The effects of international inward manufacturing outsourcing on welfare and productivity in developing economies

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Abstract

The purpose of this paper is to provide the first empirical study on the effects of outsourcing in the manufacturing sector on the economy of the host country. Due to the lack of data on outsourcing, this study uses proxy measures and utilizes static and dynamic econometric models to estimate the nature and magnitude of the impact of outsourcing in 121 developing countries in the period 2000-2013. The effects of outsourcing on productivity and welfare are analyzed using various proxy variables and are compared to those of inward FDI. Results obtained for developing countries in Asia are compared to those for all developing countries. The findings show that outsourcing has positive impact on the recipient economy, but the scope of the impact sets Asian countries apart from the rest.

Key words: inward manufacturing outsourcing, welfare, productivity, FDI, developing countries

1. Introduction

In the past few decades 'outsourcing' has become a buzzword not only in the corporate world but also in mass media, with the declining share of world output accounted for by countries traditionally defined as industrialized or developed, the rapid industrialization of formerly less industrialized and lower-income states, and most recently, the Global Financial Crisis of 2007-2008 having all contributed to the frequencification of the term. In countries perceived to be net sources of outsourcing, the term has been widely circulated in populist arguments related to the loss of jobs, higher unemployment and decreasing welfare. For that reason existing theoretical and empirical studies alike almost exclusively view offshore production through the lens of the source country, most commonly the USA. Research concerning inward outsourcing, however, has been scarce and almost entirely theoretical. The purpose of this study is to explore that niche by analyzing the effects of outsourcing on the welfare and productivity of the recipient economy. The focus is the manufacturing sector of developing countries, defined as non-high income by the World Bank. A novel method of calculating inward outsourcing is proposed and its impact is analyzed in both relative and absolute terms. The impact of outsourcing is also analyzed in comparative terms with regards to developing countries in Asia on the one hand, and all developing countries, on the other. The rest of this paper is structured as follows: section two discusses previous research on measuring outsourcing, section three presents our contribution to the outsourcing calculation methodology, section four deals with the data, sample and variables, section five outlines descriptive statistics and preliminary tests, section six contains the empirical analysis and section seven concludes the paper and suggests paths for future research.

2. Previous research

2.1. Offshoring: Outsourcing versus FDI

Considering the skill levels typically required, Alfaro and Charlton (2007) rank the various wealth creation practices in global production sharing in the following way:

Outsourcing – least skill-intensive

Vertical FDI (VFDI)

Horizontal FDI (HFDI) – most skill-intensive

Miroudot (2009) provides an excellent definition framework for the different kinds of sourcing. In practice, however, outsourcing and VFDI are so similar in their intent and purpose, that a number of authors have argued that there exists a tradeoff between VFDI and outsourcing from the firm's perspective, for example Antràs (2003, 2005), Grossman and Helpman (2002, 2004, 2005). Therefore, when measuring outsourcing the risk of including some VFDI is always present.

While there is a general consensus that FDI is largely beneficial to the host country, especially in terms of productivity gains (see Amiti, and Wei, 2006, Görg and Hanley, 2005, Egger and Egger, 2006, and Calabrese and Erbetta, 2005), there has been no genuine empirical research on how outsourcing affects the recipient economy. The most relevant study seems to by Grover (2005), who examines theoretically the benefits of a host country that can be attributed to outsourcing vis-à-vis FDI. Grover claims that the welfare of the host country is affected in a different way depending on whether production sharing arrangement is internalized by the parent firm in the form of a VFDI relationship or transacted externally through outsourcing contracts. Grover theorizes that a recipient county's ability to maximize welfare in these two regimes is contingent on its absorptive capacity. If the host country's absorptive capacity is above a threshold

level, outsourcing is more welfare enhancing vis-à-vis VFDI. Nonetheless, even with an absorptive capacity below this threshold, outsourcing being welfare-improving over VFDI cannot be dismissed. Grover defines absorptive capacity in terms of the skill level of the labor force. Based on evidence from existing literature, Grover hypothesizes that an unaffiliated supplier employs a higher skill intensive technique of production vis-à-vis a subsidiary. In other words, *ceteris paribus*, outsourcing is more skill-intensive than VFDI, partly because local firms use older and less productive technology than foreign subsidiaries, which means that in order to stay competitive they have to employ workers with better skills, who can compensate for the lack of modern technology. One purpose of the present study is to test this hypothesis by comparing the effects of FDI versus outsourcing on various aspects of the economy of the host country.

2.2. Measuring manufacturing outsourcing: Existing methodologies and issues

In this study, the focus is on outsourcing in the field of manufacturing, as opposed to overall outsourcing or outsourcing in services. The motivations are that (1) similar to Alfaro and Charlton's argument, by restricting the analysis to the manufacturing sector the results can be straightforwardly compared to the existing theories and findings which are more focused on manufacturing than services, (2) manufacturing can be measured relatively easily due to the availability of data, (3) so far no country has skipped the industrialization stage in its development and this is relevant considering that the focus of this study is developing economies, where the manufacturing sector is usually more important to the economy than it is in developed ones.

As far as measuring outsourcing in the manufacturing sector is concerned,

according to Glass Saggi (2001), Feenstra and Hanson (1996) were the first to model the effects of international outsourcing in an empirical study (again, in the sending country USA). They use intermediate goods to proxy for the amount of outward outsourcing. The use of trade in intermediates and the related intra-industry trade (IIT) as a proxy for outsourcing has various motivations, and these phenomena have become a focus of intensive study recently. Studies such as the one by Fontagne (2006) reveal interesting recent trends in IIT, showing that the largest flows of bilateral IIT on a world scale are recorded in the US-Canada and US-Mexico pairs. Fontagne uses the UN Broad Economic Categories (BEC) classification, which defines the main end-use of products (primary, intermediate, capital or consumption goods). This classification is utilized by a number of other empirical studies and is also made use of in the present one.

Additionally, Jones (2008) suggests that intermediate goods or services can be seen as just another form of capital, one that depreciates fully in production. In fact, a lot of studies have focused on the role of capital goods (i.e. mostly intermediate goods) in explaining differences in productivity levels across countries (Nordas et al, 2006). Lee (1995), for example, shows that the ratio of imported to domestically produced capital goods in the composition of investment has a positive effect on per capita growth rates.

In fact, Miroudot (2009) shows that trade in intermediate inputs is more important to boosting output in the host country than other crucial wealth creating practices such as FDI. Since the trade (especially imports) of intermediate/capital goods is an integral part of manufacturing outsourcing, then, we could conjecture that outsourcing positively influence productivity in recipient countries. Miroudot (2009)

provides a plausible explanation of why we should expect outsourcing or trade in intermediate goods to influence a country's productivity positively, stating that as foreign intermediate products are assumed to possess certain technological advantages over domestic ones (after all, the reason for their import is that they embody foreign technology), there must be a positive correlation between productivity (TFP) gains and the ratio of foreign inputs to domestic inputs.

In relation to this, Amiti and Konings (2007) also provide firm level evidence on imported inputs and productivity for Indonesian manufacturing firms for the period 1991 through 2001. They find that firms that use imported inputs are on the average 9.2% more productive than non-importing firms, implying that trade in intermediates might lead to large productivity in the host country. According to a later study by Halpern, Koren and Szeidl (2011) using product level data for Hungarian manufacturing firms during 1992-2003, a higher share of imported inputs increases the productivity of firms. The authors identify and disentangle two possible channels through which imported inputs may increase productivity. They find that 40% of the total productivity gains are due to better quality or technology of foreign inputs, while the remaining 60% of productivity gains come from what they call a complementarity channel referring to the idea that the combination of different inputs is greater than their sum.

