Egypt)
2. High-tech power center (Israel)
3. Information society (Estonia)

These models can eventually serve as a basis for working out a competitive development model for Armenia.

Model 1. Platform for Regional Expansion

Countries following this model have successfully positioned themselves in the global market as platforms for global players to penetrate into large regional markets. They provide advantages for global companies to serve targeted regional markets more effectively. Through creation of a favorable business environment, provision of high skilled labor force and developing necessary infrastructure, they managed to become an attractive investment destination for mostly market-seeking FDI's in the particular region. This was leveraged by various types of fiscal and financial incentives. Cultural and language similarities have also supported the process.

Successful examples for this model are Ireland and Egypt (See box 3). Ireland implemented a sophisticated phased policy aimed at attracting global, mostly US, multinationals that sought efficiency and access mainly to the EU markets. Seven of the 10 major software companies in the world have substantial operations in Ireland. Egypt and Jordan are positioning themselves as leaders or platforms for the MENA region (Middle East and North Africa) trying to replicate the Irish success. Currently, the UAE also tries to turn into a regional hub for high technologies making heavy investments in this sphere.

The key success factors in this model are:

- free access to regional markets (in the case of software, this is not heavily complicated by transportation problems);
- availability of qualified work force;
- cultural and/or language similarities with outsourced countries and regional players;
- pro-business government policies;
- reliable physical infrastructure and connectivity;
- comprehensive and effective workforce development initiatives.

Model 2. High-Tech Power Center

This model implies developing advanced technologies & science-based clusters, and infrastructure. The value proposition to leading technology MNCs includes unique and sophisticated competences for their global value chains. The model to a large degree rests on creation of a highly skilled workforce pool able to develop and design innovative and sophisticated products and services. Creation of world-class science and technology schools, improvement of quality of math and science education in public schools and heavy investments in R&D (both public and private) are the most critical factors determining the success of the model. Government initiatives, such as fiscal and financial incentives for R&D and development of high-tech export-oriented products, coupled with business development skills through technology incubator programs, attract global venture capital to fund risky innovative start-ups. Solid and effective financial markets (especially stock markets) should be in place to support business initiatives and, particularly, venture capital exit strategies.

Israel represents a success story of the model (for a more detailed presentation of its story, see Box 5). 40% of its GDP growth in recent years has been achieved due to the high-tech sector; it is the leading R&D center for Intel, IBM, Motorola, Microsoft, Boston Scientific, Oracle, Sun Microsystems, HP, Texas instruments, Cisco SAP, GE Medical Systems, etc.

The key success factors for this model are:

- Highly skilled science and technology graduates (Israel reatly benefited from a massive inflow of engineers and scientists from the Soviet Union in the early 1990s);
- Financial and fiscal incentives;
- R&D-oriented government programs and initiatives;
- Creation of technology incubators;
- Availability of venture capital funds;
- Advanced financial markets;
- Culture of risk-taking and entrepreneurship.

Model 3. Information Society

This model has a clear positioning as a center for developing or processing ICT enabled tools/applications. The IT sphere initially develops as a result of the internal infrastructure growth and domestic demand. The main drivers of the model are government-led initiatives, such as e-governance; the so-called e-society projects; heavy investment in the ICT and telecom infrastructure; promotion of ICT use in the country through school connectivity, internet access centers, and computer literacy trainings, etc. Legislative changes are necessary regarding adoption of e-business practices and use of on-line government services (on-line tax filing, on-line public procurement, etc.) The increase of local demand drives the future of the IT sector and development of new innovative, ICT-enabled services and products that are later exported into foreign markets. The general computer literacy and Internet/PC penetration rate of the society determine the level of the model's success.

Estonia and Chile represent the success stories of this type of model. Investments in the telecom infrastructure in the early 1990s, ICT use promotion, and relatively skilled labor force attracted Nordic MNCs, such as Nokia and Ericsson to set up pilot production units in Estonia (See box 4). Skype Software was developed in Estonia. Government-led initiatives in the first half of the 1990s resulted in emergence of "Chilean E-society" in the first half of the 2000s.

The key success factors for this model are:

- Government initiatives of e-society/e-governance building;
- Investment in the ICT/telecom infrastructure;
- High computer literacy and Internet penetration;
- Favorable business environment;
- Workforce development initiatives.

The priorities under each model are summarized in Table 8.

Table 8: Strategic choice matrix

Development Models	Importance of drivers	Drivers			
		Incentives*	**Workforce Development**	**Infrastructure**	**FDI****
Regional Platform	*Very important*	• ***Fiscal***	• ***Programming skills*** • ***Certification centers***	• ***Technoparks*** • ***Incubators*** • ***Telecom*** • ***Free zones***	***Efficiency & market-seeking FDI***
	Important	• Financial	• Math & science education • Business development skills	• IPR • Venture capital	
	Less important		• General computer literacy	• PC penetration	
High-Tech Center	*Very important*	• ***Financial*** • ***Fiscal***	• ***Math & science education*** • ***Business development skills***	• ***IPR*** • ***Venture capital*** • ***Technoparks*** • ***Incubators***	***Strategic asset-seeking FDI***
	Important		• Certification centers • Programming skills	• Free zones • Telecom	
	Less important		• General Computer literacy	• PC penetration	
E-society	*Very important*		• ***General computer literacy*** • ***Programming skills***	• ***IPR*** • ***Telecom*** • ***PC penetration***	***Mixed; FDI is less important than in other models***
	Important	• Fiscal • Financial	• Math & science education • Business development skills	• Technoparks • Incubators • Venture capital	
	Less important		• Certification centers	• Free zones	

Notes:

* Fiscal incentives (e.g. tax holidays, tax credits); financial incentives (e.g. investment and R&D grants).

** Types of FDI:

- **Market-seeking**: Investments, which aim at either penetrating new markets or maintaining existing ones.
- **Efficiency-seeking**: Investments, which are expected by firms to increase their efficiency by exploiting the benefits of economies of scale and scope, and also those of common ownership.
- **Strategic asset-seeking:** Investments undertaken to protect or augment the existing ownership specific advantages of the investing firms or to reduce those of their rivals.

Box 3
Ireland and Egypt: Platform for Regional Expansion

Ireland: Window to EU

World's largest exporter of software
Manufacturer of 25% of Europe's computers.
Highest Quality of Life Index (Economist Intelligence Unit World in Review 2005)
Second-highest per capita income in the EU (2006)
Fourth highest GDP (based on PPP) per capita in the world (2005)
Fourth in the UN Human Development Index (2006)

From the poor economic indicators stemming from the political and social troubles dogging the modern Republic of Ireland since its founding in 1919, the period from the mid-1990s to the early 2000s saw tremendous, unprecedented economic growth – the "Celtic Tiger". The transformation of Ireland's economy from one of the poorest in Europe to one of the richest is generally explained by governmental policies, such as low corporate taxation, a low-cost, well-educated, English-speaking labor force and advantages arising from EU membership, such as free access to the market and the receipt of subsidies. This was enhanced by the clear positioning of Ireland as a platform for expansion into the European market for competitive multinationals.

Economic Incentives and the EU

During the mid-to-late-1990s, taxation and public borrowing was reduced in Ireland, stimulating the economy, attracting newcomers to both the private sector and the labor market.

Ireland had been part of the Common Market since 1973, and this gave the country free and direct access to a large, growing and dynamic economy. The European Union membership also contributed as such to economic growth, with transfer payments through Brussels accounting for up to 5% of the GDP during the late 1990s. The role of low interest rates was also significant, especially with the introduction of the Euro in 1999.

Tax policies also played a key role in boosting economic activity. Apart from areas with special regimes, such as the Shannon Free Zone, Ireland set up low, extremely favorable conditions, such as the 10% "manufacturing rate" of corporate taxation. Over time, to keep the country's legislation in line with EU directives, these policies have had to be phased out or modified; however, they are still far more attractive than elsewhere in Europe (the corporate tax went up to the still-low figure of 12.5%).

Foreign Investment

Perhaps the most significant factor in the economic boom of Ireland was the tremendous increase in FDI, particularly in the ICT sector, with money coming in especially from the US, but also from other developed economies, including investments worth billions of dollars by Microsoft, Dell, Intel, Apple, IBM, Hewlett Packard, Oracle, Xerox and Ericsson, to name a few. More than 300 foreign ICT enterprises, including seven of the world's top ten companies in the field, employ around 45,000 in the country, carrying out substantial undertakings in manufacture, software and R&D (2005).

In terms of software alone, Ireland ranks as the world's largest exporter, with more than 800 local and foreign companies employing 32,000 people in that sector. This accounts for 10% of the country's exports, generating €12 billion in revenue (2006).

Besides manufacturing computer hardware, chips and components, ICT companies in Ireland also carry out marketing, sales, software development, technical support, shared services, IP management and many other related activities.

