The wiiw Balkan Observatory

Working Papers | 012 | December 2001

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Recovery and Growth in the Manufacturing Sectors of CEE Transition Economies: Short and Long-Term Efficiency Improving Factors

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The GDN–SEE programme is financed by the Global Development Network, the Austrian Ministry of Finance and the Jubiläumsfonds der Oesterreichischen Nationalbank.

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RECOVERY AND GROWTH IN THE MANUFACTURING SECTORS OF CEE TRANSITION ECONOMIES:

Short and long-term efficiency improving factors

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ABSTRACT

The first aim of the paper was to explain a cross-sector differences in evolution of gross product of Slovenian manufacturing sectors in the period 1992-98 using different short and long-term factors. Results pointed out great importance of initial conditions (sector orientation to convertible or non-convertible markets, and distorted production structure), as well as structural reforms and macroeconomic and institutional environment. Added long-term factors revealed positive association with short term output growth during the transition period – it is obvious that these factors (FDI, exports, imports of inputs, cooperation) create channels for the transfer of technology, improving the efficiency of production. It turned out also that quality improving exports to the EU countries is significantly positively correlated with the sector output performance.

The paper further studies the importance of both direct and indirect means of technology transfer for transition countries and its impact on productivity growth of local firms. Using firm-level data for eight transition countries for the period 1994 - 1998 and employing growth accounting approach, the paper explores the importance of FDI, intra-industry knowledge spillovers from FDI, firm's own R&D accumulation and of international R&D spillovers through trade for firm's TFP growth. Time-invariant firm-specific effects are taken into account using panel data techniques, and potential selection bias for foreign investment decisions is corrected by using a generalized Heckman two-step procedure. After controlling for common economic policy influences and industry effects, our results confirm for five advanced transition countries that technology is being transferred to domestic firms primarily through direct foreign linkages. Evidence on some international R&D spillovers through arm-length trade has been found for four transition countries. Our results also suggest that FDI do not generate positive intra-industry spillovers for domestic firms. Moreover, for three transition countries FDI were found to have significant crowding-out effects for local firms in the same industry.

1. Introduction

Despite universal collapse of the output at the beginning of transition and similar output paths – an asymetric »U« - shape curve with an initial decline and gradual recovery - quite different experience could be observed both in terms of the magnitude of the initial decline and the timing and strength of the recovery of the transition economies.

One could find a growing literature dealing with this common transition experience and the cross-country differences based on one or two of three main groups of possible explanatory factors which were thought to promote recovery and sustained growth: a) the role of macroeconomic variables such as inflation and fiscal balance (Fisher, Sahay and Vegh, 1996a,b; 1997), b) structural reforms, in particular liberalisation and privatization (de Melo, Denizer and Gelb, 1996, 1997; Denizer, 1997; Selowsky annd Martin, 1997; Havrylyshyn et al., 1999) and c) initial conditions such as the degree of macroeconomic and structural distortions at the beginning of transition, or wars and internal conflicts (de Melo et al., 1997; Krueger and Ciolko, 1998). Some studies went a step further in studying the main potential determinants jointly (Wolf, 1997; Havrylyshyn, Izvorski and van Rooden, 1998; Berg et al.,1999; Havrylyshyn et al., 1999; Fischer and Sahay, 2000). The results obtained pointed out the predominance of structural reforms over both initial conditions and macroeconomic variables in explaining cross-country differences in performance and the timing of the recovery. A cruical component of reform package was found to be the reduction of government size and expenditures (Havrylyshyn, Izvorski and van Rooden, 1998, p. 33)

There is also another strand in the empirical literature to be worth mentioned which deals with the growth prospects for the transition economies (see for example: Denizer, 1997; Havlik, 1996; Fisher, Sahay and Vegh, 1998). Besides the important result that long-run trends are significantly different before and after 1989, this literature pointed out a fourth category of factors – development of institutions as determinants of growth (EBRD, 1997; Brunetti, Kisunko and Weder, 1997; Havrylyshyn and van Rooden, 2000).[1] While the EBRD study estimated that the absence of further institutional change should lower long-term growth rates by 1,5 percentage points, Havrylyshyn and van Rooden (2000) found that development of an institutional framework had a significant positive impact on growth in transition economies during the 1991-98 but macroeconomic variables and economic reforms remain the key determinants of growth.

All these studies in fact tried to follow in a way a synthesized model known as endogenous growth theory based on: a) neoclassical growth model (growth is the outcome of the expansion of capital and labor and exogenous technological progress), extended with b) the explanation of technological progress (Romer, 1990) with increasing returns, R&D and imperfect competition, human capital and government policies, and c) property

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1 *»The term »institution« covers the practicies, rules and organisations that guide and govern economic activities. The institutional infrastracture of a market economy includes the way that market operate, the ease of entry into the market by new firms (the avoidance of bureaucratic obstacles and restrictive procedures) and for the exit of established firms (including bankruptcy procedures), property law and contracts and their judical enforcement, taxation, the effective regulation of financial and infrrastracture services and environmental protection« (EBRD, 1997, p. 48).*

rights policies (Olson, 1997).[2] The second source were indeed some studies that developed a base concept of the transition process (Kornai, 1994; Blanchard, 1997).[3] The actual changes in the transition economies are the combination of two processes – reallocation of resources from old to new activities (closures and establishment of new firms) and restructuring within surviving firms (rationalization of labor, changes in products and investment; see Blanchard, 1997) – the concept, very close to the Shumpeterian concept of "creative destruction" by entrepreneurial activity (Romer, 1990; EBRD, 1997).

Implications for the transition economies derived from these basic concepts were the following: a) output will necessarily decline initially, b) successful structural reforms are necessary for the process of reallocation and restructuring of the old and the creation of the new production, c) initial recovery will be mainly the outcome of efficiency improvements rather than the expansion of factor inputs.

It is thus not so surprising that empirical studies on growth of transition economies focus their attention on efficiency improving factors and ignore the long-term factors such as high level education of labor, investment and technological change.[4] They are also primarily concerned on the aggregated data for a number or countries in transition.

In this paper we followed primarily the same way, extended also with the long-term factors – the role of different channels of technology transfer. The recent rise of endogenous growth theory, starting with Romer (1986, 1990), Lucas (1988), Grossman and Helpman (1991), has stressed the importance of knowledge as an endogenous determinant of growth. Gaining access to new knowledge is essential for the transition economies of Eastern Europe to catch-up with the EU. With over 90 per cent of global R&D activity centered in the OECD countries, it becomes all the more important that transition countries can gain access through the direct transfer of technology or spillovers from transnational corporations (TNCs). The channels of international technology transfer and their importance for growth have been studied extensively in the 1990s. These studies identify three principal channels of international R&D spillovers. The first is a direct transfer of technology via international licensing agreements (Eaton and Kortum 1996), though recently these provide less important source as the latest and most valuable technologies are not available on license (World Investment Report 2000). Second is foreign direct investments (FDI) that provides probably the most important and cheapest channel of direct technology transfer as well as indirect, intra-industry knowledge spillovers to developing countries (Blomström and Kokko 1997). Several studies offer empirical

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2 *Olson (1997) analysed the role of property rights, rule of law, institutions and corruptions and relaxed the incorrect assumption that countries make the most efficient use of factor inputs and available technology – the waste of resources was greatest where the institutional basis of property rights and the rule of law were least well developed.*

3 *Kornai (1994) emphasized two key changes needed for profit-maximizing market behavior – the move from sellers' to buyers' market and enforcing a hard budget constraint.*

4 *Indeed one could find some empirical studies dealing with technology transfer as a fundamental source of economic growth and development for particular countries in transition – see, for example Djankov and Hoekman (1999) who investigated the relative importance of foreign investment as a channel of technology transfer in the Czech Republic using firms level data during the initial post-reform period 1992-96; or Repkine and Walsh (1999) who concluded that recovery in sector output is explained by increasing importance of inherited EU-oriented production over time.*

evidence on the importance of FDI flows for firm's productivity growth in developing countries (see Aitken and Harrison 1999, Borensztein, De Gregorio and Lee 1998, Blomström and Sjöholm 1999). Third channel of technology transfer is through international trade, in particular imports of intermediate products and capital equipment (see Markusen 1989, Grossman and Helpman 1991, Feenstra, Markusen and Zeile 1992) as well as through learning by exporting into industrial countries (Clerides, Lach and Tybout 1997).

In the first part of the paper we focused our attention on explanation of cross-sector differences in evolution of gross product of Slovenian manufacturing sectors in the period 1992-98. In the second part the analysis of direct and indirect means of technology transfer and their impact on productivity growth of local firms has been extended to eight transition countries in the period 1994-98. Time invariant firm-specific effects were taken into account using panel data techniques and potential sample selection bias for foreign investment decisions was corrected using a generalised Heckman two-step procedure.

The outline of the paper is as follows. In Section 2 we present the model specification, estimation methodology, the data and the estimation results of cross-sector differences in evolution of gross product for one particular country, Slovenia. In section 3 different channels of technology transfer as a fundamental source of long run economic growth and development for eight countries in transition were analysed. Final Section summarizes the basic findings of the paper and set out some implications for further work.

2. Recovery and growth of manufacturing sectors – the case of Slovenia

2.1. Model specification

In order to determine the relative importance of the particular factors in explaining variations in sector economic performance, we have conducted an econometric analysis of economic growth in Slovenian manufacturing sectors during the period 1992-98. As we were primarily focused on short term changes of the effectivenes, we used indices of changes of real sector gross output (base year 1992) as endogenous variable. We thus implicitly assumed that initial conditions and structural reforms have permanent effects on output levels, but not on how output continues to evolve after the transition (see Berg et al.; 1999:13). On the other hand we tried to find out if used long run factors did have any short term effect on sector output.

On the side of independent variables we included different variables that represent those factors we believed to be important in explaining sector economic perfomance. They can be classified into the four sets of variables:

a) initial conditions variables;
b) structural reform variables;
c) macroeconomic and institutional variables;
d) long-term variables.

a) Regarding the importance of initial conditions our hypothesis was that sectors more oriented towards market economies (measured with the share of convertible exports in the

output in 1989) had better chance to succesfully reorient their production towards western markets after the independence and substantial contraction of home market.[5] We could expect positive association with output growth also in sectors with closer connections with the foreign markets through higher import shares of inputs (measured with the share of the value of imported inputs in the value of output in 1989), innovation activities (approximated with the new products in 1989) and better economic performance (measured with labour productivity in 1989).

