TECHNOLOGY TRANSFER IN
TRANSITION

by

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Abstract

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In this research we investigate the instances of technology transfer through the production linkages between unaffiliated enterprises. This study is unique in the use of the direct measures of firm-level innovation. A new methodology is introduced in using the product, process and organizational innovation as proxy measures for the product, process and managerial know-how technology transfer. Using the ordered logit model, we find a strong relationship between the forward and backward production linkages and the level of technology transfer to domestic firms. The results for the general sample regression using the 'BEEPS' dataset with firms in 26 transition countries are consistent to the findings of the industry-specific regressions, and are subject to various robustness checks. We follow up with testing our empirical model on an additional dataset of Ukrainian enterprises and obtain evidence that supports the findings of the main dataset. This gives grounds to claim that production linkages are an important channel for the inter-firm technology transfer, and that transition governments should pay vast attention to their promotion for sustainable growth.

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Chapter 1

INTRODUCTION

The crucial role played by technological progress in economic growth is now widely accepted (Baranson and Roak, 1985). Technology itself plays a key part in the process of creation and development of the competitive advantages (Bateman and Snell, 1996). At present the patterns of technology transfer are modified by the globalization of the world's economy, liberalization of the developing countries' economies, the shortening of the product life cycle, and the rise of competition (Badawy, 1993). Under transition, innovation and technology become even more critical, as they represent the weakest elements of the old planned economy system from which such "transition" is being made (Radosevic, 1997).

How can relevant technology be obtained? Can an economy in transition independently (internally) produce it in sufficient amount? The Global Competitiveness Report 2001-2002 rates Ukraine 60th in technological sophistication, and 72nd in firm-level innovation out of the 75 countries investigated. The latter suggests that success depends solely on the ability of enterprises to identify, assimilate and exploit acquired technologies from specific external sources (Kinoshita, 2001).

The belief in the existence of the positive influence from the presence of international companies in domestic economy is widespread. Countries hope to benefit primarily from foreign direct investment (FDI). They are interested in its quality, in terms of benefits for sustained economic development. Policymakers often intend to tap the benefits through attracting FDI inflows, which would bring new technologies, know-how and contribute to the domestic industries productivity increase. Sometimes following these considerations, foreign companies are offered better terms of entry than domestic enterprises would.

In this research we analyse the innovative infrastructure in transition economies: evaluate the absorptive capacity of the economy in general and industries in particular. We expect to find the relationship between forms of technology transfer and their impact on the innovativeness of the enterprises within a set of transition countries, and inside a specific industry. We want to do this by investigating the instances of technology transfer that takes place through the linkages between unaffiliated enterprises. Finally, we anticipate being able to formulate policy implications to avail technology transfer in the countries under transition.

The current work differs from the previous studies in the field by the nature of the relationship examined, as we focus on the direct measures of innovation at the firm level. This in itself enables us to encompass the straightforward analysis of the foreign companies' impact on the domestic enterprises' performance. Unlike our predecessors in research, we do not limit the scope of our view just to the 'spillover effects' from FDI activity in any particular industry; we can and do examine the impact of the relations with foreign firms on the innovativeness of each enterprise, and do it via introducing our own measures for the level of technology transfer.

The contribution of this research becomes apparent in the introduction of the new methodological approach: the use of the product, process and organizational innovation as proxy measures for the product, process and managerial know-how technology transfer. To the best of our knowledge, such measures to identify the influence of the level of technology, transferred from foreign to local firms, on the innovativeness of the domestic enterprises do not have a precedent. In this way our research significantly differentiates itself from the other studies, already performed in the field, that measure the effect of the inter-firm production linkages on productivity and competitiveness of the firms in both the developed and transition economies.

The forthcoming section will define the kinds of technology transfer considered in our study. In section 3 we proceed with the review of the literature, relevant to our research. Sections 4 and 5 outline the methodology used and provide the description of the data. Results and their interpretation are presented in Sections 6 and 7. We follow with robustness checks, additional findings and extensions in Sections 8 to 10. Section 11 concludes our analysis and provides policy implications.

Chapter 2

DIFFERENT KINDS OF TECHNOLOGY TRANSFER

Before we dive into the broad world of the literature on technology transfer, we would like to shortly introduce the means though which the technology can be obtained, taking into account the difficulties of dealing with technologies at large, and define the different channels for the transfer of technology in production.

According to Caves (1999), "the market for technology entails transfers between firms of technical information (designs, descriptions, plans, etc.), including the right to use or infringe on patents, and frequently the services of the licensor's personnel to install and debug the technology or train the licensee's operators".

Technology transfer can be defined as the transfer of product and process technology (in a broad sense) from the producer of technology to the receiver of technology through delivery of machinery and equipment, transmission of knowledge and experience, collaboration and consultation, etc.

The very important channel of TT that we will consider is production linkages between foreign affiliates and domestic firms. The World Investment Report 2001 presents a very thorough classification of linkages that we will use in our study. When the foreign affiliate is involved in acquiring goods or services (used as inputs in affiliate's production) from the local firms, the process of supplier – user, or "downstream" to "upstream" firm cooperation is called "backward linkage". When the interaction between "foreign" and "domestic firm" occurs in the same industry, and the enterprises involved in it might be called competitors, this relations are called the "horizontal linkage". Other kinds of linkages stimulating technology transfer processes take place among the foreign and local firms and the non-business entities of the host country. The latter stand for universities, training centers, research and technology institutes, business incubators, etc. Linkages provide a mode to spread valuable knowledge throughout the economy via the direct flows into the linked firms, as well as spillages to and from the latter.

TT to supplier firms may also be categorized according to the area of technology involved: an affiliate may engage in several simultaneously. The first area of TT relates to product technology and the second area - to the process technology.

Forms of the product technology transfer include the following[1]:

- Provision of proprietary product know-how
- Transfer of product designs and technical specifications
- Technical consultations with suppliers to help them master new technologies
- Feedback on product performance
- *Collaboration in R&D*

The main forms of transfer of process technology are:

- Provision of machinery and equipment to suppliers
- Technical support on production planning, quality management, inspection and testing
- Visits to supplier facilities to advise on layout, operations and quality
- Assistance to employees to set up their own firms

Separately, we would like to introduce the *forms of transfer of organizational and managerial know-how:*

- Assistance with inventory management and the use of just-in-time and other systems
- Assistance in implementing quality assurance systems

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[1] Classification adapted from the World Investment Report 2001

Chapter 3

LITERATURE REVIEW

The literature on the subject of technology transfer is abundant: the basis for the scientific discourse is provided by the theories that explain how technology transfer is driven by the desire of the multinational corporations to acquire benefits for themselves; and the other kinds of theories, which mainly take the stand for the benefits that the local firms could obtain from the foreign investment and foreign presence in the domestic economy, as well as the comprised benefits for the domestic country "at large". Our research interest lies in the latter approach, so our focus will be primarily on it. Hence, we will consider business theories on one end, and the early endogenous growth and innovation models on the other. In our study we would like to encompass both in order to build on the best from both the business literature, and the economics literature on the subject of the technology transfer.

