

Good or bad? - The influence of FDI on productivity growth

An industry-level analysis*

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Abstract

This paper attempts to reconcile the often inconclusive evidence on the impact of FDI on growth by taking two into account the heterogeneity both among industries and among countries. Using a comparable database at the industry level for 35 countries in OECD, Asia and Eastern Europe from 1987 to 2002, we test both stage of development and FDI industrial pattern for the economic impact of FDI on growth. In certain industries and for the catching-up countries, a significant and positive relationship emerges when FDI interacts with investment or export orientation.

JEL-classification: C33, F14, F21, L60;

Keywords: FDI, labour productivity, heterogeneity, manufacturing sector, panel data analysis;

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1. Introduction

While in theory the nexus between FDI and growth (in terms of output and productivity) is in general positive, the empirical literature is far less conclusive. Some studies find positive effects from outward FDI for the investing country (Van Pottelsberghe and Lichtenberg, 2001; Nachum et al., 2000), but suggest a potential negative impact from inward FDI on the host country. This results from a possible decrease in indigenous innovative capacity or crowding out of domestic firms or domestic investment. Thus, in their view and in line with the standard literature on the determinants of FDI (i.e. Dunning's OLI paradigm, see Dunning 1988) inward FDI is intended to take advantage of host country (locational) characteristics instead of disseminating new technologies originating in the sending country. Other studies report more positive findings: Nadiri (1993) finds positive and significant effects from US sourced capital on productivity growth of manufacturing industries in France, Germany, Japan and the UK. Also Borensztein et al. (1998) find a positive influence of FDI flows from industrial countries on developing countries' growth. However, they report also a minimum threshold level of human capital for the productivity enhancing impact of FDI, emphasizing the role of absorptive capacity. Absorptive capacity or minimum threshold levels in a country's ability to profit from inward FDI is often mentioned in the literature (see also Blomström et al. 1996). Consequently the effect of FDI depends among other things to a large extent on the characteristics of the country that receives FDI. However, the resulting issue of cross-country heterogeneity has largely been neglected in the literature so far with few exceptions. Blonigen and Wang (2005) stress explicitly cross-country heterogeneity as the crucial factor which determines the effect of FDI on growth. Further, Nair-Reichert and Weinhold (2001) and Mayer-Foulkes and Nunnenkamp (2005) explicitly take up this aspect in their analysis. Our paper will follow their direction and introduce two forms of heterogeneity, differences between countries and differences between receiving industries.

We argue that since host country heterogeneity plays a role, it is equally likely that the impact of FDI on the host economy differs greatly according to the receiving industry. FDI in constant returns to scale industries will have different effects than FDI in increasing returns to scale industries. Likewise, the effect of FDI may be related to the technology and human capital intensity of the industry and other factors. As a very intuitive example, heavy FDI in the extractive sector in Nigeria has not improved the country's growth performance (Akinlo, 2004). Consequently, the potential for positive spillovers does not solely depend on a country's overall absorptive capacity, but also on which sectors or industries in the economy receive FDI. Thus, the impact of FDI differs depending on country specific absorptive capacity or stage of development as well as on the sectoral and industrial structure and allocation of FDI. Since the two are in general related, this implies a relationship between the industrial pattern of inward FDI and its effect on the host country. The economy wide effect of industry specific FDI inflows will then further depend on the extent of intra-industry versus inter-industry spillovers.

In this paper we use a unique panel data set at the industrial level for a range of industrialized and catching-up countries to investigate the magnitude of all these factors for the role played by FDI in different manufacturing industries in the economic development of the host economy. Due to measurement issues, interdependencies between various types of spillovers and their complexity, it is difficult to distinguish between different theoretically possible channels of technology transmission in empirical research. Therefore, we will focus on the overall effect of foreign sourced capital on manufacturing productivity growth in addition to the effects of traditional factors (domestic capital and labour) and controlling for other factors. What is new in our analysis is the focus on the industry-level of the economy. To our knowledge, there is very little empirical research on FDI at this level of disaggregation. Disaggregated data on FDI for a large and heterogeneous set of countries rarely exist in a comprehensive and comparable form. If these data exist, they are often

plagued with two kinds of problems: On the one hand, the coverage of firms and flows which are recorded as FDI can differ between countries (problems are often caused by the exclusion of reinvested profits in some countries). On the other hand, the classification into industrial activities may differ between countries. We therefore established a comprehensive new data set in order to address adequately the role of industrial FDI patterns.

The paper proceeds as follows: The next section describes the data set. Section 3 revises briefly the theoretical background of the FDI-growth nexus and introduces the estimating framework. The results are summarized in Section 4. Section 5 concludes.

2. Industrial Patterns of Inward FDI

Due to a lack of comparable data at the industry level, empirical research on the link between FDI and development has largely remained at the macro level, since comparable FDI data across countries are best available at this level. More recently, firm-level datasets have been released and, as a consequence, the number of studies using micro data has grown rapidly. However, in contrast to the macro-level analysis, which often takes a global perspective and analyses large cross-country data sets (in the cross-section dimension as well as in the panel dimension), many firm-level studies are limited to one country or a homogenous group of countries (like the EU) due to issues of data-availability and comparability.

In order to get a good picture of the link between FDI and growth of individual industries, we collected indicators like output, gross fixed capital formation, inward FDI stock data and exports from several sources (UNIDO, UN COMTRADE, OECD, wiiw, ASEAN Secretariat, Timmer 2003, MOEA 1993). Woerz (2005) gives a detailed description of the dataset. In total, our data set contains more than 3000 observations for 28 to 35 countries, eight industries and 14 years (1987-2000). The data set is highly unbalanced, the number of

countries varies over time, with data for 28 countries over the years 1987 to 1997 and data for 35 countries over the years 1998 to 2000. We collected information on output, employment, FDI inwards stock, gross fixed capital formation, exports and imports for a rather heterogeneous group of countries: OECD members, ASEAN members, other dynamic Asian countries and Central and Eastern European countries. The time series for CEECs start only in 1993 or later.

The ratio of inward FDI stock to output varies along all dimensions, across industries, years and countries. For the complete sample, the FDI to output ratio ranges from far less than 1% in the textiles and wood industry in Japan to more than 100% in the industry group comprising fuel, rubber, plastics and chemicals in Indonesia. Also the variance is highest in the latter industry (see Figure 1).

[insert Figure 1]

It is further striking to see not only the rise in average FDI to output ratio, but also the rapid increase in variance over time. In some cases, the ratio of FDI to total industry output has increased to 100%.¹ The general rise in FDI in relation to industry output clearly reflects the increasing internationalisation of production. The additional sharp increase in variance across countries tells us that this internationalization did not happen at equal rates for all countries and industries. While Asian countries on average show higher shares of FDI in total industry output, they also exhibit much more variation across individual countries than OECD members. Entering the picture at a much later point in time, CEECs show again substantially

¹ In a few cases, not shown in the figure, the stock of inward FDI valued at the end of the year exceeds the industry's output of the same year, leading to a ratio above 100%. This may happen as a result of heavy foreign investment in a specific year. As a consequence of these investments, one would expect strong increases in output in the following years, for the theoretical reasons given below.

higher FDI to output ratios, yet with considerably less variation across countries. Thus, this region experienced a uniformly high inflow of foreign capital into manufacturing. On average, CEECs display higher FDI to output ratios than most other countries in the sample. Many of the former communist countries allowed and actively encouraged the inflow of foreign capital as a way to privatize the former state owned companies. Due to a general lack of domestic capital and the disruption of state owned companies, with many inefficient firms exiting the market, the share of foreign capital was especially high in transition countries.