On the other hand there were some variables for initial conditions which were expected to be negatively correlated with growth. The evolution of non-convertible industrial output within sectors was expected to follow the same pattern as that observed for CIS countries – a persistent decline in output. We proxied this variable using data from the 1990 IO- table: shares of sales and purchases from the rest of Yugoslavia in total output. With the share of sector in total output in 1989 we tested whether small sectors grew faster than large sectors due to exogenous inter-sector structural changes taking place over the observed period. We can also consider this variable as a proxy of degree of distortions inherited in the past development of manufacturing sector during the socialist period – higher values impede or slow recovery.

In a panel regression context, one can find that authors tend to treat the initial conditions as observable country-specific fixed effects, using fixed effects model or by explicitly included variables representing initial conditions (see for example Havrylyshyn, Izvorski and van Rooden; 1998). Berg et al. (1999:15) stated that:«…for a study on transition, this seems much too strong an assumption: the impact of inherited macroeconomic distortions, for example, would be expected to vanish as the economy is liberalized and stabilized, and would no longer have a notable influence on output thereafter.« Regarding the variables we used and the time period observed, we assumed that the effects of initial conditions were of the same intensity.[6]

b) In order to find variables denoting structural reforms we tried to follow the literature as much as possible, based mainly on the work of de Melo, Denizer and Gelb (1996a, b). They constructed an index of structural reforms combined from three indices: an index of internal liberalization (which scores price liberalization and the dismantling of trading monopolies in domestic markets), an index of external liberalization (which measures the removal of trade controls and quotas, moderation of tariff rates and foreign exchange restrictions), and an index of private sector conditions (which measures progress in

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5 *We used also the share of EU exports in total output in 1989 and got very similar results.*

6 *In practice, the same value of particular initial condition variable was entered into the data set for each year od data sample.During the estimation process we tested also for significant differences in estimated parameters comparing two sub-periods: sub-period 1993-95 and 1996-98. General observation, regarding the role of initial macroeconomic and structural conditions, was that in the observed period there was no sign of decreased importance of used variables. Even more, some of the variables gained more importance in the second subperiod (the variables denoting unfavourable structure of manufacturing production and sales with the former Yugoslav Republics). It seems that largely still unfinished process of privatization postponed the necessary restucturing process in manufacturing firms. On the other hand variables denoting favourable initial conditions were found to have positive association with the ouput growth in both sub-periods.*

privatization and financial sector reforms). The overall liberalization index is computed as a weighted average of the three indices, with the last one having the highest weight.

We proxied an index of internal liberalization with the sector differences in producer price index compared to the average producer price index, an index of external liberalization was proxied with the sector effective rate of protection, and an index of private sector conditions with the share of output of private firms and firms with mixed ownership in total sector output.[7] During estimation procedure we used all the three variables separately. Producer price index was expected to be negatively correlated with growth, as well as effective rate of protection. On the other hand we expected that sectors with higher shares of private and mixed firms will grow faster. These assumptions were in line with the conclusions found in the literature regarding the impact of structural reforms – more reforms are associated with better growth performance, but we tried to confirm these assumptions for the development of the output of particular manufacturing sectors within one country.

c) We could not include directly the first and fourth set of factors related to the macroeconomic variables (stabilization and fiscal balance) and the role of the legal and institutional framework – the fact is that factors as inflation (as the main stabilization proxy), better institutional quality, political stability, government credibility and other similar indicators of market enhacing environment, affect all sectors within one country.[8] All these variables were included indirectly through the use of annual dummies. We expected positive and growing values of parameters denoting positive changes in the Slovenian macroeconomic and institutional framework.

d) With the inclusion of some factors affecting long-term output growth, we tried to find out if they had some impact on output during the transition period. We thus tried to follow the thesis of Repkine and Walsh (1999) that EU-oriented production made an easy transition to private ownership and efficient structures with the aid of foreign investment, and expanded output over time. The collapse of the artificial market, the loss of state privileges, and the failure to reorient production to the EU market made the transition period very difficult for products traditionally produced for the CMEA market, thereby leading to sharp declines in output. The exogenous investment demand shock created by trade liberalization (FDI from the EU countries) was predicted to induce a discrete jump in the level of investment made available to EU-oriented production within sectors in the initial year. This induced annual waves of product creative destruction through changes in firm ownership within EU-oriented output and induce sector growth. Constructed creative-destruction index (CDI), calculated from the EU-exports data, reflects this creative destruction and innovation process within EU-oriented production.[9] Additionaly, we

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7 *As an index on external liberalization we used also nominal rates of protection of inputs and outputs and got significantly negative parameters – we decided to use the effective protection rates as they include both nominal rates. Another variable, import penetration (measured as a share of imports in domestic demand), was used in order to find correlation between increased competition on domestic market and output growth.*

8 *We used values of sector subsidies as a proxy for soft budget constraint but the results we got were not satisfactory – estimated parameter was not statisticaly significant.*

9 *The results show that FDI are very important for the recovery of Slovenian manufacturing, but their impact can hardly be captured by the model proposed by the Repkine and Walsh. Another way of*

constructed another, quality index, reflecting changes in differences of unit values of Slovenian EU-exports compared to average unit values of total (intra+extra) imports of EU countries. We used this index as indirect proxy variable for creative destruction and innovation process.

Using the share of output of the firms with FDI, we assumed that FDIs have a direct, positive correlation with the output growth (compared with the indirect impact assumed and verified in Repkine and Walsh paper (1999)). FDI were treated as one of the channels of transfer of technology, the others being exports (measured by export propensity, the share of exports in output), cooperation with foreign firms (meassured by the share of cooperation in total exports), and imports of intermediate products (the share of imported inputs in total inputs). For all these variables a positive correlation with output growth was expected.

Regarding different statistical data required to perform necessary analyses we used different data sources. The primary source for the trade data was data base from Statistical Office and Eurostat Comext data base. Output data, data for imports of intermediate products, cooperation, new products, privatisation, and data for the FDI were gathered from two sources based on activity classification: (1) the industrial survey (so-called IND 21) prepared by Statistical office, and (2) the income statements sheets of the manufacturing firms. Both data went through changes of classifications. Industrial survey data were available for the period 1992-98 - for the period 92-94 10-digit Industrial classification, based on Unified Classification of Activities (UCA), was used; for the period 1995-98 Industrial Products Nomenclature, based on Standard Classification of Activities (SCA, the same as NACE Rev.1), was used. The data covered quantities of projected and actual production as well as the value of sales for each particular product.

In the second stage we had to aggregate primary data from both sources to the 6-digit UCA levels. All data were recalculated into 1992 constant prices. With the help of the people from the Statistical office we prepared concordance key between the Industrial classification based on UCA and NACE rev. 1. Income statements sheets were also used for the data on FDI where the additional sources were also Bank of Slovenia and the Register of firms. We defined FDI using the OECD benchmark definition of 10% or higher foreign equity share. Accordingly, less than 10% foreign equity share characterises foreign portfolio investment. Data for the external liberalization were estimated by Majcen (1995) and data on producer price index were prepared by Statistical Office.

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thinking about the role of FDI in the recovering process of Slovenian manufacturing sector is that FDI have not restructured Slovenian firms in terms of product composition, but they influenced it through fresh capital inflows, technology transfers, new managerial skills, ownership controls and through distribution networks in the EU markets. The above factors could be essential for improving the efficiency of firms and further opening of EU markets for exports of Slovenian firms. For us, the need to give more attention to the individual firm's performance and to control for differences in performance between domestic and foreign owned firms becomes urgent. Our current research concentrates in this area and first results (see Rojec, Damijan and Majcen, 2000) show indeed that there are significant differences between domestic and foreign owned firms in terms of their export propensity and in terms of their other fundamental operational characteristics.

In order to classify sectors according to their fcator intensities cluster analysis was performed using firm level data. Using four variables (assets/employee, labour costs/employee, labour costs/value added and labour costs/total costs) sectors were finally classified into three groups: labour-, capital-, and skill-intensive group.

To ensure a certain degree of robustness of the results, we tested the following specification including current or lagged values of all mentioned variables, using random effects panel data model:[10]

$GROI_{i,t} = a_0 + b_j INCOND_{i,j} + c_k STREF_{i,k} + d_l LONGT_{i,l} + e_m S_m + f_n T_n + v_i + e_{i,t}$, where

$GROI_{it}$ - index of the sector real gross output growth (base year 1992=100);

$INCOND_{i,j}$ - a set of variables representing initial conditions:

- *IPROD91* - *a share of sector output in total manufacturing output (1991);*
- *KONVP89* - *a share of convertible exports in sector output (1989);*
- *NEW89* - *dummy for sectors with new products (1989);*
- *IDELU89* - *a share of imported inputs in sector output (1989);*
- *PRODZ89* - *output per worker (1989);*
- *DELY90* - *a share of sales to former Yugoslav republics in sector output (1990);*
- *DNAB90* - *a share of purchases from former Yugoslav republics in sector output (1990);*

$STREF_{i,k}$ - a set of variables representing structural reforms:

- *ICENE* - *producers price indices (1992=100);*
- *EZ* - *effective rates of protection (1992-98);*
- *DPROD_ZA* - *a share of output of private firms in total sector output (1992- 98);*
- *DPROD_ME* - *a share of output of firms with mixed ownership in total sector output (1992-98);*

$LONGT_{i,l}$ - a set of long-term variables:

- *TK-DEL1* - *a foreign equity share in particular sector, lagged by one year (1992-98);*
- *IMPRS1* - *a share of imported inputs in total sector inputs lagged by one year (1992-98);*
- *KOOP5* - *dummy for sectors with the share of cooperation with foreign firms less than 0,05 (1992-98);*
- *KOOP510* - *dummy for sectors with the share of cooperation with foreign Firms higher than 0,05 (1992-98);*
- *CDI* - *creative-destruction index (1992-98);*
- *UVAL92* - *quality index for labour intensive sectors (1992=100);*
- *DKKVAL* - *quality index for capital intensive sectors (1992=100);*
- *DSKKVAL* - *quality index for skill intensive sectors (1992=100);*

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10 *Due to theoretical specification of the model (initial values of explanatory variables are important) we use random effects model in our estimations. We used also a fixed effects model with sector specific constant, assuming that these constants capture also the effect of relevant initial conditions We checked for possible model misspecifications using Hausman test, which clearly confirms significant differences in estimated coefficients in comparison to the fixed effects model.*

S_m *and* T_n - a set of sector (according to factor intensities) and time dummies;
v_I - a set of factors specific to sectors.

Using panel data framework we had data for 108 sectors for the period of seven years. As we had some lagged variables we had finally 648 observation on disposal.

2.2. Empirical results

2.2.1. Short-term factors

Table 1 represent final econometric results. In the table only the results of random effect panel estimates are presented with the Hausman test that differences in estimated coefficients (using both, random and fixed effects models) are not systematic. We can start with the general observation that most of the coefficient signs are as hypothesized and statistically significant, with quite satisfactory goodness of fit regarding the fact that we used sector data.