Foreign investment also boosted spending in R&D and software development. Total public and private investment in higher education in the country increased on average by 10% annually during the past ten years. (IDA Ireland Website, OECD STI Scoreboard Report, 2002)

Apart from access to Europe, American companies were drawn to Ireland by its attractive taxation policies, favorable time difference and skilled workers. Besides traditional goods, such as textiles, confectionary and beer, and the already well-established products and services in the ICT sector, Ireland has also begun to diversify and carry out substantial operations in the financial and legal sectors, pharmacy, accountancy, call centers, customer services and tourism.

The Labor Market

An important factor in the Celtic Tiger was the availability of a relatively young and well-educated, English-speaking labor force. Governmental initiatives in education have prepared and continue to bring a steady supply of engineers, scientists and management personnel to the economy. In 2003, the Irish government spent €1,484 per capita on education, accounting for 5.5% of the GNP.

Today, Ireland produces more than 34,000 graduates annually, with a 32% increase in students pursuing higher engineering and technology courses since 1992 (2006). The combined annual spending on research by universities in the country, institutes of technology, state-backed advanced technology programs and technology centers has more than doubled in recent years.

Increased employment was boosted by greater participation in the labor force as well, especially by women, resulting in a fall in unemployment from 17% in 1987 to 4% in 2004. Foreign workers have also been attracted to Ireland, with migrant communities from the new EU member states in Eastern Europe, and also from China and Nigeria.

The Celtic Tiger. Challenges ahead

Ireland saw a growth rate between 6% and 11% during the period of 1994-2000. A downturn in the ICT sector on a global scale in the early 2000s severely affected the economy, reducing growth to 2%, which significantly increased once again, however, to around 4-5% in 2004-2005, with continued growth expected over the next few years.

The Irish government is taking steps to keep the economic growth sustainable. The Celtic Tiger allowed for greater public spending without significant increase in taxation, and a lot of investments in infrastructure have been carried out. The National Development Plan and Community Support Framework invested €57 billion from public, private and EU sources in education, roads and transport, health and social services, rural and local development, industry and waste during the period of 2000-2006. Science Foundation Ireland was set up within this framework, specializing in R&D

in biotechnology and information and communication technology. The International Financial Services Centre, established earlier in Dublin in 1987, ended up creating more than 10,000 jobs in the banking, finance and insurance sectors.

Even so, certain issues still need to be addressed, such as further improvements still in infrastructure, healthcare and lesser dependency on fossil fuels for energy. The big fear is that the Celtic Tiger was a phenomenon that would be difficult, if not impossible, to maintain in Ireland or reproduce elsewhere, given the unique nature of the factors that led to it.

Egypt: Platform for MENA Regions

32nd in GDP (based on PPP) in the world, second in Africa (IMF, 2005)
53rd in e-readiness (Economist Intelligence Unit rankings, 2005)
13 million mobile phone users in 2005, with penetration of 18.5%
1428 ICT companies (October, 2005)
Over 250,000 undergraduate and graduate degrees obtained annually penetrate

In the second half of the 1990s, the government of Egypt, recognizing the need for more diversified foreign exchange earnings besides its main sources (Suez Canal duties, tourism and gas exports), identified the potential of becoming another Ireland or India, if the workforce were adequately trained and the available stock were expanded, in order to become one of the main offshore outsourcing destinations for the leading IT multinationals.

The Egyptian government, inspired by this idea, undertook serious legislative changes and reforms to position the country as the leading Arab IT hub and one of the key players in the international ICT circuit. In 2005, software export was estimated at 500 million USD. In 2004, the IT services market was estimated at 445 million USD.

Egypt became the major IT hub for the Arab region by 2002 and the major exporter to the countries of this region, competing with the UAE and Jordan. More than two-thirds of software demand of the region was supplied by Egypt, and major software exporters established their branches in the UAE, Saudi Arabia, Bahrain and Oman.

The Ministry of Communications and Information Technology

The Ministry of Communications and Information Technology (MCIT) was established in October 1999 and, in December, the Ministry introduced the Egyptian National Communications and Information Technology Plan (ENCITP) to set up a viable, export-oriented IT sector, to boost employment in ICT and build an information society.

In 2003, the Ministry started building Smart Village, a Silicon Valley model of a business technology park, the first in the country, in order to attract both domestic and international key ICT players. By the time it will be completed, this area on the outskirts of Cairo will contain 67 office plots, accommodating about 30,000 employees. Smart Village will provide all the necessary amenities in terms of infrastructure, including high-speed fiber-optic telecommunication lines, while maintaining a modern, environmentally-friendly look. Microsoft, Vodafone, Hewlett Packard and Ericsson have already established offices there. The complex also includes recreational facilities, a conference centre and a hotel.

The MCIT continues to be at the forefront of developing and sustaining the ICT sector of the Egyptian economy.

Economic Incentives

Tax holidays were made available by the government to make investing more attractive in Egypt. All software companies were granted a five-year tax holiday, and ten years were granted to those that established their operations in new industrial zones. Software products were also made free of customs and sales tax.

In 2003, the Egyptian pound was made to float freely as part of a general liberalization of the foreign currency exchange rate. This resulted in a dramatic increase in value in terms of exported goods and services, including software.

Workforce Development

In 1993, the government established the Information Technology Institute to enroll IT experts for special nine-month training courses. In 1996, a Faculty of Computers and Information was established at Cairo University, and, in 2001, 900 students were enrolled in four departments there.

In 2001, by the approval of the Prime Minister of Egypt, the Egyptian Technology Institute was established. The government, realizing the need for increasing the current pool of IT specialists and the current trends in the offshore outsourcing market, estimated the cost for each new IT specialist training at 20,000 USD. To produce 5,000 specialists annually, 100 million USD was required within a five-year period in the early 2000s. The MCIT built strategic alliances and established various programs with multinationals, such as IBM, Microsoft, Oracle, Lucent, Qualcomm, etc. to assist to produce world-class specialists. The MCIT was sharing the cost with MNCs on a fifty-fifty basis in case of strategic alliances. By the early 2000s, IBM alone had trained 15,000 specialists, including university graduates in web design and database development.

ICT Research and Development Initiatives

The MCIT promotes and strengthens R&D initiatives and public-private partnerships between the government and multinationals. These included, for example, the Virtual ICT R&D Centers of Excellence, which created collaborative R&D linkages among professionals, private sector initiatives and academia to support innovations in ICT applications. The centre was helping the companies to fill in patent applications, and was assisting in marketing activities.

Also, the Technology Development Fund was established in 2004 as a public-private partnership and was chaired by the MCIT. Leading companies provided 50 million Egyptian pounds (≈9 million USD), and in 2005 the amount reached 150 million EGP (≈27 million USD) (MCIT, 2006). The first incubation facility was established within the framework of this project, and the Fund also assisted start-ups and SMEs by providing technical, financial and administrative support.

Earlier, in 2001, the Software Engineering Certification Centre (SECC) had been established in Egypt, one of the very first in the region. The main goal of the project was to strengthen the software industry to compete internationally by increasing the quality of practices used by the IT companies. The Centre offered trainings on software process improvement, workshops for managers and CEOs, and supported the leading software companies to be qualified for industry-standard assessments and accreditation.

Key Figures

An annual real GDP growth rate of 5.1% was recorded in 2004-05, with a highly-reduced inflation rate, down to 4.7% in that period. Stock market capitalization also accounted for 55% of the GDP. Software and IT services accounted for an estimated 1% of GDP in 2004-2005.

In terms of ICT, internet users went from 300,000 in 1999, up to 5 million users, estimated in 2005. There are almost 1500 companies working in the field, employing more than 40,000 people. Egypt also produces a further nearly 9000 multi-lingual and well-trained university graduates every year.

Box 4
Estonia: Information Society Model

First in State of World Liberty Index (2006)
Seventh in Index of Economic Freedom (2006)
23rd in the Networked Readiness Index (Global Information Technology Report 2006-2007)
34% of all households equipped with a computer (2006)
Completely covered by digital mobile phone networks
The development centre for Skype
Year-on-year GDP growth of 9.9% (Q4, 2005)

A couple of decades after independence in 1918, Estonia's primarily agriculture-based economy was shaken through occupation and forced Socialization. After the fall of the USSR in 1991, the country underwent major political and economic reforms, joining the WTO in 1999, and NATO and the EU by 2004. Today, Estonia is perceived as one of the most progressive countries in the world in terms of developing information technology in the economy, and putting it to use in society as such.

Far-Reaching Economic Reforms

Estonia was one of the earliest former communist countries to adopt market liberalization and promote privatization. Governmental policies, such as regulating and simplifying taxation, have largely attracted foreign investment, especially from the Scandinavian countries. For example, corporate income tax was abolished in 2000 for social or employment projects and reinvested projects (this is not in line with the EU regulations, however, and is due to be revised by 2009). Foreign companies were also given the same rights as local ones, with no exchange controls or restrictions on foreign investments or capital flows.

The national currency, the Kroon, came into effect in 1992 pegged to the Deutschmark (8:1), later taking on a fixed rate with the Euro as well (15.64:1). This also served as a stabilizing factor for the economy and was an added incentive in bringing in investors. However, this liberal Estonian monetary policy, the currency peg as law and the constitutional requirement for maintaining a balance between revenue and expenditure in the budget at the central level were factors in the delay of joining the Eurozone, which is now foreseen for 2008.