At first we will look at the growth models in an attempt to support our claim of the positive influence of firm – level advancement through technology flows on economic growth. In addition, we will provide the outlook to the theories of technology transfer by the multinational corporations (here referred to as MNC's). Under both headlines we will include the empirical studies on developing and transition countries: the business case studies, as well as the studies, performed by economists.

Can a country grow by acquiring technology? The answer to this will be introduced through the prism of the following growth models. It is the accumulation of knowledge, which is defined to be one of the key determinants for the economic growth of a country. This statement is supported by both the endogenous growth and the innovation literature. Such stock of knowledge can increase via investment in R&D capital or through the diffusion (transfer) of existing technology.

The theoretical proposition that capital accumulation and innovation are complementary processes runs through the majority of the endogenous growth models. As described by Aghion and Howitt (1999), the extended schumpeterian model of creative destruction suggests, that as innovations arise in one sector (when the research is motivated by the prospect of local monopoly rents), among the number of the assumed sectors of the economy, then there arises a flow of innovations in the whole economy. In this setting, each innovation has only an incremental impact on the growth of knowledge in the economy, through a technology spillover.

The model, described in aggregate terms by the Cobb-Douglas aggregate production function in capital and labor ("efficiency units" of labor), includes an efficiency parameter, which represents the state of technological knowledge to which all innovators contribute. The model shows that more capital accumulation stimulates innovation by raising the equilibrium flow of profits, just as more innovation stimulates capital accumulation by raising the rate of productivity growth. Neither process can take place without the other in the long run. For without innovation, diminishing returns would choke off investment, and without net investment the rising cost of capital would choke off innovation.

The counter going belief, stating that the incentives to perform R&D determine long-run growth independently of the stock of capital, is grounded in the endogenous growth models introduced by Romer (1990), and also by Grossman and Helpman (1991). The latter models assume that labor is the only input to research, as opposed to the model, presented in Aghion and Howitt, which assumes that research uses the same mix of inputs as the production of capital and consumption goods.

According to Kinoshita (2003), innovations, generated by research activities and technology spillovers from the stock of knowledge are interrelated, and become particularly vital in raising the productivity of the firms. In addition, the diffusion of technology does not automatically arise if some stock of knowledge is attained. Unless the recipient of technology owns the ability to absorb and adopt the technology, it will not be able to spread it to others.

Because of the nature of technology (the normal features of which include imperfect understanding and tacitness), TT is not as simple as the purchase of a capital good. Recipients would normally have to devote substantial resources to assimilate, adapt and build improvements upon the original technology. Also, the research and development activities should be aimed at helping to increase the absorptive abilities of the firm in order to make hypothetical technological spill over actual. The successful use of technology is heavily dependent not only on the firm's readiness to absorb technology, but also on the firm's developing its own technological capabilities. Many researchers provide typologies of technological capabilities, representing the abovementioned concept of absorptive capacity. Baranson and Roak (1985) distinguish among operational (ability to conduct obtained technology), duplicative (ability to produce a similar product after having been introduced to it), and innovative (ability to improve upon, change and make something new) capabilities, and suggest that none of these capabilities will automatically come to passive recipients, as each requires an increasing level of technological effort.

If the firms do own the ability to use the technology when facing it, then the next question becomes: How can such technology be transmitted? To give an answer, we will turn our attention to the channels for transfer of technology.

The impact of the channels of TT on growth have been studied and extensively tested empirically in the last decade of the 20th century. As defined in the literature, the transfer of technology from multinational corporations occurs through three principally different channels (Damijan et. al., 2003). The first of them concerns the so-called "direct transfer of technology via licensing agreements" (Eaton and Kortum (1996)). This channel has some drawbacks, connected to the difficulty of licensing the "latest" technologies. The newer the technology is, the longer it takes to patent it. This and other factors of delay (like need for the prolonged description of the technical characteristics, formalization and detalization of the new production process, etc.) contradict the desire of the company-producer of this high technology to commercialize it quickly, i.e. they would have great incentives to transfer it through internal channels of company network, which would make the spillage to the outer firms decrease. Thus, in the majority of cases, the firm would not want to license such "latest" technology on the outside market.

The second channel of TT, takes place via imports and exports. Imports of intermediate products and capital equipment, and exports into more developed countries, which involve learning, as defined in Grossman and Helpman (1991).

The third channel defined in the literature is FDI. This important channel is comparatively inexpensive, and speedy, as it accomplishes actual intra-firm technology transfer in addition to the intra-industry spillovers of knowledge to developing countries (Blomstrom and Kokko (1998)). The importance of FDI for the domestic firms' productivity growth has been empirically tested for developing countries in the study of Blomstrom and Sjoholm (1998).

It is necessary to stress the importance of FDI as the engine of the productivity growth for the firm. Here, foreign investment comes in as the inflow of advanced knowledge from foreign firms. Among the channels though which knowledge spills over into the country, FDI is one of the most effective, as it conveys not only technology embodied in goods and services, but also intangible assets such as managerial skills, that would not be transferred through other avenues (Kinoshita 2003).

The local firms – receivers of FDI may get significant benefits in different ways. Firstly, foreign firms usually are representative of efficient firms, that own intangible assets, and are willing to invest abroad with target to exploit their advantages, it is reasonable that local firms would have the FDI-embodied technology transferred to them through their imitation of what foreign firms produce. In such way, the entry-competitive pressures of foreign firms may influence the growth in productivity of local firms. Secondly, the benefits to local enterprises may also materialize in making them able to produce output with a higher standard, or in being forced to use a better (new) technology by acquiring the intermediate inputs from foreign suppliers or by providing their own output as an input to foreign companies - producers of final goods. And thirdly, foreign companies may train the employees of the local firm, with which they become partners in joint venture.

From the abovementioned statements it is clear that the "utility" from the FDI-affiliation is at door. But do the possible benefits promised apply in the actual transition economy environments?

In an attempt to answer this question we will investigate, whether these arguments have been able to find any support in the world of empirical research. A profound study performed by Radosevic in 1997 posed the question of how TT can be used as a means to enhance and promote economic growth, and structural change under conditions of transition economy. Technology transfer is examined in the 'sourcing context', meaning the "long-term relationships between either independent or dependent firms", where one purchases "sub-assemblies, components or processed materials produced by a firm located in another country" (Radosevic 1997). The author claims, that while there are no signs of structural improvement due to TT on the aggregate level, the micro evidence provides a more complex picture. The author also suggests that the opportunities to close the capability gaps (product, market development, and management gaps) for enterprises operating in the transition economy context, exist via using different technology transfer channels, such as FDI, joint ventures, subcontracting, exports, alliances and licensing.

Recent developments in the field of technology transfer involve empirical studies of several types. As already mentioned, we would like to encompass the findings of both the economics and the case-study business literature. The business study by Sharp and Barz (1997), for instance, checks whether the investment by multinationals into transition economies is sufficient to provide the capital equipment, skills and export earnings necessary to build and restructure the productive capabilities of the transition economies. This latter study includes pilot (or preliminary) studies with four multinationals from Western Europe that are already involved in business relations and ventures in CIS countries and countries of Eastern Europe. They find that while multinational corporations can provide the crucial mechanism of upgrading skills, capabilities as well as equipment, it is questionable, whether the penetration of these companies in the transition economies will be quick-enough to reach a "genuine" transformation.