Insert table 1

As expected we found a negative association between output growth and the sub-set of variables capturing initial macroeconomic and structural conditions of Slovenian manufacturing sectors – significant and negative parameters for variables denoting initial orientation of trade towards former republics and CMEA countries do confirm the evolution of non-convertible industrial output (proxied with the importance of trade with the former republics of Yugoslavia in the year 1990).

On the other hand variables denoting initial orientation towards convertible markets, with high shares of imported inputs, new products and higher labour productivity, capture favourable initial conditions – the recovery in sector output is explained by the easier expansion of inherited oreintation of production towards western convertible markets together with the innovation process (revealed with the new products). We can conclude that industrial products traditionally exported to the western economies have had a fundamentally different evolution during the first years of transition after the independence when compared to products traditionally sold into the former Yugoslav and CMEA area.

Regarding the factors explaining structural reforms, the results we got, confirm expected signs of parameters – sectors with higher growth performance had generally lower producer price indices, are more opened to foreign competition and have higher shares of private firms and firms with mixed ownership.[11] The conclusion regarding the

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11 *Regarding the factors explaining structural reforms foreign trade liberalisation has an expected negative sign of parameter with the even increased importance in the second observed period. Continued foreign trade liberalisation during the restructuring process as the outcome of the adoption of Slovenian own customs system with the new tariff schedule and inclusion into the WTO (1996) and adoption of several Free trade agreements (with EFTA, CEFTA countries, and other european countries) and Association agreement with EU (1997), has had increased positive impact on manufacturing output. These results are certainly in line with the results obtained when simulating the effects of further foreign trade liberalisation using CGE models (Potocnik and Majcen, 1996; Potocnik 1996, 1997; Majcen and Buehrer, 1999, 2001).*

privatization process does not hold when the annual time dummies (denoting changes in macroeconomic and institutional environment) are added. One possible explanation could be that our variable was not prepared correctly or, and this might be more realistic reason, this might be the outcome of still not finished process of privatization. The process of privatization is namely only in the first, formal phase when the enterprises get the new owners. This is still far from "normal" ownership structure which should develop in future. The fact is that the privatization process has in a number of enterprises postponed the necessary restructuring for the increase of the national competitive advantages of a country highly dependent on export markets. Increasing deficit in foreign trade balance suggest that enterprises (with some exceptions) has difficulties in keeping their export competitiveness on the basis of present export pattern and structure of the manufacturing sector.

The set of factors related to the macroeconomic variables and institutional framework were included indirectly through the use of annual dummies. As expected we got significant, positive and growing parameters for the period 1995-98, denoting positive changes in the enterprises market environment.

2.2.2. **Long-term factors**

Firstly we followed the thesis of Repkine and Walsh (1999) that EU-oriented production made an easy transition to private ownership and efficient structures through the aid of foreign investment. We used the same model and regressed the instrumented CDI indices (decomposed into CI and DI indices) using random effects model against the initial sector size, initial FDI flows, product quality, sector and time dummies (see Damijan and Majcen, 2001). Results for both data sets (Nace Rev.1 and UCA 6 digit; Damijan and Majcen, 2001; Table 2) exhibit the same picture: individual sector growth is negatively associated with product innovation turbulence. In other words, sectors with larger product innovation turbulence (for the EU market) have recovered slower than more “stable” sectors that continued to sell the same products and in the similar quantities to EU as they have done before. More precisely, the greater the product creation activity in individual sectors, the smaller is their growth, while product destruction activities are not significantly associated with growth.

How can be this finding, that is just the opposite of the Repkine and Walsh’s findings for other CEEC’s, possibly explained? There are several possible explanations. First, the most plausible explanation would be that sectors, that were significantly oriented towards EU sales already prior the transition period, are, consequently, less turbulent in terms of product expansions and contractions. Hence, their growth does not depend upon trade reorientation. Second, in the instrumentalisation process we found that foreign owners induced rather product destruction than product creation processes. One could, in addition, also imagine that at the same time as foreign owners dropped non-viable products they potentially induced a quality upgrading process of the remaining EU oriented products. After explicitly controlling for this possibility, we found significant association between the change in quality (see variable UVAL92 in table 1) and the growth of individual sectors.

Based upon these results (relatively poor fits in both data sets that are, in addition, mostly driven by included dummy variables and opposite signs of crucial independent variables) one could conclude that the underlying theoretical model is not particularly suitable to explain the process of recovery of Slovenian manufacturing sector. The fit of all estimations deteriorates significantly when excluding sector and time dummies, indicating that only a very modest proportion of sector growth can be explained by innovations in EU-oriented output after 1992. Having in mind the pattern of inherited trade structure before the open-up and the pattern of FDI afterwards in Slovenia, the results do not come up as extremely surprising.

After controlling for the impact of FDI directly through current FDI flows rather than indirectly through their product innovations activities, we could observe a significantly faster growth of sectors with larger FDI inflows. The results, hence, show that FDI are very important for the recovery of Slovenian manufacturing, but their impact can hardly be captured by the model used. Another way of thinking about the role of FDI in the recovering process of Slovenian manufacturing sector is that FDI have not restructured Slovenian firms in terms of product composition, but they influenced it through fresh capital inflows, technology transfers, new managerial skills, ownership controls and through distribution networks in the EU markets. The above factors could be essential for improving the efficiency of firms and further opening of EU markets for exports of Slovenian firms. For us, the need to give more attention to the individual firm's performance and to control for differences in performance between domestic and foreign owned firms becomes urgent.

We thus turned to the initial model we used for the short-term factors. Regarding the results obtained with Repkine and Walsh CDI index, we used another variable reflecting quality changes of the EU exports and thus the process of creative destruction within this part of production. The result we got, confirm the thesis that sectors which increased the quality of their product sold on the EU market have higher output growth.

Additionally we studied the importance of both direct and indirect means of technology transfer for Slovenian sectors and their impact on output growth. We thus explored the importance of FDI and international R&D spillovers through trade. After controlling for common economic policy influences and industry effects, we found FDI as an important vehicle of technology transfer to Slovenian firms. In addition, the evidence suggests that sectors are bound to alternative sources of international R&D spillovers. Both imports of inputs and exports are found to be significant sources of international knowledge spillovers.[12] This, hence, provide a clear evidence that technology is being transferred to Slovenian firms either through direct foreign linkages or through arm-length trade.

Contrary to the results of many empirical studies that conventional factor or technology factors of growth are not statistically significant for transition economies, as the recovery is

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12 *With the export propensity decomposed according to sector factor intensity, one can find the result for labour intensive sectors, with significant negative association with output growth, strange. Possible explanation of this result should be found in the fact that in the group of labour intensive sectors domestic firms has the highest share – quick foreign trade liberalization accompanied with the severe decline of former domestic market forced domestic firms to drop non-viable products and continue to export remaining products traditionally sold on western markets.*

based on reallocation and efficiency improvements, our results confirm the importance of some long-term factors in the recovery phase of transition process of Slovenian manufacturing sectors.

At the end the importance of particular group of short and long term variables has been estimated following the methodology applied by de Melo, Denizer and Gelb (1997), which uses the adjusted R^2 to determine the contribution of each group of variables to the total variation explained by the complete set of factors. As the macroeconomic and institutional variables were included indirectly through the use of annual dummies (estimates of additional values to the constant in particular year) we could calculate the importance for the other three groups. We found that initial conditions account for 42% of total variation explained, structural reforms 26% and long-term variables 32%. The results are certainly not comparable with the results of other studies as they tried to explained growth performance between countries. But, nevertheless, initial conditions revealed to be very important in explaining the sector growth in Slovenian manufacturing, and also long-term variables are important in the recovery during the transition process.

In the next section we continued our analysis of growth performance of the eight CEEC. We focus our attention, according to the endogenous growth theory, to the long-term growth factors – channels of technology transfer affecting the improvement in firm performance through increased total factor productivity. Other, short term factors (initial conditions, structural reform, macroeconomic and institutional variables), were controlled using sector and time dummies and panel data techniques (random and fixed effects models) that do explicitly take into account the firm specific effects.

3. The importance of direct and indirect means of technology transfer

The results presented in the previous section do confirm the importance of direct and direct means of technology transfer in the transition process of Slovenian manufacturing sectors. We continued the analysis in order to examine the role of three channels of technology transfer play in the economic transformation of Eastern Europe. Using panel data for firms in eight transition countries we address several important questions. First, does FDI represent a significant channel for transfer of technology to transition countries? Second, does majority ownership facilitate transfer of more complex technology and management skills to local firms? Third, does FDI generate significant externalities for domestic firms? Fourth, do technological spillovers from FDI depend on the absorptive capacity of domestic firms? And fifth, do imports of capital and intermediate goods, and learning-by-exporting provide an alternative source of technology transfer to domestic firms?

The major contribution of this section is that it addresses the above questions using a unique large firm level data base for individual transition economies and employing common methodology and econometric approach. In order to obtain efficient and non-biased coefficient estimates, time-invariant firm-specific effects were explicitly taken into account using panel data techniques. Accordingly, we corrected for potential selection bias for foreign investment decisions using a generalized Heckman two-step procedure.

3. 1. Sources of technology transfer

The standard growth accounting approach of Solow (1957) can be used as a way to measure both direct and indirect technology transfer to the transition economies. The objective of this approach is to study the various factors that affect overall productivity, including the growth of technology. This is done by decomposing total factor productivity or TFP growth into factors internal and external to the firm, including R&D investments and human capital, and different sources of international technology transfer, respectively.

Following Basu and Fernald (1995), we consider a firm's *i* production function having a following form:

(1) $$Y_{it} = A_{it} K_{it}^{a} L_{it}^{b} N_{it}^{g}$$

where Y_{it} is gross output, K_{it}, L_{it} and N_{it} represent capital stock, labor input and materials, and A_{it} is total factor productivity (TFP) or Solow residual for firm *i* at time *t*. The production function is homogenous of degree *r* in *K*, *L* and *N*, so that *r = a+ß+?* ? 1.

To get the firm's TFP growth, we differentiate (1) over time. Under assumption of competitive markets, marginal products of each input are equal to its factor price, hence, (1) can be rewritten:

(2) $$y_{it} = a_{it} + ak_{it} + bl_{it} + gn_{it}$$

where y_{it} = log (Y_{it+1}/Y_{it}), a_{it} = log (A_{it+1}/A_{it}), k_{it} = log (K_{it+1}/K_{it}), l_{it} = log (L_{it+1}/L_{it}), and n_{it} = log (N_{it+1}/N_{it}). According to the above accounting, TFP growth (or technological progress) is the difference between the growth of output and weighted sum of growth of inputs, with weights being the individual shares of factors used in production.