Table 1 below gives the weighted averages of inward FDI stocks to output ratios for different geographic regions towards the end of the observation period.² The table illustrates nicely the two sources of heterogeneity, stemming from differences among countries as well as between industries. There are distinct differences between industries, with the highest ratio in general prevailing in the petroleum, chemical, rubber and plastic industry. CEECs are the only region with the highest FDI to output ratio in the transport industry. Apart from the strong role of FDI in petroleum, chemicals, rubber and plastics, all regions differ with respect to the importance of FDI in individual industries. Thus, the data exhibit very large disparities across regions as well as across industries, supporting our argument of the two sources of heterogeneity in the relationship between FDI and output or productivity.

[insert Table 1]

² We classified countries into advanced OECD members (Australia, Austria, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Japan, The Netherlands, Norway, Sweden, Great Britain, USA), and different groups of catching up countries: OECD members (Greece, Mexico, Portugal, Spain, Turkey), the four Asian Tigers (Taiwan, Hong Kong, Korea, Singapore), Emerging Asia (Indonesia, Malaysia, Philippines, Thailand) and CEECs (Croatia, Czech Rep., Hungary, Latvia, Poland, Slovak Rep., Slovenia). See also Appendix Table A1.

Structural developments have also been diverse between these regions, with more structural change in both groups of OECD countries as opposed to more stable FDI patterns in East Asian countries (including the four Tigers). There is further a low correlation between FDI patterns and output patterns in both groups of OECD countries and in Emerging Asia. The four Asian Tiger economies and CEECs seem to be different with closely matching FDI and output structures. In the case of the four Tiger countries, where the observation period extends over 20 years, the sequencing of industry patterns suggests that high FDI shares in electrical machinery have resulted in subsequently high output shares in the industry. For the CEECs, the time period is too short for any conclusions. However, FDI seems to play a more important role in these two regions and less so in others.

3. Theoretical Background

3.1 The FDI-growth nexus in theory

Economic theory has provided us with many reasons why foreign direct investment may result in enhanced growth performance of the receiving country. In the neo-classical growth literature, FDI is associated positively with output growth because it either increases the volume of investment and/or its productivity and thus puts the economy on a higher long-term growth path. In an exogenous growth model, FDI has only a level effect in the steady state and no permanent impact on the growth rate, except during the transitional dynamics to the new steady state. The potential role for FDI is much greater in endogenous growth models. In a neoclassical production function, output is generated by using capital and labour in the production process. With this framework in mind, FDI can exert an influence on each argument in the production function. FDI increases capital, it may qualitatively improve the factor labour (explained below) and by transferring new technologies, it also has the potential to raise total factor productivity. Further, as discussed in more recent theoretical growth

models (e.g. by Grossman and Helpman, 1991) by raising the number of varieties for intermediate goods or capital equipments, FDI can also increase productivity (see Borensztein et al., 1998 for an empirical analysis of this channel).³ Thus, in addition to the direct, capital augmenting effect, FDI can also have additional indirect and thus permanent effects on the growth rate. Most importantly, FDI can permanently increase the growth rate through spillovers⁴ and the transfer and diffusion of technologies, ideas, management processes, and the like.

The literature mentions different channels at the micro level which allow for technological spillovers from FDI to the host economy (Kinoshita, 2001, Halpern and Muraközy, 2005): through imitation, through the labour market (i.e. training of local workers by foreign firms), by inducing a competition effect and through backward or vertical spillovers. For all of these channels, host country characteristics – in particular the relative development level of the host country compared to the sending country in terms of technology, human capital etc. – play a relevant role.

A potential problem at the micro-level, where the spillovers arise, is the evidence for self-selection bias. I.e. while there is general consensus that FDI increases the productivity of receiving firms, part of this effect is in fact due to FDI selecting better firms as targets for takeover (Bellak, 2004). At the more aggregate level, this translates to the imminent causality or endogeneity problem, faced by all empirical studies on the effects of FDI.

³ The same effect can also be achieved through imports of such goods. In this sense, FDI represents an alternative means to increase the number of available varieties in addition to trade, even if there are qualitative differences between the two.

⁴ Spillovers occur when multinationals are unable to capture all the productivity effects that follow in the host country's local firms as a result of the presence of the multinational (Caves, 1996).

Another crucial role in this context is played by the absorptive capacity of the host country. The importance of absorptive capacity – often captured by differences in the stage of development between donor and host country - has been a central finding in many empirical studies on the FDI-growth link (Blonigen and Wang 2005; Borensztein et al. 1998; De Mello 1999). There are also theoretical justifications for the importance of a certain amount of absorptive capacity. For example, Markusen and Rutherford (2004) develop a three-period model where they show that the speed and degree of positive spillovers from FDI is positively related to the absorptive capacity of the host country. In an earlier paper and using a new economic geography model, Rodriguez-Clare (1996) relates the developmental impact of multinational firms to the type of the linkages which they create. Positive linkage effects are stronger the more intensive the multinational is in the use of intermediate goods, the larger the costs of communication and trade between headquarters and local plants and the more similar home and host country are in terms of the variety of intermediate goods produced. This implies stronger linkages - and thus greater positive effects - if the developmental gap between donor and host country is smaller.

To summarize, one can argue that positive spillovers will only occur in a suitable setting. If the host economy does not provide an adequate environment in terms of human capital, private and public infrastructure, legal environment and the like, many of the spillovers that may potentially arise from FDI can not materialize. Public infrastructure such as educational institutions, publicly funded R&D collaborations can significantly support potential spillovers. As a consequence, country specific effects have a strong influence on the effects of FDI on growth. Hence, cross country heterogeneity is one of the important aspects to be addressed in empirical research on the topic. In addition, different stages of economic development are characterised by specific industrial patterns. In line with the previous arguments, a high structural match between the donor and the host country would imply a proximity in stage of development and thus also a good precondition for the absorptive capacity of the receiving

country to be high. In other words, the match between the industrial allocation of FDI and the host country's stage of development as characterised by its industrial structure determines the effectiveness of FDI. We argue in this paper that the "optimal" pattern of FDI across industries varies with the stage of development. The effect of FDI in the same industry but in countries at different stages of development can be just as much different as the effect of FDI in one country but in different industries. Thus, we will address both, cross country and cross industry heterogeneity in this paper.