A special body, the Estonian Privatization Agency, was established to oversee the sale of large and small state assets. Even with controversies and the mishandling of some deals, FDI were at 31% of the GDP in 1999, with the private sector as a whole officially accounting for 85% of the GDP in 2001.

"e-Stonia"

More than from investments in the information technology sector, Estonia benefits from the role that computers and telecommunication plays in the overall running of society. The government was a significant factor in promoting information technology use in the country.

Another major factor in this was the country's proximity to the Nordic countries, and particularly the historical, cultural and linguistic ties with Finland. Early on after independence, Estonia acted as a base for pilot productions of especially telecom-related companies, such as Nokia and Ericsson, and this led to the development of software applications, such as, in recent years, Skype.

In the 1990s, large investments were put in place in the telecommunications infrastructure of Estonia. The state-owned Estonian Telecom Company was granted a seven-year monopoly on fixed lines in 1993, in return for committing to modernize the prevalent infrastructure. This was key to a very fast growing telecommunications and IT clusters, outpacing the country's Baltic neighbors.

The country ranks as one of the best-connected in the world, both in terms of infrastructure and usage. Internet users comprise 54% of the population aged 6 to 74, with 20-25% of all households online. More than a million enjoy internet banking (this, in a country with a population of 1.37 million) (2006). There were more mobile subscribers than inhabitants by late 2005, with fixed-line telephones in decline. WiFi and broadband are widely available, and all schools and libraries have internet connections.

Governmental initiatives have included electronic ID cards, a Digital Signatures Act (2000) and e-government cabinet sessions following an internet-based system. The government has also highly simplified all forms of taxation, putting in a flat tax of 26% and a VAT of 18%, with about three-quarters of the population availing of the fast and easy facility of filing for income tax online. Internet voting was also put to use in local elections in 2005.

One of the "Baltic Tigers"

GDP in Estonia had risen to 13.1 billion US dollars by 2005, with a growth rate of 9.1% estimated for that year. Unemployment fell as well, from 13.6% in 2000 to 4.2% in 2006.

In spite of these impressive figures, Estonia is also facing some obstacles. One issue in particular is software piracy. Strong measures taken in the past have been of great benefit to that sector, with the reduction by 33 points in the piracy rate between 1996 and 2002, adding 75 million US dollars to revenues. But more efforts still need to be made in that regard.

There was a strong connection and interdependence among developing the telecommunications infrastructure, spread of ICT tools and software development. However, the boom in this sector in Estonia is more concentrated with regards to developing telecommunications, steering clear of the potentially-lucrative global

outsourcing market. Most ICT companies in Estonia are also foreign-owned, and although EU membership mitigates this factor, it can still act as an issue in stifling home-grown enterprises.

All of the "Baltic Tigers" are expected to record growth of 5-10% until 2010.

Box 5
Israel: R&D-Based Model

14th most creative country in the world (Dar, 2005)
Sixth nation in the number of US patents per capita (2004)
Highest concentration of high-tech companies in the world after Silicon Valley (2005)
Highest level of venture capital as a percentage in GDP in the world (2005)
Highest high-tech start-ups density in the world with a success rate of 50% (2005)

Government policies and initiatives, such as heavy and effective investments in education, incentives favoring foreign investors, capital market reforms, high R&D spending (4.6% of the GDP), incubator and venture capital programs, coupled with immigration, Jewish egalitarian culture and Diasporan business links, enabled Israel to emerge as a high-tech power in the late 1990s and the beginning of 2000s. The government was encouraging and supporting the private sector to compete in international markets, ready to withdraw, however, as soon as the latter was able to continue on its own. Software exports reached $2 billion in 2004, from $135 million in 1992, representing about 7% of total Israeli merchandise trade (MATIMOP, 2005).

The primary focus of the Israeli policymakers was on innovation and R&D to strengthen the capacities of the private sector to export highly competitive innovative goods and services, relying on the "comparative advantage" of Israel: qualified human capital, scarce natural endowments, and hostile neighbors.

Investment Incentives. Capital Market Reforms

The Law for the Encouragement of Capital Investment (LECI), adopted in 1959, was aimed at increasing exports and employment in least developed areas and to promote export-led business initiatives by granting government grants (up to 24% of tangible assets) and tax benefits depending on the percentage of foreign ownership and location. The Law deliberately introduced a bias in favor of foreign investors to attract high-tech multinationals. Capital market reforms were carried out, resulting in the increase of the efficiency of the stock market, turning it into one of the most technologically-advanced stock markets in the world.

As a result of these reforms, many start-ups emerged, since it became easier to get a loan. The flow of international investors to Israel increased during the 1960s and 1970s, including high-tech giants, such as IBM, Motorola and Intel, bringing significant spillovers (access to new markets, financing, and know-how, knowledge transfer). In 2003, Intel employed 6,000 workers, and was the top electronics exporter in Israel ($1.6 billion).

Government Support for R&D

The first step in this direction was done in the late 1960s by establishing the Office of Chief Scientist (OCS). The Law for the Encouragement of Industrial R&D (LEIRD) was adopted in 1984 to foster science-intensive, export-oriented private industrial R&D to absorb the growing labor force by providing grants, loans and other incentives. The OCS implemented both national and international projects (pre-seed, generic and competitive R&D).

The MATIMOP (national hub) was established to assist the OCS with implementing and overseeing projects aimed at the participation of Israeli industrial firms in bilateral and multilateral R&D projects. About 20-50% of the proposed project budget was funded. On average, $300 million per year was allocated from the budget for 1,000 industrial R&D projects - the largest national program.

The Magnet Program was initiated in 1993 to strengthen collaboration between the academic world, that is, Israeli universities, and private industrial firms; only a consortium of industrial companies and at least one academic institution were eligible for funding. Up to 66% of the proposed project budget was funded. In 2005, 31 consortia were operating in the Israeli market.

Technology Incubators

In 1991, the Government initiated the Incubator Program to assist start-ups and immigrants from the erstwhile Soviet Union who lacked knowledge of market economy, English and Hebrew, and did not know how to get funding. The goal of the program was "to polish the diamond", to assist those with export-oriented and innovative ideas by providing necessary investments to develop new products. The program was very successful in fostering the emergence of start-ups.

In Israel, 24 technology incubators were established. The total Incubator Program budget was $30 million in 2005. Up to 85% of funding was provided by the government in the form of grants and soft loans, the remainder being given by the venture firm, the incubators or the entrepreneur. Each incubator is implementing 10 projects on average.

Venture Capital Funds

The government played a significant role in establishing the venture capital industry. In 1990, two venture capital funds worth $59 million were operating in the industry. In 1992, the OSC initiated the Yozma Program to accelerate the venture capital market by providing $100 million to attract international venture capital funds to invest in high-tech firms. Ten international venture capital funds came to be established. In 1995-2004, venture capital investments contributed to the 40% increase in GDP, 15% in employment, and comprised 50% of exports and 65% of foreign investments (Harel, 2005). The Silicon Valley Bank established its Israeli Branch in 2005 (Brown, 2004). The Israel Venture Association was actively raising venture capital for Israeli start-ups worldwide. In 2006, there were about 50 Israeli venture capital funds (over $12 billion) that raised capital from the United States, Europe and elsewhere.

Source: The Global IT Report 2005-2006

Appendix 1

Table 1: EU software market, by member states, € million, 2005

	2005		Systems		Application	
	Systems	Application	Growth '03-'05	Growth '05-'07*	Growth '05-'07*	Growth '05-'07*
Germany	8,251	7,836	8.2%	10.3%	8.2%	10.2%
UK	7,907	6,604	14.1%	15.3%	8.0%	9.0%
France	6,545	5,248	12.6%	14.1%	7.8%	9.1%
Netherlands	2,675	2,321	12.8%	14.8%	6.2%	8.7%
Italy	2,585	2,307	5.1%	8.9%	3.2%	5.3%
Sweden	1,306	1,369	16.7%	23.0%	35.8%	-7.2%
Spain	1,375	1,157	20.5%	10.8%	-9.8%	28.1%
Belgium/ Luxembourg	800	938	8.3%	15.9%	47.5%	-21.0%
Denmark	774	789	0.9%	27.8%	-10.3%	29.2%
Austria	817	680	19.8%	8.9%	-7.5%	27.1%
Finland	701	570	12.3%	15.5%	8.4%	10.5%
Poland	340	368	29.8%	27.1%	29.6%	31.5%
Czech Rep	248	246	1.6%	31.5%	15.0%	1.2%
Ireland	268	245	16.0%	20.5%	9.9%	11.8%
Portugal	275	227	41.0%	11.3%	20.7%	37.0%
Hungary	195	219	1.6%	29.7%	57.6%	-22.4%
Greece	215	153	30.3%	5.1%	-9.5%	69.3%
Slovakia	57	70	72.7%	-15.8%	66.7%	-10.0%
Slovenia	40	51	233.3%	-55.0%	168.4%	-45.1%
Lithuania	15	24	36.4%	-6.7%	26.3%	4.2%
Latvia	13	22	8.3%	23.1%	22.2%	13.6%
Estonia	13	21	-72.3%	438.5%	-62.5%	319.0%