Estimating (1) or (2) on aggregate data or firm level data may give us some information on average technology stock or average TFP growth in the economy or across firms. Since the technology parameter is simply the regression residual, i.e. part of variance of output that cannot be accounted for by variance of factor inputs, it says nothing about the factors that influence TFP growth. In reality this residual may capture a number of factors that may have little in common with technology level or TFP growth. In this specification the technology parameter depends crucially on the goodness of fit of the model. This is especially true in transition economies, in which this estimation approach - due to an inefficient utilization of production factors - may return incorrectly high parameters of technology level or TFP growth. The data for Slovenia indicates that FIEs had in the period 1994-1998 significantly lower parameters of technology level as compared to domestic firms (Damijan and Polanec 2001).

Ideally the model should include those factors that determine the level of technology or its growth. Often this can be difficult since technology embodies skills and knowledge that is not easy to measure. In present model we define the firm's technology level A_{it} as:

(3) $$A_{it} = G_i(RD_{it}, H_{it}, F_i, S_{jt}, X_{it}, M_{it}, d_j, d_t)$$

where RD_{it} and H_{it} capture the sources of technology internal to the firm, and factors F_i through M_{it} capture the sources external to the firm, i.e. international technology spillovers. RD_{it} represents annual R&D expenditures (relative to output), H_{it} indicates accumulated human capital (measured as average labor costs per employee), F_i is dummy for foreign ownership, S_{jt} measures intra-industry R&D spillovers stemming from foreign owned firms (measured as the share of foreign owned firms in industry *j's* domestic sales and exports), X_{it} and M_{it} refer to the export propensity (exports to sales ratio) and import propensity (ratio of imports to the material costs) of the firm, respectively, while d_j and d_t are the sector and time dummies.

The term R&D captures the innovative and absorptive capacity of the firm. This factor reflects both the innovation effect and learning or absorption effect of R&D activity. These two effects are controlled for in the model by considering RD_{it} as innovative effect to the firm and $RD_{it}S_{jt}$ as absorptive capacity, i.e. the ability of the firm to identify, assimilate and exploit knowledge spillovers at the sector level. The stock of human capital (H_{it}) represents the skills of the workforce and increases overall productivity of the firm. Firms employ labor of different skills, which employees acquired through education and training both inside and outside the firm. Human capital is assumed to lie within the firm's scope in this model since it indicates the firm's eagerness to enhance its technology level by engaging high skilled workers. Inter-firm diffusion of labor (job reallocation) is captured by the variable S_{jt}, which represents intra-industry spillovers from foreign to domestic firms. The model assumes that workers trained by foreign firms migrate to domestic firms to some extent. Labor costs per employee proxy the human capital stock of the enterprise, which rests on an assumption that firms with higher average per capita labor costs do on average employ higher skilled labor. We allow human capital to have different impact on TFP growth in foreign relative to domestic firms.

If FDI is an efficient channel of technology transfer, it is reasonable to infer that the "foreign ownership factor" (F_i) not only shifts the technological constant A_{it} of the host firm but also affects the efficiency of its factor utilization. As a consequence, it is not possible to assume identical production functions across firms but have to allow the efficiency of capital, labor and use of materials to differ between foreign owned and domestic firms. This is allowed for by multiplying K, L and N by foreign ownership dummies ($F_i k_{it}$, $F_i l_{it}$, $F_i n_{it}$) to obtain different a, ß and ? for foreign and domestic firms. A dummy variable is also included in the model to separate majority-owned foreign firms from minority-owned foreign firms. This is to find out whether majority foreign ownership facilitates transfer of more complex technology and management skills to local firms.

For firms without foreign participation, knowledge spillovers (S_{jt}) from foreign firms in the same industry may be important. These externalities, however, may not only be positive, as local enterprises may be "crowded out" by foreign enterprises if they do not have the capability to adapt quickly enough. Foreign enterprises create externalities by demonstrating new technologies and management methods, competition, backward and forward linkages with local suppliers and workforce training. Previous studies control for these effects either by taking the share of aggregate foreign employment in total industry's employment or aggregate foreign share in total industry's output. We test for these externalities by including the variable $S.D_{jt}$ (share of aggregate sales by FIEs in industry's total sales) that controls for crowding out caused by relatively large domestic sales of FIEs

and imitation and agglomeration effects stimulated by the export orientation of FIEs.

Finally, we test for alternative sources of international R&D spillovers. We do this by including the export propensity (X_{it} - export to output ratio) and import propensity of the firm (M_{it} - ratio of imports to the material costs).

We argued above that it is not reasonable to expect all firms to have identical production function in terms of identical input parameters. It is urgent to allow for foreign and domestic firms to differ in terms of the efficiency of factor inputs. In addition, we also allow for sector specific effects by including sector dummy variables d_j. In transition economies it is also necessary to assume that the efficiency of enterprises will improve over time as more productive capital and more skilled labor is employed. The model controls for this by including a time variable d_t. In the absence of other proxies, the time variable is also intended to capture time specific aggregate shocks to the whole economy. These shocks are inherent to transition economies.

In order to identify sources of TFP growth of manufacturing firms in transition countries, in section 3.2. we estimate model (2) constrained to determinants of TFP growth specified in (3) using three different specifications. First, we examine the importance of direct transfers of technology through FDI to selected local firms and the associated, indirect intra-industry spillovers from FDI to other domestic firms in the same industry. In the second step, we investigate the importance of R&D accumulation of domestic firms for the capability to adjust to intra-industry spillovers from firms with foreign participation. Finally, we focus on the importance of alternative sources of diffusion of technology to domestic firms, such as imports of capital and intermediate goods and learning by exporting.

Data at the firm level provides the best way to test for productivity spillovers. Panel data for the period 1994(5)-1998 were obtained for eight transition countries. For Estonia and Slovenia data were obtained from local Statistical offices, while for other transition countries source of data is the Amadeus database[13]. Our database consists of manufacturing firms with more than 100 employees (for Slovenia the lowest bound of 10 employees is applied). Due to different firm data coverage and different quality of the source data, non-balanced panel data had to be constructed (the exception being the Estonian and Slovenian data). The size of firm panel data samples differs significantly across countries. The poorest coverage of firms is for Hungary (134 firms) and Slovakia (136 firms), while for other countries the coverage of firms regarding the distribution of firms by size is good. Panel of Bulgarian firms consists of maximum of 1233 annual observations, the Czech republic's panel includes 1115 firms, Estonian panel has 373 firms, Poland panel consists of 2199 firms, Romanian panel includes 1918 firms, and Slovenian panel includes 1093 firms per year.

Insert table 2

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13 *As a part of the Phare ACE research project P97-8138-R coordinated by LICOS Institute, we had access to the Amadeus CD-ROM (version June 2000), a Pan European financial database, provided by Bureau van Dijk Electronic Publishing SA.*

Share of FIEs in total number of firms in our panels is on average about 10 per cent. The exception being the panels for Estonia and Hungary, where these shares are about 30 per cent. Let us leave aside for the moment the panel of Hungarian firms due to poor quality of data. Table 1 reveals that the aggregate shares of FIEs in total employment of individual transition economies exceed the shares of FIEs in total number of firms by 35 per cent to 90 per cent. On the other side, the aggregate shares of FIEs in total assets and sales exceed the share in total number of firms by two- to threefold. This indicates that FIEs are not only larger relative do domestic firms in terms of employment, assets and output, but also that FIEs are more capital intensive and more efficient in terms of labor productivity. In addition, breakdown of the above figures by individual manufacturing sectors reveals greater concentration of FIEs in more capital and skill intensive sectors. Another interesting fact can be seen from the figures on R&D accumulation by foreign and domestic firms. In Bulgaria, the Czech Republic, Estonia, Romania and Slovakia, the R&D activities are basically concentrated in foreign firms. On the contrary, the Polish and Slovenian domestic firms seem to lay emphasis on R&D accumulation in the same manner as FIEs do. This may have important implications for the autonomous innovative ability of domestic firms and their absorption capacity for potential R&D spillovers in the economy in both groups of countries.

Having in mind the above differences in characteristics between foreign and domestic firms, one can argue that our panels of firm data might suffer under selection bias. This is due to the fact that foreign investment decisions are not randomly distributed but are probably subject to firms' characteristics and to their initial performances. Foreign and domestic firms, hence, cannot be treated as homogenous units of observation due to possible endogeneity of foreign investment decisions. In order to correct for this problem the generalized Heckman two-step procedure for correcting sample selection bias has been used. According to Heckman (1979), in the first step we determine the probability of foreign investment choices using a probit model. We base foreign investment choices on initial firm size, firm's initial capital and skill intensity, initial productivity, firm's initial export propensity and sector dummies. Year 1994(5) or one year before the ownership change (for FDI that occurred later than 1995) has been chosen as the initial year in our probit estimations. In the second step we then follow generalized Heckman approach as developed by Amemiya (1984) and calculate inverse Mill's ratios (also called lambda) for all observations (for non-zero as well as zero observations regarding foreign investment choices). In doing so we obtained an additional independent variable in our estimated model, which we then use as an instrument for the unobserved impacts on foreign investment decisions.

Insert table 3

The results of probit model in Table 3 do in fact confirm the existence of selection bias in our database. When deciding about the investment choices in transition countries, TNCs were found to tend to acquire more capital and skill intensive firms. In 5 countries, the probability of TNCs to acquire more capital and skill intensive local firms is confirmed. Labor intensive firms are less likely to be chosen by TNCs (a negative correlation is confirmed in 4 countries). In Slovenia and Estonia, more export oriented firms are found to be preferred by TNCs. This may be true also for firms in other transition economies, but unfortunately, we did not dispose with the export data at the firm level for all countries.

Before switching to estimation results different appropriate econometric techniques for estimating the consecutive (4), (5) and (6) models should be addressed. As we deal with the panel data the OLS may give biased and inconsistent estimates of the consecutive models. These models may suffer from probable correlation between the productivity effects and the output variable. As there are no suitable firm specific instruments to control for this problem, one should rather use one of the two panel data techniques (random or fixed effects model) that do explicitly take into account the firm specific effects. As argued by Djankov and Hoekman (1998), none of the two techniques, though preferable to OLS, is absolutely accurate for the purposes of our estimations. Fixed effects model (FEM) assumes constant TFP growth over time for a single firm. In the present context, this is inappropriate assumption, as the aim is to examine the impact of different factors on changes in TFP growth. On the other hand, major disadvantage of random effects model (REM) is in the assumption that changes in TFP growth at the firm level are random and only reflected in the error term, i.e. uncorrelated over time. We perform estimations using both the OLS, REM and FEM techniques. The Hausman (1978) test shows that FEM provides better specification of our models relative to REM. However, as argued above FEM is not a proper specification in our case due to the assumption on firm's constant TFP growth over time. In addition, as the consecutive models are estimated in first differences, Hausman test found no significant differences between OLS and REM estimations. We therefore report only OLS estimations that provide biased, though more efficient estimations relative to REM and FEM specifications.

