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PRODUCTIVITY AND SOURCES OF ENTERPRISE LEVEL EFFICIENCY IN ARMENIA[1]

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PREPARED FOR THE AIPRG ANNUAL CONFERENCE

MAY 17-18, 2008

WASHINGTON, DC

[1] The authors are grateful to Prof. S. Estrin (LSE) for his valuable guidance and useful suggestions.

1. Introduction

The objective of the study is to provide an analysis of the productivity of the Armenian private sector and present policy conclusions. Armenian firms have, for some years, been operating in an economic environment where widespread economic reforms have been implemented, and this has laid the foundations for a strong macro-economic performance. As a result, the economy has maintained strong economic growth for more than a decade, though employment (in the formal sector) has not been rising and investment rates have been moderate. This suggests that efficiency gains may have been one of the important engines of economic growth (see Path to Prosperity, 2007; Armenia: The Caucasian Tiger, 2006) via both the reallocation of labor from low to high productivity uses within and between sectors and from technical advance which may have increased technical efficiency of production over time. Whether this is true or false, it is certain that as Armenia enters more advanced stages of transition it will be necessary to improve enterprise productivity. In this study, we try to understand in detail the sources of productivity growth in the Armenian economy, in order to be able to develop policies which encourage sustainable growth in the future.

Our approach in this paper is to focus on the potential determinants of company productivity, drawing on the large theoretical and empirical literatures that analyze both developed economies and, more recently, the transition economies. We survey this literature deducing theoretical and empirical findings of potential relevance to Armenia. We then go on to consider the economic situation in Armenia at the aggregate level with respect to these determinants, in particular, competition, ownership and foreign direct investment.

The central part of this paper comprises the empirical analysis of a sample survey of approximately 300 Armenian firms in the manufacturing and service sectors in the years 2003 to 2005 to provide estimates of total factor productivity (TFP). We will use these estimates to explore the determinants of productivity and to see how these differ from

other economies. We also investigate the pattern of variation in TFP in firms across industries, time and region over this period. The findings can be used to identify the areas of greatest potential in terms of productivity, and those where greater efforts will be required to bring the firms to the productive frontier. We will base our formulations on studies of productivity in other transition economies, including those of Central and Eastern Europe (CEE) and the former Soviet Union. This will allow us to compare and contrast our findings concerning the factors influencing productivity in Armenia with the paths followed in comparable economies elsewhere. This approach influences our development of policy conclusions from this study.

The paper has five further sections. In the following section we survey the large literature concerning the definition and the determinants of productivity growth in developed market and transition economies. The former helps us to identify appropriate estimation methods for calculating productivity, namely estimation of TFP via stochastic frontiers. The latter provides us with a number of hypotheses concerning the possible determinants of productivity differentials in Armenia, in particular, with respect to competition and the impact of foreign direct investment. In the third section we present information on the movements of the key determinants of productivity in Armenia, before outlining in the fourth the estimation methods used in this study and the data employed in our empirical work. The results of our estimations are reported in the fifth section, which provides estimates of TFP by year, industry and region as well as explores the principal determinants of company level total factor productivity in Armenia. We bring together the findings and draw policy conclusions in the sixth section.

The strengths of this study are its ability to derive analytically advanced and robust measures of company efficiency across different industries and time, as well as the ability to explore, based on the theoretical literature and the plethora of studies for other transition economies, carefully developed hypotheses concerning the determinants of differential productivity performance in Armenian firms. This work can provide a sound basis for the development of policy to encourage the enhancement of productivity in Armenian firms. However, it is also useful to note the limitations of this Report. Our

research is based on a relatively short sample (three years) and hence is not well suited to the evaluation of long term trends. Moreover, the strength of the Report – its ability to identify firm level productivity and its determinants - is also its weakness. Because it is based on a survey of existing enterprises, it is not designed to explore some of the issues which have been given stress in the productivity literature, for example the role of so called "creative destruction" as proposed by Joseph Schumpeter whereby productivity within a sector is increased by the entry of new and relatively more efficient firms, who supplant their less efficient competitors to raise productivity overall (see Bertelsmann, Haltiwanger and Scarpetta, 2004). Because our sample is constructed to cover a group of firms that survive throughout the sample period, we exclude all entrants and exiters and hence cannot explore the impact of "creative destruction" on productivity growth.

2. Measuring Company Productivity and its Determinants

2.1 Estimating Total Factor Productivity

This Report focuses on providing calculations of the dispersion in company productivity based on formal estimates of TFP. There are two approaches to estimating TFP in the literature, and we employ both in this Report. The first is based on the Solow production function and develops Tornquist indexes by constructing the residual in a production function calculated at the mean of the sample. Hence one is directly estimating TFP by estimating a production function. The TFP is the residual in this function, calculated for example for the Cobb Douglas specification by the difference between actual output (value added) and predicted output using the factor shares of labor and capital as the weights for the two inputs. The approach was used in the US by, for example, Jorgenson, Gollop and Fraumeni, 1987. For developing countries, the work was extended by Chenery, Robinson and Syrquin, in their path breaking 1987 book, "Industrialization and Growth". For transition economies, the approach has been used especially to analyze the impact of privatization and there are well over 100 studies using some sort of production function method (see Djankov and Murrell (2002) for a survey).

The second approach to identifying TFP is via the estimation of frontier production functions. The idea here is to compare the efficiency of firms, on average, with a constructed composite representing the most efficient producer. Thus one estimates the relative distance for a firm between its actual combination of inputs and the predicted input combination for a given level of output that would be required by the estimated "most efficient" firm. The approach is to calculate, using information about the input-output combinations of the most efficient firms, the technology frontier and then measuring TFP in other firms as a distance from this, controlling for capital intensity. Estimation is usually undertaken using non-parametric estimation methods (see Schmidt, 1985; Cornwall, Schmidt and Sickles, 1990). This approach has been used less frequently in the analysis of developing and emerging markets, perhaps because of data limitations, but it provides a clear picture of the dispersion of efficiency within each sector.

Using either approach, but more commonly with the Solow method, one can identify the factors that influence TFP. Using the Solow approach, one can estimate simultaneously a second round regression which includes potential determinants on the right hand side. In the frontier method, one can either compare the estimates of mean (median) TFP in subsamples defined across determinants or include these as independent variables in the "augmented" frontier production function estimates. We used both approaches in this study, but have tended to report the findings from the former method because given the sample size these are probably more reliable for inference.

2.2 Determinants of TFP

The Western literature on the determinants of enterprise productivity has tended to focus on the role of competition, organizational factors (notably ownership and the effects of foreign direct investment) and institutional environment, including government regulations. These factors have also proved to be important in transition, so it is upon these and the findings of the huge literature on the determinants of TFP in transition economies that this brief survey will concentrate. One can therefore identify three factors

in the transition literature that are expected to influence the level and rate of change of total factor productivity: competition, ownership (notably foreign ownership), and characteristics of the firm (often proxied by the age of the firm).

2.2.1 Competition

It is usually hypothesized that company efficiency will be positively affected by the competitiveness of the market in which the firm operates. The argument is that monopoly power provides firms with a margin of comfort which they exploit by failing to undertake the organizational changes necessary to maintain and increase TFP. Competition puts pressure on management because they have to work harder to maintain their profits against the encroachments of other firms and potential entrants. This leads them to undertake more efficiency enhancing activities, for example, innovation - introducing new production methods and new products, and rearranging organizational structures so as to keep performance ahead of other firms in the market. These pressures are necessarily reduced in a less competitive environment, where managers, because they do not face the same "struggle for survival", may become complacent or indolent.

In a closed economy, the forces of competition derive principally from the domestic market. In this study, we proxy these buy industry dummy variables. They may also derive from international competition. Thus firms which operate primarily in overseas markets, exporting the bulk of their output, may face much greater competitive pressure and this may force them to enhance their TFP relative to firms facing competitive pressures only in their domestic markets. Finally, firms that are innovating new products may also be more productive, in that their lower cost base allows them to successfully bring to market new products. Alternatively, high rates of product innovation may instead indicate firms that are struggling to survive given their current levels of TFP, and represent more a signal of desperation than efficiency.

2.2.2. Private Ownership

The privatization policies of transition economies are based on the hypothesis that privately owned firms will have higher TFP than state owned ones, because of their

superior corporate governance. There is very considerable evidence for this argument (see Djankov and Murrell, 2002). The higher levels of efficiency arise because it is easier in a privately owned firm to align the interests of owners and managers and to reduce the problems of asymmetric information between owners and managers which lie at the heart of the corporate governance problem (see Estrin, 2002). With private ownership, monitoring can be efficient and the flows of information transparent either via direct owner representation on boards or through the competitive pressure of the stock market. Moreover, bankruptcy laws impact on private but not state firms, and the absence of a bankruptcy threat can lead to "soft budget constraints" that distort managerial incentives. The structure of ownership is in principle a very important issue in Armenia as in all transition economies, but is not of direct empirical relevance for our study because all the firms in our survey are privately owned.

2.2.3 Foreign Direct Ownership

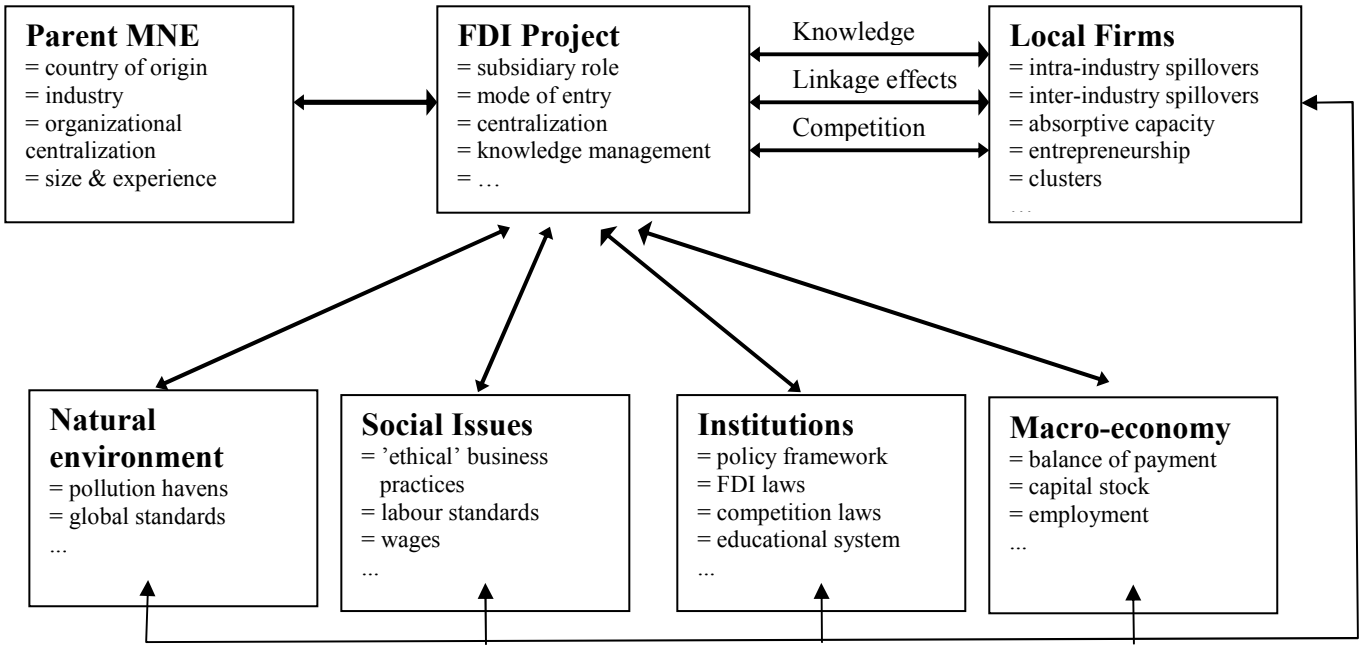
In the transition context, as we will show below, foreign ownership has proved to be the most significant source of productivity gains. One can consider the impact at three levels:

- On the macro-economy
- On the firms which have been bought by new foreign owners
- On other firms in the economy, through either horizontal or vertical spillovers.