3.2 Analytical framework

We start from a simple Cobb-Douglas production function of the form given in equation (1):

$$Y_{cit} = A_{cit} K_{ct}^{\alpha} L_{ct}^{1-\alpha} \quad (1)$$

where Y_{cit} is the output in time t of industry i in country c . K_{it} is the capital stock in the economy at time t and L_{it} is labour endowment respectively. Endowments of both factors vary by country and over time. We chose to work with output per employee as given in equation (2):

$$\left(\frac{Y}{L}\right)_{cit} = A_{cit} \left(\frac{K}{L}\right)_{ct}^{\alpha} \quad (2)$$

Total factor productivity A_{cit} in turn is determined by previous investment into physical capital in the sector as given in equation (3):

$$A_{cit} = f(ID_{cit-1}, IF_{cit-1}) = ID_{cit-1}^{\phi} * IF_{cit-1}^{\theta} \quad (3)$$

where ID stands for domestic investment and IF refers to foreign investment (i.e. FDI). We assume that it takes one period for new investment to translate into productivity effects due to learning, etc. This also implies that we have a simple solution to the imminent endogeneity problem between FDI and growth. Taking logs and working in first differences, we get:

$$gy_{cit} = \phi gid_{cit-1} + \theta gif_{cit-1} + \alpha gk_{ct} \quad (4)$$

where gy_{cit} is the growth of industry i 's output per employee in country c and time t . Hence, the growth rate of output per employee is a function of previous growth of investment (both domestic and foreign) in the respective industry and country and of changes in the country's capital-labour ratio k . We will capture these changes in capital-labour ratio by country specific time varying effects. Since we are thinking of economies that are in transition rather than in a steady state (i.e. catching up economies like the Central and Eastern European countries and emerging Asian countries) we do not assume a constant capital-labour ratio. We further normalize both, domestic and foreign investment by output before calculating its growth rates, in order to avoid extremely high growth rates due to very low levels, especially of FDI (i.e level effects).⁵ Given that the model is in growth rates, the results become less dependent on the initial levels in every country in a cross-section context. Furthermore, growth rates are more likely to be stationary, while levels may not be, especially in the case of less developed countries (Weinhold, 1996). Intuitively speaking, the model allows to answer the following question: If FDI shares in certain countries and industries grow faster compared to other countries and industries, will output per employee also grow faster?

⁵ In the empirical estimation, we additionally face the restriction imposed by the data that domestic and foreign investment cannot clearly be separated. Hence, we proxy for the former by total gross fixed capital formation, while the latter will be given by the growth of FDI inward stocks in a certain industry.

4. The empirical FDI-growth nexus

4.1 Econometric specification

In deriving our empirical specification we follow Nair-Reichert and Weinhold (NRW 2001) who explore the relationship between FDI and economic growth at the macro economic level with a special emphasis on causality and on cross-country heterogeneity. We focus in our paper on the second issue and adapt for our estimation their specification to include industry specific FDI.

The econometric model to be estimated in this paper over our sample of countries c , industries i and years t , is the following:

$$GY_{ict} = \alpha + \beta_{1i} * GFDI_{ict-1} + \beta_{2i} * GINV_{ict-1} + \beta_{3i} * GEX_{ict-1} + \mu_i + \gamma_{ct} + \varepsilon_{ict} \quad (5)$$

where μ_i are industry specific effects, γ_{ct} are country specific time trends and ε_{ict} is the basic error component. The empirical model is augmented by the growth of export share in output for the following reason: Industries are usually opened up to international competition by arms-length-trade first, while FDI usually follows later in time. As a consequence, FDI is hardly ever observed in isolation (especially in the manufacturing sector, we are dealing with in this paper) but always in combination with a certain outward orientation through trade. Therefore, we control for this openness by including the growth of export shares. Also the specification by NRW (2001) includes this variable. GY_{ict} refers again to growth of output per employee in the respective country, industry, and time period. The results are however robust to using output growth instead.⁶

⁶ Results for output growth are available from the authors upon request.

Since we have a panel of country/industry-combinations over time, we are dealing in fact with three dimensions. To emphasize this point, we do not simply treat every country/industry-combination as one individual “economy”, but we assume industry characteristics to remain constant across countries and over time, and additionally include time varying country-specific effects that are independent of the respective industry. These effects capture first of all short term changes in the capital-labour ratio, but also more generally structural changes that occur in the process of economic development as well as changes in factor endowments and country specific shocks (due to business cycles, etc.) Thus, we control explicitly for industry and country specific effects in our estimation. Also, we have a common error term which is capturing the correlation between industry specific disturbances, i.e. representing identical non-systematic influences over countries, industries and time. We see this as a first step to control for both types of heterogeneity – across countries and across industries - while allowing for interactions between industries.⁷

We use the growth rate of the inward FDI stock to output ratio as our explanatory variable of main interest in the regressions. As mentioned above, this normalization was motivated by the fact that industries with very small initial FDI levels (especially so in the less developed countries in the sample) often exhibited extremely high FDI growth rates (due to the level effect). By normalizing FDI by output levels we avoid a possible bias in the results stemming from these level effects.⁸

⁷ The results are extremely robust to alternative specifications, for instance when only industry fixed effects are included or when time invariant country dummies are used as well as when industry and country specific time varying trends are included instead.

⁸ We also normalized FDI by employment, however, we believe that this gives a different flavour to the analysis. FDI to employment ratios are higher for less labour intensive industries, yielding potentially higher growth rates in the labour intensive industries. This induces a bias towards labour intensive industries. The results were surprisingly not too different again.

Given our focus on the impact of heterogeneity in the FDI-growth nexus, we base our conclusions on heteroskedastic-consistent standard errors (HC-type 1).

As mentioned before, the one period lag in the control variables avoids a simultaneity bias between output growth and the explanatory variables.⁹ This bias could alternatively be reduced by instrumenting the predetermined variables or by using a dynamic panel estimation method in a long time series panel. Given the short time dimension in our case, the effect of a weak instrument cannot be assessed (Kiviet 1995).¹⁰ There might also be a collinearity problem because FDI could be determined together with domestic investment and with openness. In an alternative specification, we consider this relationship in an explicit way, with the interaction of FDI with each of the two in turn: the domestic investment share and the openness of the receiving industry. The effect of foreign capital may depend on the amount of investment as such in the sense that a certain amount of investment in an industry is necessary for absorbing the external effects of FDI. Also, this interaction reflects the need of structural matching between foreign and domestic investment. Moreover, FDI is often related to export orientation of a country or industry, whereby it can act as a complement or a substitute for the exchange of goods. These two possibilities arise primarily from differences in the motives for FDI. On the one hand, resource- or labour-seeking inward FDI is often

⁹ In this setting an endogeneity bias is possible only if the relationship is driven by forward-looking expectations, which are excluded here, especially because growth rates are extremely difficult to predict for catching-up countries.

¹⁰ The validity of several sets of instruments has been tested - like the lagged endogenous variable, initial values of right hand side variables and employment levels – and the GMM estimation was considered, but in all cases the instruments are rejected. These weak instruments together with the short time series could add more and unknown biases in the estimation. Moreover, it is very unlikely to have a big endogeneity bias because forward-looking expectations are excluded in this specification.

associated with a complementary relationship to outward trade and can result in footloose production units, which move globally in order to utilise the necessary resources. Thus, the potential for spillovers with a positive influence on long-run development in a specific location is limited. On the other hand, market-seeking and strategic FDI, substituting for arm's length trade, pursues very different objectives and as a consequence positive effects on the industry's development in the host country may result from linkages with upstream producers as well as downstream consumers.