Sitchinava (2008) summarizes all these methods and identifies three major types of existing measures using intermediate goods, namely (1) Trade in parts and components, (2) Proxies based on input-output relationships and (3) Others, i.e. processing trade. According to Sitchinava, the first method, trade in parts and components, has been the most common approach to assess the trade in intermediate inputs or global production sharing. Pioneered by Yeats (2001), this line of

methodology has focused on the trend of cross-border fragmentation of production, which initially began as North-North trade, but rapidly transitioned into trade between the developed and developing countries. The second input-output approach which estimates trade in intermediate goods combining data on total imports with output data to determine the extent of an industry's purchases of intermediate inputs from overseas suppliers. This is the measure proposed by Feenstra and Hanson (1996). The third group of measures tend to focus on a subset of trade in intermediates. They usually use highly industry-specific and product-specific disaggregated data which is the reason why they are usually greatly limited in the scope of their country, commodity, and year coverage.

2.3. Measurement issues

Empirical studies in the field of outward outsourcing, such as the ones outlined in the previous few paragraphs, only provide a vague basis for the calculation of outsourcing, since the factors that determine the direction of this phenomenon could be argued to differ significantly. In addition, as discussed by Feenstra (2010), there has been a lot of ambiguity surrounding the disentanglement of outsourcing and FDI, two phenomena which Feenstra collectively refers to as 'offshoring'.

In general, seminal studies like the ones by Feenstra and Hason, Hsieh and Woo (2005), Lawrence (1994), Slaughter (2000), Berman et al (1994) and Geishecker and Gorg all reply on data on imported intermediate inputs in order to measure outward outsourcing. This in itself means that a very strong assumption has been made about the relationship between the direction of outsourcing and that of trade in intermediates, which could cast doubts about the validity of what is 'inward' and 'outward'.

As is widely acknowledged, the label "Made in country X" implies that the

product was finished (assembled) in country X, but it provides neither information about the origin of the components contained in the final product nor information about their added value. The assembly, or the least skill-intensive, most labor-intensive part of the production process, and thus, supposedly, the link of the value chain that has the least amount of value added, is in fact the last step in the production cycle and it could easily claimed that outward outsourcing does not in fact involve importing intermediate inputs, but instead, final goods. Especially in the case of manufacturing it is logically the country of assembly, which is usually the labor-intensive low-wage country that is the recipient of outsourcing, that needs to import the unfinished goods from either the country where the final good is to be exported, or from a third country that has better technology. Hence, using intermediate imports as the sole factor in calculating outsourcing, there is always the risk of calculating the total amount (inward plus outward) outsourcing instead of outward outsourcing only, and there is also the risk of failing to include outward outsourcing that uses domestic inputs.

In addition to the inward-outward distinction, there exists the domestic-international distinction. As Geishecker and Gorg mention, Feenstra and Hanson's method does not capture the difference between domestic and international outsourcing sufficiently well. Geishecker and Gorg try to correct for this in their study by using normalizing input-output table by industry-level output.

Finally, there is the issue of FDI-outsourcing distinction, which is problematic if only intermediate input data is used when proxying for outsourcing. Following the initial seminal study of Feenstra and Hanson, in his 2010 study Feenstra in fact changed the word outsourcing to offshoring in order to include FDI and he uses the word 'offshoring' when he cites his previous studies on outsourcing. He proposes a

classification of international production sharing activities summarized in Table 1.

Consequently, the calculation method we propose in the next section tries to solve comprehensively or partly the following three crucial distinctions: (1) Outward vs. inward outsourcing, (2) Domestic vs. international outsourcing, and (3) Outsourcing vs. FDI.

3. Methodology used in this study

In order to measure the total international inward manufacturing outsourcing stock (TIIMOS) in the recipient economy *i* for year *t* we propose the following equation and use it to calculate outsourcing in the empirical part of the study:

$$\text{TIIMOS}_{\text{it}} = TIMIM_{it} - \left(\left[\frac{IMFDIS_{it}}{MVA_{it}}\right] \times \left[\frac{TMEX_{it}}{NGDP_{it}}\right]\right)$$

Table 2 provides abbreviation explanations. After the total amount of TIIMOS was calculated, outsourcing was also calculated as percentage of GDP and also per employee in the manufacturing sector. In addition, it should be noted that in the equation, the United Nations Broad Economic Categories (BEC) 121, 22, 32, 42 and 53 were used to define the term 'intermediate manufactured good' based on Ueki (2011) and Gaulier et al. (2005) who provide a definition of intermediates, according to which products with the following BEC codes can be considered intermediate goods. Refer to Table 3 for details.

We refer to outsourcing as 'stock' in the same way FDI is analyzed in terms of 'stock' and 'flows'. In fact, it could be argued that the term 'stock' might be irrelevant to trade and outsourcing, especially that the calculation of the latter in our framework relies on trade statistics. However, we would like to emphasize the fact that the 'flows' we are accounting to while referring to manufacturing outsourcing are not just flows of

goods to be exported after being processed, but rather, the total value of manufactured products produced by companies engaging in outsourcing activities, such as licensing and contracting. In this framework, whether filling an order from a foreign company can be considered outsourcing is questionable, and we cannot guarantee that it is excluded from our definition of outsourcing. In any case, however, our purpose is to broadly capture all production that somehow uses a foreign company's technology and exports at least part of its production to it. That is why we prefer to liken it to FDI and we symbolically call it 'stock'. Whether we choose to call it 'stock', 'value', 'intensity', 'magnitude' or 'flows', this equation could be considered the most significant theoretical contribution of this paper, since no similar method of calculating outsourcing has yet been put forward. The two major motivations for using exactly this formula were to:

(1) Separate manufacturing FDI from manufacturing outsourcing.

We do this by subtracting the amount of IMFDIS from the TIMIM, which, based on Feenstra's definition, we assume to proxy for both FDI and outsourcing. In turn, since data on manufacturing FDI is unavailable, we calculate the approximate extent of manufacturing FDI by multiplying the value of TIFDIS by the ratio of foreign affiliates in manufacturing of all foreign affiliates in the economy, obtained as a percentage of MNFA of TNFA. On the other hand, since TIMIM is flows, and IMFDIS is stock, we divide it by MVA in order to normalize its volume by accounting for annual changes in manufacturing output. FDI inflows would be inappropriate in this case, since they are often negative and their fluctuations from year to year would yield inconsistent data.

(2) Separate inward from outward manufacturing outsourcing

In order to do this, we include exports in the equation. Since in out framework inward

outsourcing would normally mean importing an intermediate inputs, bringing them one or several stages of production further down the value chain and exporting them as either again intermediate or as final products back to the outsourcing-sender country, we would like to control for the amount of merchandise exports, which include both final and intermediate products. Following this line of thought, merchandise exports should be positively correlated with the amount of inward outsourcing, since they are both not intended for domestic consumption, and they already include all the outsourcing-induced final and intermediate exports. Thus, by dividing TMEX by NGDP, we obtain a fraction which would be larger, the larger the merchandise exports are. This method also excludes energy commodities such as oil from the equation, whose insufficient relevance to the manufacturing outsourcing is also discussed by Feenstra and Hanson (1996). The inclusion of TMEX in the equation also helps us account for 'hidden' outsourcing, i.e. outsourcing industries using domestic inputs but exporting their production.

In addition to these two major, we would have liked to include in the formula two other considerations, namely to:

(3) Include non-intermediate non-energy foreign inputs for manufacturing outsourcing in addition to intermediate inputs.

(4) Include production of outsourced manufacturing industries intended for domestic consumption in addition to the ones exported back to the outsourcing-sending country.

Unfortunately, due to data constraints, accounting for these was at this stage beyond our capabilities. Although it could be argued that the opposite effects of these two potentially existent phenomena might cancel each other out, future research would be

necessary to ascertain the nature of any such effects.