Having looked at this business study, we are left with the question: "Is it really worth putting governments' efforts into promoting foreign involvement in the domestic, for the country to climb out of the "transition pit"? The following studies testify to the great ambiguity in answering questions of this sort.

It is often argued in the literature that FDI has positive influence on the productivity growth of domestic enterprises. It is rarely explained, though, why it does. Why only foreign investment has such an impact, and why does direct investment from a foreign company lead to the enhancement of the domestic enterprises' performance?

The expectation to find the positive link between the foreign investment and domestic productivity growth holds much favor in this field of research. In particular, the evidence on the positive influence of direct transfer of technology from MNE's to the local affiliates, represented by higher productivity and growth, can be found in Haddad and Harrison (1999) and Ponomareva (2001). Both papers use the firm-level panel data approach, while the former does it for developing, and the latter does it for a transition country (Russia). Ponomareva

2001 finds evidence of the positive productivity spillovers from FDI on domestic firms on the sectoral level, and a negative effect of the rise in market competition caused by the entry of foreign firms into the domestic market of Russia on local enterprises.

The studies testing for the technology spillovers from a local affiliate of the MNE to its horizontal "rivals", as well as to its vertical suppliers and customers, have been able to find only the very weak or negative evidence of potential spillages. The result appears unexpected, and explanations of it become necessary. Damijan et. al. (2003) suggest some explanations for this matter. In their opinion, the primary reason is the desire of MNC's to internalize their technological advantages, and prevent the spillages from taking place. Another explanation can be found in the failure of empirical studies to account for the spillages at individual firm level, as the approach used by majority of researchers is aggregation by industry and/or sector. The use of cross-section rather than panel data to pin down the technological spill over effects could have caused the inability of researchers to find any positive spillover effects. Among other explanations for the mentioned results are the quality of data available and limited samples of enterprises under study as well as an inappropriate hypothesizing of the linear relationship between spillovers and productivity growth of domestic enterprises.

The empirical literature on transition countries suggests the existence of some FDI-induced spillovers on an intra-industry level. Study by Konings in 2001, for Bulgaria, Poland and Romania, finds that FDI is important in transfer of technology to an affiliate; but finds no evidence of horizontal spillovers to domestic firms. Other studies, like the one on the Czech Republic, by Djankov and Hoeckman (2000) suggest that positive spillovers from FDI may not exist, and that there may not have been TT among the affiliates of foreign companies located in the country in the mid 1990's.

Innovations generated by R&D activities and technology spillovers from the stock of knowledge are important for raising the productivity of a firm. The empirical study that underlies the influence of R&D investment and technology spillovers from FDI on the productivity of the firm is Kinoshita (2003): in the instance of finding the positive spillovers from FDI, it is reasonable to hypothesize that these take place not only due to the "infusion of foreign stock", but mainly due to the transfer of technical know how, management practices, and human potential. As suggested by Smarzynska (2003), the search for positive technological spillovers from FDI in transition countries has been less successful because it was wrongly targeted. The studies performed, have been forwarded to find spillovers between competitors, when the actual FDI-educed technological spillovers under transition are more likely to take place though vertical (supplier-related linkages among firms) channels.

As a consequence, the empirical study by Smarzynska (2003) takes the outlined difficulties into account and shows the positive spillovers from FDI through contacts between foreign affiliates and their local suppliers in upstream sectors. The author finds no indication of spillovers occurring within the same industry. The study uses data on Lithuania to indicate that local firms benefit from the operation of foreign affiliates both in their own region, and in other parts of the country. The empirical results show that the stronger positive influence on the domestic enterprises comes from the foreign companies producing for the local market, as opposed to the ones, which are export-oriented. In addition, there is no indicated difference between the impacts of fully owned foreign firms and those with joint domestic and foreign ownership.

To top review of the literature off, we would like to point out the results obtained in the empirical paper by Yudayeva, Kozlov, Melentieva and Ponomareva (2003). This work analyses the effect of the direct foreign investment on domestic enterprises in Russia. It determines the significance of the spillovers from foreign-owned to domestic firms operating in the same industry; and the spillover effects between vertically related enterprises. It is peculiar that while the paper results of the positive effect of the direct foreign ownership on productivity are in tune with the other studies on transition countries, the indirect effect results regarding the effects of foreign firms on their vertically integrated competitors go contrary to the results received by other studies using the datasets for several transition countries. The paper demonstrates strong evidence of negative spillover effects on local firms, vertically related in both upstream and downstream integration. The authors explain this phenomenon by the specificity of Russian foreign-owned firms, which do not have foreign partners, and suffer from the break-up of production chains at the entrance of foreign firms into the market. It is questionable whether this is the true cause of such results obtained.

In our study, we would like to empirically test whether the forward and backward linkages of the foreign firms to the domestic ones have a positive effect on the performance of the local firms. We will use the dataset that covers a large sample of firms operating in 26 transition countries to allow us avoid the drawbacks of the previous sited work; as to abstract from the specific firm characteristics in any separate country. Further still, we will use different from the previous studies' productivity measures of firm performance. Our main indicator of domestic firm's performance - the level of innovativeness- should be more appropriate to single-out the influence of the foreign ownership on the technology transfer to the domestic companies, as it would help see the effects of product, process, and management-level innovations, which stem from foreign involvement. In this way we will measure the combined effect of technology infusions taking place, and the receiver's absorptive capacity: i.e. how well would the local firm be able to use the received knowledge' to innovate in the market. We will further proceed with the methodology description.

Chapter 4

METHODOLOGY

In this section we describe the approach, which will be taken to examine the relationship between forms by which technology is transferred and the innovativeness of the enterprises in an industry. We will do this through determining whether the transfer of technology occurs through the production linkages of domestic firms with unaffiliated foreign enterprises; and finding the magnitude of the effect that the existence of such production linkages has on the firms' performance.

To determine the level of technology transfer that occurs via production linkages of domestic enterprises with the foreign firms, we will use 3 different measures for firm-level technology transfer:

a) Product innovation

b) Process innovation

c) Organizational innovation

The outlined measures cannot be obtained directly, and thus will need to be proxied in order to form the desired empirical model. We will use the following empirical proxies for the TT measures:

1) The share of the new products introduced by a firm in a given year in the total number of firm's products.

2) The development of a new product line (3 categories are used to distinguish between: fundamental, incremental and zero process innovation).

3) The change of the organizational structure by a given firm (ranged from no to complete change).