Finally, in the last two specifications, we turn towards the role of the stage of development and absorptive capacity of the host country. The impact of these two on the FDI-growth relationship is tested first by the interaction of FDI with the host country's per capita income level, measured at purchasing power parities. The role of threshold effects in human capital – often referred to in the literature (see Borensztein *et al* 1998 among others) – is captured here by interacting the FDI ratio with secondary school enrolment. We therefore also test whether our coefficient on FDI is affected by human capital, and we expect this factor to play an important role in specific industries but not in all alike.

In a further step, the heterogeneity problem stemming from differing stages of development can be palliated by splitting the sample into different subsamples of countries: advanced and catching-up economies.

4.2 Estimation Results

Table 2 reports the results from estimating the above discussed empirical model, including various interaction terms. The specific industry and country-time varying dummies are not reported here for the sake of space. These are used for controlling changes in the capital-labour ratios for each country over the years. The results for the basic model in column 1 shows no significant effect from FDI in any industry. Labour productivity however receives a

positive direct influence from domestic investment and increased openness in the following industries: food (openness only), textiles and petroleum, chemicals and rubber industry (PETCHEM). A strong effect is expected for PETCHEM, mainly because of the high-tech component inherent in pharmaceuticals, but as well due to the capital intensive refining of petroleum.¹¹ In general, both domestic investment and/or export orientation seem to be more important for the growth of lower-tech, resource intensive industries as petroleum, chemicals, textiles or food.

[insert Table 2]

When we interact FDI growth with investment or export shares (Table 2, columns 2 and 3 respectively) the same industries show an important change, with negative direct effects but positive marginal effects in combination with a sufficient level of investment in the host country. This may indicate that FDI leads to increased productivity growth *only* in the presence high overall investment shares; in other words, FDI and domestic investments are complementary. This is true both for petroleum, chemicals and rubber, but also for textiles and food; this two latter also need a high share of exports for channelling FDI growth towards productivity. Moreover, domestic investment still plays a positive role in textiles, petroleum, chemicals and rubber, and so does export orientation on food and textiles (Table 2, columns 2 and 3).

¹¹ It would be highly desirable to have detailed information on each individual industry contained in this group, since petroleum extraction is not only very capital intensive, but also very closely tied to endowments and international technology and distribution networks of big oil multinationals and thus not relevant for every country in the sample. Chemicals on the other hand cover a very wide spectrum of economic activities ranging from low-skill, resource intensive production to high-skill, technology intensive activities (such as pharmaceuticals). However, for the present sample, covering a wide range of countries, any further disaggregation was not possible.

Thus, we conclude that FDI strongly depends on additional factors in order to exert a significant effect on growth, i.e. a sufficient level of domestic investment or export orientation is necessary. This result is in line with the finding by Carkovic and Levine (2005) who find in the macroeconomic context that the exogenous component of FDI does not exert a robust, independent influence on growth.

Given the existing literature on host country effects of FDI, differences are expected depending on the development level and human capital endowment (Table 2, columns 4 and 5 respectively). Interactions with the development level (real per capita income at purchasing power parities) show a significant effect for the same industries, positive for food and textiles and negative for petroleum and chemicals. The results imply a dampened effect of FDI in more developed countries, given the opposing signs of the coefficient on the FDI ratio and the interaction term. A different interpretation appears when looking at the interaction with schooling (secondary school enrolment of the population over 25 in 1985) which is used here to proxy for human capital. Food, textiles and PETCHEM show a negative interaction together with a positive exogenous effect. This actually reveals a smaller positive effect of FDI in these industries for countries with higher levels of schooling in general. At first look this result seems to be in contradiction to the existing literature which claims that FDI needs sufficient human capital for a significant effect. However, the interpretation in our sample is slightly different. We could rather think about an opportunity at the beginning of the catching-up process. Indeed, we can say that our sample excludes the really human-capital poor African countries and other LDCs. Thus, all countries in our sample most likely exceed the threshold found in the literature for human capital (Blomström et al. 1996). Both results put together suggest that, for the catching-up countries, education and human capital is a very important way for attaining a higher increase in productivity.

Given the importance attached to the stage of development as a determinant of the absorptive capacity, and to deal with this heterogeneity we stratified our the sample in Table 3 into two broad groups which can roughly be associated with differing stages of development. The first group contains advanced OECD member countries, while all other countries are classified as catching-up countries and subsumed in the second group (see Table A1 for a listing of countries and their grouping). These two groups of countries are relatively homogenous in terms of schooling and current real GDP. The results in Table 3 strongly supports our decision to treat these two groups of advanced and catching-up countries separately.

[insert Table 3]

In line with earlier literature, FDI mainly exerts a statistically significant effect in the subsample of catching-up countries¹². In this group, both food and petroleum, chemicals and rubber show a positive main effect, together with a positive main effect of investment and export shares in the same industries and textiles. But, as for the whole sample, these results change when interaction terms are introduced. In this case, the direct effect of FDI growth is negative for textiles and PETCHEM, but host countries with a higher share of investment and exports achieve a faster productivity growth. The direct effect of FDI on food is less evident, but it shares the positive role of interactions. In other words, FDI shows a complementarity with domestic investment and with export performance. Looking at the coefficients of the main and indirect effects of FDI growth, a threshold for domestic investment and export shares can be computed. Specifically, the threshold for food is 1%, for textiles 2% of

¹² For the subsample of advanced OECD countries, we have obtained a positive main effect of FDI growth on output growth in petroleum, chemicals and rubber. But this could be spurious if faster growth simply attracts more FDI than a weaker dynamism. Indeed, this does not translates into a higher growth of productivity, as can be read from table 3.

domestic investment share for achieving a positive effect of FDI growth on productivity; and the threshold for export share is at 9% for food but for textiles it has to be as high as 78%. Moreover, textiles always receive a positive direct effect from domestic investment and export performance implies a positive effect in both industries, food and textiles. We may conclude that investment and exports are necessary preconditions for FDI to result in higher productivity growth. We can further say that the effect is more or less limited to labour-intensive industries, such as textiles and food. The latter industry shows at the same time strong domestic demand with very characteristic local preferences. Thus, locally operating producers may be more suited to serve local tastes and needs. The textile industry is very different, but all the more important as an early industry in economic development. It provides employment for unskilled workers who enter the paid labour force at the same time. In combination with highly specialized machinery (provided for instance through foreign investors), a high degree of productivity can be achieved almost instantly and thus lead to a good export performance of the industry. This story is reflected in our estimation results.

Productivity growth in the industry conglomerate PETCHEM receives a positive effect from FDI, domestic investment and export growth in the subsample of catching-up countries. When we include the interaction terms, we find a complementary relationship with domestic investment and with openness again for the catching-up countries only. Again, the complementarity with these two variables reverses a negative direct effect once a critical threshold of investment and openness is attained. Looking at the coefficients of direct and interaction effects, for PETCHEM these thresholds are at 8% for domestic investment and at 27% for export performance. As we can see, the thresholds – and so complementarity - for domestic investment are higher for the capital intensive industries (around 8%) than for the lower tech industries (1-2%).