4. Data, sample and variables

4.1. Data sources

In the data assembly process attention was paid to the following factors: the reputability of the data source, the availability of data over at least a decade for as many countries as possible to ensure a valid panel data analysis, and the standardization of data using units of measurements that ensure comparability without excessive data manipulation in order to ensure a reliable cross-country analysis. For various reasons not discussed here for considerations of space, data which would otherwise be useful to the present study, such as the one provided by ILO, UNIDO, OECD and several consultancies was eventually not used. Instead, data was primarily sourced from COMTRADE, UNCTAD, IMF, ITC and the World Bank.

In specific, data on imports of intermediate goods, which was used to construct the key independent variable in this analysis, was sourced from the COMTRADE unit of the UN. Data on international trade, FDI and other macroeconomic indicators was taken from UNCTAD and IMF. Data on various aspects of economic and social development was obtained from the World Bank. Data on the number of foreign affiliates in a country was taken from ITC. Additionally, data on various aspects of the quality of a country's institutions and political situation was sourced from the Heritage Foundation. The latter was used for constructing instruments using principal component analysis but those were used in the preliminary tests not reported in this paper. Table 4 provides the respective source for each variable in this study.

4.2. Sample size and time period

Data was sourced between June and September 2014, and it was assembled into a panel consisting of 176 countries, including representatives of all income groups and geographic regions of the world, small and large states alike, considered to be a representative sample, including more than 90% of the 193 UN member states. Some of the relatively large countries not present in the analysis include Uzbekistan, Tajikistan, North Korea, the DRC, Chad, Liberia, as well as some UN non-members with disputed sovereignty (e.g. Western Sahara, Somalia, Kosovo, the Vatican) and countries that only came into being recently and do not report independent data for the entire period of the study (East Timor, South Sudan etc.). It should be noted that since ITC provides data on the number of foreign affiliates only for developing countries, and since the focus of this study is inward outsourcing, which is believed to occurs mainly in low-wage countries, only non-high-income states were used in this analysis, amounting to a total of 121 counties for which key data was fully available (refer to Table 5).

The time period covered is the years 2000 through 2013. The resulting panel consists of over 60 relevant variables, rendering a total of about 150,000 country country-year-variable observations. Unfortunately, not every single cell contains data, but STATA defines the panel as strongly balanced, and unit-root tests (in this case, the Fisher unit-root test based on the augmented version of Dickey-Fuller test was used) did not suggest the presence of stationary data. Therefore, the sample data was deemed appropriate for the purposes of the study.

4.3. Variables

Table 4 provides a list of the variables used in the empirical part of this study.

The main independent variable of interest, whose effect is the focus of this study, is the amount of outsourcing, measured in relative terms as a percentage of a country's GDP and in absolute terms, as outsourcing per employee in manufacturing, using the authors' calculation method, as specified in the previous section.

Other independent variables include standard factors widely controlled for in related empirical literature such as macroeconomic, demographic and social indicators. Several dummy variables were also used to control for the income group and the geographical region of a country with respect to the main locations of outsourcing, namely developing Asia, Latin America and Eastern Europe in the broad sense.

The selection of dependent variables, on the other hand, was aimed at pinpointing factors that could be used as proxies for the intensity of manufacturing and productivity in the manufacturing sector, as well as proxies for the transfer of knowledge[1]. As a result, the following five variables were deemed the most appropriate and were carefully selected as dependent variables based on their relevance to the way in which outsourcing affect the welfare and productivity of the host country, since no direct measures are available. Dependent variables used to proxy for welfare and productivity were:

(1) Output (GDP) per employee in the economy

(2) Output (GDP) per employee in the manufacturing sector

Dependent variables used to proxy for productivity, efficiency and technology transfer were:

[1] In measuring technological transfer, Pachamuthu (2011) uses variables such as Research and Development expenditure per economically active population, Output per employee in manufacturing sector, Value added per employee in manufacturing sector, Output per employee of the specific industry, and Value added per employee of the specific industry, are considered in the case studies for developing the technology index function.

(3) Export efficiency, calculated by UNCTAD export value in USD divided by export volume (the physical amount of exports calculated on year-to-year basis at the SITC 3-digit level). If the coefficient is higher, the value added, in other words, the technology embodied in the exports, is greater signifying better technology in the exporting country. The aim of the unit value indices published by UINCTAD is to provide tentative estimates for most developing countries on a comparable basis

(4) High-tech exports as a percentage of total manufacturing exports

Dependent variables used to proxy for relative productivity of the manufacturing sector were:

(5) Value added of the manufacturing sector in the economy (GDP)

These dependent variables were expected to capture the direct positive effects of outsourcing on the economy, particularly on manufacturing, without focusing excessively on spillover effects, which are harder to measure.

5. Descriptive statistics and preliminary tests

After the selection of variables, descriptive statistics and preliminary test, such as correlations tests, were performed in order to ensure the presence of balanced and realistic data, the lack of multicollinearity, and hence the high degree of reliability and validity of the subsequent empirical analysis.

5.1. Amount of outsourcing

Table 5 summarizes the results of our calculation of the amount of TIIMOS as a percentage of a country's GDP. The numbers look reasonable, in most of the countries

the percentage of outsourcing is smaller than that of FDI, which is in accordance with expectations. There are not outliers, with the exception of Malaysia, which is a borderline case due to the apparently enormous amount of outsourcing there. The vast majority of countries exhibit a magnitude of outsourcing equivalent to 0-20% of GDP, the average is about 6%. For FDI the range is also about 1-20%, the average being about 8%. Considering the size of the manufacturing sector in the economy, these numbers are considered reasonable. Although the results exceeded our expectations I terms of lack of outliers and face-value validity with respect to real-world trends, naturally, they cannot be taken as exact estimates, due to several issues with the estimation, which are as undeniable as they are unsolvable given the availability of data.

First, due to the fact that nominal GDP is used to calculate outsourcing. We use nominal GDP, because if we are to use statistics of trade in intermediate goods as the base for this equation, we have to take into account that trade does not happen in purchasing power parity (PPP) dollars. Products are traded in nominal current currency units, and exchange rates obviously affect the amount and direction of trade flows to a very significant extent. On the opposite, PPP is generally agreed upon as the better way to measure the real size of the GDP of a country since it eliminates exchange rate fluctuations and price differences. In that sense, using nominal GDP to measure the extent of outsourcing is both necessary and problematic, since although generally high, correlation levels between nominal and real (PPP) GDP levels are not 1.0, being around the 0.8-0.9.

Another potential problem with the method used here is discussed by Miroudot (2009), who argues that an unavoidable drawback of the BEC classification used by the UN is that the allocation of commodities according to their main use is based on expert

judgment, which is by nature subjective. Many goods might be both final and intermediate depending on the context.[2] A related problem might be buying intermediate goods with the aim of reselling them. A recent media example concerned Russia, which buys Iranian oil, refines it and sells it, avoiding sanctions and embargoes. However, as energy-related intermediate inputs are not included in our method, it is hoped that this should be no significant concern in the present study.

Despite the above-mentioned issues, when the rankings of countries receiving the largest shares of outsourcing as a part of their GDP using our estimation method is compared to a list of 'outsourcing hot spots' published by influential consulting firms, it can be observed that the rankings are highly consistent: compare Tables 5 and 6. Therefore, considering that the composition of the rankings and reports by major consultancies in the field of outscoring fit very well with our estimations, we confidently proceed with the empirical analysis.