We derive the model using the latent variable approach to the ordinal regression modeling (ORM): we think of variable INNOV as providing incomplete information on the underlying TT* (technology transfer variable) according to the following measurement equation:

$INNOV_i = m \text{ if } \tau_{m-1} <= TT^* < \tau_i$, where $m=1$ to J

We will have the following structural model:

$TT^* = x_i\beta + \varepsilon_i$

Through the use of simple manipulations we obtained the following form for our model:

$Pr(INNOV = m/x_i) = F(\tau_m - \mathbf{x}\beta) - F(\tau_{m-1} - \mathbf{x}\beta)$

Where: $\mathbf{x}\beta = \beta_1 FW + \beta_2 BW + \beta_3 FOREIGN,$

INNOV – proxy measure for the level of TT

FW – the firm's export as a proxy for the forward linkage

BW – the firm's import as a proxy for the backward linkage

FOREIGN – the proxy for foreign direct investment (dummy for foreign stake in the ownership of an enterprise).

Here, *F* stands for the cumulative distribution function of the specific error distribution assumed in the model: Φ – for normal, Λ – for logistic. A number of controls are also introduced:

1) Industry Dummies – to single out industry-specific effects
2) Country Dummies – to account for the country-specific effects

3) Size dummies[2] – measures used to proxy firm size

In order to proxy the forward and backward production linkages that occur between domestic and foreign firms, we will be using the corresponding measures of the domestic firm's export and import. A manufacturing firm exporting intermediary products is automatically establishing a forward linkage to the firm, which is using the output of the latter as an input to further production. A firm exporting finished goods is establishing a forward linkage to the distribution network enterprises. In both instances the forward linkage is expected to have a positive influence on the firm's innovativeness as technology transfer process could take place. A firm that imports is establishing a backwards linkage to the firms, whose output it imports. We expect the sign of the BW coefficient to be positive, which is consistent with the previous studies (Smarzynska, 2003). In using export and import as proxy measures for backward and forward linkages between domestic and foreign firms, industry to which firm belongs might play a very important role, as will be discussed later.

The use of Sales as a proxy for the firm size is supported by a wide array of literature representing the 'schumpeterian' approach. The discussion is based on the Schumpeterian hypothesis that the market power and large firms stimulate innovations. The general reasoning that appears in the literature is as follows: large (monopolistic) firms are able to finance innovation internally, they have 'deep pockets' and that enables them to take on large and expensive R&D projects. Again, larger projects may enjoy the economies of scale and scope, - have research interaction between and within the research teams, exploit a broader scientific base, and, last but not the least, make room for the 'serendipitous discovery' – which is of chief importance for us, as innovation is not a something that anyone can plan or predict well, but rather a process that

[2] The controls for size come as a set of S_1, S_2…S_{10} dummy variables ranged from the lowest to the highest value of firm Sales.

very much resembles the 'Eureka' experience. A comparative analysis of the empirical findings in this field is presented in Symeonidis, 1996. In the very thorough review of the literature, the author points out that under certain conditions (like the existence of high sunk costs, economies of scale and scope, etc.) the positive relationship between size and innovative activity is expected but not certain to occur. Based on the literature mentioned, we do not have absolutely definite grounds to expect the sign of the respective coefficient to be positive.

Chapter 5

DATA DESCRIPTION

The main dataset that we are using is the World Bank 'BEEPS' Survey[3]. It covers a multitude of firms in 26 transition countries: Albania, Armenia, Azerbaijan, Belarus, Bosnia, Bulgaria, Croatia, Czech, Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Rep. Serpska, Romania, Russia, Slovakia, Slovenia, Turkey, Ukraine, Uzbekistan. The dataset includes 4105 observations.

To check the robustness of our estimates, we use 1 more dataset: the LICOS Database - Survey on Ukrainian enterprises.

To continue, we will give the description to the measures that are used in our study as proxies for the level of technology transfer (TT) that occurs though production linkages between the foreign and domestic firms, which come from the main dataset used. The empirical analysis will involve three different measures for the firm-level innovation as a dependent variable (all three are ordered categorical variables):

INNOV1[4]: The proportion of new products launched on the market over the past 3 years. This variable is ordered with the following categories:
(None, <20, 20-50, 50-80, > 80[5], All)[6]

[3] Downloadable from the http://www.worldbank.org/wbi/governance/data.html#beeps.

[4] The exact questions asked in the survey are available from the author upon request

[5] Data provided in percentage points

INNOV2: Development of a new product line (3 categories are used to distinguish between: fundamental, incremental and zero process innovation). This variable is ordered with the following categories measuring the level of process innovation: (Zero, incremental, fundamental).

INNOV3: The change of the organizational structure by a given firm. This variable is ordered with the following categories: (No change, slight change, medium change, complete change).

The model will be estimated involving INNOV1, INNOV2 and INNOV3 measures for the level of technology transfer. Thus, we would like to present some statistics to describe the three measures of technology transfer by country in the text here, and all of the remaining explanatory variables and controls used, in the Appendix A. The descriptions of our data by country go in tune with the already mentioned Global Competitiveness Report 2001-2002 results. For instance, in the Report, Ukraine is rated 60th in technological sophistication, and 72nd in firm-level innovation out of the 75 countries investigated. In our dataset, the firms in Ukraine, on average, approach the lower middle bound on innovation, standing close to Romania, Estonia and Bosnia, and so also fall into approximately the same range.

In addition, the summary statistics for all three measures for technology transfer by aggregated industry type are available in the Appendix A. We find that the mean values of dependent variable come close for different industry types. On average, the least innovative firms in terms of product innovation in our sample appear to be in Mining and Transportation, while the highest mean value of product innovation is observed in Power Generation, Wholesale and Mining.

[6] We are aware of the fact that the cut-off points of the dependent variable are known to us ex-ante; this may potentially lead to the loss of efficiency in estimation, but by no means to the biased results. Moreover, the size of our sample is substantial, and that should minimize the loss of efficiency altogether.

The highest process and management innovation is found in Power Generation, Wholesale, Mining, Financial Service, Business Service and Construction. These preliminary observations correspond to our expectations to find more innovation in the quickly growing sectors.

TABLE 1. **SUMMARY STATISTICS BY COUNTRY:**

COUNTRY	**INNOV1**	**INNOV2**	**INNOV3**
Albania	3.29	0.75	1.69
Armenia	3.37	0.68	1.78
Azerbaijan	3.20	0.76	1.71
Belarus	3.71	0.75	1.71
Bosnia	3.51	0.71	1.76
Bulgaria	3.39	0.73	1.86
Croatia	3.81	0.60	1.79
Czech Republic	3.41	0.81	1.57
Estonia	3.58	0.60	1.72
Georgia	3.34	0.91	1.66
Hungary	3.82	0.77	1.69
Kazakhstan	3.43	0.75	1.87
Kyrgyzstan	3.46	0.77	1.83
Latvia	3.76	0.74	1.84
Lithuania	3.58	0.77	1.78
Macedonia	3.55	0.69	1.88
Moldova	3.17	0.99	1.76
Poland	3.39	0.69	1.69
Rep. Serpska	3.29	0.96	1.54
Romania	3.59	0.79	1.62
Russia	3.40	0.74	1.84
Slovakia	3.64	0.70	1.82
Slovenia	3.62	0.78	1.83
Turkey	3.09	0.73	1.68
Ukraine	3.55	0.75	1.84
Uzbekistan	3.42	0.88	1.88
Total	**3.48**	**0.75**	**1.77**

Chapter 6

BASIC RESULTS[7]

The first estimation output obtained for the ordered logit model with dependent variables INNOV1, INNOV2 and INNOV3 is presented in the table below[8]. The results received show that the coefficients of our main variables of interest FW and BW representing the effect of the forward and backward linkages on the level of firm's innovativeness are both significant. Because the form of the empirical model is ordered logit, we cannot interpret the estimation results directly. At this stage only the signs of the coefficients by the explanatory variables should be considered.