There is a qualitative difference in the results for the whole sample and for the split sample, with significant effects being restricted to the subsample of catching-up countries. Another qualitative difference lies in the fact that in this subsample, FDI also shows a significant impact on productivity growth in other industries, such as metals and mechanical products, electrical machinery and transport equipment. While the interaction with domestic investment implies a positive effect in metals and machinery, in the two other industries this interaction actually lowers the positive direct impact of FDI. The positive coefficient of FDI growth for productivity growth in the electrical machinery and transport equipment industry is not robust to alternative specifications and should therefore not be stressed here. Thus, the most technology and often also capital intensive industries in our sample do not turn out to be important when it comes to the effects of FDI on productivity growth. There is some evidence that FDI can additionally spur productivity growth if it is accompanied by an adequate level of domestic investment or sufficiently strong export orientation, however the evidence is weak in the high tech industries. It is however relatively strongly present in the labour and partly also resource intensive industries. This result is similar to the findings by Damijan and Rojec (2004), where they look for evidence of a “flying geese pattern” in five new EU member states. In line with a common criticism of the Flying Geese Model, which says that catching-up via FDI occurs mainly at the lower end of the technology spectrum and thus at earlier stages of development, they conclude that the new EU members could not rely to a major extent on FDI when attempting to catch-up in technologically advanced industries and/or more advanced stages of development. Our results confirm these findings more generally by extending the geographic range of the sample also beyond the European context and in particular including Asian economies.

Thus, our results point towards a strong role for the stage of development in the relationship between FDI and growth, which has also been emphasized in previous research (Borensztein et al. 1998, NRW 2001, Bloningen and Wang, 2005). More precisely, we find a

significant relationship between FDI and growth only for catching-up economies and not for the most advanced industrialized countries. By using productivity growth as our dependent variable we can assess the improvements in efficiency concomitant with increases in FDI in a certain industry/country pair. Our focus on individual industries here allows us to identify certain industries where inward FDI in combination with high investment or outward orientated production offers the greatest potential for economic growth given a certain stage of development. Again, these industries correspond in general to the more labour intensive and lower tech industries, which are important at earlier stages of economic development. Very often, we found a negative direct effect of FDI growth on productivity growth in these lower tech industries (food and textiles), but in combination with sufficient domestic investment or export orientation these effects are diminished or even reversed. This also happens for metal and mechanical products, while the results are less robust for this industry. As for the most technology and capital intensive industries, like electrical machinery and transport equipment, a positive direct effect of FDI growth on productivity growth is observed for catching-up countries, which is especially pronounced if domestic investment is low. However, no effects are found for these industries when FDI is interacted with openness rather than investment.

6. Conclusions

In this paper we use a newly established panel data set that combines data on FDI, output, trade and investment at the industry level for a range of highly industrialized as well as catching-up countries. With this we investigate the role of FDI for productivity growth and hence efficiency effects in the receiving economies. We argue that the aspect of heterogeneity in this relationship has largely been neglected in the empirical literature so far.

While recent studies emphasize increasingly cross-country heterogeneity, we additionally stress the effect of heterogeneity arising from the industrial structure of a country.

We can conclude from our empirical analysis that the impact of FDI on economic development (in terms of productivity and thus efficiency gains) differs between countries at different stages of development. The role for FDI is much stronger in catching-up economies. We should stress here that our sample includes moderately advanced, emerging countries in Eastern Europe and East Asia as well as very advanced OECD members. Thus, we do not make any statements about the truly less developed countries here. We can say that the effects of FDI are in general modest, and more important in the catching-up countries. This can also be argued by the fact that the importance of FDI in relation to output is in general greater in these countries compared to the most advanced economies. Thus, as a general result, FDI does not lead to miracles, but it can act as a valuable catalyst in certain stages of the catching-up process, as will be argued below.

Further, the results differ also across individual industries. The two patterns match closely in the sense that FDI plays a significant role in labour and partly also resource intensive industries, which are in general important at earlier stages of the catching-up process. For a country's long term prospects it is thus crucial, which types of industries receive foreign capital and not so much the aggregate amount of FDI flowing into a country. This has important implications for the design of industrial and trade policies as well as for policies restricting or allowing capital mobility across borders. The decisions, when, how, and which industries to open to the international capital market are important and should be guided by the long-run implications of FDI in different industries. We find in general a close match between the industries which are generally important during the process of catching-up (i.e. labour and resource intensive industries) and those industries, where FDI exerts a significant influence on productivity growth.

Secondly, not only does the industrial allocation in connection with the timing of FDI over the development process matter, there are also important interactions between FDI and domestic investment as well as between FDI and export orientation. FDI often turns out to be an important contributor to growth in combination with high investment or exports. This is especially true for the group of catching-up countries, where the interaction between openness and FDI is often positive while the direct effect of FDI is negative in many industries. Therefore, we conclude that FDI can be an important contribution to the host country's economic development, provided that the conditions and/or the economic environment is conducive to bringing out its positive impact. Further, the relationship between FDI and economic development implies a great deal of heterogeneity, thus the impact of FDI can differ substantially across countries and industries.

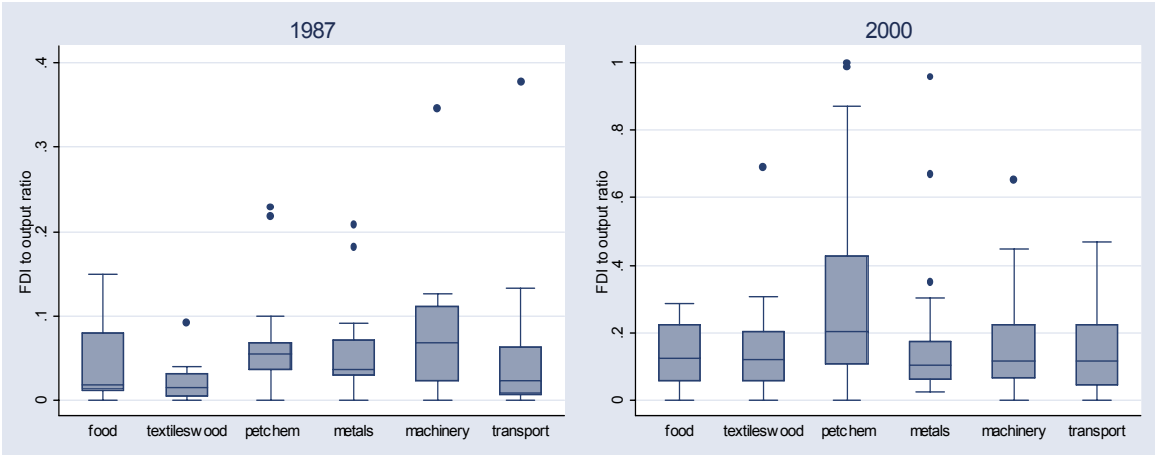
Finally, we should stress here again that the causality between FDI and growth remains unclear. In our setup, the issue of causality is addressed by using lagged values of FDI and all other explanatory variables in the regressions. Given limitations in the data (most importantly, the short time series dimension and the highly unbalanced sample) we were not able to do a rigorous causality test in this case. In a related paper (Stehrer and Woerz, 2006), we looked at the issue of causality for the subsample of OECD countries only. The results point towards a strong endogeneity between the two variables. Thus, further research should address this issue in more detail.