3.2. Estimation results

3.2.1. Direct and indirect effects of FDI

In this subsection direct and indirect effects of FDI (as a channel of technology transfer) on productivity growth of manufacturing firms in transition economies are estimated. Based on equations (2) and (3), we estimate the following model:

$$(4) \qquad y_{it} = b_{it} + dF_i + ak_{it} + bl_{it} + gn_{it} + cF_ik_{it} + fF_il_{it} + jF_in_{it} + kH_{it} + lF_iH_{it} + mS_{jt} + q_jd_j + y_td_t + e_{it}$$

where b_{it} is a log of a constant term (residual that accounts for alternative sources of TFP growth not accounted for in the model), d measures the difference in TFP growth rates between domestic and foreign firms, a, ß, ?, and ?, f , f represent shares of factor inputs in domestic and foreign firms, respectively, ? and ? represent the impact of human capital in domestic and foreign firms, μ measures intra-industry spillovers from foreign to domestic firms, ? and ? are parameters of sector and time dummies, while e is the error term.

Insert table 4

The estimation results in Tables 4 indicate that FDI is an important direct channel for the transfer of technology to FIEs located in the Czech republic, Estonia, Poland, Romania and Slovenia. However, this evidence only appears after the regression is corrected for initial

selection bias for foreign investment decisions[14]. In Bulgaria, Hungary and Slovakia FIEs do not seem to grow faster than domestic firms. At least for Hungary and Slovakia this is clearly a result of the poor quality of data. In the five transition economies with significant impact of FDI, foreign ownership is found to contribute to average growth rate of firms by 0.5 to 0.7 percentage points. Only in Romania this figure is significantly larger (1.1 percentage points) indicating much lower average productivity level of domestic firms. These figures are much higher than those obtained by previous studies of other transition countries. Djankov and Hoekman (1998) found that in the Czech Republic the average growth rate of FIEs relative to domestic firms was 0.03 percentage points higher. Konings in the last version of his paper (2001), employing a different estimation technique, found no evidence on differences in average growth rate between FIEs and domestic firms in Bulgaria and Romania, while in Poland FIEs were found to grow faster by some 1.13 to 0.21 percentage points. The above different results among individual studies may refer to different specification of estimation model and different estimation techniques. Another reason for different results may also lie in the fact that we estimated our model in a panel of manufacturing firms only, while other researchers used panels of both the manufacturing and non-manufacturing firms.

The results in table 4 also confirm that TNCs do not necessarily transfer more complex technology to their subsidiaries where they acquire a majority share. A dummy on majority ownership proved to be insignificant in all countries.[15]

The results also indicate that with the exception of Romania there are no significant spillovers to other firms in the same industry. The results also found that there were no differences in capability to adapt to spillovers between foreign and domestic firms (insignificant interaction terms between spillovers and FDI dummy). Using a similar model specification, there were no significant spillovers found in any of the previous studies on transition economies. Djankov and Hoekman (1998) and Konings (2001) found even negative spillovers in the Czech Republic, Poland and Romania. As suggested by Kinoshita (2000), the lack of finding spillovers in individual transition countries might probably be explained by the fact that so far we didn't control for the absorptive capacity of domestic firms to adapt to spillovers generated by FIEs.

3.2.2. Innovative and absorbptive capacity of domestic firms

In this subsection we report estimation results when productivity growth and potential spillovers in domestic firms are related to their innovative and absorptive capacity. We estimate the following model:

$$(5) \qquad y_{it} = b_{it} + dF_i + ak_{it} + bl_{it} + gn_{it} + cF_i k_{it} + fF_i l_{it} + jF_i n_{it} + kH_{it} + lF_i H_{it} + \\ + hRD_{it} + mS_{jt} + rRD_{it} S_{jt} + q_j d_j + y_t d_t + e_{it}$$

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14 *Compare the results in Table 4 to those in Table A1 in Appendix, where the latter refer to the model estimations without correction for sample selection bias.*

15 *The study by Rojec, Damijan and Majcen (2000) failed to find significant differences in operational characteristics between majority and minority owned foreign firms in Slovenia as well as in Estonia.*

where in addition to (4) *?* is the rate of return on firms' R&D investments (parameter of innovative capacity of firms), and *?* measures absorptive capacity of firms to adapt to technology shocks in domestic market. The model is estimated in a panel of domestic firms only, since we are interested in accounting for the importance of different potential productivity spillovers that are available to domestic firms in the economy.

Insert table 5A and 5B

Relatively high shares of R&D accumulation of domestic firms in some transition economies should result in some impact on innovative capacity of firms and absorptive capability of firms to exploit knowledge spillovers from FIEs at the sector level. The estimation results in Table 5A, however, indicate significant positive innovation effects only in the Czech Republic, while in Slovakia even negative innovation effects were found. Still, our results provide no evidence for any spillovers from FDI to domestic firms in any of the transition economies. After controlling for absorptive capacity we find evidence on positive spillovers to domestic firm only in Romania. Surprisingly, even negative impact of absorptive capacity of firms is found in more advanced transition countries (Czech Republic and Poland).

Evidence from other studies is mixed. Djankov and Hoekman (1998) after controlling for firms' innovative and absorptive capacity report no significant spillovers to domestic firms in the Czech Republic in the period 1992-1996. In contrast, Kinoshita (2000) finds innovative capacity of Czech domestic firms not to be correlated with their TFP growth and she also finds no significant spillovers (measured as the share of foreign owned firms in total sector's employment). But in contrast to Djankov and Hoekman she does find significant positive impact of absorptive capacity of Czech domestic firms in the period 1995-1998 to exploit spillovers generated by FIEs.

The above insignificant results on spillovers may also be a consequence of the implicit assumption that these spillovers are equally relevant for all manufacturing sectors. But we know that in some industries the R&D accumulation is more important in order to be able to attain economies of scale. Hence, in some of the industries firms have to accumulate human capital in larger proportions and are therefore more capable to take advantage of intra-industry spillovers generated by FIEs. In the next step, we therefore restrict our panel to those firms only that are located in industries characterized by larger economies of scale and larger R&D expenditures.[16] However, restricting the panels does not alter much the estimation results (see Table 5B). In addition to the whole panels, the innovation effect becomes significant also in Estonia and Romania. On the other side, however, there is still no evidence on any spillovers to domestic firms. After controlling for the absorptive capacity of firms, the evidence is found again on negative spillovers to domestic firms in Bulgaria, Poland and Romania, while there is no evidence on positive spillovers.

Based on the above findings one can conclude that FIEs provide an important channel of technology transfer to transition economies. However, this positive effects is restricted

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16 *We estimate the model (5) in a panel of firms in the following 2-digit ISIC sectors: 24, 29, 30, 31, 32, 33, 34 and 35.*

only to selected local firms, while all other domestic firms suffer under strong competition effects.

3.2.3. International R&D spillovers to domestic firms

The economic growth in transition economies after 1993 is not restricted to firms with foreign participation only, but is a general feature of the U-shaped economic performance and technological modernization of firms during the process of transition. Hence, if the R&D accumulation by individual local firms is not correlated with the growth of firms and if there are no spillovers from FIEs, there must be some alternative sources of technology transfer to local firms. In this subsection we check for the impact of these alternative sources of international technology diffusion for domestic firms' TFP growth. Trade provides an important source of international R&D spillovers (see Coe and Helpman 1995, and Coe, Helpman and. Hoffmaister 1997). In order to account for international R&D spillovers through international trade we estimate the following model:

$$(6) \qquad y_{it} = b_{it} + dF_i + ak_{it} + bl_{it} + gn_{it} + cF_ik_{it} + fF_il_{it} + jF_in_{it} + kH_{it} + lF_iH_{it} + \\ + oX_{it} + pM_{it} + hRD_{it} + uRD_{it}X_{it} + wRD_{it}M_{it} + q_jd_j + y_td_t + e_{it}$$

where in addition to (4) *?* and *p* represent international R&D spillovers via firms' (sectors') exports and imports, *?* is the rate of return on firms' R&D investments, *?* and *?* measure the absorptive capacity of domestic firms to technology shocks through exports and imports. The model is estimated again in a panel of domestic firms only. International R&D spillovers to domestic firms are ideally measured by the share of imports in total costs of materials (imports of capital equipment and intermediate goods) and by the share of exports in total sales (indicating capability of firms to meet high quality standards in western markets). However, because the data on firm export and import performance is missing for most of the countries in our database (with the exception of Estonia and Slovenia), the data on NACE 4-digit sector export and import performance[17] has been used instead. More specifically, we have explicitly taken into account only trade flows with the EU, since these may be the most important channel of knowledge spillovers through trade to transition economies.

Insert table 6A and 6B

The estimation results in Table 6A reveal that only for Slovenia significant positive international R&D spillovers to domestic firms both through exports as well as through imports can be found. These positive spillovers are not restricted to firms with higher R&D accumulation, but is a general feature of Slovenian manufacturing firms. On the other side, while significant international R&D spillovers were found also for firms in the Czech Republic, these are available only to firms with higher R&D accumulation. Moreover, the evidence show that there are negative spillovers for Czech firms that do heavily depend on exports to western markets. Similar results for Czech Republic were found by Djankov and Hoekman (1998). While they did not account for knowledge spillovers through exports,

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17 *Export and import performance at the industry level is calculated as a ratio of industry's exports and imports to total industry's sales and total industry's material cost, respectively.*

they found significant positive impact of large import penetration on TFP growth of domestic firms.

These results again provide no evidence on general importance of alternative sources of technological modernization for most of the transition economies. The reason behind may again be the fact that technological modernization is more important for some R&D intensive sectors only. Therefore, we re-estimate the model (6) in a panel of firms engaged in R&D intensive industries. The results in Table 6B in a certain way confirm the above expectations. For Slovenia, again, exports are found to be an important vehicle of knowledge spillovers from western countries, while imports serve as an important channel of international knowledge transfers only for firms with higher R&D accumulation. For Czech firms the previous linkage between trade and productivity growth is missing after taking into account R&D intensive sectors only. In contrast, a positive correlation between export and import performance and productivity growth has been established for firms in Poland and Romania. These international knowledge spillovers are, however, available only to firms with higher R&D accumulation. For other transition economies international trade does not seem to be an important vehicle of technological modernization and productivity growth.