Hence, let us look at the variables of our main interest. The positive sign of the coefficient BW is consistent with our expectations. The negative sign of the FW coefficient contradicts our logic, and also the empirical findings of Smarzynska, 2003 for Lithuanian firms. In addition, we find that foreign investment has an insignificantly positive effect on the level of firm's innovativeness; and that the influence of firm size on firm-level innovation is largely ambiguous; and not very large or significant in a statistical sense.

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[7] We fitted the model using both the ordered logit and the ordered probit model and obtained very close estimates. In addition, the relevant literature provides support and wide use of the ordered logit. Hence, we will not report the results of the ordered probit regression further and will only present them as a test of our final specification of the model later.

[8] For the reader's convenience, we will present results of three models using 3 different dependent variables (INNOV1, INNOV2 and INNOV3) as proxies for the product, process and managerial know-how transfer from the foreign to domestic firm in the combined output table below.

TABLE 2. **REGRESSION RESULTS: ORDERED LOGIT**[9]

Variables	*INNOV1*	*INNOV2*	*INNOV3*
FW	**-0.319** **-4.39**	-0.002 -0.02	**0.546** **6.97**
BW	**0.304** **4.20**	0.073 0.94	**0.293** **3.79**
FOREIGN	0.099 1.03	0.021 0.20	**0.400** **3.91**
S1	-0.074 -0.66	0.108 0.89	-0.016 0.13
S2	-0.004 -0.03	0.227 1.49	-0.290 -1.83
S3	-0.068 -0.44	-0.005 -0.03	-0.071 -0.42
S4	-0.105 -0.67	0.105 0.63	0.015 0.09
S5	-0.165 -1.09	-0.029 -0.17	0.144 0.88
S6	-0.174 -0.95	0.158 0.83	-0.015 -0.08
S7	0.405 2.10	0.078 0.37	0.250 1.19
S8	-0.138 -0.65	-0.013 -0.05	0.004 0.02
S9	-0.028 -0.12	-0.005 -0.02	0.114 0.46
S10	-0.400 -1.12	-0.756 -1.62	0.469 1.14
Log-likelihood	-6179.1541	-3613.3468	-3993.5795
Number of obs	3536	3553	3543
LR chi2	78.79	33.61	211.03
Prob> chi2	0.0019	0.9130	0.0000
Pseudo R2	0.0063	0.0046	0.0257

** Industry dummies - Yes*
** Country dummies - Yes*
** Legend: b/t*
** t-statistics at 10% significance level*

A possible explanation for the negative sign of the FW coefficient lies in the fact that proxies of export and import used for backward and forward linkage don't work equally well for all industries, as they differ in terms of supplier-user

[9] Coefficients statistically significant at 10% level or less in this text are presented in bold.

relations between the foreign and domestic firms. To provide the solution to this we will run separate equations for each industry to account for such differences. The results of the industry-specific regressions will be presented later in the text.

Let us now follow with estimating two more models, replacing the dependent variable by INNOV2 and INNOV3[10]. We observe that for the model that uses process innovation proxy as a dependent variable, both FW and BW coefficients have positive signs, although, BW becomes insignificant. Sales and Forward remain positive and insignificant. Finally, we estimate the model using the INNOV3 (managerial technology transfer proxy) as a dependent variable. This version of the model seems to meet our initial expectations for the direction of effects. FW and BW are both significant and positive, which shows that forward and backward linkages of domestic firms to foreign firms increase the innovativeness of the latter. In this model the coefficient of Foreign becomes significant. This seems to indicate that the management know how, i.e. organizational technology, is easiest to transfer through the supplier-user relations. Moreover, the foreign direct investment influence is passed through more by organizational than by the product or process technology transfer.

[10] The output table is not reporting the country and industry dummies in the main text not to overcrowd it. Additional results are available from the author upon request.

C h a p t e r   7

RESULTS INTERPRETATION

In order for us to define the effects that forward and backward linkages, as well as foreign affiliation, have on the probability of a certain level of firm innovation to occur, it will be necessary to extend the estimation to finding the predicted probabilities of the dependent variables' outcomes. After fitting our model, a useful first step would be to check the predictions that our model makes. Thus, we have made the range of predictions for the dependent variables' outcomes available[11].

Next, let us turn to the table of probabilities to observe the degree to which the separate and combined existence of forward and backward production linkages between the foreign and domestic enterprises affects the level of technology transfer for the firms, average on all other characteristics. In the table presented below, the categories of the three variations of the dependent variable (INNOV1, INNOV2 and INNOV3 for the product, process and managerial know-how technology transfer respectively) are kept as defined before. We distinguish between three types of firms: firms going from no linkage to getting just a backward linkage, firms getting just a forward linkage, and firms obtaining both the forward and backward linkage simultaneously.

From the table of the discrete change in the predicted probabilities, we find the magnitude of the influence that the forward and backward linkages have on the

[11] The plots of predicted probabilities are available in the Appendix B.

innovativeness of the enterprises involved. Having only a backward linkage appears to increase the chances of having greater product innovation in all cases.

TABLE **3. DISCRETE CHANGE IN THE PREDICTED PROBABILITIES FOR THE LEVEL OF TECHNOLOGY TRANSFER[12]:**

VARIABLE NAMES:	**CATEGORIES OF THE DEPENDENT VARIABLE:**					
INNOV1	**1**	**2**	**3**	**4**	**5**	**6**
Average firms with FW only	**.0570**	**.0200**	**.0010**	**-.0080**	**-.0190**	**-.0510**
Average firms with BW only	**-.0450**	**-.0220**	**-.0080**	**.0030**	**.0151**	**.0570**
Average firms with both FW&BW linkage	**.0480**	**.0230**	**.0081**	**-.0031**	**-.0162**	**-.0600**
INNOV2	**1**	**2**	**3**			
Average firms with FW only	.0005	-.0001	-.0004			
Average firms with BW only	-.0183	.0031	.0151			
Average firms with both FW&BW linkage	-.1832	.0003	.0151			
INNOV3	**1**	**2**	**3**	**4**		
Average firms with FW only	**-.1347**	**.0466**	**.0462**	**.0418**		
Average firms with BW only	**-.0717**	**.0278**	**.0237**	**.0201**		
Average firms with both FW&BW linkage	**-.1351**	**.0318**	**.0502**	**.0529**		

12 Bold here means coefficients significant

While having a forward linkage in addition to the backward linkage reduces the chances to introduce a completely new product, it has a much greater positive influence on the introduction of the process and organizational innovations by a given firm.

The highest positive change in probability of falling in the high product technology transfer category occurs for the firms, which have just the backward linkage. We notice that the existence of the forward linkage not only decreases the chances of the firms to fall into the three high product innovation categories, but also increases the probability of falling into the low product innovation levels.