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Figure 1: Inward FDI stocks to output ratios, 1987 and 2000.



Note: The median is given by the bar in the middle of the box, the upper and lower bound of the box signifies the 25- and 75-percentile. Observations which are outside the 75-percentile plus 1.5 times the innerquartile range, as well as observations below the 25-percentile minus 1.5 times the innerquartile range are classified as outliers and drawn as dots.

Table 1: FDI-output ratios, 1998-2000.

| | adv. OECD | catch-up OECD | 4 Tigers | Emerging Asia | CEEC |
|-----------------------------|--------------|------------------|----------|------------------|------|
| Food | 4.6 | 10.5 | 7.1 | 2.9 | 13.7 |
| Textiles/Wood | 7.4 | 7.7 | 4.6 | 11.8 | 12.2 |
| Pet/Chem | 15.7 | 16.3 | 16.1 | 30.4 | 15.4 |
| Metals/Machinery | 5.7 | 13.3 | 4.5 | 9.0 | 9.1 |
| Transport | 3.6 | 9.5 | 4.6 | 6.7 | 18.6 |
| Electrical machinery | 6.6 | 8.3 | 12.4 | 11.1 | 13.7 |

Table 2: GLS estimation for the whole sample. (specific industry and country-trend dummies not reported)

| Variable | Industry | (1) | | (2) | | (3) | | (4) | | (5) | |
|--------------------|--------------------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|
| | | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| GFDI | Food | -0.0050 | -0.74 | -0.2333 | -11.56 | -0.0532 | -8.12 | -0.0065 | -0.96 | 0.1037 | 3.72 |
| GFDI | Textiles/Wood | -0.0066 | -1.12 | -0.1455 | -12.24 | -0.0504 | -7.47 | -0.0128 | -2.02 | 0.0591 | 2.66 |
| GFDI | PETCHEM | 0.0025 | 0.70 | -0.0956 | -6.00 | -0.0015 | -0.19 | 0.0140 | 1.88 | 0.0393 | 1.63 |
| GFDI | Metals/Mechanicals | -0.0006 | -0.20 | -0.0178 | -0.85 | 0.0008 | 0.16 | -0.0004 | -0.13 | -0.0095 | -0.44 |
| GFDI | Electr. Machinery | -0.0005 | -0.10 | 0.0212 | 1.17 | -0.0036 | -0.32 | -0.0004 | -0.07 | 0.0000 | 0.00 |
| GFDI | Transport | 0.0000 | 0.09 | 0.0146 | 1.47 | -0.0043 | -0.78 | 0.0009 | 0.13 | -0.0002 | -0.35 |
| GFDI | Other | 0.0000 | 0.00 | -0.0059 | -0.40 | 0.0005 | 0.04 | 0.0002 | 0.02 | 0.0009 | 0.03 |
| GFDI | N.A. | 0.0000 | 0.22 | -0.0055 | -0.52 | -0.0019 | -1.76 | 0.0000 | 0.16 | 0.0003 | 0.30 |
| GINV | Food | -0.0008 | -0.10 | -0.2698 | -11.34 | -0.0016 | -0.24 | -0.0004 | -0.06 | 0.0033 | 0.41 |
| GINV | Textiles/Wood | 1.7166 | 14.69 | 1.0016 | 8.94 | 1.2014 | 10.50 | 1.7336 | 14.88 | 1.6882 | 14.52 |
| GINV | PETCHEM | 0.6251 | 5.39 | 0.2270 | 1.96 | 0.6433 | 6.42 | 0.6385 | 5.52 | 0.6010 | 5.17 |
| GINV | Metals/Mechanicals | -0.1010 | -2.37 | -0.2165 | -1.72 | -0.0890 | -2.38 | -0.0988 | -2.32 | -0.0984 | -2.32 |
| GINV | Electr. Machinery | -0.0981 | -1.28 | -0.0800 | -1.11 | -0.0851 | -1.30 | -0.0962 | -1.26 | -0.0955 | -1.26 |
| GINV | Transport | -0.0131 | -0.52 | -0.0601 | -1.59 | -0.0109 | -0.50 | -0.0125 | -0.50 | -0.0122 | -0.49 |
| GINV | Other | -0.1159 | -2.17 | -0.1464 | -3.02 | -0.1059 | -2.27 | -0.1150 | -2.16 | -0.1157 | -2.14 |
| GINV | N.A. | -0.0002 | -0.29 | 0.0049 | 0.50 | -0.0002 | -0.28 | -0.1600 | -0.26 | -0.0002 | -0.27 |
| GEX | Food | 2.4770 | 141.47 | 1.9097 | 38.04 | 1.1321 | 13.08 | 2.4206 | 92.40 | 2.3749 | 77.18 |
| GEX | Textiles/Wood | 1.2470 | 12.89 | 0.6314 | 6.65 | 1.0935 | 12.94 | 1.2100 | 12.44 | 1.1962 | 12.30 |
| GEX | PETCHEM | 0.3142 | 3.70 | 0.2184 | 2.86 | 0.3165 | 4.33 | 0.3537 | 4.04 | 0.3001 | 3.55 |
| GEX | Metals/Mechanicals | 0.0963 | 0.88 | 0.0669 | 0.69 | 0.0822 | 0.85 | 0.0810 | 0.70 | 0.0979 | 0.90 |
| GEX | Electr. Machinery | -0.0306 | -0.28 | -0.0408 | -0.44 | -0.0369 | -0.40 | -0.0363 | -0.34 | -0.0326 | -0.31 |
| GEX | Transport | -0.0157 | -0.36 | -0.0133 | -0.35 | -0.0193 | -0.52 | -0.0160 | -0.37 | -0.0166 | -0.39 |
| GEX | Other | 0.0654 | 0.45 | 0.0590 | 0.47 | 0.0521 | 0.42 | 0.0690 | 0.47 | 0.0635 | 0.44 |
| GEX | N.A. | 0.0534 | 1.52 | 0.0497 | 1.65 | 0.0567 | 1.89 | 0.5340 | 1.53 | 0.0536 | 1.55 |
| GFDI*INV | Food | | | 4.9062 | 11.81 | | | | | | |
| GFDI*INV | Textiles/Wood | | | 3.8318 | 14.98 | | | | | | |
| GFDI*INV | PETCHEM | | | 1.9430 | 6.26 | | | | | | |
| GFDI*INV | Metals/Mechanicals | | | 0.4185 | 0.81 | | | | | | |
| GFDI*INV | Electr. Machinery | | | -0.2997 | -1.25 | | | | | | |
| GFDI*INV | Transport | | | -0.2933 | -1.47 | | | | | | |
| GFDI*INV | Other | | | 0.0690 | 0.48 | | | | | | |
| GFDI*INV | N.A. | | | 0.1108 | 0.52 | | | | | | |
| GFDI*EX | Food | | | | | 0.2084 | 15.78 | | | | |
| GFDI*EX | Textiles/Wood | | | | | 0.1517 | 9.89 | | | | |
| GFDI*EX | PETCHEM | | | | | 0.0087 | 0.57 | | | | |
| GFDI*EX | Metals/Mechanicals | | | | | -0.0062 | -0.28 | | | | |
| GFDI*EX | Electr. Machinery | | | | | 0.0005 | 0.31 | | | | |
| GFDI*EX | Transport | | | | | 0.0135 | 0.78 | | | | |
| GFDI*EX | Other | | | | | 0.0002 | 0.02 | | | | |
| GFDI*EX | N.A. | | | | | 0.0298 | 1.80 | | | | |
| GFDI*GDPpc | Food | | | | | | | 0.0002 | 2.90 | | |
| GFDI*GDPpc | Textiles/Wood | | | | | | | 0.0001 | 2.71 | | |
| GFDI*GDPpc | PETCHEM | | | | | | | -0.0000 | -1.75 | | |
| GFDI*GDPpc | Metals/Mechanicals | | | | | | | 0.0000 | 0.37 | | |
| GFDI*GDPpc | Electr. Machinery | | | | | | | -0.0000 | -0.30 | | |
| GFDI*GDPpc | Transport | | | | | | | 0.0000 | 0.13 | | |
| GFDI*GDPpc | Other | | | | | | | -0.0000 | -0.24 | | |
| GFDI*GDPpc | N.A. | | | | | | | 0.0000 | 0.11 | | |
| GFDI*SCHOOL | Food | | | | | | | | | -0.0003 | -4.01 |
| GFDI*SCHOOL | Textiles/Wood | | | | | | | | | -0.0003 | -3.08 |
| GFDI*SCHOOL | PETCHEM | | | | | | | | | -0.0002 | -1.54 |
| GFDI*SCHOOL | Metals/Mechanicals | | | | | | | | | 0.0001 | 0.42 |
| GFDI*SCHOOL | Electr. Machinery | | | | | | | | | -0.0000 | -0.08 |
| GFDI*SCHOOL | Transport | | | | | | | | | 0.0002 | 0.35 |
| GFDI*SCHOOL | Other | | | | | | | | | -0.0000 | -0.02 |
| GFDI*SCHOOL | N.A. | | | | | | | | | -0.0000 | -0.29 |
| CONST | | 0.2616 | 1.80 | 0.2901 | 2.41 | 0.2497 | 1.96 | 0.2682 | 1.84 | 0.2557 | 1.78 |
| adjusted R-squared | | 96.15 | | 97.28 | | 97.09 | | 96.19 | | 96.52 | |
| Std. Error of Reg. | | 0.5588 | | 0.4724 | | 0.486 | | 0.556 | | 0.5534 | |