Since this is such an important area, we will consider each of these impacts in turn. The impact of FDI on host economies is complex as foreign investors interact with, and thus influence, many local individuals, firms and institutions. However, on average, the *net* effect may well be less than many observers expect. Figure 1 outlines various channels of impact. Any FDI project closely interacts with local businesses; most of the impact on the host economy is transmitted through this interaction. Beyond this, FDI also impacts on other aspects, including macroeconomic variables, the host economy's institutional framework as well as the natural and social environment. Most of these interactions are bilateral. On the one hand, foreign investors adapt to the local institutional, social and natural environment in designing their strategies. On the other hand, they would –

intentionally or not – influence the environment through, for instance, political lobbying, setting good examples of labor standards, or polluting the environment. The FDI project in turn is designed by a Multi National Enterprise (MNE) located outside the country. The structure and strategies of this MNE thus shape the project and its interactions with the local environment.

Figure 1: Channels of Impact of FDI



Source: Meyer (2004)

2.2.3.1 Macro Effects

FDI is argued to influence the main macro-economic variables of concern to policy makers: balance of payments, employment, and gross domestic investment. FDI is commonly believed to have a positive effect on each of these variables.

At the country level, scholars have attempted to relate the inflow of FDI to macroeconomic growth in terms of GDP on the basis of endogenous growth models, e.g. Borensztein, Gregorio and Lee (1998). They find a complementary effect of countries'

absorptive capacity, measured by proxies for human capital, which positively moderates the relationship between FDI inflows and GDP growth. In particular, a minimum threshold level of human capital is required to benefit from inward FDI. Balasubramanyan, Salisu and Sapsford (1996) differentiate countries by their trade openness, and find that FDI has a more positive effect on economic growth of countries with export-oriented trade regime compared to countries with import-substitution type trade regimes.

More recently, Li and Liu (2005) examine the macroeconomic relationship taking account of the endogeneity of FDI, that is foreign investors are likely to seek locations with higher economic growth as well as contribute to this growth. Their empirical study shows that such an endogenous relationship has increased over the time period of their study from 1970 to 1999. This endogeneity reinforces the complementary relationship between FDI and local human capital in promoting economic growth.

2.2.3.2 Horizontal spillover effects to local firms

Hirschman (1958) argues that poor countries would benefit from pursuing unbalanced industrial growth promoting, in particular, the developing of industries with strong backward and forward linkages.

The benefits that local firms may attain arise through several channels:

- **Demonstration effects** work through the direct contact between local agents and MNEs operating at different levels of technology. After observing an innovation adapted to local conditions, local entrepreneurs may recognize their feasibility, and thus strive to imitate them. As local businesses observe existing users, information about new technologies and business practices is diffused, uncertainty is reduced, and imitation increases.
- Foreign investors affect local businesses not only through productivity effects, but in a variety of other ways. For example, scholars have investigated market access

benefits generated by foreign investors (Aitken, Hanson and Harrison, 1997; Greenaway, Sousa and Wakelin, 2004). The rationale of this literature is that MNEs would directly or indirectly **share knowledge** on how to operate in international markets, by building trade channels, and by enhancing the country-of-origin reputation.

- FDI contributes to human capital formation, especially through training and **labour mobility**. Trained local employees may move to locally owned firms or set-up own entrepreneurial businesses. MNEs typically pay salaries above local standards to discourage highly trained employees from leaving, yet they may not oppose such movements if the new firms become business partners. Many successful local firms trace their origins to entrepreneurs or top managers that had prior links to MNEs (Altenburg, 2000). Even where few employees move, those that move may make a substantive contribution to local business.
- FDI may help local firms to access **export markets.** MNEs are more likely to share general trade knowledge, as it is less industry-specific and not part of their core capabilities and its diffusion to local businesses does not endanger their own competitive advantage. Moreover, foreign investors may help building trade channels and a country of origin reputation that local followers may use for their exports (Altenburg, 2000).
- Foreign investors may support local supplier industries and **markets for specialized inputs**, such as labor and materials. Beyond the quality of physical products this may enhance in particular the quality of services provided by suppliers, such as just-in-time delivery and low default rates. With these improved inputs, local firms in turn may enhance their productivity.

Negative spillovers on local firms are also possible, notably through **crowding out effects**. Foreign investors may gain market share at the expense of local firms. This would leave the local firms, at least in the short run, with excess production capacity and thus low productivity and low profitability. Moreover, foreign investment may source internationally and thus weaken the local industry's domestic supplier base. These seem

less likely to be relevant than the positive effects in the case of Armenia which is a relatively small and open economy with low levels of FDI.

In the 1980's, a theoretical debate ranged about the 'flying geese pattern' of economic development observed in East Asia. Japanese scholars Ozawa (1979) and Kojima (1985) suggest that vertical FDI seeking natural resources or relocating labor intensive production processes would be more beneficial for economic development than horizontal FDI because of its trade creating effects. Thus, this FDI would help host economies to better exploit their comparative advantages, and transfer technologies that are more closely aligned with the needs of the hosts.

Perez (1997) offers an evolutionary model of technology spillovers that depend on the absorptive capacity of local firms and are inversely related to the technological gap; yet received spillovers influence the market share dynamics between local and foreign competitors. He thus suggests that strong local firms would benefit from competition from foreign investors, while weak firms are likely to be crowded out completely. Markusen and Venebles (1999) analyse the relationship between the number of foreign-owned firms and the number of domestic firms under a range of assumptions and scenarios. They argue that, under certain conditions, entry of foreign investors would trigger entry of new domestic firms in vertically related industries.

The research question that has probably attracted most *empirical* research is horizontal spillovers, in particular the productivity benefits that local firms attract from foreign investment in their industry. This literature bypasses the fact that knowledge flows are not measurable directly by estimating local firms' productivity as a function of, among other factors, the presence of foreign investors in the industry. This stream of research was initiated by Caves (1974), and in 2007 we counted over 60 studies using this approach (Meyer and Sinani, 2007).

This literature has evolved in several stages, notably to employ more complex datasets and more sophisticated analytical techniques, and to incorporate moderating variables

that may influence this relationship. Important references include Caves (1974), Blomström and Persson (1983), Kokko (1996), Sjöholm (1999), Haddad and Harrison, (1993) and Aitken and Harrison (1999). Görg and Strobl (2001) review this literature using a Meta-analysis of 21 studies and find that these methodological issues substantially affect the results, such that early cross-sectional studies may have overstated the actual effects of FDI. Moreover, they point to important variations of spillovers across countries.

More recently, this line of work has been extended to understand the conditions that may facilitate the emergence of positive spillovers. Thus, scholars have analysed how the characteristics of the potential recipient firms influence their received benefits. Early discussions on FDI spillovers have focused on the technological gap hypothesis suggested in Findlay's (1978) model, which suggest that developing countries can benefit more the further they are from the technological frontier. However, several studies point out that local firms' benefits crucially depend on their own ability to utilize received technologies. Following Cohen and Levinthal (1990), this work has in particular focused on the concept of **absorptive capacity** (e.g. Sinani and Meyer 2004).

It is important to add that there is strong evidence about the positive association between FDI and the level of institutional development. Thus, institutional development attracts more FDI, as has been shown in a number of studies using economic freedom (Bengoa and Robles 2003; Kahai, 2004), and corruption (Smarzynska and Wei, 2000 Voyer and Beamish, 2004; Cuervo-Cazurra, 2006) indices.

2.2.3.3. Vertical spillover effects to local firms

Local firms may benefit from **vertical linkages** in a supply chain, benefiting from knowledge transfers to suppliers and customers. MNEs may make a deliberate effort to improve the quality of local suppliers, especially for components that cannot be cost-efficiently imported due to high transportation costs or where the local industry has a natural cost advantage (e.g. for labour intensive components). These effects benefit also

firms in other industries, for instance providers of business services, such as accounting or legal services. Similarly they may support their customers, for instance by providing training in sales and marketing.

We have less empirical evidence on this matter, mainly because the datasets required to analyse vertical interactions along the supply chain are fairly complex and hard to obtain. Lall (1980) provides the first major study on vertical spillovers. Building on Hirschman (1958), Lall develops the theoretical arguments on why backward linkages would emerge, and he provides probably the first systematic empirical evidence.

An innovative approach to study vertical linkages has been used by Belderbos, Capannelli and Fukao (2001). They analyze local content ratios of Japanese overseas manufacturing affiliates across 14 countries to identify project and country-specific determinants of the extent of interaction with local suppliers. They find that more linkages exist for older affiliates, acquisitions and joint ventures, and in less developed countries also by less-R&D intensive foreign investors. Moreover, local content requirements appear to have a positive effect while FDI established to jump tariff barriers has less local content.

Javorcik (2004) employs industry-level input-output data from Lithuania, and finds higher productivity in industries which are suppliers to industries with high foreign presence. This productivity effect is larger when the foreign investors are domestic market oriented rather than export oriented. At the same time, she finds no evidence of spillovers within the same industry.

2.2.3.4. Sources of Variation in FDI Impact

Multinationals vary in their internal operations, including for instance the centralization of decision making, organizational cultures, and human resource management practices. Consequently, subsidiaries in emerging economies would vary in their interactions with other business units of the parent's network. This in turn affects interactions with local businesses, for instance, the development of local supply networks, investment in human capital, employee mobility, and the stages of the value chain located in the host economy.

Some of these variations are due to *industry-specific features* (Grosse 2005). Infrastructure FDI for instance in transport or telecommunication can greatly enhance productivity in other sectors of the economy, yet at the risk of foreign control – possibly even monopoly – if the sector is not appropriately regulated. Similar benefits and risk arise from financial sector investment. Services such as information technology operate in more competitive markets and may benefit a wide range of other business. In manufacturing, major variations arise from the need or opportunity to produce close to the market due to high transportation costs or low scale economies.

An aspect of particular relevance for MNE spillovers is *intra-firm knowledge transfer*. Knowledge sharing within the MNE is a precondition for knowledge spillovers. Typically investors would transfer 'know how' to their affiliates to enhance efficiency and productivity. Yet they would keep tighter control over their 'know why', because such knowledge could – if diffused to other firms – threaten the international market position of the firm. Knowledge spillovers would also rise with higher value added activities, such as complex manufacturing processes like making customized machinery, rather than mass assembly of, for example, garments or shoes.

In particular, *research and development* (R&D) is commonly believed to generate positive spillovers. Traditionally, MNE would keep their R&D activities close to their home base, or locate it in leading edge clusters such as Silicon Valley. However, recent data show that R&D is increasingly located in countries such as China, India, Singapore

and Brazil (UN 2005). This potentially boosts the technology flows between MNEs and local suppliers or local institutions, such as universities.

Another source of variation is the mode of entry. In a *joint venture*, two partners share their resources in return for access to the partner's resources. This can lead to mutual learning, and thus extend linkages and knowledge spillovers in the local business community. Yet MNEs would be more concerned about unwanted technology diffusion and thus be more reluctant to share crucial knowledge with local employees. *Greenfield* projects create new businesses and thus have direct positive effects on employment and domestic value added, and increase competitive pressures on local competitors. *Acquisitions*, on the other hand, are at the time of entry fully operating enterprises. The new owners may or may not continue traditional business relationships, possibly drawing on their existing suppliers, which would strongly impact on local industries. However, based on inherited operations, acquisitions are more likely then Greenfield projects to engage in R&D.

These variations influence the effectiveness of government designing policies aimed to attract FDI. The literature shows that policies ought to consider explicitly what type of FDI would benefit the host economy, rather than focusing on quantitative targets for FDI. Moreover, evaluation of policies should analyze what types of investors, and with what type of projects would consider the local environment (incl. political institutions) attractive.

2.2.4 Age of the Firm

A large literature (see Djankov and Murrell, 2002) attests to the argument that in transition economies, *de novo* entrants may be more efficient than existing firms. This is because new firms do not carry the heritage from the Soviet era of hoarded labor, antiquated capital and weak management. As we have noted above, privatization may improve corporate governance of former state owned firms, but former state owned

enterprises (SOEs) may, for some years, face problems in their attempts to enhance performance. This is because SOEs may take considerable time to reduce employment to appropriate levels and to invest in new equipment. New firms will not face the problems of restructuring to the new market environment that is at the heart of the transition problem for SOEs. Being created from scratch, they do not inherit the structural problems - over-manning, underinvestment, poor quality control, weak marketing and financial control and all the other difficulties - which beset SOEs and former SOEs. "Firms" under socialism did not have many of the functions of independent Western enterprises; sales, marketing, distribution, supply, finance or investment. In many cases, the inherited structures, attitudes and organisational cultures of the old state owned firms are so strong that such radical restructuring is impossible or at least very slow. This implies that it may be easier and more successful to satisfy the demands of the market economy in entirely new organisations (see Kornai, 1990; Estrin, Meyer and Bytchkova, 2005). Moreover the selection process that determines the foundation of new firms may also ensure that more market focused and entrepreneurial people will lead them from the outset. We are not able to explore this issue using our Armenia sample.