Comparing results obtained by either way of indirect international R&D spillovers (from FIEs and through trade) may give us an important information on the net effects of both sorts of indirect spillovers for domestic firms without direct foreign linkages. Comparing results between Tables 5A and 6A and Tables 5B and 6B reveals that in Poland and Romania negative spillover effects generated by FIEs are by some 10 to 25-times larger than positive international spillover effects through trade. This evidence, hence, suggests that the competition effects from foreign owned firms to domestic firms may outweigh the positive spillovers generated through trade.

This, in turn, raises the question on what were the real determinants of technological modernization and productivity growth in local firms in transition countries. If it was not the FDI and potential intra-industry spillovers generated by FDI, if it was not the autonomous R&D accumulation and if was not the international trade, then there must exist some other alternative means of technological modernization in transition economies. Unless the technological gap between local firms and competitive western firms is too large, resulting in crowding out of domestic firms in R&D intensive industries and reallocation of domestic resources towards less R&D intensive and more lower skilled labor intensive sectors. Certainly, more research should be devoted to this issue in the future.

4. Conclusions

The first aim of the paper was to explain a cross-sector differences in evolution of gross product of Slovenian manufacturing sectors in the period 1992-98 using different short and long-term factors. Results pointed out great importance of initial conditions (sector orientation to convertible or non-convertible markets, and distorted production structure), as well as structural reforms and macroeconomic and institutional environment. Added long-term factors revealed positive association with short term output growth during the transition period – it is obvious that these factors (FDI, exports, imports of inputs, cooperation) create channels for the transfer of technology, improving the efficiency of

production. It turned out also that quality improving exports to the EU countries is significantly positively correlated with the sector output performance.

The results obtained point out to the importance of oppening the domestic market to foreign competition together with the attraction of FDI inflows, successfully introduced institutional reforms, and improved macroeconomic environment.

The paper further studies, according to the endogenous growth theory, the importance of long-term growth factors - both direct and indirect means of technology transfer for firms in eight transition countries and their impact on productivity growth. Using firm level panel data for the period 1994 - 1998 and employing growth accounting approach, we seek to explore the importance of FDI, intra-industry knowledge spillovers from FDI, firm's own R&D accumulation and of international R&D spillovers through trade for firm's TFP growth.

After controlling for selection bias, common economic policy influences and industry effects, we found FDI as the most important vehicle of technology transfer to 5 out of 8 transition economies. In contrast to widely spread considerations, we found no or even negative intra-industry knowledge spillovers from foreign owned firms to domestic firms. In addition, the evidence is found that in a certain way trade serves as an important alternative source of international R&D spillovers to local firms in the Czech Republic, Poland, Romania and Slovenia. Both imports and exports are found to be significant sources of international knowledge spillovers to local firms with no foreign participation. The paper, hence, provide an evidence that technology is being transferred to firms in transition economies primarily through direct foreign linkages. The spillovers through arm-length trade are only exceptionally present, while the spillovers from foreign to domestic firms are negative or insignificant.

As positive and significant spillovers through exports and imports of intermediate inputs were found for Slovenian manufacturing sectors and confirmed also using the firm level data, we can expect that results obtained for other CEEC's reflect also the difficulties with the data used – export and import data at the industry level. In the further research we should therefore improve the quality of the data used in order to be able to give more reliable conclusions regarding the spillovers through trade channel.

It should be also stressed out that we were searching only for the intra-industry spillovers from foreign to domestic firms. Perhaps even more important channel would be inter-industry spillovers through sales of inputs between foreign and domestic firms. These, so-called vertical spillovers (backward and forward) are indeed the topic of our future research.

We should devote more time also to the improvement of the models and techniques used through the use of dynamic panel data framework and GMM estimators to eliminate unobserved firm-specific effects and used lagged instruments to correct for simultaneity in the first-differenced equations.

REFERENCES

Aitken, B.J. and A.E. Harrison (1997), Do Domestic Firms Benefit from Direct Foreign Investments? Evidence from Venezuela, American Economic Review, 89, 3: 605-618

Amemiya, T. (1984), Tobit models. A Survey, Journal of Econometrics, 24: 3-61

Basu, S. and J. Fernald (1995), Aggregate Productivity and the Productivity of Aggregates, NBER Working Paper, no. 5382

Berg, A. et al. (1999), The Evolution of Ooutput in Transition Economies: Explaining the Differences, IMF Working Paper, No. 73

Blomström, M. and A. Kokko (1997), How Foreign Investment Affects Host Countries, Policy Research Working Paper, no. 1745, World Bank

Blomström, M. F. and Sjöholm (1999), Technology Transfer and Spillovers: Does Local Participation with Multinationals Matter?, European Economic Review, 43: 915-923

Blanchard, O. (1997), The Economics of Transition in Eastern Europe, Oxford: Clarendon Press

Borensztein, E., J. De Gregorio, and J.W. Lee (1998), How Does Foreign Direct Investment Affect Economic Growth?, Journal of International Economics, 45: 115-135

Brunetti, A., G. Kisunko and B. Weder (1997), Institutional Obstacles to Doing Business, Waashington: World Bank Policy Research Working Paper, No. 1759

Coe, D. and E. Helpman (1995), International R&D Spillovers, European Economic Review, 39: 859-887

Coe, D., E. Helpman, and A. Hoffmaister (1997), North-South R&D Spillovers, Economic Journal, 107: 134-149

Clerides, S., S. Lach, and J. Tybout (1997), Is Learning-by-Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico and Morocco, Quarterly Journal of Economics, 113

Damijan, J. and S. Polanec (2001), Is Vintage Capital Important? Efficiency of Foreign vs. Domestic Firms in Slovenia, University of Ljubljana, mimeo

Damijan, P.J. and B. Majcen (2001), Trade reorientation, firm performance and restructuring of slovenian manufacturing sector, Ljubljana : Institute for Economic Research, Working Paper, No. 5

De Melo, M., C. Denizer and A. Gelb (1996), From Plan to Market: Patterns of Transition, Policy Research Working Paper 1564, The World Bank

De Melo, M., C. Denizer and A. Gelb (1997), Transition to Date: A Comparative Overview, in Salvatore Zecchini (ed.), Lessons from the Economic Transition. Central and Eastern Europe in the 1990s, Dordrecht-Boston-London: Kluwer Academic Publishers, pp. 59-78

Djankov, S. and B. Hekman (1999), Foreign Investment and Productivity Growth in Czech Enterprises, The World Bank Policy Research Working Paper, No. 2115

Eaton, J. and S. Kortum. 1996. "Trade in Ideas: Patenting and Productivity in the OECD". Journal of International Economics, 40: 251-271

European Bank of Reconstruction and Development (1997), Transition Report, London: EBRD

Fisher, S, R. Sahay and C. Vegh (1996a), Stabilization and Growth in Transition Economies: The Early experience, Journal of Economic Perspective, Vol. 10, No. 2, p.45-66

Fisher, S, R. Sahay and C. Vegh (1996b), Economies in Transition: The Beginnings of Growth, American Economic Association Papers and Proceedings, Vol. 86, No. 2, p. 229-233

Fisher, S. and R. Sahay (2000), The Transition Economies After Ten Years, IMF Working Paper, No. 30

Grossman, G. and E. Helpman (1991), Innovation and Growth in the Global Economy, Cambridge, MA: MIT Press

Havrylyshyn, O. et al. (1999), Growth Experience in Transition Countriees, 1990-1998, Washington: IMF Occasional Paper No. 184

Havrylyshyn, O., I. Izvorski and R. van Rooden (1998), Recovery and Growth in Transition Economies 1990-97—Astylized Regression Analysis, Washington: IMF Working Paper, No. 141

Havrylyshyn, O. and R. van Rooden (2000), Institutionss Matter in Transition, but so do Policies, IMF Working Paper, No. 70

Heckman, J.J. (1979), Sample selection bias as a specification error, Econometrica, 47 (1): 153-161

Denizer, S. (1997), Stabilization, Adjustment and Growth Prospect in Transition Economies, The World Bank, Policy Research Department, pp. 37

Kinoshita, Y. (2000), R&D and Technology Spillovers via FDI: Innovation and Absorptive Capacity, CERGE-EI, mimeo.

Konings, J. (2000), The Effects of Foreign Direct Investment on Domestic Firms: Evidence from Firm Level Panel Data in Emerging Economies, LICOS Discussion Paper, no. 86

Kornai, J. (1994), Transformational Recession: The Main Causes, Journal of Comparative Economics, Vol. 19, pp. 39-63

Krueger, G. and M. Ciolko (1998), A Note of Initial Conditions and Liberalization during Transition, Journal of Comparative Economics, December 1998, 26(4), pp. 718-734

Lucas, R.E (1988), On the Mechanics of Economic Development, Journal of Monetary Economics, 22: 3-42

Markusen, J.R (1989), Trade in Producer Services and in Other Specialized Intermediate Inputs, American Economic Review, 79: 85-95

Majcen, B. (1995), Zunanjetrgovinska liberalizacija industrijskih in kmetijskih proizvodov (Foreign trade liberalization of industrial and agricultural products), Ljubljana : Inštitut za ekonomska raziskovanja, pp. 52

Majcen, B. in T. Buehrer (2001), Izracunljivi model splošnega ravnotežja slovenskega gospodarstva, (Computable General Equilibrium Model of Slovenian Economy), Inštitut za ekonomska raziskovanja, Ljubljana, 48 p. + 71 p. in Annexes

Olson, M. (1997), Distinguished lecture on Economics in Government »Big Bills Left on the Sidewalk: Why Some Nations Are Rich and Others Poor«, Journal of Economic Perspectives, Vol. 10, pp. 3-24

Potocnik, J. in B. Majcen (1996), Slovenija in EU: analiza posledic približevanja z modelom splošnega ravnotežja (Possible Effects of Slovenian Integration to the EU - CGE Approach), zbirka Analize, raziskave in razvoj, Urad R Slovenije za makroekonomske analize in razvoj, 290 p.

Potocnik, J. (1996), Analiza posledic vkljucevanja v EU z modelom splošnega ravnotežja slovenskega gospodarstva temeljecim na matriki družbenih racunov za leto 1993 (Analysis of the effects of the inclusion into the EU with the CGE model of Slovenian economy based on the 1993 SAM), Inštitut za ekonomska raziskovanja, Ljubljana

Potocnik, J.(1997), Effects of Slovenian Integration to the EU – CGE 1995, Institute for Macroeconomic Analysis and Development, Ljubljana

Repkine, A. and P.P. Walsh (1999), Evidence of European Trade and Investment U-shaping Industrial Output in Bulgaria, Hungary, Poland, and Romania, Journal of Comparative Economics 27, pp. 730-752

Rojec, M., J.P. Damijan, and B. Majcen (2000), Export Propensity of Foreign Subsidiaries in Slovenian Manufacturing Sector, University of Ljubljana, mimeo.