5.2. Comparing FDI and outsourcing

Concerning the FDI-outsourcing distinction, we proceed to check if our calculation methodology fits the expectations that FDI is much larger in scale than outsourcing. Table 5 compares the percentage of inward manufacturing FDI stock and that of inward manufacturing outsourcing stock and the expectations are largely met: FDI is larger than outsourcing in most countries (about two thirds). There is still 43 countries (a third of the sample) where outsourcing is larger than FDI in the manufacturing sector but a more careful analysis shows that the actual number is much

[2] For instance, wheat flour belongs to BEC 121 - Processed food and beverages mainly for industry - and is hence classified as intermediate. Despite being an important input for the food industry, flour is also a consumption good for many households.

lower: the countries with population of over 1 million where outsourcing is significantly larger in magnitude than FDI (more than 1% difference, as a GDP ratio) and is significant in its sheer size (more than 1,5% of GDP), are concentrated in Eastern Europe and East Asia.[3] This is also the case in four natural resource exporters (Oman, UAE, Algeria and Botswana). This observation is in line with both our expectation and with ranking provided by the most influential consultancies in the field of investing and outsourcing, such as the ones in Table 6.

5.3. Correlations tests

In order to ensure the lack of multicollinearity in the subsequent analyses, a correlation test was run to establish the presence of highly correlated variables. The variables that turned out to be highly correlated are FDI stock and the amount of trade at the per capita level and variables measuring the same phenomenon from a slightly different angle, such as GDP per capita and GDP per employed person. Since none of these variables were used simultaneously in the same model, there were no concerns about multicollinearity which gave green light for the subsequent analysis. For detailed Pearson correlation coefficients, refer to Table 7.

6. Empirical analysis

6.1. Regression models

In order to reduce further the probability of multicollinearity and to standardize the indicators as much as possible, following the practice in empirical literature, all

[3] These countries are Philippines, Rep. of Korea, Thailand, Malaysia, Belarus, Czech Rep., Hungary, Rep. of Moldova, Slovakia, Slovenia, Oman, UAE, Algeria, Botswana, Kyrgyzstan, Guinea and Zimbabwe. Of all these, Malaysia is the only notable case, where outsourcing represents more than a quarter of the economy, and could be considered borderline outlier.

variables used in the analyses reported here are in their natural log format (ln).

The regression models calculated next were all calculated using relative values, meaning the amount of outsourcing and FDI as percentage of the GDP of the country, and using absolute values, meaning the absolute value of outsourcing and FDI per employee in the manufacturing sector. This was done with the purpose of obtaining more accurate idea of the impact of these phenomena, and also considering that some of the dependent variables in the models are ratios and other are absolute values. Using natural logarithms to a large extent solved this issue, but nonetheless both relative and absolute measures were used so as to investigate the issue as comprehensively as possible. In addition to static models, dynamic models were calculated too in order to explore the causal relationship between outsourcing and FDI on the one hand and welfare and productivity increases in the host country on the other. Tables 8 and 10 provide a summary of results from the static models, and Tables 9 and 11 – of the dynamic. The following models were estimated using OLS and fixed effects (FE) with robust standard errors respectively:

(1) $lny_{ij} = \alpha + \beta_1 lnOutsourcing_{ij} + \beta_2 lnInwardFDI_{ij} + \beta_3 lnGDPperEnergyUnit_{ij} + \varepsilon_{ij}$

(2) $lny_{ij} = \alpha + \beta_1 lnOutsourcing_{ij} + \beta_2 lnInwardFDI_{ij} + \beta_3 lnGDPperEnergyUnit_{ij} + \beta_5 AsiaDummy_{ij} + \beta_6 EasternEuropeDummy_{ij} + \beta_7 LatinAmericaDummy_{ij} + \varepsilon_{ij}$

Dynamic models (Arellano-Bond 'xtabond' method with robust standard errors) using one lag and two lags of the independent variables respectively:

(3) $lny_{j,j} = \alpha + \beta_1 lny_{,j-1} + \beta_2 lnOutsourcing_{i,j} + \beta_3 lnOutsourcing_{i,j-1} + \beta_5 lnInwardFDI_{ij} + \beta_6 lnInwardFDI_{i,j-1} + \varepsilon_{ij}$

(4) $lny_{j,j} = \alpha + \beta_1 lny_{,j-1} + \beta_2 lnOutsourcing_{i,j} + \beta_3 lnOutsourcing_{i,j-1} + \beta_4 lnOutsourcing_{i,j-2} + \beta_5 lnInwardFDI_{ij} + \beta_6 lnInwardFDI_{i,j-1} + \beta_7 lnInwardFDI$

$_{i,j-2} + \varepsilon_{ij}$

In these models y stands for the five dependent variables considered to be representative for the purpose of the study. A list of them plus the motivations behind their selection can be found in section 4.3 above. In the dynamic models only the essential variables were included for considerations concerning the limited number of observations.

Naturally, dummy variables were only included in the OLS models. In fact, the OLS method was solely used in order to observe the effects of the dummy variables. Otherwise, according to the Hausman test of random vs. fixed effects, the latter should be considered more appropriate in this case, given that there is great variation among countries in the sample. Thus, in the following paragraphs FE results are considered.

6.2. Results and analysis: all developing countries

Static models

Relative values: The results reveal that when considered in relative terms, as a percentage of GDP, outsourcing does not have significant effects on any of the dependent variables measuring welfare and productivity. On the other hand, FDI does have a major positive effect on export efficiency. See Table 8.

Absolute values: When using the absolute value of outsourcing per employee in manufacturing, however (Table 10), it can be observed that outsourcing has large, positive and significant effects on export efficiency and on both GDP per employee in the economy and on GDP per employee in manufacturing. As expected, the effect on GDP per employee in manufacturing (0.265) is much larger than that on GDP per employee in general (0.048). Since we are looking at manufacturing outsourcing this

result makes perfect sense. The large effect on export efficiency demonstrates that outsourcing does have a positive impact on the transfer of technology and on productivity levels.

Manufacturing FDI, on the other hand, affects GDP per employee in manufacturing equally much. However, unlike outsourcing, it does not seem to affect export efficiency. In brief, outsourcing seems to affect both welfare and productivity, while FDI only affects welfare.

The effects of the dummy variables are also in line with expectations. Asian countries reveal a great advantage when it comes to manufacturing, both in terms of its value added in the economy, and in terms of GDP per employee. On the opposite, Asian countries lag behind their Eastern European and Latin American counterparts when it comes to GDP per employee in general. This means that Asia has a great comparative advantage in manufacturing, which probably explains why it is considered number one regions for outsourcing attractiveness. The consistency of the results with expectations and actual data support the validity of our analysis.

Significant effects are summarized in Table 16, where 'A' means that there were significant effects for the respective variable in the absolute value models, and 'R' – in the relative values model.

Dynamic models

In order to check if a real causal relationship exists between outsourcing and welfare and productivity as revealed by the static analysis, we proceeded to perform a dynamic estimation based on the Arellano-Bond method, which uses lagged variables as instruments. Tables 9 and 11 summarize the results using the relative and absolute

calculation methods respectively. The obtained results confirm the robustness of our results.

Relative values: In the models using relative values, outsourcing significantly affects GDP per employee in the economy, GDP per employee in manufacturing and export efficiency in the two-lag model. In addition, its coefficient is also significant with regards to the value added of manufacturing in the economy in both one-lag and two lags models. Just like in the absolute-value static model, we observe a confirmation of the expectation that the effect on GDP per employee in manufacturing in particular is quite larger than the effect on GDP per employee in the economy in general. FDI, on the other hand, affects GDP per employee in the economy, GDP per employee in manufacturing and export efficiency much more than outsourcing and it does so in both one-lag and two-lag models. This is once again in line with expectations, as the size of FDI in manufacturing is larger than that of outsourcing for the majority of countries, as demonstrated in the descriptive statistics section of this paper. To summarize, in the static models, outsourcing and FDI seem to have similar effects, the effects of FDI being larger than those of outsourcing. The important thing here is that the results are in line with the ones obtained from the static models, and they confirm the presence of causality.