2.3 Findings from the Literature on Productivity in Transition Economies

The literature on the determinants of productivity in transition economies is huge, and there are a number of major surveys including Djankov and Murrell (2002) and Estrin *et al,* 2007. These papers each cite more than one hundred works respectively. Most papers in the literature focus on the effects of TFP of ownership and especially foreign ownership. Thus the Djankov and Murrell concluded that the effect of private ownership was positive in Central and Eastern Europe (CEE) but insignificant in the Commonwealth of Independent States (CIS).

There are around 20 more recent studies that analyze the impact of ownership on TFP or rate of change of TFP in the transition economies, using value added, total product or sales revenues as the dependent variable and either dummy variables or percent share ownership as measures of different types of ownership (see Estrin et al 2007). A number

of these studies have simply examined the differential effect of state versus private ownership, while others examine the effects of other sub-categories of ownership. The studies cover both the CEE and CIS regions.

With the possible exception of Russia, studies usually find the effect of private ownership on TFP to be positive or non-negative. Moreover, studies that break private ownership into several categories show that the overall private v. state ownership dichotomy includes different private ownership effects. Except for two of the three studies of Slovenia, all studies uniformly suggest that privatization to foreign owners' increases efficiency. The effect of foreign ownership is strong and robust across regions. This is a very important finding for policy makers in Armenia to which we return in the conclusions.

The effect of domestic private ownership on TFP is by and large also found positive in the CEE region and in Ukraine, but it is quantitatively much smaller than that of foreign ownership. This is probably because the countries of CEE are more advanced on the transition path (see e.g. EBRD Transition Report Indicators and World Bank Doing Business Indicators). Russia appears to be different from Ukraine in that Sabirianova, Svejnar and Terrell (2005) and Brown, Earle and Telegdy (2006) find with large data sets the effect of domestic private and mixed ownership to be negative or insignificant. Similarly, Commander and Svejnar (2007) use a large firm-level data set from 26 transition economies and find an insignificant average (across countries) effect of domestic private ownership relative to that of the state ownership. In general, the effect of domestic private ownership appears to be more positive in the CEE region than in the CIS and it seems likely that this is a consequence of the greater progress made in institutional development. This confirms the results from findings for other emerging markets. Once again this is an important conclusion for Armenian policy makers.

Thus, more recent studies find a strong positive effect of foreign ownership in both the CEE and CIS regions, and a quantitatively smaller positive effect of domestic private ownership in CEE and in Ukraine but a negative effect in Russia. The reason for finding a

stronger positive effect in more recent years than in earlier studies is in part that the contemporary work is taking into account the problem of selection/endogeneity of ownership, whereas the earlier surveys did not place as much emphasis on this issue. Another reason for the stronger and more uniform findings of positive effects of private ownership may be that the studies referred to cover recent years and privatization may take a few years to have an effect as strong owners take control and markets start to function. Finally, institutional development is a slow process and more recent data may pertain to a more developed legal and institutional setting in most of the transition economies.

Several studies examine concentration of ownership and find that it plays an important part, with majority private ownership having mostly positive effects on TFP. The overall positive effect is again driven primarily by foreign owned firms. The effect of majority domestic private ownership tends to be positive as well, but it tends to be smaller in magnitude. As before, the effect is found to be positive in Ukraine but negative in Russia which may be associated with institutional differences.

Two studies focus on newly created (*de novo)* private firms. Sabirianova, Svejnar, and Terrell (2005) use 1992-2000 firm-level data for almost all industrial firms in the Czech Republic and Russia and find that foreign start-ups are less efficient than existing foreign owned firms, but more efficient than domestic start-ups, which are in turn more efficient than existing domestic firms. This study hence suggests that new firms tend to be more efficient than firms privatized to domestic owners. Using 2002 and 2005 firm-level data from 26 transition economies, Commander and Svejnar (2007) find that domestic start up firms are less efficient than foreign owned firms but not significantly different from domestic privatized or state-owned firms. The two thus indicate that *de novo* firms are more productive than or at least as productive as SOEs privatized to domestic owners, and therefore highlight the importance of new firm entry in raising TFP in transition economies.

It is also important to understand the factors driving technical progress; the change in company TFP. Studies that examine the change in productive efficiency show that foreign-owned firms improved efficiency faster than domestic private and state-owned firms in the 1990s and early 2000s. This differential effect is not detectable, however, in Commander and Svejnar's (2007) study of the 2002-2005 panel data from the 26 transition economies. It is hence possible that foreign owners brought about a sizable increase in efficiency in the period immediately after acquiring the local firms in the 1990s, but that later on the rate of change in efficiency has been on average similar in all the principal types of ownership of firms.

It is also interesting to consider the experience of China, where growth has proceeded at high levels for several decades, arguably on the basis of both increases in factor inputs and rises in TFP. There are a number of important studies of TFP in China. Probably because privatization is a relatively recent phenomenon in China, a number of studies, including Jefferson and Rawski (1996), address TFP issues with firm level data but do not examine differences in TFP related to privatization or ownership. Studies that address these issues find diverse results, with the effect of non-state ownership being mostly positive but sometimes statistically insignificant and sometimes negative. Thus Jefferson and Su (2006) use a large sample of firms ($N > 20,000$) and show that the effect of private joint stock ownership on the level of TFP is positive. Hu, Song, and Zhang (2004) in turn use a much smaller sample of firms in selected regions ($N > 700$) and find the effects of cooperative as well as domestic and foreign private ownership to have a positive effect on the level of productivity. Yusuf, Nabeshima, and Perkins (2006) use a relatively large sample of firms ($N > 4,000$) and find the effect of domestic private, collective and complete foreign ownership on the level of productivity to be statistically insignificant, the effect of foreign joint ventures to be positive, unreformed state ownership negative, and reformed state ownership positive. Finally, Dong, Putterman, and Unel (2006) use firm-level data from Nanjing ($N = 165$) to examine the effect on the rate of change of TFP, and they find the effect of state urban ownership to be positive, while the effect of state rural and both private urban and private rural ownership is found to be insignificant.

The TFP studies of CEE, CIS and China hence generate a fairly clear overall picture which is highly relevant to Armenia. There is clear evidence that foreign ownership raises productivity. In China and CEE, the estimates suggest that private domestic ownership also raises TFP relative to state ownership but the effect is quantitatively smaller than that of foreign ownership. Russia and elsewhere in the CIS is different in that the performance effect of privatization to domestic owners is found to have a negative or insignificant effect on TFP, and that is probably because of weaknesses in the institutional framework. In addition, concentrated (especially foreign) private ownership has a stronger positive effect on performance than dispersed ownership in CEE and CIS. Data from CEE and CIS suggest that new firms are equally or more productively efficient than firms privatized to domestic owners.

In view of the above results, the question naturally arises as to why the TFP effect of privatization to domestic owners has been much smaller than the TFP effect of privatization to foreign investors. Discussions with managers, policy makers and analysts suggest three leading possible explanations. The finding may reflect in part the limited skills and access to world markets on the part of the local managers. Domestically owned privatized firms are also the ones where performance-reducing activities such as looting and defrauding of minority shareholders have been most frequent. Finally, in a number of countries the nature of the privatization process initially prevented large domestic private owners from obtaining 100% ownership stakes and insiders or the state often owned sizeable holdings. It often took these large shareholders several years to squeeze out minority shareholders and in the process the large shareholders sometimes artificially decreased the performance of their newly acquired firms in order to squeeze out the minority shareholders at low share prices.

3. Corporate Economic Behavior in Armenia

The previous discussion indicates that it will be important to focus on the following determinants of TFP in Armenia:

- Competition
- Foreign direct investment
- Institutional development

In this section we briefly review the situation in Armenia, where possible against potential comparators among transition economies.

3.1 Competition

There is little direct information about market structure in Armenia. As noted, in the empirical work which follows we control for market power effects by the use of industry dummy variables. However, there is some encouraging evidence on this subject. As can be seen in Table 1, Armenia has made considerable progress in the areas of price and trade liberalization, relative to other countries in the FSU and the Balkans. Thus the private sector share is amongst the highest in the sample, and for both price and trade liberalization, Armenia joins the more advanced transition economies in achieving the highest possible ranking. However, the possibility of serious monopoly problems is indicated by the low score with respect to competition policy, though the levels are not out of line with other countries in the sample. We return to this issue below.

3.2 Foreign Direct Investment and Ownership

It can be seen in Table 2 that FDI inflows into Armenia have been surpisingly low, in absolute terms and in comparison with the sample of FSU economies. It should be noted that in fact the levels of FDI have been even higher for the transition economies which have acceeded to the EU, for example Czech Republic, Hungary and Poland.

Figures 1 – 4 show the rate of FDI inflows and GNP growth in Russia, Ukraine, Poland and Bulgaria from 1992 to 2005. It can be seen that there has been an upswing in FDI levels in the former Soviet Union economies and Bulgaria from a low base, and this is

associated with an acceleration .of economic growth (one should be careful not to infer causality here – the two phenomena are correlated but the causality is not clear). However, it can be seen that the increase in growth in Armenia since 1999 is not correlated with changes in FDI, indeed FDI levels remain very low throughout. Figures 6A and 6B highlight that FDI levels remain unusually low in Armenia, even by the standards of most economies of the former Soviet Union.

[Finally, we note in Table 3 that the structural pattern of FDI inflows to Armenia have not been to sectors most likely to yield the crucial horizontal and vertical spillovers highlighted in the previous section. Thus, the foreign investment into the secondary sector has been minimal, and concentrated in the period covered in the food sector. Most foreign investment has gone into the utility infrastructure, though this may provide important efficiency gains for the economy and vertical spillovers. It is also surprising that investments into sectors such as finance and construction have been so modest. Thus we conclude that not only have levels of FDI into Armenia been low, not only in absolute terms and relative even to the region, but that also the distribution of FDI across sectors has not taken a form likely to encourage spillover benefits for the rest of the economy.]

3.3 Institutional Development

According to the EBRD Transition Reports, Armenia has made considerable progress in terms of institutional development. The average score across the EBRD indices is around 3.1, which is the highest in the CIS though below Lithuania (3.7), Latvia (3.64) and Estonia (3.75). It is above possible comparator states like Georgia (3.05) and also Russia and Ukraine (3.0).

A richer framework can be developed from the Heritage Foundation, that provides indications of "economic freedom" on a scale from zero to 100 (best). Armenia's situation in the key measures with respect to FDI and productivity are given in Table 4, relative to other transition economies. The United States is also included as a reference point. It can be seen that in many ways Armenia looks very strong with respect to

business and investment freedom and the overall indicator also suggests that the policy environment (measured by the remaining indicators not reported) is rather benign. However, the table also indicates some deep rooted problems in Armenia with respect to the enforcement of property rights and corruption. As indicated in section 2, these are likely to have had a negative effect on the flows of FDI.

3.4 Summary

The literature on productivity in developed and transition economies places emphasis on three determinants: competition, foreign direct investment and institutional development. In this section, we have considered Armenia's performance in these three areas, in comparison with other transition economies. We find that reforms with respect to price and trade liberalization have been very effective but Armenia lags with respect to Competition Policy. Since the Western literature stresses the role of competition in TFP determination, this may be a source of difficulty. However, the most significant issue is the low levels of FDI in Armenia. These have remained at a low level for a number of years, despite fast growth and a modestly good institutional environment among transition economies. It seems likely that this will hinder the evolution of TFP in Armenia.