Romer, P.M. 1986. "Increasing Returns and Long Run Growth". Journal of Political Economy, 94: 1002-1037.

Romer, P. (1990), Endogenous Technological Change, Journal of political Economy, Vol. 98, No. 5, pp. 71-102

Selowsky, M. and R. Martin (1996), Policy Performance and Output Growth in the Transition Economies, The World Bank, december 1996

Wolf, H. (1997), Transition Strategies: Choices and Outcomes, New York University, Stern Business School

World Investment Report. 2000. "Cross-border Mergers and Acquisitions and Development". UNCTAD.

Tables to be included into text

Table 1: Growth determinants of Slovenian manufacturing sectors output - Random effects panel estimates (period 1992-98)

	With annual time dummies		Without annual time dummies	
	Variables	t-statistics	Variables	t-statistics
R2 (within)	0.3333		0.3118	
R2 (between)	0.4278		0.4412	
R2 (overall)	0.4067		0.4123	
Wald (chi2) statistics	332.90		313.96	
Prob (chi2) statistics	0.0000		0.0000	
Constant	144.4101	8.199	129.6028	7.594
IPROD91	-22.20753	-4.989	-22.83918	-5.157
KONVP89	81.88286	2.446	78.87735	2.360
NEW89	19.00319	2.399	18.92867	2.396
IDELU89	0.55722	2.268	0.57723	2.355
PRODZ89	0.01545	2.568	0.01558	2.595
DELY90	-43.45548	-2.269	-46.05697	-2.412
DNAB90	-58.54500	-2.442	-57.36664	-2.398
IPRICE	-47.15993	-6.406	-35.17089	-5.549
EZ	-43.44719	-2.376	-46.37314	-2.545
DPROD_ZA	0.20742	0.029	11.53299	1.845
DPROD_ME	6.11482	1.205	17.31885	4.486
TK_DEL1	77.43160	6.295	84.26895	6.927
EXPPS1	-22.70505	-2.335	-17.71881	-1.826
DKEXP1	43.14658	2.015	42.51982	1.972
DSKEXP1	54.41121	2.785	55.40958	2.820
IMPRS1	44.81459	4.315	44.60716	4.261
KOOP5	11.57455	3.359	11.74876	3.644
KOOP510	24.10899	4.168	23.28921	4.164
UVAL92	11.09432	2.863	12.06992	3.111
DKKVAL	-6.94231	-0.700	-7.52669	-0.761
DSKKVAL	-8.70426	-1.415	-9.33976	-1.506
DUMK	-9.32729	-0.528	-7.84656	-0.444
DUMSK	-25.20952	-1.647	-25.51860	-1.663
YEAR94	5.20164	1.448		
YEAR95	18.08263	4.572		
YEAR96	26.69303	5.663		
YEAR97	32.83519	5.967		
YEAR98	35.85843	5.707		
YEAR9498			16.06443	5.843
No of observations	648		648	
Hausman test	30.00		26.74	
Prob chi2	0.1184		0.0840	

Table 2: Descriptive statistics for foreign vs. domestic manufacturing firms in 1998

	BG	CZ	EST	HU	PL	RO	SK	SLO
No of all firms	1233	1114	363	110	2199	1918	136	1093
No. of FIEs	87	181	106	39	180	206	11	116
% of FIEs in no. of firms	7.1	16.2	29.2	35.5	8.2	10.7	8.1	10.6
% of FIEs in Employment	13.6	21.8	52.1	22.6	11.1	8.0	12.0	18.5
% of FIEs in Sales	20.4	34.5	48.2	26.1	21.7	14.2	23.1	26.9
% of FIEs in Assets	22.8	31.1	36.4	15.9	21.2	19.5	28.7	13.8
% of FIEs in R&D Expend.	52.1	29.3	71.4	21.0	9.3	26.8	23.9	14.2

Table 3: Probability of foreign investment decisions (Results of probit model)

	BG	CZ	EST	HU	PL	RO	SK	SLO
Size	1E-07	*9E-07	2E-06	-9E-07	9E-07	3E-07	***1E-05	**-7E-08
	(0.049)	(1.683)	(0.668)	(-0.503)	(1.285)	(0.285)	(2.980)	(-2.179)
Capital intensity	**0.009	0.001	***0.003	***0.007	***0.007	**0.007	-0.003	2E-06
	(2.093)	(1.534)	(3.045)	(2.707)	(2.731)	(2.231)	(-0.657)	(1.035)
Skill intensity	***0.609	*-0.011	***0.015	-0.005	***0.083	0.042	-0.042	**0.0001
	(3.779)	(-1.649)	(3.589)	(-0.251)	(2.898)	(0.840)	(-0.380)	(2.130)
Labor intensity	***-0.010	***-0.014	0.009	-0.012	-0.005	***0.011	**-0.025	***-0.010
	(-2.961)	(-5.859)	(1.530)	(-1.368)	(-1.094)	(5.028)	(-2.129)	(-3.035)
Lab. productivity	-0.006	4E-05	6E-05	**-0.003	-0.001	0.004	0.006	*5E-06
	(-0.583)	(0.140)	(0.182)	(-2.064)	(-1.092)	(1.574)	(0.643)	(1.747)
Exp. propensity			**0.006					***0.014
			(2.242)					(9.493)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.080	0.055	0.255	0.106	0.109	0.044	0.263	0.127
Number of obs.	1233	1115	373	134	2199	1918	136	1093

Notes: (i) dependent variable: FDI dummy, (ii) probit estimations on initial data (for year 1995 or one year before the ownership change), (iii) t-statistics in parentheses, (iv) *****, **** and ***** indicate significance at 1, 5 and 10 per cent level, respectively.

Table 4: Impact of FDI: Direct effects and spillovers (Sample of foreign owned and domestic firms; with control for sample selection bias)

	BG	CZ	EST	HU	PL	RO	SK	SLO
Constant	**0.118	-0.204	***-0.378	0.054	***-0.237	***-0.629	0.240	***-0.303
	(2.011)	(-1.617)	(-3.742)	(0.098)	(-2.883)	(-9.125)	(0.714)	(-5.522)
Capital	***0.094	***0.925	***0.048	**0.256	***0.179	***0.166	**0.332	***0.027
	(8.076)	(28.202)	(4.873)	(2.247)	(6.819)	(15.610)	(2.076)	(3.401)
Capital-FDI	-0.021	***-0.294	**-0.046	***-1.106	-0.013	-0.003	-0.185	-0.018
	(-0.646)	(-4.348)	(-2.246)	(-4.015)	(-0.185)	(-0.127)	(-0.230)	(-0.750)
Labor	***0.185	***0.265	***0.662	0.118	***0.131	***0.221	***0.973	***0.468
	(7.401)	(5.073)	(14.434)	(0.621)	(3.849)	(22.029)	(6.609)	(31.971)
Labor-FDI	-0.047	-0.140	***0.642	0.006	0.015	***0.131	0.206	***-0.296
	(-0.726)	(-0.996)	(12.236)	(0.021)	(0.234)	(4.547)	(0.169)	(-7.164)
Intermediates	***0.550		***0.011	***0.480	***0.447	***0.611		***0.238
	(60.158)		(2.307)	(4.097)	(33.190)	(80.277)		(32.185)
Intermediates-FDI	*0.053		0.002	0.069	***-0.352	***-0.055		***0.108
	(1.854)		(0.255)	(0.309)	(-13.537)	(-3.357)		(3.478)
FDI dummy	0.068	***0.576	***0.678	-0.237	***0.469	***1.140	-0.493	***0.551
	(0.628)	(2.523)	(4.201)	(-0.257)	(2.805)	(8.522)	(-0.633)	(5.552)
Majority share dummy	0.003	0.063	0.001	-0.191	0.087	0.046	0.047	-0.029
	(0.045)	(1.175)	(0.025)	(-0.784)	(1.384)	(1.359)	(0.137)	(-1.089)
Spillovers	-0.0001	-0.0002	0.0011	-0.0008	-0.0002	**0.0007	-0.0007	-0.0002
	(-0.323)	(-0.466)	(1.043)	(-0.329)	(-0.446)	(2.263)	(-0.193)	(-0.785)
Spillovers*FDI	-0.0002	-0.0007	-0.0012	0.0051	-0.0001	**-0.0013	0.0020	0.0004
	(-0.273)	(-0.847)	(-1.032)	(1.213)	(-0.049)	(-2.274)	(0.278)	(0.910)
Lambda	-0.009	**-0.330	***-0.416	0.150	***-0.293	***-0.718	0.231	***-0.333
	(-0.164)	(-2.389)	(-4.323)	(0.265)	(-3.061)	(-8.934)	(0.613)	(-5.351)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	3756	4177	1119	282	1188	6818	365	4372
Adj. R^2	0.870	0.265	0.767	0.276	0.602	0.749	0.097	0.528

Note: t-statistics in parentheses. *****, **** and ***** indicate significance at 1, 5 and 10 per cent level, respectively.

Table 5A: Impact of R&D - Importance of innovative and absorptive capacity (Sample of domestic firms only)

	BG	CZ	EST	HU	PL	RO	SK	SLO
Constant	***0.115	***0.090	***-0.427	-0.041	0.004	-0.016	0.018	***-0.278
	(6.814)	(3.477)	(-3.503)	(-0.370)	(0.195)	(-1.620)	(0.231)	(-2.861)
Capital	***0.096	***0.931	***0.049	***0.267	***0.211	***0.179	0.222	***0.034
	(7.972)	(27.334)	(5.223)	(3.016)	(7.948)	(18.428)	(1.571)	(3.810)
Labor	***0.182	***0.257	***0.665	0.166	***0.110	***0.212	***1.075	***0.453
	(7.298)	(4.825)	(14.959)	(1.137)	(3.268)	(23.176)	(7.648)	(28.753)
Intermediates	***0.551		**0.011	***0.490	***0.453	***0.610		***0.257
	(60.878)		(2.454)	(5.464)	(33.939)	(87.278)		(32.856)
R&D	-0.002	***0.015	-0.006	0.001	0.006	0.0003	***-0.004	-0.001
	(-0.504)	(6.258)	(-0.323)	(0.463)	(1.436)	(0.256)	(-11.58)	(-1.240)
Spillovers	-0.0001	-0.0002	0.001	0.001	0.0002	0.0004	-0.002	-0.0001
	(-0.332)	(-0.396)	(0.648)	(0.489)	(0.490)	(1.393)	(-0.359)	(-0.375)
Spillovers*R&D	0.0001	**-0.0002	0.0003	-0.0005	**-0.0005	***0.0002	0.002	0.0001
	(1.149)	(-2.397)	(0.418)	(-0.474)	(-2.539)	(3.602)	(0.356)	(1.613)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	3490	3520	815	209	1061	6187	304	3937
Adj. R^2	0.870	0.269	0.317	0.416	0.633	0.766	0.384	0.488

Note: t-statistics in parentheses. ***, ** and * indicate significance at 1, 5 and 10 per cent level, respectively.