Absolute values: In the models using absolute values, outsourcing significantly affects GDP per employee in the economy and on GDP per employee in manufacturing in both one and two-lag models. As expected, its effects on GDP per employee in manufacturing are larger than those on GDP per employee in the economy. Interestingly, FDI does not appear as significantly affecting GDP per employee in manufacturing. However, FDI does seem to affect export efficiency in the one-lag model and GDP per

employee in the economy in both one and two-lag models. Significant effects are summarized in Table 17, where letters in bold signify that the significance from the static model is replicated:

The overall conclusion about the impact of outsourcing and FDI in the manufacturing sector of developing countries, therefore, is that whereas outsourcing has important implications for GDP per employee in manufacturing, and therefore smaller-scale effects for GDP per employee in general, reflecting a positive impact on welfare, FDI matters more for efficiency (productivity) and overall GDP in general (i.e. not specifically in the manufacturing sector), potential having broader and more spread-out, spill-over-like effects on the economy. By induction, we could posit that whereas outsourcing is rather welfare-enhancing and more focused in its impact, FDI is more productivity-enhancing and its impact is rather diffuse and non-concentrated. The ensuing analysis suggests that this, however, might not be the case in developing counties in Asia.

6.3. Results and analysis: developing countries in Asia

Static models

Relative values (Table 12): Here the only significant effects that can be observed are the positive ones exerted by outsourcing on the value added of the manufacturing sector in the economy. Interestingly, FDI has negative significant effects on the same variable, but they are very small and can be ignored since they could be attributed either to the small amount of multicollinearity that is unavoidable, or to the fact that the value added of manufacturing usually decreases as a country develops, but the amount of FDI usually increases. It should be taken into account that DSI and

outsourcing are motivated by different consideration, the major one for outsourcing being cheap labor, while the main ones for FDI including potential markets, and especially for VFDI, educated (and cheap) labor. Here it is worth mentioning that although all models are calculated using natural logarithms, independent variables based on relative values are more likely to have significant effect on dependent variables using relative values such as the percentage of high-tech exports of total exports, or the value added of manufacturing in the economy. The results so far have confirmed this hypothesis.

Absolute values: Turning to models using absolute values, summarized in Table 14, it is observed that outsourcing has positive effects on GDP per employee in manufacturing and on export efficiency. This is very much in line with the results obtained about all developing countries in general. FDI, on the other hand, exhibits significant effects on GDP per employee in manufacturing too (the only significant effects of FDI), but these are twice as large as the effects of outsourcing – the coefficients are respectively 0.529 and 0.257. The results of the static models are summarized in Table 18 in the already established format.

Dynamic models

Relative values (summarized in Table 13): Using the relative values method, outsourcing exhibits very significant effects on output per manufacturing employee in both one-lag and two-lag models. FDI had significant impacts on output per manufacturing employee and export efficiency too, its coefficients being comparable to those of outsourcing, showing a similar effect. However, FDI also showed significant effects on export efficiency, in contrast to outsourcing, which did not.

Absolute values (Table 15): When absolute values per manufacturing employee were considered, outsourcing had very significant effects on GDP per employee in manufacturing in both one-lag and two-lag models. In addition, large effects are observed on export efficiency and on GDP per employee in the one-lag model, and on the percentage of high-tech exports in the two-lag model. FDI, in turn, showed significant impacts on GDP per employee in manufacturing and on high-tech exports in the two-lag model, on the value added of manufacturing in the one-lag model.

Although the coefficients of the lagged FDI variables are larger than those of outsourcing in the absolute model, concerning GDP per employee in manufacturing, they are not significantly different in the relative models and in the one-lag absolute model they are not significant, in contrast to those of outsourcing. This points to the conclusion that these two phenomena causally affect productivity and technological advancement in similar and comparable ways. Significant effects are summarized in Table 19.

In final summation, Asian developing countries appear to differ from the rest in that in the rest outsourcing is welfare rather than productivity enhancing, and FDI – productivity rather than welfare-enhancing, in Asia there is no such distinction and the two phenomena seem to affect the economies in similar ways. It could even be claimed that, on the opposite, outsourcing in more productivity-enhancing than FDI, especially looking at the summary table above. Considering Figures 1 and 2 might cast some light on why this is so. Hypothetically, in economies where manufacturing is focused on high-tech exports, but labor force is relatively poorly educated, outsourcing, which relies on cheap labor, might indeed provide better productivity-enhancing technology transfer opportunities than FDI, which is skewed more towards countries with highly

educated labor force, as evidenced from the FDI distribution among developing and developed countries. Therefore, which practice is more beneficial to a country might entirely depend on the structure of its economy (or manufacturing, for that matter) and also on the characteristics of its labor force.

7. Concluding remarks

In the current framework, countries managing to orient their manufacturing towards high-tech industries, while lagging behind in terms of human capital, can benefit more from outsourcing than the rest in terms of productivity gains. Considering that productivity gains are more important in the long-term than immediate welfare gains, it could be interpreted as a policy recommendation that countries with such profiles should prioritize outsourcing over FDI. On the opposite, human-resource-abundant countries lacking high-tech industries should aim at attracting FDI.

Since this study is the first empirical attempt at calculating outsourcing, it is far from comprehensive, and there are many paths for improving both the calculation method proposed here and the interpretations of results. In addition to that, our suggestions for future research include performing empirical analyses based on exploring the impacts of outsourcing across different income groups of countries, on countries with different size, on different time periods, on more world regions, on natural-resource exporters vis-a-vis the rest, and across many other different sections and strata of data, as well as using modified versions of our equation, industry-segregated data as well as different regression models. At any rate, it is hoped that this paper has made the first step towards understanding better the impact of outsourcing in the recipient economy.

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Appendix

Table 1. Organization choices for the firm by Feenstra (2010)

		Location of production process	
		Home country	Foreign country
Ownership of production process	In-house	Integration	Multinational
	Outsource	Domestic outsourcing	Foreign outsourcing

Table 2. Abbreviations used in the estimation method

TIIMOS	Total international inward manufacturing outsourcing stock
TIMIM	Total intermediate manufacturing imports in BEC 121, 22, 32, 42 and 53
IMFDIS	Inward manufacturing FDI stock
TNFAT	Number of foreign affiliates in the economy
MNFA	Number of foreign affiliates in the manufacturing sector
TIFDIS	Total inward FDI stock
MVA	Total value added of manufacturing in the economy (GDP)
TMEX	Value of total merchandise (manufacturing) exports
NGDP	Value of total nominal GDP

Table 3. Definition of intermediate goods by based on Ueki (2011) and Gaulier et al. (2005)

3-stage product classification	5-stage product classification	BEC code	Title in BEC
Intermediate goods	Semi-finished goods	121	Foods and beverages mainly for industry
		22	Processed industrial supplies not elsewhere specified
		32	Processed fuels and lubricants
	Parts and components	42	Capital goods (except transport equipment), and parts and accessories thereof
		53	Transport equipment and parts and accessories thereof