4. Estimation Methods and Data

4.1 Estimation Methods

The analysis has been carried out by using the stochastic frontier framework to measure the technical inefficiency of the economic agents, either firms or industries, that are the objects of the assessment. This methodology allows us to evaluate the performance of each agent, relative to a common estimated best-practice frontier of production. The estimates of this frontier are based on the performances of the other agents in the economy. In fact, according to the classical microeconomic theory, functioning markets do not tolerate inefficiency. But this axiom is easily contradicted by any empirical

analysis. In the empirical context therefore, efficient producers will be those who produce as much as possible with the employed inputs and this idea is implemented in the stochastic frontier analysis.

Since the analysis concerns a single output production, we can think of technical efficiency in terms of TFP. That is the ratio between actual output and the optimal value as specified by a theoretical production function. The production function is the mechanism through which the firm transforms inputs into outputs. There can be different specifications of the production function that reflect different restrictions on its properties.

It is important to point out that, given this definition of technical inefficiency, the correct specification of the theoretical production function and the list of inputs are decisive in avoiding errors in the measurement of it.

The output of the fully efficient firm can be expressed as:

$$y_i = f(X_i,\beta)\exp(v_i)$$

where $f(X_i,\beta)$ is the theoretical production function, β is the vector of parameters of the production function to be estimated. i indexes the i^{th} firm in the sample of N firms and $\exp(v_i)$ is an unrestricted idiosyncratic and stochastic component of the model. This last component embodies measurement errors and any statistical noise and random shock of the frontier.

The output of the less than efficient agent is:

$$y_i = f(X_i,\beta)\xi_i\exp(v_i)$$

where $0 < \xi i < 1$ is the actual technical efficiency of the firm.

The empirical analysis carried out with stochastic frontier models was originally proposed by Aigner, Lovell and Shmidt (1977) who made distributional assumptions on the composed error $\varepsilon_i = v_i - u_i$ defining it as the sum of a symmetric normally distributed variable (the idiosyncrasy) and the absolute of a normally distributed variable (the inefficiency):

$v_i \sim N[0, \sigma_v]$

$u_i = |U_i|$ where $U \sim N [0, \sigma_u]$

This is the half-normal specification of the model. Both components are assumed to be independent and identically distributed across observations.

The analysis usually focuses on the measurement of ξ_i more than on the estimates of the technology parameters and it is carried out in a linear form after the logarithmic transformation of the previous model:

$$\ln y_i = \ln f(\beta' X_i) + v_i - u_i$$

where u_{it} is $-\ln\xi_i$, is always non-negative and can be interpreted as the percentage variation of observed performance from the firm's own frontier performance (or efficient performance).

The empirical analysis of inefficiency that arises from this framework requires two steps. In the first step the estimates of the technology parameters β, σ_v and σ_u allow to construct estimates of the composed error ε. In the second step the estimate of ξ_i can be calculated using the formula proposed by Jondrow *et al*. (1982):

$$\xi_i = E(\exp(-u_i|\varepsilon_i)].$$

The assumption of half normality for the inefficiency term constrains the mean of this stochastic component to be equal to zero. However this assumption can be relaxed. Some authors such as Stevenson (1980) extended the model to a truncated normal distribution

for ui that allows the mean to be non-zero. This new and less restrictive distribution implies:

$ui = |U_i|$ where $U_i \sim N [\mu, \sigma_u^2]$

The mean of the inefficiency component of the model can now be modelled to vary with some factors that the researcher considers decisive such as industry, location and so on. Formally, the inefficiency can be specified as a linear function of these factors:

$\mu_i = \mu_0 + \theta' Z_i$

As will be shown later, the parameters of the underlying distribution of ui provide a mechanism to introduce heterogeneity in the production in the model.

Sometimes analysts perform a third step in which they try to explain the variation of this estimated inefficiency ξ_i with the variation of some covariates. However it is possible to argue that these explanatory variables, if they do have any power in explaining the variation of inefficiency, should be included in the first step to avoid biases due to omission of them. Only the truncated variable specification allows the inefficiency to be modelled and estimated at the same time as the production function.

The available data for our analysis of Armenian firms consist of a sample of N economic agents observed over T years so the model can be now written as:

$lny_{it} = lnf(\beta' X_{it}) + v_{it} - u_{it}$

where each observation concerns firm i in period t and $t = 1,2,\ldots,T$.

The greater amount of information contained in the panel structure of the data can be exploited in the estimation of the production function parameters and the efficiency scores. However, while increasing the available information, panel data can exacerbate

the presence of heterogeneity. The large variation of characteristics between all the sectors and firms of the Armenian economy produces a large amount of measured and unmeasured heterogeneity.

As described earlier, in stochastic frontier analysis the ultimate objective is to obtain estimates of u_{it}. The first step is to estimate the technology parameters β, σ_v and σ_u. If these estimates are inappropriate or inconsistent then the estimation of εi and therefore u_i is likely to be problematic as well. Heterogeneity in the production function and in the inefficiency distribution can be a cause of inconsistency in the structural parameters estimation. Heterogeneity can be either observable (if we have some measure of it or variables which capture it) or unobservable (such as the individual effects and time effects in panel data).

When heterogeneity is observable, it is important to understand how it enters the model: that is whether it affects the production function or the inefficiency distribution, or it scales them in the form of heteroskedasticity. One approach, following Good *et al*. (1993), embeds the heterogeneity directly into the production function assuming that the environment alters the shape of the production function. The second approach, following Battese and Coelli (1995), assumes that heterogeneity affects the degree of technical inefficiency but not the shape of the production technology: thus the mean of the inefficiency distribution is modelled as a linear function of this measured heterogeneity. The first approach produces technical efficiency scores that are net of heterogeneity. The second approach produces technical efficiency scores that incorporate heterogeneity.

When heterogeneity is unobservable and therefore unmeasured, it is important to use an adequate panel data estimator. The commonly used random and fixed effects estimators fail to distinguish between cross individual heterogeneity and inefficiency and to capture time varying trends of the same efficiency. Moreover is it important to estimate the model in a way that the heterogeneity affecting either the frontier or the inefficiency distribution, or possibly both, is incorporated in the estimation of the technology parameters. Not accounting for heterogeneity while estimating these parameters could

produce a bias in the estimates in the first step that is carried forward to the second and, if adopted, in the third step.

In order to address all these heterogeneity issues, two different treatments of stochastic frontiers with panel data have been carried out in order to find the specification of the model that better fits the described data. The first treatment is pooled cross-section estimation to be performed within the stochastic frontier framework. Even if this estimation could appear restrictive because it assumes that all observations are independent and it does not exploit the within variation of panel data, it could be an interesting starting point for the analysis.

With this specification, when the assumed underlying distribution is the truncated normal, it is possible to introduce heterogeneity into the distribution of efficiency by modelling the mean as:

$$\mu_{it} = \mu_0 + \theta^T Z_{it}$$

where Z_{it} can include all the factors that are likely to affect the underlying inefficiency distribution, such as binary indicators for employees training and innovative firms. Moreover this specification allows the heterogeneity to be introduced in the model through the heteroskedasticity of both random components v_{it} and u_{it} as, for instance, depending on dimensional variables. Modelling the mean of the inefficiency distribution and the variances of the random components gives more flexibility to the estimation and allows the introduction of full heterogeneity in the model. Moreover the estimates of efficiency are time varying.

The second treatment of stochastic frontiers that is feasible with panel data is the so called "true fixed effect" model put forward by Greene (2002):

$$y_{it} = \alpha_i + \beta' X_{it} + v_{it} - u_{it}$$

in which individual effects are introduced simply by placing industry dummies in the classical stochastic frontier model. There are two advantages of this technique: the industry effects are allowed to be correlated with the explanatory variables of the model and the estimated efficiency is time variant.

In our empirical work on Armenia, we employed many of these techniques to calculate the measures of technical efficiency. In particular, our estimates provided estimates of technical efficiency (u_{it}) as well as the technology parameters β, σ_v and σ_u. We also addressed the heterogeneity issues using the pooled cross section approach.

4.2 Data

The empirical work is based on a survey of 300 enterprises in Armenia covering the period 2003 to 2005. It focused on industrial firms in 11 sectors, including chemicals, textiles, jewelry and beverages (including juices) as well as services. It was designed to provide the basis for analysis of trends in company behavior, including productivity. Thus, it collected information about output, labor input and factors influencing productivity such as ownership, legal status, privatization and competitive pressures (e.g. exports). The data from the questionnaire was supplemented by information from the database of the Annual Administrative and Regulatory Cost Survey of Armenia (on the business environment) and official statistics from the National Statistical Service of Armenia. The latter was used to provide information on capital input.

5. Estimates of TFP and Its Determinants in Armenia

In this section, we discuss the results of a large number of econometric exercises to estimate TFP in Armenia, to analyze the ways that it varies across industries, ownership and time and to understand the forces that drive the determination of levels of productive efficiency in Armenia.

5.1. The Stochastic Frontier Production Function in Armenia

The estimation methods used in this study are discussed in the previous section. We first report the findings based upon the estimates of TFP using stochastic frontier methods. In fact numerous specifications were used but the results of interest did not vary to any significant degree. The particular specification on which this section is based uses a truncated normal model and the results of the estimation are reported in Table 5. The estimated equation is strongly significant and the coefficients on labor and capital are plausible and highly significant.[2] An important test of whether the results are "sensible" is given by the "Test for CRTS". The test asks whether the estimated coefficients when added sum to unity, implying constant returns to scale. The estimated coefficients add up to almost precisely unity, and the test confirms that the estimates are not significantly different from unity. This allows one to place some faith in the findings since most other studies for developed and developing economies also tend to find the coefficients summing to around unity. The economic interpretation is that future growth in Armenia deriving from increments of factor inputs- labor and capital- will not be constrained by the onset of diminishing returns. One should not place excessive emphasis on this finding, however, since more sophisticated specifications of technology have not been tested and would be hard to fit on a dataset of this size.

5.2 Measuring Differential Performance in Armenia

Given the stochastic frontier reported in Table 5, one can calculate the variation in efficiency according to a number of criteria. In this sub-section, we first consider TFP overall, and then analyze the variation according to the principal drivers discussed in the literature summarized in section 2, as well as the Armenian literature. These include year, activity, legal status, foreign ownership, region and sector.

[2] These results are preliminary and not entirely comparable with those in the literature. First, TFP estimates are usually undertaken at the sectoral level and with careful control for the quality of labor and capital inputs. The dataset was too small to permit disaggregation at this stage, though it is hoped to undertake finer estimation in the future. There are also some concerns about the quality of the data concerning capital, which was measured at historic cost.

5.2.1 Overall TFP

Our estimates suggest that productivity in the average firm in Armenia is calculated to be 78.12% of the level found in most efficient firm in the country. The standard deviation around this estimate is found to be around 20%, which suggests that the least efficient firms are probably operating at approximately 60% of the productivity of the most efficient firms (if the distribution of the errors were normal).

There have been a large number of estimates of TFP for Western and transition economies and some of the results are summarized in Table 6. It can be seen that the Armenia estimates are on the high end by both Western and transition economy standards. Thus, our estimates suggest that there is slightly less variation on average between the productivity of Armenian firms and of the most efficient firms in the economy. One must however be quite careful in interpreting this result. We do not know whether the most efficient firms in Armenia are efficient by international standards. We only know that the forces of competition and openness to international trade, for example, have acted to keep the dispersion efficiency among Armenian firms low by international standards. Perhaps the most important point is that these estimates for Armenia are broadly comparable with those for developed and transition economies, and certainly well within the standard range. This gives us some confidence when considering the results with respect to the determinants of productivity.

5.2.2 Growth in Productivity

The findings with respect to productivity growth over time are reported in Table 7. The influential Caucasian Tiger study stressed the potential role of technical advance and increases in TFP as the basis for future Armenian growth. In this context, the mean levels of TFP by year reported in Table 7 may seem to be disappointing. They show that while the estimated mean level of TFP in Armenian firms was 0.7812 (78.12%) of the most efficient firms, this mean value did not vary to any significant extent across the

three years of the study. Indeed, if the mean was changing at all, it was in a downward direction. This implies that we have not been able to identify a positive significant technical progress (increase in TFP) over the period of our study.

However, it should be noted that the time period is short and one should not expect great changes in TFP over such a short period. The international companies reported in Caves (1992) also failed to identify dynamic effects in TFP estimates. Even so, we must conclude that in this time period productivity growth as measured by TFP has not been significantly different from zero, which highlights the need for policies to accelerate its growth in the future.