Table 5B: Impact of R&D - Importance of innovative and absorptive capacity (Sample of domestic firms in technology intensive sectors)

	BG	CZ	EST	HU	PL	RO	SK	SLO
Constant	***0.089	0.053	0.119	0.100	***-0.202	**-0.033	-0.164	***-0.738
	(3.011)	(1.364)	(0.061)	(0.844)	(-4.128)	(-1.964)	(-0.873)	(-4.255)
Capital	***0.072	***0.689	***0.047	0.140	***0.322	***0.089	**0.913	0.012
	(3.522)	(18.752)	(2.741)	(1.330)	(5.764)	(4.935)	(2.104)	(0.778)
Labor	***0.199	***0.199	***0.413	-0.001	0.084	***0.182	***1.080	***0.374
	(4.286)	(3.845)	(3.333)	(-0.998)	(1.475)	(9.589)	(3.935)	(14.269)
Intermediates	***0.698		***0.271	***0.819	***0.003	***0.710		***0.311
	(38.714)		(5.787)	(7.403)	(9.693)	(56.917)		(22.430)
R&D	0.000	**0.008	*0.269	-0.001	-0.002	***0.012	***-0.004	-0.001
	(0.106)	(2.369)	(1.934)	(-0.118)	(-0.451)	(3.715)	(-9.904)	(-0.977)
Spillovers	0.001	0.0001	0.002	-0.001	-0.0004	0.0003	0.010	-0.0002
	(1.637)	(0.191)	(0.075)	(-0.612)	(-0.498)	(0.549)	(0.146)	(-0.488)
Spillovers*R&D	***-0.009	0.000	-0.004	-0.002	***-0.001	***-0.001	-0.006	0.0001
	(-6.233)	(-0.309)	(-1.597)	(-1.384)	(-2.565)	(-3.116)	(-0.112)	(0.815)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	966	1329	136	69	364	1511	99	1301
Adj. R^2	0.903	0.339	0.372	0.915	0.422	0.820	0.570	0.533

Note: t-statistics in parentheses. ***, ** and * indicate significance at 1, 5 and 10 per cent level, respectively.

Table 6A: Impact of R&D and of international knowledge spillovers through trade (Sample of domestic firms only)

	BG	CZ	EST	HU	PL	RO	SK	SLO
Constant	***0.115	***0.085	***-0.404	-0.132	***-0.207	-0.010	0.010	***-0.542
	(7.042)	(3.321)	(-3.498)	(-0.791)	(-7.210)	(-1.091)	(0.124)	(-5.117)
Capital	***0.095	***0.933	***0.049	0.162	***0.242	***0.178	0.219	**0.023
	(7.904)	(27.413)	(5.180)	(1.569)	(6.824)	(18.356)	(1.543)	(2.210)
Labor	***0.184	***0.256	***0.663	0.001	***0.122	***0.212	***1.084	***0.401
	(7.372)	(4.806)	(14.901)	(1.128)	(2.704)	(23.176)	(7.660)	(21.252)
Intermediates	***0.550		**0.011	***0.656	***0.003	***0.611		***0.272
	(60.799)		(2.413)	(6.162)	(15.429)	(87.376)		(28.665)
R&D	0.0001	***0.012	0.002	0.005	*-0.012	**0.002	0.007	-0.00004
	(0.046)	(4.913)	(0.196)	(0.671)	(-1.659)	(1.924)	(0.302)	(-0.062)
Exports/Sales	-0.00001	0.00005	0.00011	-0.00001	-0.00009	-0.00001	0.00007	***0.00061
	(-0.874)	(0.912)	(0.282)	(-0.392)	(-1.272)	(-0.738)	(0.495)	(3.674)
Imports/Material costs	0.00001	-0.00003		0.000043	0.00015	0.000003	-0.0001	**0.00003
	(0.613)	(-0.998)		(0.879)	(1.173)	(0.469)	(-0.488)	(2.062)
R&D*Exports/Sales	0.00001	***-0.00004	-0.00004	0.00001	0.0001	0.0000	-0.00002	-0.000004
	(0.259)	(-2.708)	(-0.146)	(0.146)	(1.103)	(0.631)	(-0.481)	(-0.191)
R&D*Imports/Mat.costs	0.00001	***0.00004		-0.00009	-0.00010	-0.000002	-0.00005	-3.1E-07
	(0.132)	(3.204)		(-0.930)	(-0.766)	(-0.660)	(-0.239)	(-0.190)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	3490	3520	815	162	1061	6187	304	2943
Adj. R^2	0.870	0.270	0.316	0.419	0.632	0.766	0.382	0.475

Note: t-statistics in parentheses. *****, **** and ***** indicate significance at 1, 5 and 10 per cent level, respectively.

Table 6B: Impact of R&D and of international knowledge spillovers through trade (Sample of domestic firms in technology intensive sectors)

	BG	CZ	EST	HU	PL	RO	SK	SLO
Constant	***0.084	0.047	-0.252	0.053	***-0.225	*-0.029	-0.151	***-0.745
	(2.853)	(1.234)	(-0.832)	(0.438)	(-4.816)	(-1.737)	(-0.658)	(-4.287)
Capital	***0.074	***0.691	***0.047	0.168	***0.311	***0.084	**1.029	0.016
	(3.560)	(18.828)	(2.672)	(1.591)	(5.541)	(4.676)	(2.349)	(1.001)
Labor	***0.231	***0.197	***0.384	0.0001	*0.093	***0.181	***1.092	***0.380
	(4.877)	(3.825)	(3.047)	(-0.690)	(1.617)	(9.631)	(3.924)	(14.378)
Intermediates	***0.698		***0.275	***0.789	***0.003	***0.709		***0.308
	(37.774)		(5.771)	(7.162)	(9.700)	(57.266)		(21.925)
R&D	-0.002	***0.011	0.060	-0.003	***-0.024	***-0.016	-0.027	-0.001
	(-0.534)	(3.585)	(1.211)	(-0.279)	(-3.076)	(-3.985)	(-0.358)	(-1.231)
Exports/Sales	-0.00001	-0.00003	-0.00052	0.00001	0.00007	-0.00012	0.00018	*0.00043
	(-0.405)	(-0.362)	(-0.518)	(0.150)	(0.240)	(-1.250)	(0.775)	(1.782)
Imports/Material costs	0.00005	0.00012		0.000001	0.00031	0.00034	0.0007	0.00001
	(0.252)	(0.952)		(0.006)	(0.379)	(0.699)	(0.670)	(0.468)
R&D*Exports/Sales	0.00001	0.00001	-0.0006	0.00006	**0.0002	***0.0005	0.0003	0.00002
	(0.249)	(0.179)	(-0.418)	(0.700)	(2.406)	(6.733)	(1.009)	(0.851)
R&D*Imports/Mat.costs	0.00001	-0.00005		-0.00016	-0.00018	*0.00058	-0.002	*0.00001
	(0.110)	(-0.717)		(-1.173)	(-0.884)	(1.750)	(-1.322)	(1.764)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	966	1329	136	69	364	1511	99	1301
Adj. R^2	0.898	0.341	0.367	0.912	0.418	0.824	0.573	0.536

Note: t-statistics in parentheses. *****, **** and ***** indicate significance at 1, 5 and 10 per cent level, respectively.

APPENDIX

Table A1: Impact of FDI: Direct effects and spillovers (Sample of foreign owned and domestic firms; without control for sample selection bias)

	BG	CZ	EST	HU	PL	RO	SK	SLO
Constant	***0.127	***0.092	0.009	-0.087	0.008	*-0.021	0.041	-0.019
	(7.754)	(3.842)	(0.180)	(-0.663)	(0.437)	(-1.914)	(0.475)	(-1.359)
Capital	***0.094	***0.924	***0.050	**0.254	***0.195	***0.180	**0.318	***0.027
	(8.081)	(28.165)	(5.080)	(2.238)	(7.564)	(16.995)	(2.010)	(3.377)
Capital-FDI	-0.021	***-0.296	**-0.045	***-1.116	-0.007	-0.006	-0.183	-0.016
	(-0.640)	(-4.383)	(-2.142)	(-4.092)	(-0.094)	(-0.209)	(-0.228)	(-0.664)
Labor	***0.185	***0.263	***0.677	0.120	***0.125	***0.213	***0.965	***0.466
	(7.422)	(5.043)	(14.685)	(0.635)	(3.673)	(21.180)	(6.586)	(31.772)
Labor-FDI	-0.046	-0.142	***0.623	0.005	0.002	***0.131	0.220	***-0.301
	(-0.724)	(-1.008)	(11.811)	(0.017)	(0.031)	(4.528)	(0.181)	(-7.256)
Intermediates	***0.550		**0.011	***0.474	***0.451	***0.610		***0.240
	(61.315)		(2.297)	(4.139)	(33.566)	(79.685)		(32.386)
Intermediates-FDI	*0.053		0.003	0.074	***-0.356	***-0.054		***0.108
	(1.854)		(0.312)	(0.329)	(-13.657)	(-3.265)		(3.457)
FDI dummy	0.053	0.049	0.038	0.000	0.012	-0.007	-0.141	0.039
	(0.885)	(0.829)	(0.591)	(-0.001)	(0.153)	(-0.187)	(-0.268)	(1.475)
Majority share dummy	0.003	0.065	0.034	-0.190	0.087	0.051	-0.023	-0.022
	(0.044)	(1.202)	(0.655)	(-0.781)	(1.377)	(1.497)	(-0.072)	(-0.836)
Spillovers	-0.0001	-0.0002	0.001	-0.001	-0.0001	**0.001	-0.001	0.000
	(-0.325)	(-0.435)	(0.861)	(-0.341)	(-0.277)	(2.336)	(-0.135)	(-0.700)
Spillovers*FDI	-0.0002	-0.001	-0.001	0.005	-4.9E-05	**-0.001	0.002	0.0004
	(-0.264)	(-0.699)	(-0.969)	(1.226)	(-0.047)	(-2.039)	(0.298)	(0.799)
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	3756	4177	1119	282	1188	6818	365	4372
Adj. R^2	0.870	0.265	0.763	0.279	0.599	0.746	0.098	0.525

Note: t-statistics in parentheses. ***, ** and * indicate significance at 1, 5 and 10 per cent level, respectively.