*forecasts

Source: EITO (2006)

Table 2: Number of Jobs outsourced

EU-15	2005*	2010*	2015*
UK	26,728	48,597	87,474
Germany	2,733	10,163	17,091
France	1,480	9,051	15,447
Netherlands	1,475	5,511	9,236
Italy	853	1,771	2,807
Sweden	861	3,127	5,358
Belgium	310	1,082	1,910
Switzerland	424	1,456	2,604
Denmark	420	1,548	2,620
Spain	345	677	1,132
Austria	313	1,218	1,980
Finland	285	1,012	1,762
Ireland	127	231	416
Portugal	79	162	259
Greece	34	67	111
Luxembourg	16	58	98
Total	37,482	85,731	150,304

Source: Forrester, 2004; CBI, 2006

Note: *-estimates

Table 3: Number of Jobs outsourced

	2004	2010*	2015*
Computing professionals	24,151	65,951	118,712
Junior computing staff and operatives	6,705	19,780	31,592
Information Technology, total	30,855	85,731	150,304

Source: Forrester, 2004; CBI, 2006

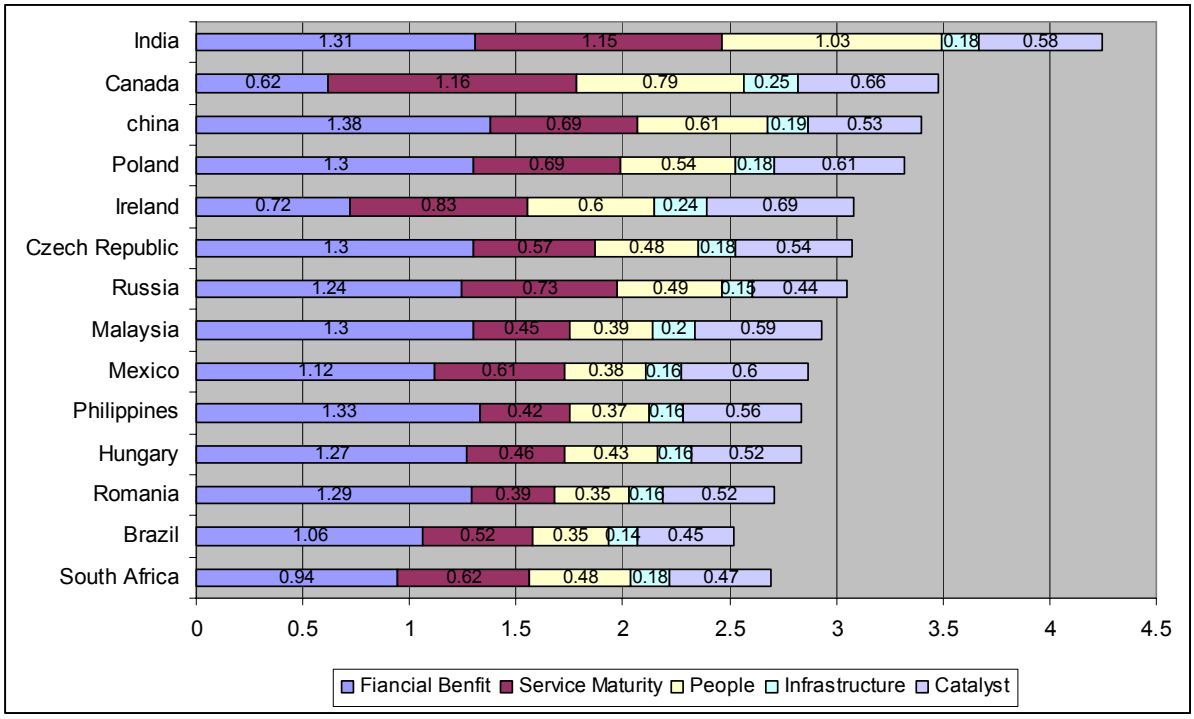
Note: *-estimates

Table 4 A.T Kearney global services location, 2005

Rank	Country	Cost	People and skill availability	Business environment	Total Score
1.	India	3.47	2.14	1.26	6.87
2.	China	3.21	1.76	1.17	6.14
3.	Malaysia	2.95	1.12	2.00	6.07
4.	Philippines	3.58	1.16	1.05	5.78
5.	Singapore	1.62	1.44	2.67	5.73
6.	Thailand	3.27	0.94	1.51	5.72
7.	Czech Republic	2.57	1.12	1.90	5.58
8.	Chile	2.73	0.97	1.87	5.58
9.	Canada	1.10	2.03	2.40	5.52
10.	Brazil	2.91	1.36	1.23	5.50
11.	United States	0.54	2.74	2.22	5.49
12.	Egypt	3.55	0.95	0.98	5.47
13.	Indonesia	3.51	1.06	0.89	5.47
14.	Jordan	3.02	0.91	1.43	5.35
15.	Bulgaria	3.29	0.86	1.11	5.27
16.	Slovakia	2.72	0.90	1.55	5.24
17.	Mexico	2.87	1.16	1.19	5.22
18.	Poland	2.67	1.06	1.44	5.16
19.	Hungary	2.61	0.88	1.63	5.13
20.	UAE	2.66	0.61	1.85	5.12
21.	Costa Rica	2.96	0.79	1.34	5.09
22.	Ghana	3.57	0.58	0.93	5.08
23.	Argentina	3.14	0.93	0.98	5.05
24.	Romania	3.07	0.92	1.05	5.03
25.	Jamaica	2.92	1.01	1.10	5.03
26.	Vietnam	3.55	0.69	0.76	5.00
27.	Russia	2.83	1.31	0.85	4.99
28.	United Kingdom	0.46	2.12	2.41	4.99
29.	Australia	0.97	1.66	2.29	4.91
30.	Tunisia	2.97	0.69	1.20	4.86
31.	Germany	0.50	2.10	2.23	4.84
32.	South Africa	2.76	0.81	1.24	4.81
33.	Israel	1.86	1.22	1.67	4.75
34.	New Zealand	1.28	1.19	2.28	4.74
35.	France	0.40	2.24	2.05	4.69
36.	Panama	2.90	0.65	1.10	4.65
37.	Portugal	1.60	0.88	1.80	4.28
38.	Spain	0.96	1.50	4.67	4.12
39.	Ireland	0.42	1.41	2.25	4.07
40.	Turkey	2.14	0.91	0.92	3.97

Source AT Kearney (2005)

Figure 1 NeoIT Offshore Attractiveness Index – ITO, 2005



Source: NeoIT (2005)

Table 5. IT Salary levels in outsourcing countries, 2005

	Average Salary	Entry Level	Team Leader	Project Manager	Total Growth (%) '05-'10
Vietnam	6,131	3,440	5,782	9,171	7.3%
India	9,896	5,715	9,374	14,597	8.7%
China	10,095	5,678	9,609	14,997	7.2%
Thailand	11,340	5,951	10,632	17,438	3.9%
Philippines	12,522	7,277	11,887	18,402	6.8%
Romania	15,743	9,085	14,606	23,536	4.8%
Brazil	15,935	9,410	15,068	23,326	5.4%
Slovakia	17,395	9,285	15,050	27,850	4.2%
Russia	21,018	12,131	19,690	31,235	7.2%
Costa Rica	21,083	11,794	19,995	31,460	7.2%
Malaysia	21,823	12,953	20,712	31,803	4.4%
Mexico	22,484	13,176	21,029	33,246	4.8%
Czech Republic	22,500	12,010	19,500	36,096	6.5%
Hungary	25,174	14,606	23,322	37,595	5.8%
Poland	29,393	16,536	27,567	44,076	5.3%
South Africa	39,696	20,357	34,694	55,036	4.0%
Singapore	41,512	24,003	38,873	61,660	3.3%
Canada	43,841	25,845	41,894	63,785	3.9%
Ireland	57,072	32,130	53,002	86,085	3.2%
Israel	39,880	23,038	38,294	58,307	3.1%
US	79,107	46,194	75,166	115,962	3.6%

Source: NeoIT (2006)

Appendix 2. Software and Service Sector Model Test Results

The coefficients of the interaction variables both have positive and negative signs. To analyze the possible differences between company characteristics, a number of tests described in the following were performed. All the tests were carried out as F-tests on a 5 % test level. (Griffiths et al 1993).

The F-test is the following (here and in the following, the term H_0 refers to the hypothesis to be tested against the alternative hypothesis H_1)

Table 1: F-test for the Estimated Model Parameters

F-Test. Whether there are no differences between company characteristics?		
Ho:	All company characteristics are equal	$\alpha_1 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$
H_1:	At least one company characteristic is different	α_1 or β_1 or β_2 or β_3 or $\beta_4 \neq 0$

The F-test rejects H_0 (accepts H_1). The F-value is 41.20, compared to an F-value of 1.55 at the 5% significance level. Therefore, at least one of the characteristics is statistically different from the others when based on the total data set.