5.3.1 Determinants of TFP in Armenia

We report the variation in TFP by activity in Table 8. The results suggest that there is no significant difference in TFP on average between the industrial and service industries. There is thus nothing in our findings to favor selecting industry over services or vice versa as a basis for a growth strategy founded on productivity growth. There is however, somewhat more useful information when one considers the variation in TFP across twelve industries in Table 9, though these must be treated with caution because the standard deviation of the technical efficiency is larger than the estimated differences. We note that, measured at the mean, technical efficiency is found to be highest in the jewelry, furniture and juice sector as well as mining. It is lowest, on the other hand, in chemicals, textiles and construction. The service sector operates more or less exactly at the mean of technical efficiency across the economy.

One must take care in interpreting these results. They do not provide information about whether the most efficient firms, at the frontier, are more efficient in the jewellery or furniture sector than in the chemicals or textile sectors. We do not have information on the relative efficiency of the most efficient firms. The results inform us about the dispersion in efficiency within different sectors. They tell us that dispersion is greater in chemical, textiles and construction than in jewellery, furniture and juices. This may be

because the latter sectors are more monopolistic, for example, so that inefficient firms emerge and survive in a manner that is harder in more competitive sectors.

5.3.2 Exporting

It might be predicted that firms subject to higher levels of competition, for example because they are selling in overseas markets which are highly competitive, would have higher levels of productivity. However this hypothesis is not confirmed in Table 10. In fact, we find virtually no difference in average levels of TFP between firms that export and those that do not. This appears to suggest that competitive pressures in export markets have not acted to raise productivity in Armenian firms. Given the discussion in section 2 about FDI and horizontal spillovers, this is a troubling finding for the Armenian economy. Indeed, the mean level of TFP in exporting firms is very slightly smaller than that found in non-exporting firms. However, it is also possible that the appreciation of the Armenian currency is reducing the value of exports relative to domestic goods, and therefore in our frontier functions, which measure output by sales, reducing the productivity measured in drams of exporting firms.

5.3.3 Foreign Direct Investment and TFP

We noted in section 3 that levels of FDI were very low in Armenia – it is therefore perhaps unsurprising that the impact of FDI on TFP is not discernable. We find in Table 11 that the mean estimated values of TFP are virtually identical in foreign owned and domestic firms. This runs strongly counter to the results in the literature for other transition economies, and indicates there may remain serious weaknesses in the institutional environment which prevent foreign owned firms from transferring their technology and know-how to Armenian companies.[3] This negative result is probably our most important finding, and we return to the policy implications in the conclusions.

3 However the sample contains very few foreign owned firms, only 4 out of more than 300. The fact that the sampling method identified so few foreign firms is indicative that foreign

5.3.4 Regional Effects

The analysis reveals considerable variation in technical efficiency on average across regions, though once again the differences in mean TFP are not great in comparison with the standard errors. We observe that TFP is highest on average in firms operating in Gegharqunik, Syunik and Vayots Dzor, and the levels are some 3or 4% on average higher than those found in the least productive regions; Aragadzotn, Lori, Shirak and Yerevan.

5.4 Solow Production Function Results

In this sub-section, we follow the bulk of the literature reported in Section 2 by estimating a Solow type augmented production function in order to understand the determinants of the residual, technical efficiency. These results are reported because they allow a direct comparison with the transition literature. However, because the estimation method is completely different, the results cannot be compared directly with those of the previous sub-section.

We estimate a production function using fixed effects in which ln output is the dependent variable and the independent variables are ln labor, ln capital, time dummies and a number of variables that in the studies reported above are often identified with higher levels of TFP. These include export category (as an indicator of competitive pressure in product markets), foreign ownership and expenditure on training of labor. We report the results of the fixed effects estimation in Table 12.

The estimated function is largely consistent with our results using stochastic frontier methods. We find that the coefficients on labor and capital sum to almost unity, and are

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ownership has not yet penetrated very deeply into the Armenian economy, and that this should be high as an objective of a second phase reform agenda.

not significantly different from unity, which provides a "common sense" check on the estimation. We also confirm in a single equation most of the findings with respect to variation in TFP discussed above. Thus, the dummy variables for time (year 2 and 3 respectively) are not statistically significant, indicating that TFP did not increase over our sample period. In fact, the estimated coefficients are actually negative, indicating slight technical regress, but since the coefficients are not significant one cannot place any emphasis on that finding. We cannot test for activity or industry effects using this method because all such variation is removed by the fixed effects estimation. However, in this approach we find a very weak but positive effect of competition, via export category, on TFP, though it is only significant at the 10% level. Once again, we are not able to identify any positive impact of foreign ownership on TFP in these equations.

5. Policy Conclusions

In this report, we have summarized the theoretical frameworks and empirical findings on the determinants of enterprise productivity in developed and transition economies, highlighted by a number of key factors including competition, foreign direct investment and the institutional environment. We went on to use a new dataset on Armenian firms to estimate measures of total factor productivity and to analyze its determinants; to calculate its variation across sectors. Our approach is based on studies from developed economies as well as the transition literature, and these provide a basis for interpreting our results.

At the aggregate level, the Armenian economy has been performing very well for a number of years, with high rates of growth and a sound macro-economic environment. However, it might be noted that in Armenia, the high rates of economic growth and of productivity have not been associated with employment growth (Figure 7). This suggests that the fast growth of output and productivity have been associated with increasing efficiency within existing firms, and have perhaps been achieved via improved capacity utilization and even associated with some small labor shakeouts. In the leading transition economies of Central Europe such as Poland and Hungary, growth of this form was observed in the early years after the large recession of the 1990s, perhaps between 1994

and 1998. From that point onwards, growth and productivity growth have been positively associated, as can be seen for Bulgaria (Figure 8), Latvia (Figure 9) and Russia (Figure 10). However, Armenia's situation is not unique – it parallels quite clearly the situation in Romania (Figure 11). However, data reinforce the view that Armenia still needs to implement its second stage of reforms, in order that employment growth and productivity growth can become associated positively and move pro-cyclically.

Thus, the strong macro-economic performance of the Armenian economy is probably based primarily on the successful implementation of reforms at the start of transition, notably price liberalization, opening the economy to trade and reliance on the private sector. However, the time has probably come for a second phase of reforms to enhance the institutional environment, increase competition in the economy and encourage deeper penetration of foreign direct investment. This view is strengthened by the fact that in our empirical analysis, we were unable to identify a significant relationship between productivity and the quality of the labor force, as indicated for example by levels of education. This indicates that productivity growth was probably largely determined by demand rather than supply side factors.

To summarize, our results, based on a survey of 300 manufacturing and service firms, provide plausible and precise estimates of production technology in Armenian enterprises. Our principal findings are:

- The average firm in Armenia operates at some 78% of the level of productivity (TFP) of the most efficient firms. These levels are comparable to those found in both developed and transition economies. The study suggests that, contrary to the arguments of macroeconomic papers, Armenia is not experiencing any growth in TFP. Thus technical progress at the level of firms is playing no part in the Armenian growth process. This indicates the urgent need for policy to ensure faster dissemination of new technologies and know-how and the improvement of labor skills.

- There is at best mixed evidence that competition is having a positive effect on TFP. This is probably because competitive pressures are not yet strong enough in Armenia to influence managerial decisions, for example forcing firms to improve their efficiency to the levels of benchmark firms.

There is no evidence that FDI acts to increase productivity in Armenian firms. Foreign ownership in Armenian firms remains low by the standard of the region, and perhaps the economic and institutional environment is not adequate to ensure either adequate FDI inflows or that the benefits of FDI are reaped by recipient firms.

The empirical analysis therefore reveals some divergence between the situation with respect to productivity in Armenian firms and international experience in transition and developed economies. Taken together, the comparison of the situation in Armenia with international experience indicates that the Armenian economy would benefit from a second stage of reforms so that economic development can become more firmly based on productivity growth at the enterprise level. Despite the favorable macro-economic picture, this is a situation that has not yet been achieved at the enterprise level according to our survey. A comparison of Armenia with the international experience highlights three inter-related areas where policy development could improve the environment in a manner consistent with attaining this objective:

- Policies to improve domestic competition
- Policies to improve further the institutional environment, especially with respect to the enforcement of property rights and the reduction of investor risk
- Policies to encourage foreign direct investment, targeted to sectors where the horizontal and vertical linkages could be maximized.

There is an enormous literature on each of these policy areas, and in these conclusions we briefly mention some of the main issues that have been discussed. Commencing with competition, there are four areas to which policy makers might turn: barriers to entry of new firms, the informal sector, Competition Policy and freedom of trade. In practice, Armenia has made considerable progress with respect to the later, and in a small open

economy this is arguably the most important. However, there are still issues that can usefully be addressed with regard to the other three. Commencing with barriers to entry, since the path- breaking work of Djankov et al (2000), it has been recognized that governments often place considerable barriers to entry by new firms, through unnecessary regulations, requirements and red tape. The literature has established that these barriers reduce entry rates, increase the monopoly power of incumbent firms (therefore hindering their TFP growth) and worsen the institutional environment by encouraging corruption. The barriers are also related to the emergence of an informal sector. The informal sector is very large in many developing and transition economies, and is usually thought to emerge for two reasons. The first is taxation and administrative burdens which are high for small firms to bear. Such firms therefore prefer to "fly below the radar screen" in order to avoid the burdens. However, this has a great cost for the economy, because such firms are often excessively small and inefficient because their informal status places capital constraints upon them, and because they avoid growing so as to remain invisible to the authorities. The second reason is that the government places a wedge between the productivity of workers (which may approximately equal their wage) and the cost of these workers via the imposition of payroll and other employment taxes. This suggests that in the second stage of reform in Armenia, considerable emphasis should be placed on analyzing and evaluating the barriers to entry of new firms and the constraints on the operation of the labor market placed by labor market regulations and employment taxes.

Turning to Competition Policy, if one wishes to ensure that market environment becomes more competitive, it is very important that a sound Competition Policy is put in place, that it is operated by an agency which is independent of the government, and that it is quickly seen to be effective in the implementation of the Law. The first issue is one that can be addressed quite easily by the adoption of legislation, for example, based on the regulations of the European Union. This was the method adopted by the EU Accession economies of Central and Eastern Europe. The latter two requirements can be more difficult, because they require governments foregoing considerable discretionary power in the development of industrial policy. Nonetheless, the Armenian authorities would be well advised to look to the experience of other transition economies, perhaps notably the Baltic States which have also emerged from the legal structures of the former Soviet Union.

Turning to the institutional environment, we noted in section 3 that Armenia has performed rather well in terms of the EBRD's Transition Indicators of institutional development, but that when one considered the deeper questions raised for example by international investors and considered in the Heritage Foundation Index, there was still considerable progress to be made. The critical issues seem to be around protection of property rights via the legal system, and these concern less the nature of the laws that have been enacted than the consistency of their enforcement. Once again, there is very considerable experience, notably in the multilateral agencies, on how to make the legal system operate in such a way as to give confidence to investors, especially foreign investors.

This brings us to the third and most important area for policy development; encouraging foreign direct investment. The most striking difference between the experience of Armenia and the other transition economies studied is that, in the latter, FDI has been pivotal in productivity growth. In Armenia, productivity growth has been very slow at the enterprise level and FDI inflows have been small. It seems likely that these two facts are correlated. In terms of policy, one should distinguish between activities to improve institutional and environmental factors likely to encourage FDI, factors that will encourage the best sort of FDI (in terms of productivity) and policies to encourage FDI.

Our discussion in section 3 highlighted that FDI is higher in economies with good macro-economic performance and in which the institutional environment is perceived as being sound, so that investor risk is reduced. While Armenia seems to have comparable institutional development to other transition countries, it has much less FDI which suggests that investors perceive greater risk. This may simply be a function of "distance"; FDI is often explained by "gravity" models in which FDI flows between a source and host economy are modeled using a (quadratic) function of the difference between source and host GDP and of the distance between the two countries. The equations are usually moderated by a measure of institutional quality (see e.g. Bevan and Estrin, 2004). Since Armenia is relatively distant from the major global sources of FDI (US, UK, Germany), this suggests policy makers should focus on encouraging FDI from closer sources, or improving the institutional environment significantly to offset the locational

disadvantages of distance, in the way that has been done for example by Dubai, and in former years by Hong Kong or Singapore. This would involve making Armenia a significantly more attractive location for FDI in terms of institutional development than other countries in the region.