For the firms with both linkages, we see the direction of the probability change follow the pattern of the firms with just a forward linkage. Meanwhile, the size of the effect changes: it becomes less likely to fall into the low product technology transfer categories (1 and 2) and more likely to fall into the higher technology transfer categories (4, 5 and 6). Interestingly enough, the forward linkage appears to have a somewhat dominating negative effect on the probability of having a higher product technology transfer. On the contrary, having a backward linkage positively influences the probability of falling into the higher product technology transfer categories.

Things change for process technology transfer. Firms with a forward linkage have an equally greater (by 0.04) chance to introduce both the fundamental and incremental process innovations. Simultaneously, the chances of having zero process innovation are decreased. Both the size and the direction of the change in probability speak in favour of the backward and forward linkages being good for the process technology transfer. Note, however, that the coefficients are not significant.

Finally, let us turn to the management know-how technology transfer. As the lower section of the table shows, the probability of falling into the top three categories (complete, medium and slight change) of the management know-how technology transfer is increased twice as much for firms with the forward linkage, as, on average, for the firms with just a backward linkage. Combining the two linkages provides for an abrupt increase in the probability of falling into the top managerial know-how transfer category 'complete change'. We see that having any kind of linkage has a positive impact on the probability of having a higher level of process and organizational technology transfer, in the absolute majority of firm type combinations. The only exception to this trend appears in the negative influence of having a forward linkage on the part of the product and process technology transfer only. The latter phenomenon is quite interesting, and requires further investigation.

Chapter 8

ROBUSTNESS CHECKS

Robustness check1:

The question that interests us at large is whether the magnitude of production linkages matters for the level of technology transfer taking place. In the model estimated we proxied the level of the forward linkage by a FW dummy variable, equal to one for the firms that have any forward linkage present. What if the firms with a greater share of export have a much greater effect compared to the firms with the minimal one?

We would like to check this by replacing the forward linkage dummy by a share of export in firm's sales variable. We are interested in whether this would bring forth a better fit of the model or maybe even alter our conclusions. Below, we present only the aggregated table for three models using FWsh instead of FW with dependent variables INNOV1, INNOV2 and INNOV3 respectively and omit other related output. From the measures of fit statistics for the three models we conclude that the model using the export dummy (proxy for forward linkage), as an explanatory variable is overall better than the model using the share of export (FWsh)[13].

The implication of this is the following: it is important that domestic firms are involved in relations with the foreign firms, but the magnitude of these relations is not crucial. Consequently, we will proceed using the initial model specification[14].

[13] Unfortunately, we do not have data to perform a similar check for the backward linkage

[14] The statistics for comparisons of models with different specification can be found in the Appendix

TABLE 4. **REGRESSION RESULTS: ORDERED LOGIT**

VARIABLES	INNOV1*	INNOV2*	INNOV3*
FWsh	**-0.005** **-3.86**	0.001 0.96	**0.005** **3.48**
BW	**0.243** **3.59**	0.050 0.68	**0.449** **6.13**
FOREIGN	0.100 1.04	0.006 0.05	**0.443** **4.30**
S1	-0.068 -0.61	0.109 0.89	0.001 0.01
S2	0.08 0.05	0.226 1.49	-0.304 -1.92
S3	-0.058 -0.38	-0.004 -0.02	-0.091 -0.54
S4	-0.095 -0.61	0.105 0.63	-0.012 -0.07
S5	-0.163 -1.08	-0.026 -0.16	0.135 0.83
S6	-0.153 0.84	0.161 0.85	-0.067 -0.34
S7	0.420 2.18	0.079 0.38	0.214 1.02
S8	-0.136 -0.64	-0.014 -0.06	-0.011 -0.05
S9	-0.009 -0.04	-0.003 -0.01	0.075 0.30
S10	-0.404 -1.14	-0.753 -1.62	-0.422 1.03
Log - Lik.	**-6181.3581**	**-3612.8841**	**-4011.7993**
Obs. Num.	**3536**	**3553**	**3543**
LR chi2	**74.38**	**34.53**	**174.59**
Prob> chi2	**0.0051**	**0.8928**	**0.0000**
Pseudo R2	**0.0060**	**0.0048**	**0.0213**

**** Industry dummies - Yes***
**** Country dummies - Yes***
**** Legend: b/t***
**** t-statistics at 10% significance level***

Robustness check 2: Endogeneity Problem

At this point we should mention a very important issue that might influence the trustworthiness of our estimation results. Reversed causality: we have grounds to suspect that more innovation leads to more export and import, while the latter are used as proxy measures for forward and backward linkages as already described. To do this, we will use the dummy variable available in our 'BEEPS' dataset, which shows whether the company's exports have changed in real terms over the last three years. Our next step will be to reestimate the model selecting only those firms for which exports did not change in the last three years. In this way, we will exclude the possibility that innovation influences export. And, thus the causation in our model will surely be going in the direction from export (as a proxy of forward linkage) to innovation. The generalized output for three models comes as presented in the table below. In consequence to the trick enacted, we watch all coefficients remain significant with no change in the direction of influence. It is worth adding, that in a regression for a general sample, the positive effect of the forward (backward) linkage for one industry may be offset by the negative effect for the other. We will next look at how, for a general sample, the existence of forward and backward linkages influences the probability of the dependent outcome.

TABLE 5: **ESTIMATION OUTPUT (ORDERED LOGIT)**

VARIABLES	INNOV1*	**INNOV2***	**INNOV3***
FW	-0.361 -4.40	0.002 0.02	**0.572** **6.48**
BW	**0.330** **4.04**	0.054 0.60	**0.300** **3.43**
FOREIGN	0.100 0.68	0.006 0.24	**0.443** **3.05**
Log-likelihood	-4837.884	-3613.3468	-3123.7688
Number of obs	2770	3553	2771
LR chi2	71.83	33.61	189.03
Prob> chi2	0.0088	0.9130	0.0000
Pseudo R2	0.0074	0.0046	0.0294

** Industry dummies - Yes*
** Country dummies - Yes*
** Size dummies - Yes*
** Legend: b/t*
** t-statistics at 10% significance level*

Robustness check 3: the Parallel Regression Assumption and the Multinomial Logit Regression

In order to employ the ORM models successfully, we must perform the test to ensure that the parallel regression assumption, also known as the proportional odds assumption for the ordered logit case, holds. We will do this by using both the LR and the Wald tests that have the critical assumption that the slope coefficients are identical across each of the J-1 binary regressions (which the ORM could be represented by). If the parallel regression assumption holds, then this implies that each of the binary logits' probability curves parallel as the β's will be equal for each equation. To the degree that this assumption holds, the estimated β's should be 'close enough'. The testing of the parallel regression assumption is presented in the Appendix B. We find that the proportional odds assumption doesn't hold overall, with the problems rising from the many control variables (which we should not be too much concerned with), and from the FW variable. The coefficients in the separate J-1 binary regressions are close enough, and so the general conclusion we draw from this confirms the use of the ordered logit model. Even so, we are welcome to try the alternative models (for nominal outcomes) in addition[15]. Hence, we employ the multinomial logit regression as another robustness check of our estimation results and find that qualitative results remain much similar to the ones of the ordered logit. Moreover, the fit statistics of the two models vote strongly in favour of the ordered logit model: such as on all three models, the general evidence of the tests is in favour of the ordered logit model. The use of the ORM is also supported by the theory in

[15] The multinomial logit model for all three dependent variables as well as the comparison statistics between the ordered logit and multinomial logit models are presented in the Appendix D.

the field. Thus, the main model used in our study, ordered logit, has stood the test, and with it we proceed.