Table 2: Test for Multicolinearity of Exogenous Variables

Variable	VIF	1/VIF
logelp_for	7.52	0.133
l_emp_exp	7.37	0.136
l_emplful	5.74	0.174
l_elp_trn	4.58	0.219
l_emp_lg	3.02	0.331
Mean VIF	5.65	

Given that the highest value (7.52) of the variance inflation factor (VIF) is less than 10 (see table #2) we can state that multicolinearity is not causing a major problem in the model.

Table 3: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance
Variables: fitted values of l_trevusd
chi2(1) = 0.69
Prob > chi2 = 0.4064

Based on the test results presented in table #3 give us a clear indication that the model does have the problem of heteroskedasticity.

Table 4: Ramsey RESET test using powers of the fitted values of l_trevusd

Ho: model has no omitted variables
F(3, 26) = 2.08
Prob > F = 0.1274

Table #4 shows that we fail to reject the null hypothesis that the model does not have ommited variables.

Table 5: Skewness/Kurtosis tests for Normality for the Residual Term of the Estimated Model

			------- joint ------	
Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
e1	0.273	0.096	4.14	0.1261

Based on all three tests (see table #5) our model shows that the model also keeps the assumption of the normality of the distribution of the error term.

Appendix 3. Results of IT Export Growth Econometric Model

Table 1. List of the Observations

country	*export04 (in mln USD)*	*ncer05*	*pol0506*	*inf0506*	*vent0506*	*qms0506*	*digop0405*
Mozambique	0.988345	3	-0.92	-0.8	2.2	3.01	0.09
Ethiopia	0.421497	10	-1.42	-0.84	1.74	2.81	0.09
Mauritius	12.3224	35	0.15	-0.2	3.32	4.23	0.14
Uganda	9.32987	22	-0.42	-0.79	2.76	2.72	0.15
Bangladesh	6.190437	234	-1	-0.83	2.34	3.15	0.2
Kyrgyzstan	0.749847	193	-1.25	-0.61	2.23	3.71	0.22
Pakistan	37.72	3235	-0.63	-0.78	3.38	3.27	0.26
Guyana	5.7	12	-1.45	-0.63	2.24	2.85	0.29
India	13179.12	60771	0.76	-0.76	4.15	5.71	0.29
Armenia	17.6353	939	-1.11	-0.55	2.28	4.61	0.29
Guatemala	1.38025	7	-1.25	-0.71	2.43	2.31	0.3
Paraguay	0.4	7	-1.68	-0.3	1.95	2.51	0.3
Moldova	2.64	562	-0.86	-0.51	2.16	4.37	0.3
Sri Lanka	79.4	505	-0.51	-0.76	2.98	3.93	0.33
Albania	1.8132	174	-1.13	-0.68	2.72	4.12	0.36
Philippines	33	4795	-0.42	-0.76	2.62	2.4	0.36
Ukraine	30	10551	-0.92	-0.34	2.88	4.67	0.37
Egypt	33.3	428	-0.1	-0.61	2.81	3.49	0.38
Colombia	16.6876	254	-0.23	-0.54	2.19	3.77	0.38
Kazakhstan	0.880498	422	-0.32	-0.45	3.38	4.1	0.38
Tunisia	18.467	11	0.62	-0.63	3.53	5.47	0.39
Brazil	53.368	1168	-0.25	-0.35	2.45	2.85	0.42
China	1374.962	270	-0.1	-0.51	2.87	4.24	0.42
Uruguay	14.13333	97	0.02	-0.15	2.06	3.54	0.43
Costa Rica	200.343	50	-0.4	-0.26	3.14	3.98	0.43
Venezuela	6	133	-1.35	-0.5	2.26	3.51	0.43
Malaysia	230.9823	909	1.43	-0.41	4.58	5.25	0.45
Russian Federation	255.8	16037	-0.99	-0.16	2.94	5.14	0.45
Romania	143	12720	-0.67	-0.44	2.8	5.62	0.46
Jamaica	34.96667	55	0.11	-0.46	2.61	2.94	0.47
Argentina	176.858	289	-0.85	-0.32	2.47	3.76	0.47
Latvia	43.5559	4742	-0.17	-0.24	3.23	4.45	0.49
Czech Republic	109.909	564	-0.01	0.21	3.26	5.68	0.51
Greece	153.0513	231	0.23	0.13	3.57	4.73	0.51
Bulgaria	28.0449	5276	-0.74	-0.03	3.32	5.16	0.51
Portugal	141.154	136	0.89	0.11	3.9	3.46	0.52
Poland	152	1330	-0.26	-0.13	3.65	5.09	0.52
Chile	70.5	119	0.64	-0.31	3.45	3.17	0.52
Slovakia	96.4843	580	-0.03	-0.09	3.34	5.21	0.53
Cyprus	249.823	118	0.89	0.56	3.35	5.1	0.55
Hungary	313.502	272	0.31	0	3.6	5.32	0.55
Lithuania	30.9665	1805	-0.02	-0.15	4.19	5.17	0.56
Malta	1.97329	28	0.76	0.72	2.62	4.57	0.58
Ireland	18316.5	393	1.5	0.97	5.3	5.21	0.58
Italy	590.13	889	0.09	0.16	3.1	4	0.59
New Zealand	118.906	844	1.7	1.73	4.43	4.79	0.6
France	1479.63	722	1.43	0.7	4.51	5.97	0.6
Spain	2893.89	348	0.5	0.28	4.2	3.9	0.61
Austria	237.722	170	1.54	0.91	4.34	4.79	0.62
Slovenia	97.5477	533	0.3	0.31	3.33	4.5	0.62
Belgium	2374.39	528	0.89	0.49	4.39	6.26	0.62
United States	5436	125722	1.89	3.62	5.89	4.55	0.62
Estonia	38.7618	883	0.97	0.32	3.89	5.16	0.63
Germany	7877.51	2139	1.8	0.87	4.31	4.41	0.63
Finland	656.236	258	1.77	2.19	5.37	5.97	0.64
Luxembourg	2215.03	31	1.19	1.67	4.63	3.84	0.64
Israel	4321.8	553	1.2	0.68	5.14	5	0.65
Australia	864.963	2635	1.76	1.98	4.88	5.02	0.65

Canada	2792.92	8872	1.48	2.53	4.78	5.31	0.65
Singapore	322.3477	881	1.96	1.2	4.58	6.5	0.65
Netherlands	3619.91	746	1.69	1.73	5.05	5.11	0.66
United Kingdom	10549.9	8093	1.92	1.27	5.36	4.38	0.67
Norway	565.948	308	1.54	2.54	4.65	3.7	0.67
China, Hong Kong SAR	293.7797	114	1.27	0.83	4.95	5.57	0.69
Iceland	53.25	97	1.82	4.29	4.43	4.83	0.69
Sweden	2192.947	589	1.31	2.06	4.45	4.5	0.69
Japan	1042.84	219	1.25	1.02	3.89	5.32	0.71
South Korea	23.3	34	0.83	0.61	4.01	5.05	0.79

Hamilton (1992) notes, that non normal error term distributions often result from badly skewed Y and or X distributions. Table 2 appraises whether the variables in the model have normal distributions via Skewness test, Kurtosis tests, and a joint test. The Null hypothesis for these tests is normal distribution. As table shows we reject the null hypothesis for the raw variables, except for qms0506 and vent0506. The natural logarithms of our variables, however, have better behaved normal distributions. As we know we can take natural logarithm of the positive numbers only. Table #1 shows, however, that there are observations where *pol0506* and *inf0506* have negative or zero value. Hence, we added 2 to the values of *pol0506* and *inf0506* be able to apply the necessary transformation. This action does not affect the sign, the magnitude, or the significance of the estimated parameters.

Table 2. Normality Test of the Variables

Skewness/Kurtosis tests for Normality				
			------- joint ------	
Variable	**Pr(Skewness)**	**Pr(Kurtosis)**	**adj chi2(2)**	**Prob>chi2**
export04	0.000	0.000	55.92	0.0000
ncer05	0.000	0.000	.	0.0000
pol0506	0.974	0.000	15.68	0.0004
inf0506	0.000	0.008	19.61	0.0001
vent0506	0.342	0.015	6.33	0.0422
qms0506	0.432	0.132	3.00	0.2231
l_ex	0.722	0.263	1.43	0.4902
l_nc	0.539	0.441	1.00	0.6069
l_pl	0.003	0.369	8.38	0.0152
l_inf0506	0.028	0.585	5.05	0.0799
l_vc	0.525	0.009	6.62	0.0365
l_qms	0.024	0.751	5.12	0.0772

Model Specification

Hamilton-98 recommends two checks on model specification; one tests for omitted variables, ovtest, and the other tests for heteroscedasticity, hettest.

Omitted Variables

We used STATA's omitted variable test, ovtest, which regresses Y on the X variables, as well as on the 2nd, 3rd, and 4th powers of predicted Y, that is, $\hat{Y}^2, \hat{Y}^3, \hat{Y}^4$.