Our literature survey also indicated factors that encourage FDI of a type likely to generate greater linkages and therefore a larger impact on Armenian productivity. For example, the skill and education of the host economy labor force is often seen as an important factor, both in encouraging foreign entrants and in increasing "absorptive capacity", the ability of local firms to benefit from the investments. Similarly, the quality of local firms up and down the supply chain is an important indicator of absorptive capacity. This points to the necessity to improve the quality and training of local management, and to ensure that corporate governance by domestic owners is effective in ensuring that managers act in the interest of shareholders. These factors all indicate a policy direction of enhanced education, not only at the level of schools but also continuing education especially for management.

Finally, in addition to policies that ensure the economic environment is well trained and educated and sympathetic to foreign investors, should Armenia also consider active policies to encourage FDI? Bartels and Crombrugge (2205) provide a careful review of this question for UNIDO. They argue that few countries succeed with FDI by simply creating a suitable environment and waiting for foreign firms to come to them. They point out that successful countries usually have very pro-active foreign investment agencies promoting the image of the country in general and seeking out specific investors. Given the low level of FDI into Armenia, such a strategy is probably worth careful consideration, though it can be expensive and success is not guaranteed.

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Table 1 : Price and Trade Liberalization in Armenia and Comparators, EBRD Transition Indicators

	Price Sector Share of GDP	Price Liberalization	Trade System	Competition Policy
Armenia	75	4+	4+	2+
Bulgaria	75	4+	4+	3-
Estonia	80	4+	4+	4-
Georgia	75	4+	4+	2
Russia	65	4	3+	2+
Ukraine	65	4	4-	2+

Source : EBRD, **Transition Report**

Table 2 : FDI Inflows into Armenia and other economies ($ m) (to be updated)

	2001	2002	2003	2004	2005
Armenia	70	111	121	219	258
Georgia	110	167	340	499	450
Russia	2748	3461	7958	15444	15151
Ukraine	792	693	1424	1715	7808
Estonia	542	284	918	972	2996

Source : World Bank

Table 3 : FDI Inflows by Sector to Armenia (to be updated)

	1998	2000	2002
Primary Sector of which	29	3	7
- Mining	29	3	3
Secondary Sector of which	27	11	40
- Food	15	9	20
- Textiles	0.3	-	6
- Chemicals	3.0	0.4	11
- Metals	0.6	-	3
- Furniture	2.0	1.1	4
Tertiary Sector of which	1767	106	94
- electricity, gas, water	43	42	42
- Construction	-	0.7	9
- Trade	23	11.0	8
- Transport	78	38	9
- Telecoms	78	37	9
- Finance	0.2	-	10
TOTAL	236	124	149

Source : UN, ECE 2003

Table 4 : Heritage Foundation : Index of Economic Freedom(to be updated)

	Overall	Business Freedom	Investment Freedom	Property Rights	Freedom for Competition
Armenia	70.3	81.3	70	35	29
Bulgaria	62.9	67.5	60	30	40
Russia	49.4	52.8	30	30	25
USA	80.6	91.7	80	90	73

Table 5: Stochastic Frontier Production Function

```
Stoc. frontier normal/truncated-normal model      Number of obs   =       458
                                                  Wald chi2(15)   =    860.14
Log likelihood = -687.94441                       Prob > chi2     =    0.0000
------------------------------------------------------------------------------
      lny_05 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lny_05       |
         lnk |   .1278713   .0323457     3.95   0.000     .0644748    .1912678
         lnl |   .8866454   .0520987    17.02   0.000     .7845339    .9887569
       year2 |  -.0665335   .1258398    -0.53   0.597    -.3131751     .180108
       year3 |  -.0959906   .1278377    -0.75   0.453    -.3465479    .1545667
  ind_dummy2 |  -1.321698   .3707701    -3.56   0.000    -2.048394   -.5950024
  ind_dummy3 |    .160997   .4061916     0.40   0.692    -.6351238    .9571178
  ind_dummy4 |  -.4853686   .3607511    -1.35   0.178    -1.192428    .2216905
  ind_dummy5 |  -1.016605   .3624284    -2.80   0.005    -1.726951    -.306258
  ind_dummy6 |  -.0711172   .3490311    -0.20   0.839    -.7552055    .6129712
  ind_dummy7 |  -.6308478   .4406056    -1.43   0.152    -1.494419    .2327232
  ind_dummy8 |   .2522162   .4507499     0.56   0.576    -.6312373     1.13567
  ind_dummy9 |  -.2580629   .4041063    -0.64   0.523    -1.050097    .5339709
 ind_dummy10 |   .2634797   .4179523     0.63   0.528    -.5556917    1.082651
 ind_dummy11 |   .0588057   .3643703     0.16   0.872     -.655347    .7729583
 ind_dummy12 |  -.7920883   .4159029    -1.90   0.057    -1.607243    .0230663
       _cons |   7.575899   22.97005     0.33   0.742    -37.44457    52.59637
-------------+----------------------------------------------------------------
mu           |
any_training |   .0766441   .1444443     0.53   0.596    -.2064616    .3597498
  any_new_pr |   .3870673    .170899     2.26   0.024     .0521114    .7220231
       _cons |   .2000052   22.96657     0.01   0.993    -44.81364    45.21365
-------------+----------------------------------------------------------------
   /lnsigma2 |   .1662499   .0660865     2.52   0.012     .0367227    .2957771
  /ilgtgamma |  -6.250392   204.6994    -0.03   0.976    -407.4538     394.953
-------------+----------------------------------------------------------------
      sigma2 |   1.180868   .0780394                      1.037405     1.34417
       gamma |    .001926   .3934877                      1.1e-177           1
    sigma_u2 |   .0022743   .4646571                     -.9084369    .9129856
    sigma_v2 |   1.178594   .4711119                      .2552315    2.101956
------------------------------------------------------------------------------
. predict te1 if e(sample), te
(442 missing values generated)
. di "Test for CRTS (RTS=1)"
Test for CRTS (RTS=1)
. test lnk + lnl = 1
 ( 1)  [lny_05]lnk + [lny_05]lnl = 1

           chi2(  1) =    0.13
         Prob > chi2 =    0.7149

. test [mu]_cons= 0

 ( 1)  [mu]_cons = 0

           chi2(  1) =    0.00
         Prob > chi2 =    0.9931
```

Table 6 : Estimates of Median TFP

Armenia	0.78
Japan	0.7
Korea	0.67
Canada	0.5 – 0.7
Bulgaria	0.6 – 0.72
Czech Republic	0.67 – 0.78
Russia	0.45 – 0.49

Source : Caves (1992), Jones, Kleindinst and Rock (1998), Sabiorianova, Svejnar and Terrell (2005)

Table 7: Growth in TFP over Time

```
Summary statistics: mean
  by categories of: year

    year |  Technical efficiency (te1)
---------+----------
    2003 |  .7956325
    2004 |   .788252
    2005 |  .7612613
---------+----------
   Total |  .7812452
--------------------
```

Table 8 Variation in TFP by Activity

```
Summary statistics: mean
  by categories of: activity

activity         |      te1
---------+----------
      industry         |  .7821307
      services         |  .778936
      other            |  .7695118
---------+----------
   Total |               .7812452
--------------------
```

.

Table 9 Variation in TFP by industry

Summary statistics: mean
by categories of: industry

industry	te1
Chemicals	.7239543
Clothing, Shoes	.7901978
Construction	.7695118
Construction Mat	.7832783
Equipment	.7717635
Food	.7711046
Furniture	.8196567
Jewelry	.8196572
Juices, mineral	.8011595
Mining	.8100853
Services	.7891505
Textile	.7529654
Total	.7812452

Table 10 Variation in TFP by Export Category

Summary statistics: mean
by categories of: export_cat (1= exporter)

export_cat	te1
0	.7853927
1	.776265
Total	.78269

Table 11 Variation in TFP by Foreign Ownership

Summary statistics: mean
by categories of: fdi_cat (1= foreign owned)

fdi_cat	te1
0	.7811207
1	.7863015
Total	.7812452

Table 12 Variation in TFP by Region

Summary statistics: mean
by categories of: marz_en

marz_en	te1
Aragadzotn	.7732723
Ararat	.7818411
Armavir	.7885883
Gegharquniq	.8184892
Kotayk	.7944084
Lori	.7725337
Shirak	.7767436
Syuniq	.819798
Vaywtc_zor	.8132148
Yerevan	.7773019
Total	.7812452

Table 13 Augmented Production Function Estimate

Fixed-effects (within) regression Number of obs = 359
Group variable (i): id Number of groups = 128

R-sq: within = 0.2197 Obs per group: min = 1
between = 0.5676 avg = 2.8
overall = 0.5506 max = 3

F(9,222) = 6.94
corr(u_i, Xb) = -0.0847 Prob > F = 0.0000

lny_05	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnk	.2174464	.0859821	2.53	0.012	.0480008	.386892
lnl	.649977	.1106177	5.88	0.000	.4319818	.8679721
export_cat	.2733843	.1599157	1.71	0.089	-.0417627	.5885314
fdi_cat	-.1123845	.3321014	-0.34	0.735	-.7668593	.5420902
)						
any_training	-.0437953	.2328367	-0.19	0.851	-.5026483	.4150576
year2	-.0352744	.080252	-0.44	0.661	-.1934275	.1228787
year3	-.0760053	.0894638	-0.85	0.396	-.2523122	.1003016
_cons	6.702185	.8811048	7.61	0.000	4.965786	8.438585

sigma_u	1.0986326
sigma_e	.59663959
rho	.77224244 (fraction of variance due to u_i)