Table 4. List of variables and their sources

Category	Variable	Source
Variables used for calculating inward manufacturing outsourcing (independent variable of interest)	Intermediate imports in BEC 22, 32, 42, 53, 121, total	COMTRADE
	Intermediate imports in BEC 22, 32, 42, 53, 122, percentage of total imports	COMTRADE (calculated)
	Number of foreign affiliates in manufacturing	calculated based on ITC data
	Merchandise exports, total value	UNCTAD
	Manufacturing, value added in GDP	World Bank
	GDP, total (nominal)	World Bank
	Inward FDI stock, total	UNCTAD
Proxies for productivity in the manufacturing sector (dependent variables)	GDP per employed person in the economy	World Bank (calculated)
	GDP per employed person in manufacturing	World Bank (calculated)
	Percentage of people employed in manufacturing	World Bank
	GDP percentage generated by manufacturing	World Bank
	High-tech exports as a percentage of manufacturing exports	World Bank
	Exports efficiency (Exports value divided by volume)	UNCTAD (calculated)
Macroeconomic, demographic and social indicators usually controlled for in empirical literature (control variables)	GDP, total (nominal)	World Bank
	GDP, total (purchasing power parity standards)	World Bank
	GDP, per capita (nominal)	World Bank
	GDP, per capita (purchasing power parity standards)	World Bank
	GDP growth rate, total	World Bank
	GDP growth rate, per capita	World Bank
	GNI, total	World Bank
	GNI, total per capita	World Bank
	Inflation rate	IMF
	Corporate tax rates	World Bank
	Inward FDI stock, total	UNCTAD
	Inward FDI stock, per capita	UNCTAD
	Inward FDI stock, as a percentage of GDP	UNCTAD
	GDP per square kilometer in USD (economic density and intensity)	World Bank (calculated)
	Total imports and exports, total	UNCTAD
	Total imports and exports, per capita	UNCTAD (calculated)
	Total imports and exports, as a percentage of GDP	UNCTAD
	Merchandise trade as a percentage of GDP	UNCTAD
	Import volume index (2000 = 100)	UNCTAD
	Import value index (2000 = 100)	UNCTAD
	Export volume index (2000 = 100)	UNCTAD
	Export value index (2000 = 100)	UNCTAD
	Gross national savings as a percentage of GDP	World Bank
	Net migration	World Bank
	GINI index (proxy for differences in income of skilled vs non-skilled labor)	World Bank
	Protection of property rights index	Heritage Foundation
	GDP percentage generated by the extraction of natural resource	World Bank
	Logistics index by the World Bank	World Bank
	Gross fixed capital formation as a percentage of GDP	World Bank
	GDP per unit of energy	World Bank
	Electricity consumption per capita	World Bank
	Tertiary enrollment ratio	World Bank
	Intellectual property payments (USD)	World Bank
	Intellectual property receipts (USD)	World Bank
	R&D technicians per million people	World Bank
	Patent applications by residents	World Bank
	Labor force participation rates	World Bank
Dummy variables for income categories (based on the World Bank)	High-income countries (GNI per capita of $12,746 or more in 2013)	World Bank
	Upper middle income countries (GNI per capita between $4,125 and $12,746 in 2013)	World Bank
	Lower middle income countries (GNI per capita between $1,045 and $4,125 in 2013)	World Bank
	Low-income countries(GNI per capita of less than $1,045 in 2013)	World Bank
Dummy variables for major outsourcing host regions	Latin America (The American continents south of the USA excluding small island nations in the Caribbean)	World Bank
	Asia (non-high-income countries in South, Southeast and East Asia, excluding the Middle East and the former USSR)	World Bank
	Central and Eastern Europe (former Communist countries, some of them currently EU members, some part of the former USSR)	World Bank

Table 5. Top recipients of manufacturing outsourcing and FDI as % of GDP, averaged for 2000-2012. Outsourcing calculated using the authors'' methodology.

Country ranking by outsourcing intensity	Inward manufacturing Outsourcing, % of GDP	Inward manufacturing FDI, % of GDP	Manufacturing, % of GDP	Country ranking by outsourcing intensity	Inward manufacturing Outsourcing, % of GDP	Inward manufacturing FDI, % of GDP	Manufacturing, % of GDP
1. Malaysia	45.2	18.3	26.9	62. Saudi Arabia	3.5	3.9	10.1
2. Viet Nam	27.2	26.5	18.4	63. Chile	3.5	13.0	14.0
3. Slovakia	25.8	17.2	23.3	64. Gabon	3.5	1.4	4.3
4. Hungary	22.3	19.7	22.4	65. Ecuador	3.4	5.4	14.1
5. Czech Rep.	22.1	16.9	24.7	66. Nigeria	3.4	7.9	4.1
6. Thailand	20.7	16.9	34.3	67. Croatia	3.2	5.7	17.1
7. Malta	17.6	25.3	16.8	68. Solomon Isds	3.2	5.2	6.7
8. Slovenia	16.5	7.6	23.7	69. Madagascar	3.1	4.2	13.6
9. Belarus	15.2	4.2	31.4	**70. Senegal**	3.0	1.6	15.0
10. Guyana	14.6	9.0	5.9	71. Ghana	3.0	4.7	8.5
11. Suriname	14.4	2.8	19.1	**72. Algeria**	3.0	1.9	7.5
12. Cambodia	13.1	19.7	17.6	73. Nicaragua	2.9	10.3	15.3
13. Mauritania	12.9	12.2	8.2	74. Jamaica	2.9	17.0	9.3
14. Papua New Guinea	12.0	6.4	7.1	75. Tanzania	2.7	5.6	9.2
15. UAE	11.7	2.3	10.2	76. Lebanon	2.6	18.5	9.5
16. Moldova	11.3	6.1	15.1	**77. Syria**	2.6	1.3	7.7
17. Honduras	11.0	10.6	20.1	**78. Iran**	2.5	2.2	11.6
18. Seychelles	10.5	7.0	11.4	**79. Kenya**	2.4	1.4	11.3
19. Philippines	10.5	5.1	23.1	80. Dominica	2.4	31.1	5.2
20. TFYR of Macedonia	10.1	14.7	17.1	81. Armenia	2.4	7.8	13.3
21. Bulgaria	9.9	20.5	16.3	82. Dominican Rep.	2.3	7.5	24.0
22. Tunisia	9.5	22.5	17.9	83. South Africa	2.2	12.5	16.5
23. Lithuania	8.5	7.8	19.2	84. Georgia	2.2	8.3	12.0
24. Jordan	8.5	12.3	18.6	85. Turkey	2.1	4.5	19.2
25. Fiji	8.2	17.7	14.3	**86. Bangladesh**	2.1	1.6	16.9
26. Kyrgyzstan	8.0	5.0	16.0	87. Niger	2.0	1.0	5.8
27. Costa Rica	7.8	7.6	20.2	**88. Benin**	2.0	0.8	7.9
28. Oman	7.8	2.2	7.6	89. Albania	2.0	3.4	8.9
29. Botswana	7.6	6.1	6.3	90. Egypt	1.9	7.2	16.7
30. Rep. of Korea	7.4	4.5	28.9	91. Saint Lucia	1.7	12.2	4.4
31. Zimbabwe	7.2	2.8	14.9	92. Peru	1.7	4.6	16.6
32. Mauritius	6.9	0.9	19.5	93. Uruguay	1.7	3.7	15.5
33. Bosnia Herzegovina	6.8	8.7	11.9	94. Venezuela	1.6	8.8	16.5
34. Belize	6.6	3.5	11.6	95. Barbados	1.5	3.1	7.9
35. Trinidad and Tobago	6.6	16.9	6.3	96. Fmr Sudan	1.5	3.8	6.9
36. Ukraine	6.6	6.2	19.1	97. Argentina	1.5	5.4	18.7
37. Namibia	6.5	6.0	13.9	98. Bahamas	1.5	3.4	4.5
38. Brunei Darussalam	6.2	7.5	13.2	99. Vanuatu	1.5	6.9	4.4
39. Latvia	6.2	9.1	12.4	**100. Nepal**	1.5	0.6	7.8
40. Panama	6.1	6.0	7.7	101. St Vincent	1.5	9.5	5.7
41. Zambia	6.0	19.7	10.3	102. St Kitts and N.	1.4	9.1	7.3
42. Congo	5.9	13.4	4.3	103. Russia	1.4	4.8	16.4
43. Kazakhstan	5.2	13.4	13.7	104. Pakistan	1.2	2.5	15.0
44. Azerbaijan	5.2	16.0	6.1	105. Cameroon	1.2	2.8	19.1
45. Poland	4.9	8.4	18.2	106. Uganda	1.2	3.2	8.0
46. Mozambique	4.8	10.5	14.6	107. Cyprus	1.2	1.8	8.8
47. Togo	4.8	1.3	8.6	108. India	1.1	3.4	15.0
48. Guinea	4.5	2.3	6.1	109. Grenada	1.1	13.4	4.1
49. Mexico	4.4	8.3	17.9	110. Colombia	1.0	5.4	14.7
50. Yemen	4.4	1.4	6.7	111. Antigua and B.	1.0	5.5	2.2
51. Malawi	4.4	3.8	11.4	112. Ethiopia	1.0	3.0	5.2
52. Libya	4.2	0.3	4.7	**113. Burundi**	0.7	0.3	11.2
53. Samoa	4.1	17.5	12.9	114. Sri Lanka	0.6	1.4	18.1
54. Indonesia	4.0	8.0	26.8	115. Brazil	0.6	8.3	16.5
55. Cote d'Ivoire	4.0	6.9	13.4	116. Tonga	0.5	5.1	8.4
56. Mali	4.0	0.7	3.2	117. Gambia	0.5	2.8	6.0
57. China	4.0	7.8	32.3	118. Rwanda	0.5	1.2	6.2
58. El Salvador	3.9	5.1	22.3	119. CAR	0.5	4.6	6.4
59. Bolivia	3.8	11.1	14.4	**120. Afghanistan**	0.4	0.3	15.8
60. Morocco	3.7	10.7	16.0	121. Cabo Verde	0.3	8.4	7.1
61. Guatemala	3.6	5.0	20.2	Total	6.1	7.7	13.4