If nothing has been left out, then, presumably, the slope coefficients for the higher powers of $\hat{Y}$ should be zero.

The Stata ovtest command then performs an F test that these three slope coefficients on the powers of $\hat{Y}$ equal zero.

Heteroscedasticity Test

The heteroscedasticity test tests the assumption of constant variance by examining whether the squared standardized residuals are linearly related to $\hat{Y}$. It is a formal test of increasing or

decreasing variation in the residuals with fitted values; in other words it models the variance as a function of the fitted values.
The null hypothesis is that they are not related, i.e., that there is no relationship between the squared residuals and the fitted values of Y, or in other words, that there is constant variance.

Table 3: Model Specification Tests

	Breusch-Pagan / Cook-Weisberg test for heteroskedasticity *Ho: Constant variance* Variables: fitted values of l_ex	Ramsey RESET test using powers of the fitted values of l_ex *Ho: model has no omitted variables*
1st Estimation	chi2(1) = 0.74 Prob > chi2 = 0.3907	F(3, 59) = 0.12 Prob > F = 0.9458
2nd Estimation	chi2(1) = 0.01 Prob > chi2 = 0.9386	F(3, 21) = 1.89 Prob > F = 0.1553
3rd Estimation	chi2(1) = 1.46 Prob > chi2 = 0.2276	F(3, 29) = 0.12 Prob > F = 0.9502

Table #4 shows the Chi square values for the heteroskedasticity and ommited variables tests for all three estimated models. Based on these test, we can't reject the null hypothesis of constant variance and we can't reject the null hypothesis that the model has no omitted variables.

Normality Test for the Distribution of the Regression Errors

Table 4: Skewness/Kurtosis tests for Normality of the error terms of the regression models

		Skewness/Kurtosis tests for Normality			
				------- joint ------	
	Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
1st Estimation	e	0.780	0.405	0.79	0.6734
2nd Estimation	e1	0.587	0.457	0.87	0.6469
3rd Estimation	e2	0.551	0.199	2.09	0.3524

Table 4 shows that we fail to reject the null hypothesis that the error term of the regression is has normal distribution for all estimated models.

Multicolinearity

Table 5: Multicolinearity Test

1st Estimation			2nd Estimation			3rd Estimation		
Variable	VIF	1/VIF	Variable	VIF	1/VIF	Variable	VIF	1/VIF
l_vc	6.02	0.166227	*l_pl*	3.93	0.254234	*l_vc*	2.30	0.435634
l_pl	4.25	0.235069	*l_vc*	3.13	0.319504	*l_pl*	1.93	0.517083
l_inf0506	2.99	0.334459	*l_inf0506*	2.76	0.362229	*l_qms*	1.86	0.536729
l_qms	1.86	0.538393	*l_nc*	1.58	0.634819	*l_nc*	1.36	0.735825
l_nc	1.27	0.789351	*l_qms*	1.07	0.937842	*l_inf0506*	1.26	0.793552
Mean VIF	3.28		Mean VIF	2.49		Mean VIF	1.74	

Table 5 uses variance inflation factor (VIF) to give us idea about the potential existence of multicolinearity. *l_vc* in the 1st estimated model has the highest VIF value (6.02) among all the factors in all estimated models. This value is rather high but it is less than 10, which hints us that there is a warning sign for multicolinearity but it is not at a problematic scale. We also should mention that VIF score is substantially lower in model #2 and model #3. Also, the estimated coefficients and their standard deviations are very stable from model to model. Based on these indicators we have concluded that there is no problematic multicolinearity in the models.

Model Diagnostics

Here we will get into some more detailed diagnostic analyses of the IT export models.

We will consider first "Model Diagnostics", which mainly focuses in on whether the regression model or the regression effects (slopes) are being unduly influenced by certain observations.

The Model Diagnostics we will cover are two:1) DF-Fit scores and 2) Cook's D scores.

DFITS and Cook's D are attempts to create two indexes that are affected by the size of the studentized residuals and the size of hi, leverage.

The DF-Fit (or DFITS) score for observation i, DFITSi, is:

$$DFITS_i = t_i \sqrt{\frac{h_i}{1-h_i}}$$

Notice how DFITS combines the studentized residuals (t) and the leverage scores (h) into a single index.

Values of DFITS above $2\sqrt{K/n}$, where K is the number of X variables plus the constant, and n is the number of cases, require a second look. Hence DFITS scores that are substantially above $2\sqrt{K/n}$ require examination.

The three provinces seem to be having more than a modest impact on the regression.

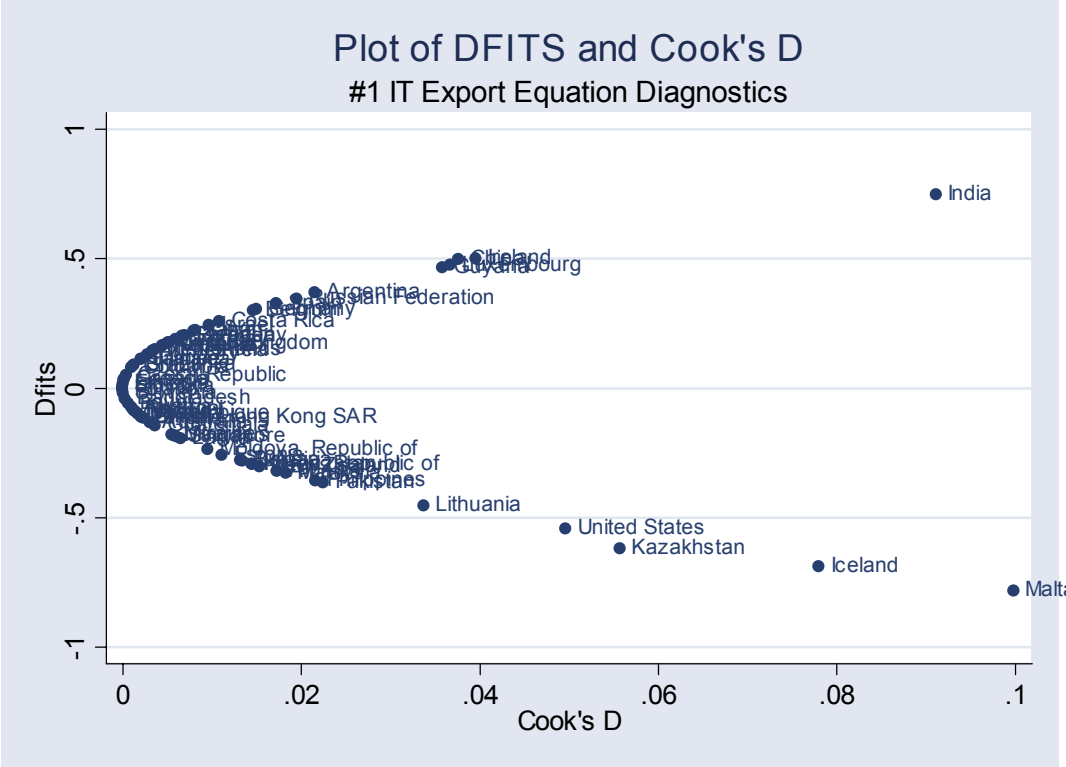
Cook's D is another measure of the case's influence on the regression model as a whole (all regression coefficients or all predicted values). The mechanical relationship between DFITS and Cook's D, as well as a formula for Cook's D for the ith observation, Di, is:

$$D_i = \frac{1}{K} * \frac{s^2_{(i)}}{s^2} * DFITS_i^2$$

where K is the number of X variables plus the constant, s is the root mean square error of the regression. Cook's D values greater than K/n should receive scrutiny.

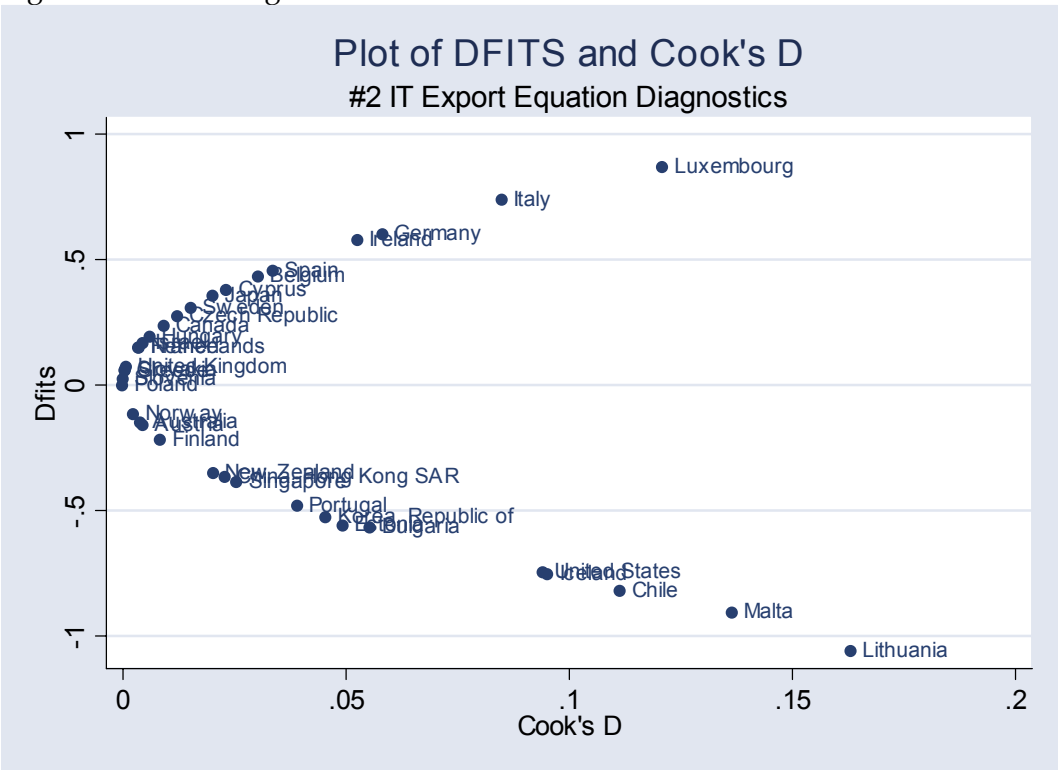
DFITS and Cook's D have somewhat different rationales, but both tend to flag the same observations as influential. Use both to have a sense of confirmation.