F test that all u_i=0: F(127, 222) = 6.56 Prob > F = 0.0000

Figure 1

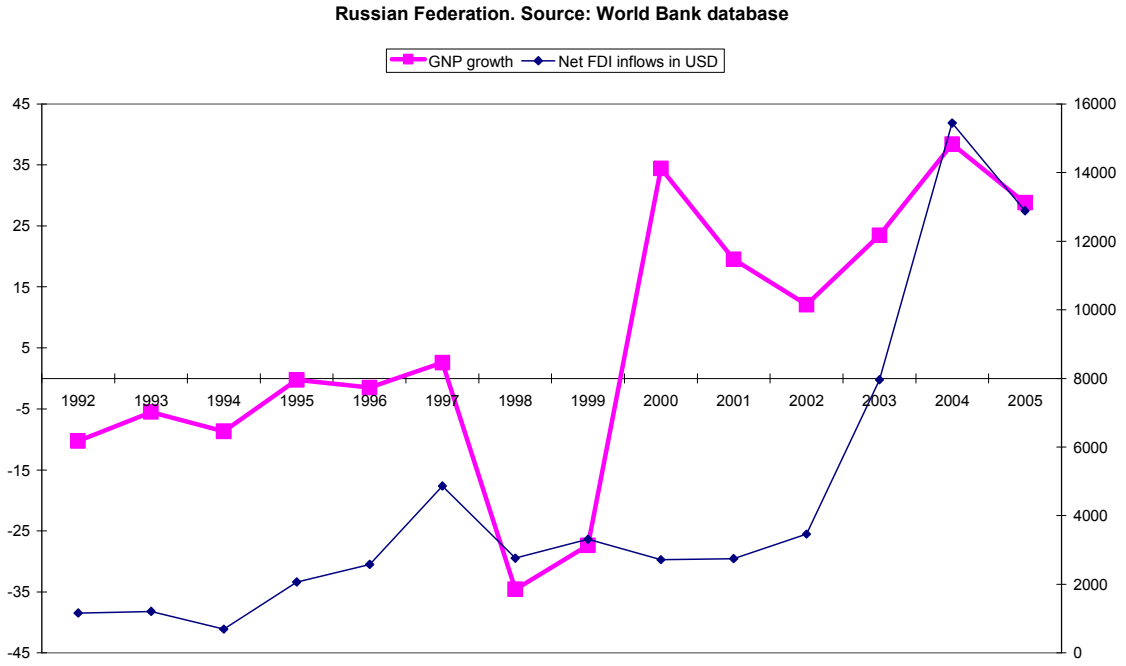

Figure 2

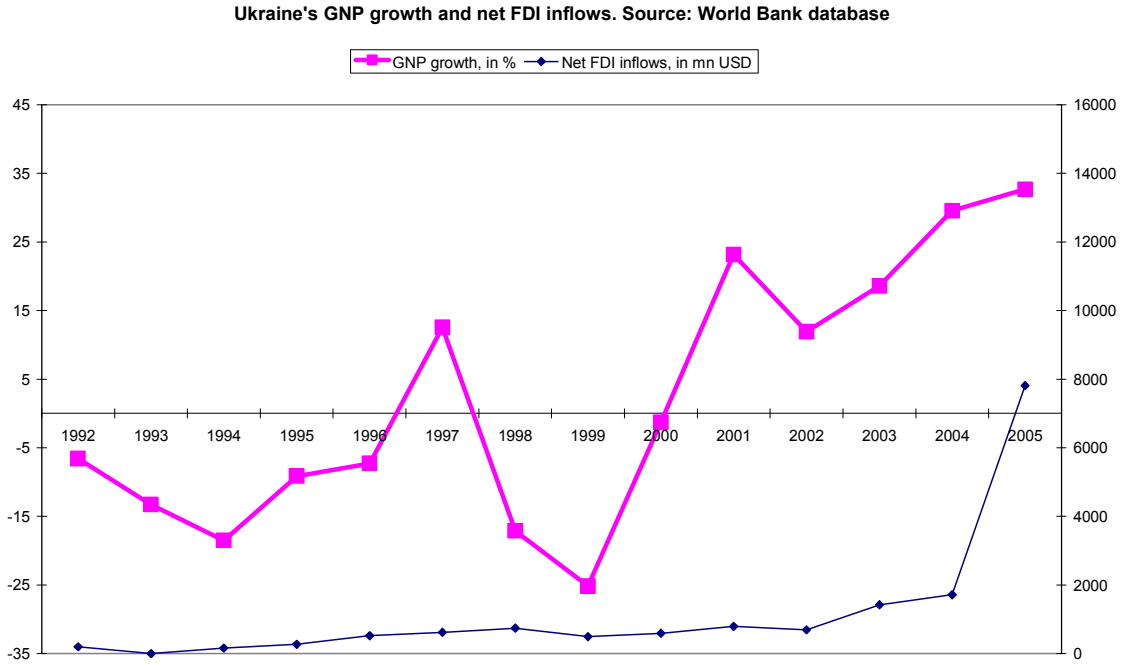

Figure 3

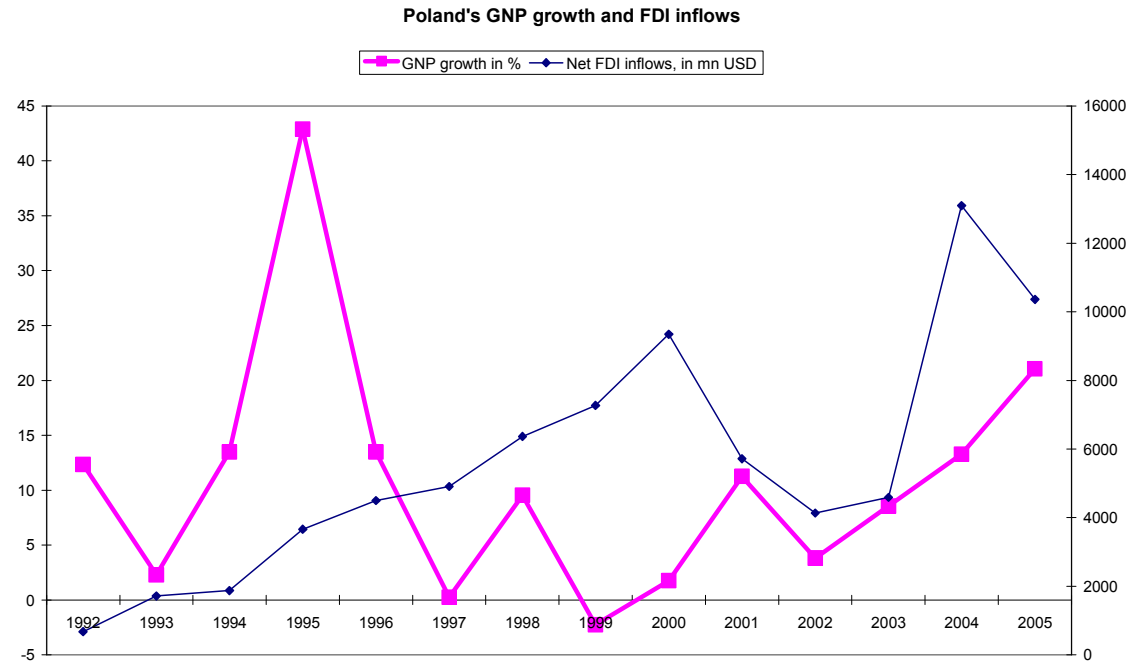

Figure 4

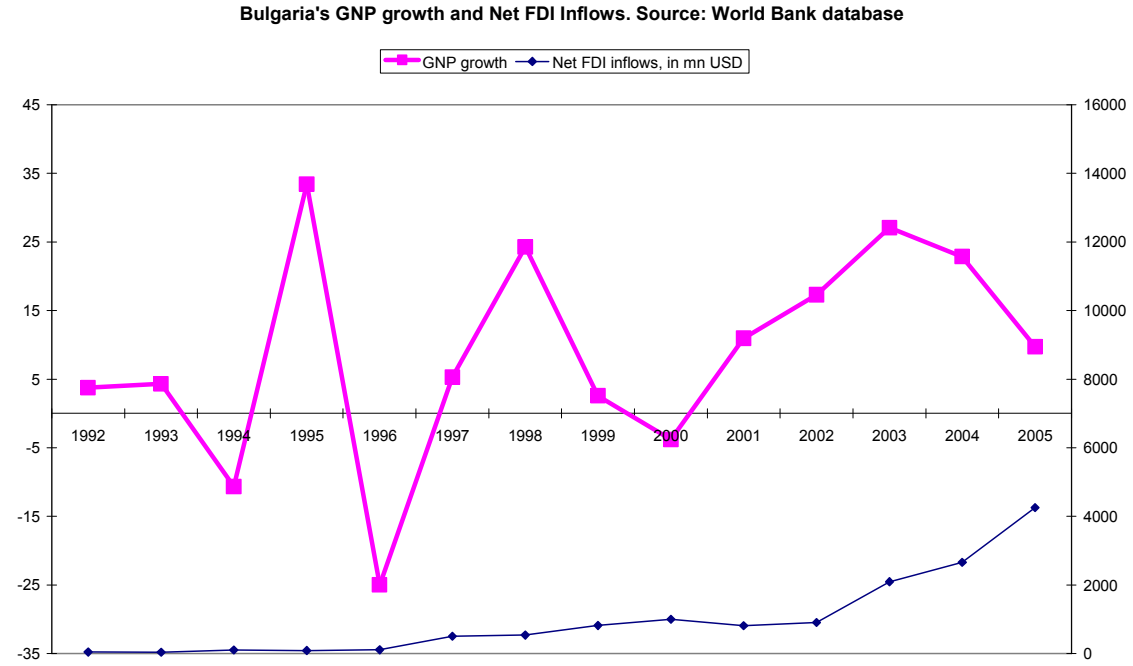

Figure 5

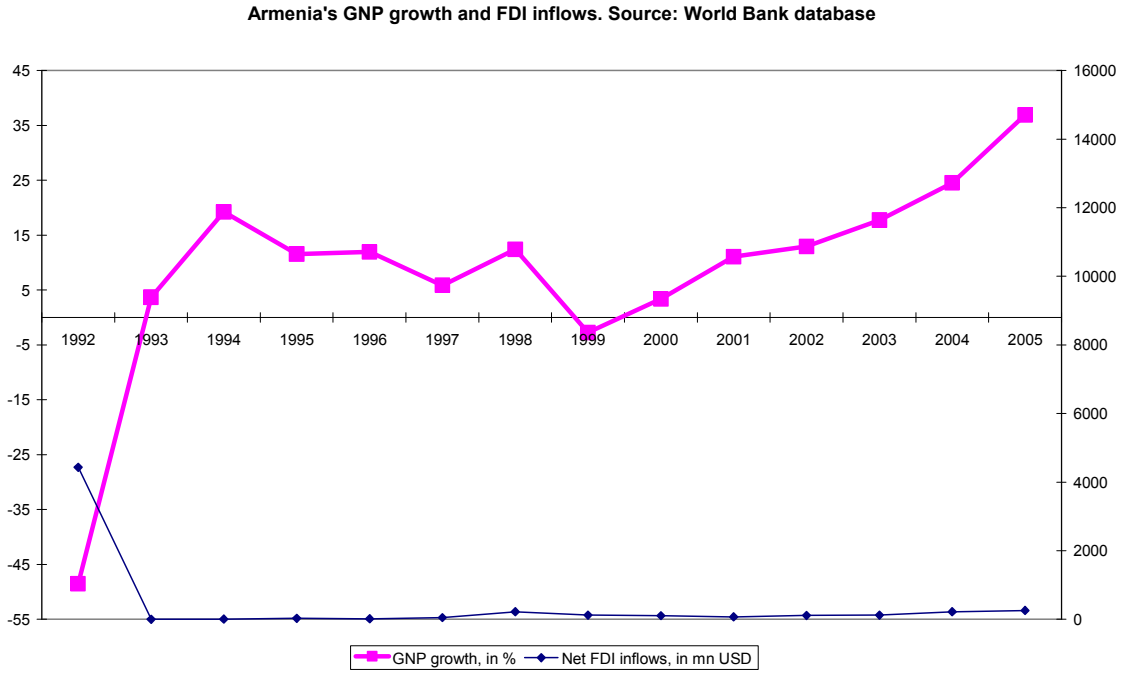