Table 6. Top Rated Outsourcing Countries according to major consultancies (2014)

AT Kearney (2014)	Clutch (2014)	Tholons (2014)	Gartner, Inc. 2010-11 (not ranked)	Sourcing Line Rankings (2014)
India	India	India	Argentina	India
China	Indonesia	Philippines	Brazil	Indonesia
Malaysia	Estonia	Poland	Chile	China
Mexico	Singapore	Ireland	Colombia	Bulgaria
Indonesia	Bulgaria	China	Costa Rica	Philippines
Thailand	China	Costa Rica	Mexico	Jordan
Philippines	Philippines	Czech Rep	Panama	Singapore
Brazil	Lithuania	Vietnam	Peru	Thailand
Bulgaria	Thailand	Malaysia	Bangladesh	Lithuania
Egypt	Malaysia	Sri Lanka	China	Egypt
Poland	Chile	Brazil	India	Malaysia
Vietnam	Egypt	South Africa	Indonesia	Estonia
Chile	Jordan	Chile	Malaysia	Chile
US	Czech Rep	Hungary	Philippines	Hungary
Lithuania	Hungary	Argentina	Sri Lanka	Poland
Sri Lanka	Poland	Singapore	Thailand	Czech Rep
Germany	Argentina	Russia	Vietnam	Ukraine
Romania	Latvia	Canada	Bulgaria	Romania
UAE	Sri Lanka	Uruguay	Czech Rep	Latvia
Jordan	Vietnam	Romania	Egypt	Vietnam
Russia	Costa Rica	Mexico	Hungary	
Estonia	Mexico	Ghana	Mauritius	
Latvia	Jamaica	UK	Morocco	
Costa Rica	Romania	Slovakia	Poland	
Pakistan	Russia	Colombia	Romania	
Bangladesh	Ukraine	Ukraine	Russia	
UK	Ghana	Bulgaria	Slovakia	
Tunisia	Israel	Estonia	South Africa	
Ghana	South Africa	Slovenia	Turkey	
Panama	Kenya	Peru	Ukraine	
Hungary	Canada	Indonesia		
Spain	Panama	Morocco		
Czech Rep	Senegal	USA		
Morocco	Pakistan	Puerto Rico		
Slovakia	USA	Turkey		
Mauritania	UAE	Taiwan		
Canada	Tunisia	Egypt		
Argentina	Brazil	South Korea		
Turkey		Australia		
Senegal		Thailand		
Ukraine		Nicaragua		

Table 7. Correlations

	gdp.man.em	int.imp.gdp	man.outs.gd	man.fdi.	man.fdi.gdp	exp.eff.	hi.tech.exp	tot.fdi.gdp.	man.val.gdp	outs.man.em	fdi.man.emp	tertiary.enr	gdp.unit.ener
gdp.man.em	1.00												
int.imp.gdp	0.79	1.00											
man.outs.gd	0.23	0.46	1.00										
man.fdi.	0.67	0.50	0.12	1.00									
man.fdi.gdp	-0.06	0.02	0.85	-0.23	1.00								
exp.eff.	0.23	0.00	-0.09	0.05	-0.08	1.00							
hi.tech.exp	0.30	0.44	0.50	0.14	0.36	-0.23	1.00						
tot.fdi.gdp.	0.66	0.40	-0.23	0.83	-0.52	0.20	0.04	1.00					
man.val.gdp	0.07	0.32	0.67	0.19	0.57	-0.43	0.48	-0.10	1.00				
outs.man.em	0.46	0.81	0.44	0.65	-0.07	-0.18	0.35	0.42	0.46	1.00			
fdi.man.emp	0.59	0.54	0.16	0.01	0.03	0.17	0.33	0.10	0.06	0.11	1.00		
tertiary.enr	0.46	0.47	0.19	0.11	0.05	0.13	0.35	0.19	0.24	0.22	0.65	1.00	
gdp.unit.ene	0.06	-0.11	-0.22	-0.15	-0.07	-0.01	-0.12	-0.03	-0.19	-0.30	0.04	-0.26	1.00

Table 8. Static models for all developing countries using relative measures of outsourcing and FDI (% of GDP)

Static models	Manuf. Output per empl.		Export Efficiency		High tech exports %		Manuf. Value added %		GDP per employee	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Manuf. Outs. % GDP	-0.402	0.046	-0.048	0.093	0.128	-0.073	0.123	0.046	0.039	0.031
	(4.38)**	(0.82)	(3.23)**	(1.89)	(1.52)	(0.51)	(7.05)**	(1.30)	(1.55)	(1.09)
Manuf. FDI % GDP	0.189	0.155	0.088	0.193	0.249	0.159	-0.005	-0.014	0.052	-0.004
	(1.76)	(1.92)	(5.74)**	(2.61)*	(2.55)*	(1.00)	(0.20)	(0.57)	(1.52)	(0.12)
GDP per unit of energy	-0.733	1.484	0.025	0.673	-0.327	-1.182	-0.159	-0.166	0.3	0.71
	(4.44)**	(6.11)**	(0.84)	(3.75)**	(1.97)*	(1.92)	(4.65)**	(1.82)	(4.40)**	(5.73)**
Tertiary enrollment	1.162	0.777	0.04	0.397	0.701	0.822	0.194	-0.094	0.602	0.196
	(8.89)**	(3.97)**	(2.32)*	(3.32)**	(8.61)**	(2.31)*	(9.98)**	(2.38)*	(21.02)**	(3.08)**
Asia (developing)	2.674		-0.146		0.418		0.444		-0.321	
	(13.03)**		(4.70)**		(1.63)		(11.44)**		(5.07)**	
Eastern Europe	-1.025		0.018		-0.158		-0.012		-0.104	
	(5.98)**		(0.50)		(1.26)		(0.34)		(1.85)	
Latin America	0.712		-0.191		0.598		0.268		-0.166	
	(3.16)**		(5.78)**		(2.98)**		(6.36)**		(2.81)**	
_cons	17.2	13.469	0.066	-2.849	-1.097	0.828	2.121	3.303	6.892	7.421
	(31.15)**	(21.75)**	(0.96)	(6.43)**	(2.70)**	(0.83)	(23.44)**	(17.83)**	(39.63)**	(37.28)**
R^2	0.39	0.60	0.14	0.48	0.20	0.04	0.42	0.10	0.67	0.62
N	460	460	632	632	625	625	632	632	542	542