Figure 1: Outlier diagnostics for the estimated model #1 with DFITS and Cook's D.



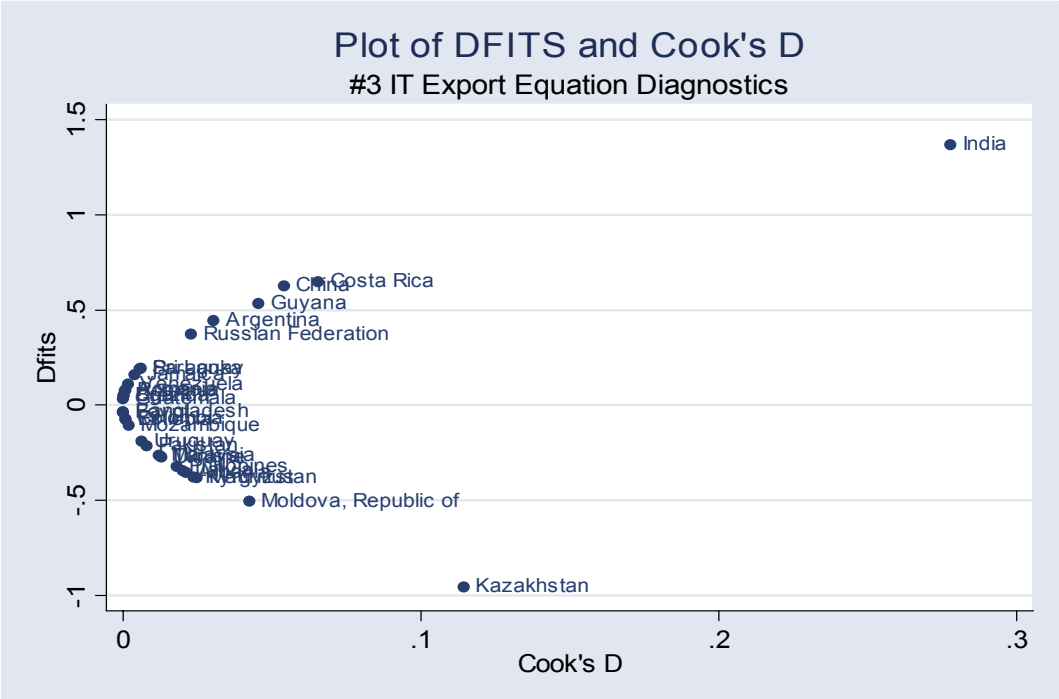
Based on the formulas for calculating DFITS and Cook's D in estimation #1, we can state that observations with DFITS values exceeding 0.59 and/or Cook's D values exceeding 0.09 can be considered as outliers. Figure #1, which presents countries positions based on their DFITS and Cook's D values, shows clearly that **India** and **Malta** can be considered as outliers in this model. For our final model we have excluded these two countries.

Figure 2: Outlier diagnostics for the estimated model #2 with DFITS and Cook's D.



For model #2, a country can be considered outlier if it has DFITS > 0.82 and/or Cook's D > 0.17. Figure #2 indicates Luxembourg as outlier. For our final model we have excluded this country.

Figure 3: Outlier diagnostics for the estimated model #3 with DFITS and Cook's D.



For model #3, a country can be considered outlier if it has DFITS > 0.87 and/or Cook's D > 0.19. We can see from Figure #3 India is clearly an outlier in this model. As in the previous cases, we have excluded this country from the sample for estimation.

At the end, we have incorporated models with and without the outliers. Table #7 gives summarizes the estimation results for all three models. Based on these results, we can state that even though the outlier observations (in our case countries) have some impact on the estimated coefficients but do not change drastically the significance levels of the parameters. The only major difference is in the estimation #2, where number of qualified programmers is found insignificant in the model with all countries included but this factor turns out to be significant when the outlier country, Luxembourg, is dropped from the model.

Table 6: Estimated models with and without outliers included.

	1st Estimation		**2nd Estimation**		**3rd Estimation**	
	All	**Without Outliers (India and Malta)**	**All**	**Without Outliers (Luxembourg)**	**All**	**Without Outliers (India)**
l_nc	0.35	0.30	0.29	0.40	0.39	0.32
	(3.58)***	(2.98)***	(1.69)	(2.14)**	(2.78)***	(2.32)**
l_pl	1.32760	1.53848	1.86959	2.58331	1.57170	1.54864
	(2.07)**	(2.39)**	(1.11)	(1.49)	(1.98)*	(2.06)**
l_inf0506	2.04e-02	6.72e-01	-1.68e+00	-2.06e+00	9.56e-01	2.46e+00
	(0.03)	(0.90)	(1.38)	(1.67)	(0.44)	(1.13)
l_vc	4.21	3.00	7.05	6.09	1.79	1.28
	(2.96)***	(2.02)**	(3.16)***	(2.64)**	(0.83)	(0.62)
l_qms	-0.55	-0.40	-1.53	-0.91	0.29	-0.13
	(0.54)	(0.40)	(0.98)	(0.57)	(0.18)	(0.08)
Constant	-2.78	-1.82	-3.68	-4.38	-2.13	-1.37
	(1.92)*	(1.24)	(1.27)	(1.51)	(1.03)	(0.68)
Observations	68	66	36	35	32	31
R-squared	0.71	0.71	0.57	0.59	0.62	0.56

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix 4: Country specific Initiatives

Country	Incentives	Infrastructure	Educational Initiatives	Government Agencies
Israel	**Investment Incentives** Approved or Beneficiary enterprise status based on the location investment area to be eligible for getting grants of up to 24% of tangible fixed assets and or reduced tax rates, tax exempts and other benefits. **R&D Incentives** • *Conditional grants of up to 50% of the R&D cost* • *Bi-national funds* Company is granted of 50% of Industrial R&D project full cost and overhead; in case of universities 100% of the additional costs and 20% of overhead • *Global Enterprise R&D cooperation Framework* Financial assistance of 50% of the Israeli company's R&D approved costs • *The technological Incubators* Grants of up to 85% of the approved cost • *The Heznek Seed Fund* Grants of up to 50% of the approved work program • *The Tnufa Program* Grants of up to 85% of the approved expenses for a maximum of $50,000 for each project to support individual entrepreneur • *The Magneton and Noffar Programs* Grants of up to 66% and 90% of the approved cost to support applied academic research • *The Magnet Program* Grants of up to 66% of the approved budget to support the formation of consortia of individual firms and academic institutions.	**Venture Capital** Yozma program – triggered (1992) the establishment of venture capital market. 100 active venture capital funds (2005), with major US/EU venture capital funds operating their braches in Israel (Silicon Valley Bank, Accel, Benchmark, Apex, Advent, Alta-Berkley, etc) and attributing to over 50% of the total dollars invested. **Technology Incubators** 24 technology Incubators with $30 million budget, each conducting on average 10 projects.	**Training support program** • ***Plant Class-***the government supports the training of workers in specific skills if the employer hires at least 50% of the class. • ***Training and Placement Class-*** the government fully covers the cost of running training for workers in specific disciplines and professions if the employers hire at least 50% of class graduates with 6 months upon completion of the class. • ***Internal Plant Training-*** the government supports on-the-job training program in the premises of the employer by covering about $250-$350 per worker **First-class Universities** Creation of first-class educational and scientific research establishments upon founding of the state of Israel.	Ministry of Communications (1971) Department: Information Technology Division Ministry of Industry Trade and Labor Office of Chief Scientist (late 1960s)