Figure 6A

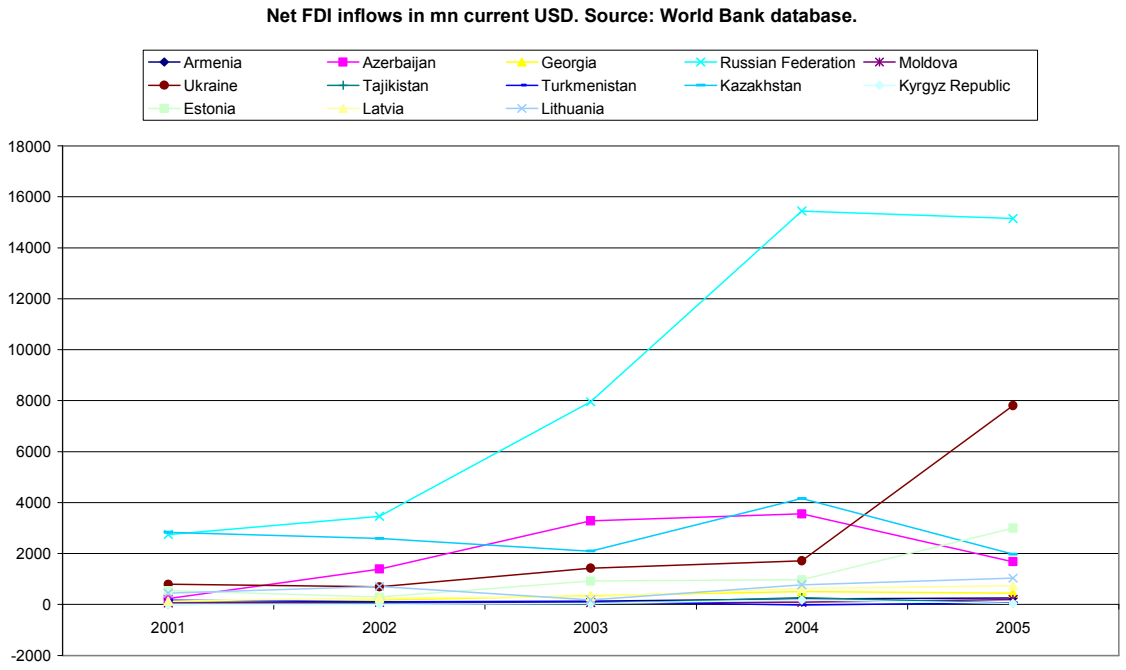

Figure 6B

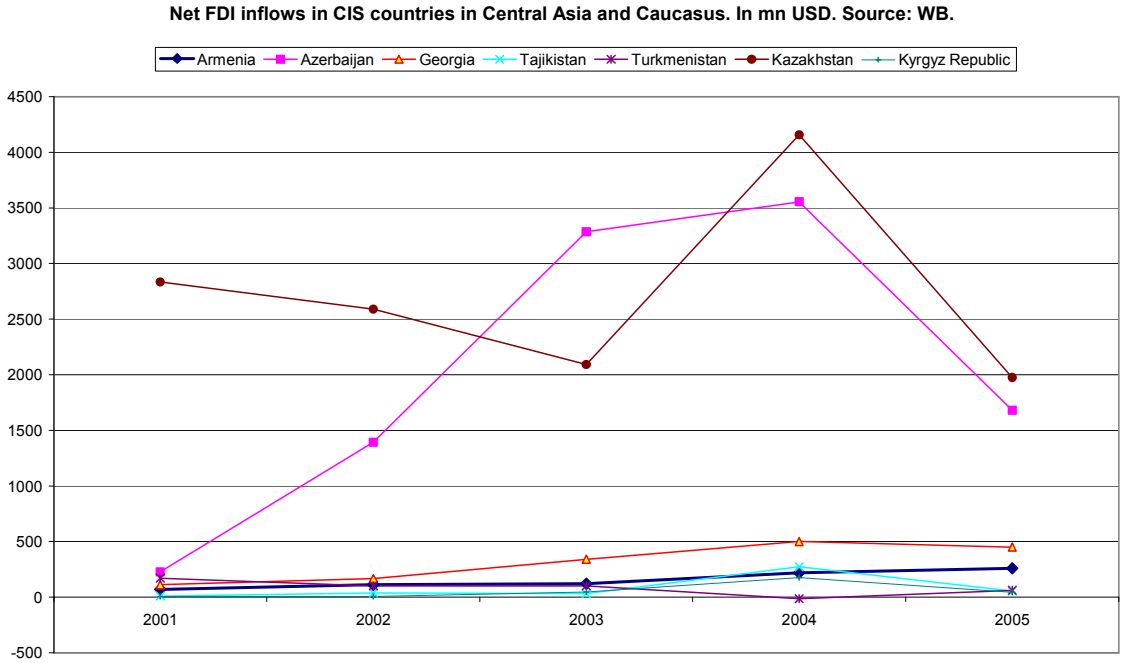

Figure 7

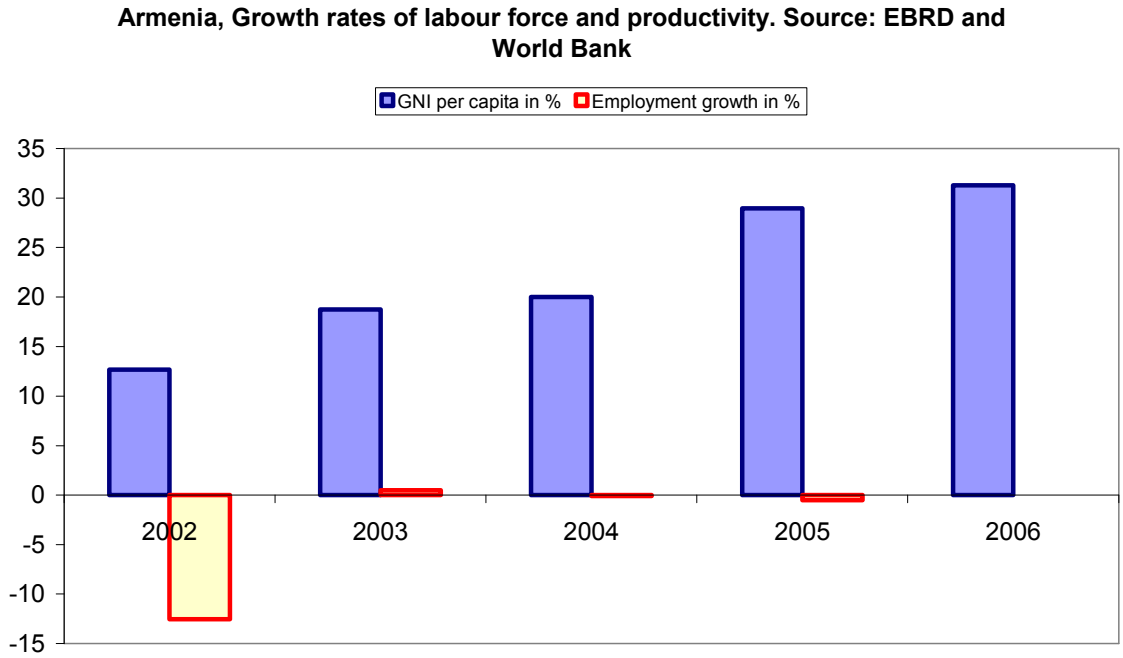

Figure 8

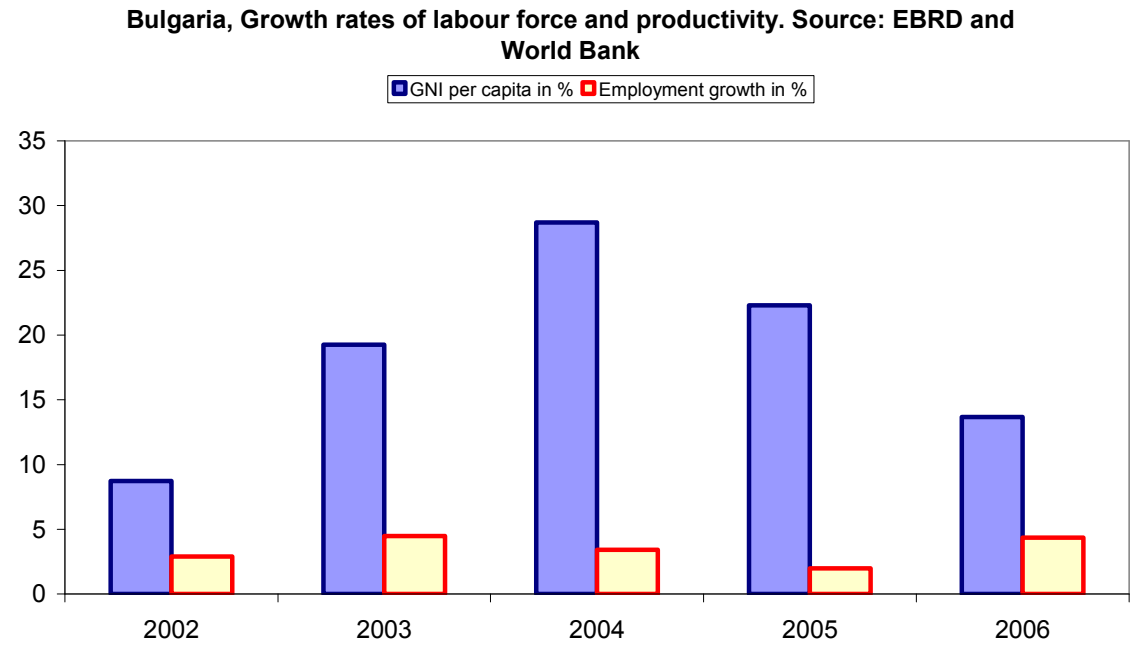

Figure 9

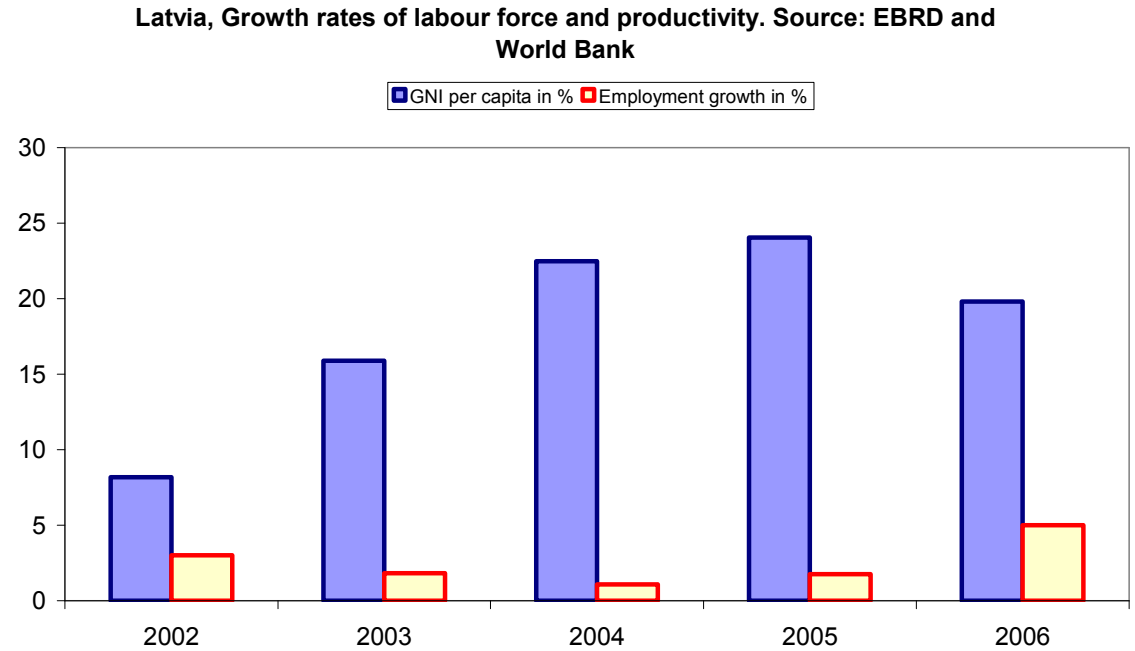

Figure 10

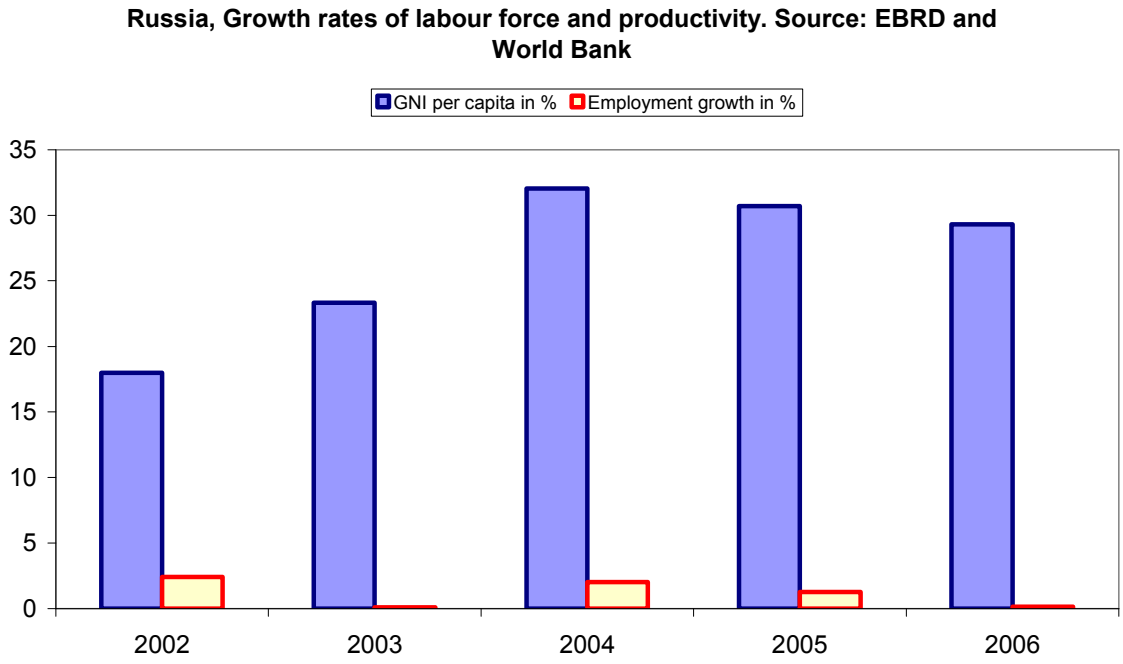

Figure 11