Robustness check 4: Industry-specific regressions

As already mentioned earlier, our general plan was to check whether the proxies of export and import used for backward and forward linkage can be used equally well for all industries, as the latter differ in terms of supplier-user relations between the foreign and domestic firms. Hence, we decided to run separate regressions for each industry type to account for such differences.

We find that the industry-specific regressions confirm the pattern from the general sample regression. Although qualitatively similar in general, some results do differ slightly across different industries. Besides, some industries had to be excluded because of the low number of observations that fall into a particular industry[16]. From the industry-specific regressions we find that for the managerial know-how technology transfer both the backward and forward linkages are important, while for product technology transfer – only the backward linkages matter. Ambiguous results are found for process technology transfer, which perfectly resembles the results for the general sample. In general, industry regressions go in line with the trends from the general sample in terms of the magnitude and direction of the effects of the secondary variables of interest, and, most importantly, support our claims on the effects of the inter-firm production linkages on the level of technology transfer.

[16] The estimation output for industry regressions is provided in the Appendix

Chapter 9

ADDITIONAL FINDINGS

To provide a broader insight into the issue under investigation, namely the process of technology transfer in transition economies, we decided to inspect several concomitant issues. Primarily, we test the hypothesis of Schumpeter that 'large firms are the dominant innovators' and find no significant effect of the size on the level of firm's innovativeness for the enterprises in our dataset. It is possible that in transition economies very few of the larger firms have been in the market long enough to have market power, or else employ the status of the industry leader in a minor fashion. The massive privatisation processes may have seduced the desire of many firms to innovate; and the very history of 'soft budget constraints' for the large (and critically important for the country) establishments remaining even in the early years of transition have become a guarantee of their survival, giving a low motivation to the attempts to innovate.

A connected issue is the influence of the foreign direct investment (FDI) on the level of the firms' technological development. The foreign direct investment in itself is considered to be a mode for technology transfer: we expect the influence of it to be positive and significant. In addition, several studies in the field found FDI to be important for technology transfer. Moreover, they found positive spillover effects accompanying the FDI (e.g. Ponomareva (2003)). Hence, the result obtained by us is somewhat surprising: we find statistically significant influence only in one of the three cases. It seems that many other factors can be important for the level of technology transfer besides foreign direct investment.

Chapter 10

EXTENSIONS

We would next like to check the robustness of our estimates and provide more insight into the issue via the use of the additional dataset available on the enterprises of Ukraine.

To start with, we set up the model to be used with the data from the LICOS Ukraine database. The dependent variable available in this set-up is a binary variable, so the model used will be the simple logit (probit). For simplicity, we will refer to the logit and probit models together as to the BRM (Binary Response Models). To derive the BRM model, we will use the plausible latent variable approach.

The latent variable is related to the observed binary variable in the following fashion: if the latent variable (the level of technology transfer) is greater than some value (say high level of technology transfer as opposed to low level of technology transfer), the observed variable is 1; otherwise it is equal to zero. Thus, the model would be linear in the latent variable; and the non-linear model would serve to relate the explanatory variables to the probability that the event has taken place.

The idea of a latent variable in our BRM is as follows: there is an underlying level of technology transfer that generates the outcome of successful introduction of the new product and process by the firm. While we cannot directly observe **y*,** at some point, a change in **y*** will result in a change that we would observe, representing the fact that the firm innovates.

The structural model relates our latent variable to the observed x's in the fashion similar to the model used before:

$$TT^* = x_i\beta + \varepsilon_i$$

Then,

$$y_i = 1 \quad if \quad y_i^* > \tau \quad AND \quad y_i = 0 \quad if \quad y_i^* <= \tau,$$

Where τ – is the threshold level

The probability of the dependent variable's outcome will be specified as:

$$Pr\ (INNOVC = 1/x) = F\ (x\beta)$$

Where[17]:

$$x\beta = \beta_1 BW + \beta_2\ UNIVR\&D + \beta_3\ R\&DP + \beta_4\ SIZE + \beta_5\ FOREIGN,$$

1) *INNOVC* – a proxy for the level of TT
2) *FW* – a proxy for the forward linkage
3) *BW* – a proxy for the backward linkage; measures the firm's dependence on imported inputs
4) *UNIVR&D* – a proxy for linkage with research institutions; shows whether state or private research institutions perform research for a given firm
5) *R&DP* – a proxy for firm's absorptive capacity
6) *SIZE* – proxy for the size of the firm
7) *FOREIGN* – proxy for foreign direct investment

Controls used:

1. Industry dummies are provided (the classification used distinguishes between the 3 sectors: manufacturing, trade and services).

[17] Here, F stands for the cumulative distribution function of the specific error distribution: Φ – for normal; Λ – for logistic.

THE DATASET DESCRIPTION

Dependent variable:

INNOVC – product & process innovation at the firm level combined – shows whether the company produced or sold new products or services in the period (binary variable with the outcomes: 0 - no, 1 - yes).

Explanatory variables:

1. *FW* – a proxy for the forward linkage measured as firm's export (dummy: 0 - no; 1 - yes).
2. *BW* – a proxy for the backward linkage – measured as firm's dependence on imported inputs (dummy: 0 - no; 1 - yes).
3. *UNIVR&D* – a proxy for the linkage with universities and research institutes that perform research for the firm:
   If the research was done by the state owned or private institutes this variable equals 1, and 0 otherwise.
4. *OwnR&D* – represents the research done by the firm itself. Equals 1 if no research was done for the firm and 0 otherwise.

5. *R&DP* – the Number of the firm's employees involved in research and innovation (proxies firm's absorptive capacity).

6. *Size* – measure used to proxy size: in this dataset are firm's Sales in 1997. The uses of Sales as measure of size have already been explained above.

7. *FOREIGN* – share of the private investors' (from outside the country) ownership

Controls:

1. Industry dummies: manufacturing, trade and services, other.

We would like to comment on the mean value of the dependent variable of the new dataset: it has quite a high average – 73% of firms in our dataset had innovated. This is higher than the average innovation level for the main dataset comparatively. The possible explanation for this may lie in the fact that our dependent variable in the new dataset consisting of Ukrainian firms represents their innovation in both products and processes, so it acts as a sum of two kinds of innovations if compared to the main dataset (where INNOV1 stood for product innovation and INNOV2 – for process innovation separately).