Country	Incentives	Infrastructure	Educational Initiatives	Government Agencies
Estonia	Foreign Investors enjoy the same rights as the local companies: • Income flat tax: 22%; • Value-added tax (VAT): 18%; • Social tax (social security contributions - state pension and health insurance): 33%; • Unemployment insurance tax: 0.3% employer + 0,6% employee. **Grants for Training of the Workforce** All companies established in Estonia can apply for financial support for the following employee training projects: • improving the qualifications for employees • professional training of new employees in connection with the expansion of a company • acquisition of new specialties and skills required for modernizing production activities The rate of the grant depends on the size and location of a company, the nature of the training, and can be no more than 70% of the cost of the training project. **R&D Grants** • up to 25% of product development costs directly related to a project . • up to 50% of industrial research costs directly related to a project.	**ICT Infrastructure** • e-Tax Board- Income Tax Statements filed on-line (since Spring 2001) • High level of ICT Penetration-60% of population are using Internet and 80% Internet banking (Summer 2006) • E-governance-the Government usage of web-based document system (since August 2000) • Public "Tiger Leap" program- all Estonian schools are connected to the Internet • Public Internet Access-over 800 public internet access points • Free wireless Internet zones-855 zones around the country (Autumn 2006) • e-billing (July 2000) • Mobile parking project (July 1, 2000) • World's first MPS project for society (May 3, 2000) • Digital Signature Act (December 2000) • ID card - (January 2002) • Look @ World project - the % of Internet users in Estonia should be increased to over 90% (2001) **Technoparks** • Tartu Science Park- founded in 1992 to support innovation, and linked to the biggest university of Estonia, Tartu. The Park was involved in provision of services for R&D commercialization. (26 tenant companies in 2003) • Tallinn Technology Park Development Foundation (TEHNOPOL)- founded in 2003 and merged with the TUIC Foundation in 2004 and started operating Tallinn Lasnamäe and Kopli Business Incubators. **Incubators** • Mustamäe Technology Incubator- was opened in 2002 as a joint project of TUIC and Tallinn City. **Venture Capital Fund** 45 portfolio companies held in the private equity and venture capital funds (2004)	The **Nations Support Program for the ICT in Higher Education "Tiger University"** was approved by the Estonian Government in January 2002. It's administration was delegated to the **Estonian Information Technology Foundation.** **Tallinn Technical University Innovation Centre (TUIC)**- was founded in 1998 to prepare the creation of Tallinn Technology Park in Mustamäe technology park, as well as to launch the "characteristic services" (incl. Mustamäe business incubator) of the park. **Estonian Information Technology College (IT College or ITC)**- a private university created as a result of a unique public-private partnership, between the largest Estonian Universities and Estonian information and Communications Technology Industry. The college was funded by Estonian Information Technology Foundation. The fund supports the IT R&D activities of academia and private sector. Fist students were enrolled in 2000.	Ministry of Economic Affairs and Telecommu-nications (1992) **Estonian Information Technology Foundation** is a non-profit organisation founded by the Estonian Republic, Tartu University, Tallinn Technical University, Eesti Telekom and the Association of Estonian Information Technology and Telecommunications Companies. **Enterprise Estonia** was founded in 2000 by the Ministry of Economic Affairs with the aim of promoting the competitiveness of the Estonian entrepreneurial environment and Estonian businesses.

Country	Incentives	Infrastructure	Educational Initiatives	Government Agencies
Ireland	*Investment Incentive* ***The Shannon Free Zone- tax-reduction initiatives:*** Upon certification the qualified company enjoys tax benefits of the Free Zone (10% corporation tax rate, VAT and customs duty exemptions, although): The areas of activities to be qualified for the certification: • The repair and maintenance of aircraft; or • Trading activities consisting of the manufacture of goods; or • Activities relating to the acquisition, disposal, license, sub-license and exploitation generally of intellectual property rights. Existing companies were given tax benefits until the end of 2005. In 2006, the tax rate increased to the 12.5% mainstream rate of corporation tax that came into effect in January 2003 upon agreeing with EU. ***The 10% 'Manufacturing Rate' of Tax*** The rate applied to • Companies manufacturing goods in Ireland; • Companies selling goods which are manufactured within Ireland by a 90% subsidiary, a fellow 90% subsidiary or a 90% parent company; and • The 10% rate could be claimed by a branch of a foreign company as well as by companies established in Ireland. The permitted activities included: • Professional services performed in Ireland relating to engineering works executed outside the EU; • ***Computer services, including data processing services and software development, and associated technical or consultancy services;*** • Certain shipping activities; • Repair or maintenance of aircraft, aircraft engines and components carried on within Ireland; • Re-manufacture and repair of computer equipment by its original manufacturer; For true 'manufacturing' companies the 10% rate will last until the original date of 2010.	**Business & Technology parks** 25 Business and Technoparks were operating in Ireland **Venture Capital Funds** 187 portfolio companies held in the private equity and venture capital funds (2004)	In the 1970s major universities started offering computer science related degrees. The National Development Plan and Community Support Framework- invested €57 billion from public, private and EU sources in education, roads and transport, health and social services, rural and local development, industry and waste during the period 2000-2006. Science Foundation Ireland- was set up within the-above mentioned framework, specializing in R&D in biotechnology and information and communication technology.	**Department of Communications, Marie and Resources** The Communications sector within the Department is divided into three divisions, namely the Business and Technology Division, the Communications Development and Electronic Commerce Division and the Postal and Regulatory Division. **IDA Ireland** (Industrial Development Agency) is an Irish Government agency with responsibility for securing new investment from overseas in manufacturing and internationally traded services sectors. It also encourages existing investors to expand and develop their businesses.

Country	Incentives	Infrastructure	Educational Initiatives	Government Agencies
Egypt	Tax holidays were made available by the government to make investing more attractive in Egypt. All software companies were granted a 5-year tax holiday, and 10 years were granted to those that established their operations in new industrial zones (Smart Village). Software products were also made free of customs and sales tax.	**Infrastructure** Virtual ICT R&D Centers of Excellence- created to establish collaborative R&D linkages among professionals, private sector initiatives and academia to support innovations in ICT applications. **Technoparks** Smart Village, a Silicon Valley model of a business technology park - in 2003, the Ministry started building the Smart Village in the country, in order to attract both domestic and international key ICT players. It will contain 67 office plots, accommodating about 30,000 employees. **Venture Capital Funds Initiatives** Technology Development Fund - was established in 2004 as a public-private partnership and was chaired by the Ministry of Communications and Information Technology (MCIT). Leading companies provided 50 million Egyptian pounds (~9 million USD), and in 2005 the amount reached 150 million EGP (~27 million USD) (MCIT, 2006). The first incubation facility was established within the framework of this project, and the Fund also assisted start-ups and SMEs by providing technical, financial and administrative support.	Information Technology Institute- was established in 1993 by the government to enroll IT experts for special nine-month training courses. Faculty of Computers and Information- was established at Cairo University in 1996. The Egyptian Technology Institute- was established in 2001, by the approval of the Prime Minister of Egypt. The MCIT built strategic alliances and established various programs with multinationals, such as IBM, Microsoft, Oracle, Lucent, Qualcomm, etc to assist to produce world-class specialists. The MCIT was sharing the cost with MNCs on a fifty-fifty basis in case of strategic alliances. Software Engineering Certification Centre (SECC)- was established in 2001 to strengthen the software industry to compete internationally by increasing the quality of practices used by the IT companies. The Centre offered trainings on software process improvement, workshops for managers and CEOs, and supported the leading software companies to be qualified for industry-standard assessments and accreditation.	**Ministry of Communications and Information Technology** (1999)

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NASSCOM – National Association of Software and Service Companies -

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INT@J – Information Technology Association of Jordan -
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List of Abbreviations

AMD- Armenian Dram
ARPU- Annual Revenue per User
CAGR-Compound Annual Growth Rate
CAPS-Competitive Private Armenian Sector
CEE-Central Eastern Europe
CIS- Commonwealth of Independent States
CMMI-Capability Maturity Model Integration
DSL-Digital Subscriber Line
EIF-Enterprise Incubator Foundation
EITO-European Information Technology Observatory
EU-European Union
EV Center- Economy and Values Research Center
FDI-Foreign Direct Investment
GDP-Gross Domestic Product
GNP-Gross National Product
ICT-Information Communication Technology
IPR-Intellectual Property Rights
IP-Internet Protocol
ISP –Internet Service Provider
IT-Information Technology
ITU-International Telecommunication Union
MENA- Middle East and North Africa
MIS-Management Information Systems
MNC-Multinational Corporation
MoES-Ministry of Education and Science
NVP-Net Present Value
OECD- Organization for Economic Cooperation and Development
OLS-Ordinary Least Squares
PC-Personal Computer
PPP-Purchasing Power Parity
RA-Republic of Armenia
R&D-Research and Development
SME- Small and Medium-sized Enterprise
SLOC- Source of Line Code
T-bills- Treasury Bills
USD- US Dollars
UAE-United Arab Emirates
UNCTAD- United Nations Conference on Trade and Development
UNDP- United Nations Development Program
USAID- United States Agency for International Development
VAT-Value-added Tax
VoIP-Voice over Internet Protocol
WEF-World Economic Forum
WiFi- Wireless Friendly
WiMAX- Worldwide Interoperability for Microwave Access