Table 3: Results by stage of development.

(Specific industry and country-trend dummies not reported)

| | Variable | Industry | (1) | | (2) | | (3) | |
|----------|--------------------|--------------------|---------|---------|---------|----------|---------|--------|
| | | | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| OECD | GFDI | Food | 0.0028 | 0.56 | -0.0085 | -0.30 | -0.0007 | -0.18 |
| | GFDI | Textiles/Wood | -0.0003 | -0.06 | 0.0045 | 0.16 | -0.0004 | -0.09 |
| | GFDI | PETCHEM | 0.0012 | 0.46 | 0.0025 | 0.16 | 0.0034 | 0.83 |
| | GFDI | Metals/Mechanicals | -0.0004 | -0.17 | -0.0108 | -0.29 | -0.0004 | -0.15 |
| | GFDI | Electr. Machinery | -0.0024 | -0.26 | 0.0208 | 0.39 | -0.0056 | -0.52 |
| | GFDI | Transport | 0.0000 | 0.21 | 0.0022 | 0.15 | -0.0034 | -0.88 |
| | GFDI | Other | -0.0016 | -0.16 | -0.0002 | -0.02 | 0.0020 | 0.18 |
| | GFDI | N.A. | 0.0000 | 0.20 | -0.0010 | -0.10 | -0.0018 | -2.94 |
| | GINV | Food | -0.0220 | -0.07 | -0.0019 | -0.01 | -0.1050 | -0.49 |
| | GINV | Textiles/Wood | 0.0692 | 0.39 | 0.0685 | 0.44 | 0.0498 | 0.43 |
| | GINV | PETCHEM | -0.0338 | -0.19 | -0.0193 | -0.12 | -0.0302 | -0.26 |
| | GINV | Metals/Mechanicals | -0.0906 | -0.47 | -0.0880 | -0.54 | -0.0899 | -0.72 |
| | GINV | Electr. Machinery | -0.0892 | -0.40 | -0.1083 | -0.56 | -0.0854 | -0.59 |
| | GINV | Transport | -0.0092 | -0.10 | -0.0096 | -0.13 | -0.0010 | -0.02 |
| | GINV | Other | 0.1360 | 1.07 | 0.1373 | 1.27 | 0.1434 | 1.74 |
| | GINV | N.A. | -0.0162 | -0.25 | -0.0142 | -0.26 | -0.0076 | -0.18 |
| | GEX | Food | 0.0975 | 0.93 | 0.0998 | 1.12 | 0.0571 | 0.80 |
| | GEX | Textiles/Wood | 0.0205 | 0.19 | 0.0052 | 0.05 | -0.0078 | -0.11 |
| | GEX | PETCHEM | 0.0198 | 0.28 | 0.0275 | 0.44 | 0.0133 | 0.28 |
| | GEX | Metals/Mechanicals | 0.0734 | 0.81 | 0.0708 | 0.90 | 0.0774 | 1.28 |
| | GEX | Electr. Machinery | -0.0427 | -0.48 | -0.0515 | -0.67 | -0.0303 | -0.53 |
| | GEX | Transport | 0.0003 | 0.01 | 0.0000 | 0.00 | -0.0004 | -0.02 |
| | GEX | Other | -0.0213 | -0.15 | -0.0197 | -0.17 | -0.0172 | -0.19 |
| | GEX | N.A. | 0.0547 | 1.93 | 0.0548 | 2.29 | 0.0559 | 3.07 |
| | GFDI*INV | Food | | | 0.2393 | 0.40 | | |
| | GFDI*INV | Textiles/Wood | | | -0.1054 | -0.19 | | |
| | GFDI*INV | PETCHEM | | | -0.0231 | -0.08 | | |
| | GFDI*INV | Metals/Mechanicals | | | 0.2578 | 0.28 | | |
| | GFDI*INV | Electr. Machinery | | | -0.5317 | -0.43 | | |
| | GFDI*INV | Transport | | | -0.0434 | -0.15 | | |
| GFDI*INV | Other | | | -0.0285 | -0.10 | | | |
| GFDI*INV | N.A. | | | 0.0197 | 0.10 | | | |
| GFDI*EX | Food | | | | | 0.015032 | 1.5124 | |
| GFDI*EX | Textiles/Wood | | | | | 0.002725 | 0.16446 | |
| GFDI*EX | PETCHEM | | | | | -0.0052 | -0.6279 | |
| GFDI*EX | Metals/Mechanicals | | | | | -0.00065 | -0.0524 | |
| GFDI*EX | Electr. Machinery | | | | | 0.005653 | 0.35278 | |
| GFDI*EX | Transport | | | | | 0.01085 | 0.87543 | |
| GFDI*EX | Other | | | | | -0.0075 | -0.3997 | |
| GFDI*EX | N.A. | | | | | 0.029425 | 2.99002 | |

Table 3 continued on next page.