REGRESSION RESULTS AND INTERPRETATION

From the results obtained on the Ukraine dataset, we notice that both the forward and backward linkages are important for the firm's innovation. Although both coefficients are positive, only the backward coefficient has statistical significance at the 10%. Foreign involvement in the firm's activity seems to be unimportant, while the number of people involved in firm's R&D activity combined with the firm's own R&D indicator show a positive influence on the product and process innovation as an outcome (the only effect that appears to be approaching significance is the indicator of the firm's own R&D activity - *OWNR&D*).

Let us now turn to the magnitude of the effects. From the table presented in the Appendix F, we see that the firm getting a forward linkage does not have a significant influence on the firms' product and process innovation, while getting a backward linkage increases the probability for the innovation to occur in a given firm by 0.17. This finding supports our previous results, where the increase in probability of the firm's innovation was greater when a firm obtained just a backward linkage compared to getting just a forward linkage.

TABLE 6: NEW DATASET REGRESSION RESULTS[18]:

VARIABLES	INNOVC
FW	0.003 0.33
BW	**1.098** **2.73**
UNIVR&D	0.219 0.62
OWNR&D	**0.547** **1.54**
RDP	0.013 0.94
SIZE	0.001 0.36
FOREIGN	**-0.013** **-1.27**
Manufacturing	**0.698** **1.71**
Service	0.097 0.19
Other	0.413 0.93
Const	0.044 0.11
Log-likelihood	**-160.2568**
Number of obs.	**295**
LR chi2	**22.31**
Prob> chi2	**0.0136**
Pseudo R2	**0.0651**
* Industry dummies – Yes * Country dummies - Yes * Size dummies - Yes * Legend: b/t * t-statistics at 10% significance level	

The fact that the firm performs research on its own has a small positive effect on its innovativeness (0.09), while even contracting R&D out to some state or private research institutions raises the chances of increased product and process

[18] The results of the probit regression are very close to the results of the logit regression: the comparison of the two models by fit statistics is in favour of the logit model. Additional results are available from the

innovation, although to a lesser extent, besides, this coefficient is not significant. This finding is of support to the general proposition of ours, presented in the introduction, stating that the firm's absorptive capacity (that here is represented by the level of R&D firm performs on its own) is important for the firm's innovation level. We also see that the number of firm's employees involved in R&D makes a difference for getting innovation at the firm level.

Qualitatively, the very fact of holding 'any R&D' within the firm increases the probability of innovation to occur by 0.0025, while the increase in probability of innovation (INNOVC equal to one) due to the change in the number of employees involved in firm R&D (from the minimum (0) to the maximum (552) persons) is substantial: 0.2623. This measure is used for the first time only in the new dataset, and so the finding that firm's absorptive capacity is important becomes uniquely interesting. It constitutes some support for the findings of Kinoshita (2003), which constitutes the importance of the firm's absorptive capacity for getting the most use of the technology transferred and enacting firm's own innovation activity. Meanwhile, we should keep in mind that the coefficients are not significant.

Finally, as far as size is concerned, we discover that the change from the smallest to the greatest value of firm's size variable brings forth a positive increase in the probability of the innovation for the firms in our dataset of 0.0986. This effect is not large, and combined with the low significance of the coefficient on the size variable supports the findings of the main dataset of our study: there too the effect of size is not defined in an absolutely clear fashion. This result is of no surprise to us, as there exists a general ambiguity in the literature about the effect of firm's size on innovation.

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author upon request.

Chapter 11

CONCLUSIONS

In our research we focus on transition economies and search for the existing possibilities for them to grow and prosper with the use of new technologies. The important role of technological progress in the global economy is now widely accepted: it is by all means a necessity to economic growth and development. Whether the countries in transition, with innovation and technology being the weakest elements of the old system, are able to create the necessary technologies internally, in their own strength, is subject to doubt. This study considers the alternative sources, from which transition economies would be able to obtain such technologies. We postulate that the creation of production linkages between the domestic and foreign companies is a trustworthy channel for technology transfer into transition countries. The linkages considered are of two basic types: forward and backward linkages. Both kinds represent the vertical supplier-user relations.

We examine the influence of the production linkages on the level of technology transferred using direct measures of firm performance. Our main indicator of the domestic firm's performance is the level of innovativeness (measured in terms of product, process and managerial know-how innovation). The introduction of this methodology allows us to uniquely distinguish between the three kinds of technology transfer, and to see the effects of product, process, and management know-how technology transfer, which stems from foreign involvement.

We find a strong relationship between the firm's production linkages and the level of technology transfer to them. Such linkages have a positive impact on the level of the innovativeness of enterprises in specific industries, and in the transition countries at large. Having at least on of the two linkages increases the probability of successful management know-how technology transfer. The presence of just the backward linkage increases the probability of successful product technology transfer, while the influence of the linkages on the process technology transfer is not important. Our findings are robust to a number of inspections. They stand the specification-testing and hold when our empirical model is tested on an additional dataset, which includes a smaller sample of firms in Ukraine only. We also discover that the results for the general sample are consistent to the findings of the industry-specific regressions.

Besides finding the answers to the questions of our main interest, we have some additional findings. In this context, we test the hypothesis of Schumpeter 'That large firms are the dominant innovators' and find an ambiguous result. Moreover, in reply to the claims of many researchers on the great importance of FDI for increasing the spillovers to local firms, we test whether foreign investment has an influence on the level of technological development of the firms in transition. Our result is somewhat surprising: a minor positive, statistically significant influence in only one of the three types of TT examined. We also find that the extent of foreign involvement does not matter for the level of technology transfer taking place: what's important is foreign presence; the magnitude of it is secondary.

The findings from the dataset on Ukrainian firms make our research complete, as we investigate whether the firms' absorptive capacity and technological capabilities are important to increase the benefits from the transferred technologies. We discover that the R&D performed by the firm itself is important to increase technology transfer, irrespective of the number of employees actually involved in such innovative activity. Moreover, contracting research and development out decreases firm innovation, as then the firm's ability to absorb the technologies coming to it drops automatically.

Our findings allow us to pose some policy implications. It is necessary for transition economy governments to understand how useful the establishment of such production linkages to foreign firms might be for the firms of their country. Oftentimes the benefits of such activity are not realized and so, the local governments do nothing, or, at worse, even prohibit foreign involvement in the activities of local enterprises. This study becomes a counter-argument for the excessive 'protectionism' of transition governments. If the latter want to reap some benefit from the technology adaptation and assimilation into their industries', it is necessary to stimulate the founding of such production linkages at the micro-level. If we have to choose between which types of linkage to target at, we would recommend focusing on the backward linkage as it shows consistent positive influence for all kinds of technology transfer. In our study the backward linkage of the domestic firms is proxied by import. So, if domestic firms import the produce (machinery, equipment, intermediary products) of the foreign firms as an input to their production, they 'learn' from their foreign counter-parts and their own innovation level rises. Exporting their own produce to foreign markets (forward linkage) also allows such 'innovative learning' to occur, but to a lesser extent. Therefore, our main policy recommendation for the transition governments in connection to promoting the production linkages will be to liberalize trade, create the environment for the unlimited establishment of relations with foreign firms, as these can be of great value for the domestic countries' development and growth.

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