Table 3 continued

| | Variable | Industry | (1) | | (2) | | (3) | |
|--------------------|--------------------|--------------------|---------|--------|---------|---------|---------|--------|
| | | | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| non-OECD | GFDI | Food | 0.1514 | 5.08 | 0.0213 | 0.56 | -0.0310 | -1.50 |
| | GFDI | Textiles/Wood | 0.0000 | 0.00 | -0.1060 | -10.85 | -0.6302 | -25.62 |
| | GFDI | PETCHEM | 0.1323 | 3.47 | -0.3417 | -5.38 | -0.1787 | -3.85 |
| | GFDI | Metals/Mechanicals | -0.0357 | -1.14 | -0.0812 | -1.86 | 0.1085 | 2.39 |
| | GFDI | Electr. Machinery | 0.0002 | 0.04 | 0.0577 | 2.68 | -0.0227 | -0.91 |
| | GFDI | Transport | -0.0007 | -0.11 | 0.0314 | 1.74 | -0.0015 | -0.30 |
| | GFDI | Other | 0.0061 | 0.39 | -0.0195 | -0.70 | 0.0012 | 0.05 |
| | GFDI | N.A. | 0.0065 | 0.66 | -0.0233 | -0.84 | -0.0531 | -2.74 |
| | GINV | Food | 0.0041 | 0.71 | -0.1059 | -4.41 | 0.0016 | 0.42 |
| | GINV | Textiles/Wood | 1.6492 | 15.68 | 0.6040 | 5.82 | 0.0396 | 0.43 |
| | GINV | PETCHEM | 0.3297 | 2.93 | -0.0825 | -0.79 | 0.2772 | 3.74 |
| | GINV | Metals/Mechanicals | -0.0931 | -2.47 | -0.3346 | -2.53 | -0.0037 | -0.12 |
| | GINV | Electr. Machinery | -0.0981 | -1.71 | -0.0222 | -0.38 | -0.0452 | -1.20 |
| | GINV | Transport | -0.0136 | -0.71 | -0.0896 | -1.75 | -0.0006 | -0.05 |
| | GINV | Other | -0.1363 | -3.27 | -0.1732 | -4.71 | -0.1097 | -4.08 |
| | GINV | N.A. | -0.0004 | -0.87 | 0.0183 | 1.11 | -0.0001 | -0.41 |
| | GEX | Food | 2.3303 | 66.33 | 2.1289 | 42.90 | 0.1440 | 1.56 |
| | GEX | Textiles/Wood | 1.8404 | 19.97 | 0.2515 | 2.20 | 0.2226 | 2.63 |
| | GEX | PETCHEM | 0.8468 | 6.96 | 0.1759 | 1.40 | 0.5313 | 6.20 |
| | GEX | Metals/Mechanicals | 0.2150 | 1.32 | 0.0514 | 0.35 | 0.1126 | 1.07 |
| | GEX | Electr. Machinery | 0.0180 | 0.12 | 0.0655 | 0.50 | -0.0606 | -0.63 |
| | GEX | Transport | -0.0718 | -0.90 | -0.0136 | -0.13 | -0.0800 | -1.56 |
| | GEX | Other | 0.2016 | 1.27 | 0.1679 | 1.25 | 0.1089 | 1.07 |
| | GEX | N.A. | 0.2470 | 1.28 | 0.0074 | 0.05 | 0.1612 | 1.28 |
| | GFDI*INV | Food | | | 2.0129 | 4.75 | | |
| | GFDI*INV | Textiles/Wood | | | 5.7611 | 19.15 | | |
| | GFDI*INV | PETCHEM | | | 4.5401 | 8.69 | | |
| | GFDI*INV | Metals/Mechanicals | | | 1.0077 | 1.77 | | |
| | GFDI*INV | Electr. Machinery | | | -0.7196 | -2.70 | | |
| | GFDI*INV | Transport | | | -0.4719 | -1.72 | | |
| | GFDI*INV | Other | | | 0.1558 | 0.97 | | |
| | GFDI*INV | N.A. | | | 0.3972 | 1.12 | | |
| GFDI*EX | Food | | | | | 0.3539 | 24.44 | |
| GFDI*EX | Textiles/Wood | | | | | 0.8089 | 26.48 | |
| GFDI*EX | PETCHEM | | | | | 0.6563 | 7.84 | |
| GFDI*EX | Metals/Mechanicals | | | | | -0.4196 | -2.99 | |
| GFDI*EX | Electr. Machinery | | | | | 0.0030 | 0.93 | |
| GFDI*EX | Transport | | | | | 0.0045 | 0.27 | |
| GFDI*EX | Other | | | | | 0.0009 | 0.08 | |
| GFDI*EX | N.A. | | | | | 0.1755 | 3.25 | |
| CONST | | | 0.2568 | 2.37 | 0.2519 | 2.83 | 0.2499 | 3.24 |
| adjusted R-squared | | | 98.13 | | 98.75 | | 99.11 | |
| Std. Error of Reg. | | | 0.4100 | | 0.3410 | | 0.2871 | |

Appendix

Table A1: Listing of countries and grouping

| Group | UNIDO code | ISO code | Country |
|-----------------------|------------|----------|-----------------|
| advanced OECD | 36 | aus | Australia |
| | 40 | aut | Austria |
| | 208 | dnk | Denmark |
| | 246 | fin | Finland |
| | 250 | fra | France |
| | 276 | deu | Germany |
| | 352 | isl | Iceland |
| | 380 | ita | Italy |
| | 372 | irl | Ireland |
| | 528 | nld | The Netherlands |
| | 578 | nor | Norway |
| | 752 | swe | Sweden |
| | 826 | gbr | Great Britain |
| 840 | usa | USA | |
| catching-up economies | 191 | hrv | Croatia |
| | 203 | cze | Czech Republic |
| | 300 | grc | Greece |
| | 348 | hun | Hungary |
| | 344 | hkg | Hong Kong |
| | 360 | idn | Indonesia |
| | 428 | ltv | Latvia |
| | 410 | kor | Korea |
| | 484 | mex | Mexico |
| | 458 | mys | Malaysia |
| | 608 | phl | Philippines |
| | 616 | pol | Poland |
| | 620 | prt | Portugal |
| | 702 | sgp | Singapore |
| | 703 | svk | Slovak Republic |
| | 705 | svn | Slovenia |
| | 724 | esp | Spain |
| | 158 | twa | Taiwan |
| 764 | tha | Thailand | |
| 792 | tur | Turkey | |