Table 9. Dynamic models for all developing countries using relative measures of outsourcing and FDI (% of GDP)

Dynamic models (Arellano-Bond)	Manuf. Output per empl.		Export Efficiency		GDP per employee		Manuf. Value added %		High tech exports %	
	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags
Manuf. Outs. % GDP	0.119	0.175	0.17	0.197	0.045	0.043	0.015	0.022	-0.33	-0.305
	(2.43)*	(4.19)**	(6.62)**	(6.42)**	(5.11)**	(5.14)**	(1.20)	(1.53)	(1.39)	(1.26)
L.Manuf. Outs. % GDP	0.005	0	-0.044	-0.059	-0.004	-0.012	-0.052	-0.054	-0.039	-0.01
	(0.15)	(0.01)	(1.96)	(2.58)**	(0.61)	(1.74)	(4.83)**	(4.40)**	(0.26)	(0.06)
Manuf. FDI % GDP	-0.188	-0.168	-0.079	-0.09	-0.04	-0.037	0.016	0.012	-0.097	-0.067
	(3.57)**	(3.46)**	(1.86)	(1.91)	(4.85)**	(3.72)**	(1.21)	(0.96)	(0.78)	(0.55)
L.Manuf. FDI % GDP	0.25	0.23	0.137	0.127	0.045	0.04	-0.033	-0.017	0.089	0.186
	(4.77)**	(3.83)**	(2.75)**	(2.68)**	(4.24)**	(4.36)**	(1.98)*	(0.88)	(0.75)	(1.66)
L2.Manuf. Outs. % GDP		0.054		0.002		0.015		0.002		-0.007
		(2.02)*		(0.16)		(2.77)**		(0.15)		(0.06)
L2.Manuf. FDI % GDP		-0.1		-0.023		-0.002		-0.009		-0.149
		(2.09)*		(1.12)		(0.22)		(0.47)		(1.83)
L.Manuf. Output per empl.	0.893	0.885								
	(21.37)**	(22.29)**								
L.Export Efficiency			0.749	0.766						
			(26.40)**	(28.09)**						
L.GDP per employee					0.878	0.865				
					(43.60)**	(40.56)**				
L.Manuf. Value added %							0.803	0.842		
							(10.99)**	(11.50)**		
L.High tech exports %									-0.003	-0.061
									(0.02)	(0.48)
_cons	1.864	2.07	-0.128	-0.066	1.093	1.217	0.555	0.445	1.59	1.662
	(2.62)**	(3.00)**	(2.81)**	(1.47)	(6.14)**	(6.46)**	(2.74)**	(2.10)*	(3.69)**	(3.52)**
N	503	451	1,034	911	772	690	1,074	950	952	839

Table 10. Static models for all developing countries using absolute measures of outsourcing and FDI (USD per employee in manufacturing)

Static models	Manuf. Output per empl.		Export Efficiency		High tech exports %		Manuf. Value added %		GDP per employee	
	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS
Manuf. Outs. per employee	0.265	-0.129	0.256	-0.111	0.08	0.28	0.028	0.092	0.048	0.068
	(8.70)**	(0.73)	(9.98)**	(3.36)**	(0.44)	(2.44)*	(1.30)	(2.25)*	(4.04)**	(1.56)
Manuf. FDI per employee	0.235	0.217	-0.087	0.146	0.467	0.238	-0.083	-0.05	0.018	0.103
	(2.16)*	(0.86)	(1.42)	(3.01)**	(1.82)	(1.30)	(1.73)	(1.00)	(0.53)	(1.58)
GDP per unit of energy	0.739	-0.823	0.08	-0.089	-0.066	-0.148	0.063	-0.2	0.161	0.247
	(4.33)**	(2.39)*	(0.44)	(1.14)	(0.08)	(0.51)	(0.52)	(2.63)**	(1.96)	(2.55)*
Tertiary enrollment	-0.072	1.216	0.341	-0.042	-0.519	0.794	0.035	0.265	0.094	0.382
	(0.78)	(4.15)**	(3.11)**	(0.70)	(1.13)	(2.89)**	(0.49)	(4.07)**	(1.61)	(5.78)**
Asia (developing)		2.208		-0.274		1.456		0.522		-0.126
		(5.63)**		(3.74)**		(3.94)**		(6.44)**		(1.21)
Eastern Europe		-1.087		0.014		0.393		-0.163		0.151
		(3.74)**		(0.21)		(2.03)*		(2.41)*		(2.03)*
Latin America		1.15		-0.207		1.167		0.087		0.119
		(2.91)**		(3.10)**		(4.38)**		(1.01)		(1.64)
_cons	16.874	16.816	-1.423	0.754	1.468	-3.518	2.733	2.051	8.922	7.202
	(35.94)**	(11.85)**	(2.39)*	(2.46)*	(0.73)	(2.88)**	(7.25)**	(6.96)**	(33.67)**	(18.41)**
R2	0.51	0.38	0.53	0.29	0.05	0.35	0.06	0.41	0.25	0.58
N	151	151	151	151	149	149	151	151	140	140

Table 11. Dynamic models for all developing countries using absolute measures of outsourcing and FDI (USD per employee in manufacturing)

Dynamic models (Arellano-Bond)	Manuf. Output per empl.		Export Efficiency		GDP per employee		Manuf. Value added %		High tech exports %	
	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags
Manuf. Outs. per employee	0.25	0.169	0.244	0.145	0.048	0.024	0.048	0.024	0.073	0.731
	(5.28)**	(1.80)	(5.93)**	(2.78)**	(3.90)**	(1.38)	(1.79)	(0.66)	(0.31)	(0.69)
L.Manuf. Outs. per employee	-0.063	0.011	-0.088	-0.024	-0.016	0.001	-0.015	-0.006	-0.017	-0.442
	(2.16)*	(0.27)	(2.69)**	(0.76)	(2.18)*	(0.07)	(0.77)	(0.38)	(0.16)	(1.07)
Manuf. FDI per employee	0.307	0.298	-0.001	-0.056	0.035	0.053	-0.1	-0.07	0.041	0.416
	(2.45)*	(2.55)*	(0.01)	(1.55)	(1.62)	(3.43)**	(2.56)*	(1.79)	(0.14)	(0.85)
L.Manuf. FDI per employee	0.06	0.085	0.123	0.049	0.048	0.049	0.013	-0.003	-0.028	0.463
	(1.03)	(0.81)	(2.70)**	(1.60)	(2.55)*	(2.33)*	(0.46)	(0.10)	(0.14)	(0.91)
L2.Manuf. Outs. per employee		-0.068		-0.111		0.007		0.013		0.348
		(1.51)		(3.60)**		(0.68)		(0.77)		(0.78)
L2.Manuf. FDI per employee		0.103		0.001		0.008		-0.051		-0.065
		(1.80)		(0.04)		(0.43)		(2.54)*		(0.21)
L.Manuf. Output per empl.	0.207	-0.023								
	(2.42)*	(0.13)								
L.Export Efficiency			0.249	0.326						
			(2.99)**	(3.77)**						
L.GDP per employee					0.479	0.415				
					(4.19)**	(3.15)**				
L.Manuf. Value added %							0.336	0.403		
							(2.32)*	(4.99)**		
L.High tech exports %									0.172	-0.336
									(1.18)	(1.27)
_cons	13.763	18.182	-0.623	0.352	4.677	5.206	2.054	2.033	1.154	-3.293
	(9.29)**	(7.21)**	(2.24)*	(1.30)	(4.38)**	(4.32)**	(4.44)**	(5.42)**	(0.88)	(0.70)
N	99	54	99	54	89	48	99	54	96	52

Table 12. Fixed-effects models for developing countries in Asia using relative measures of outsourcing and FDI (% of GDP)

Fixed-effects models	Manuf. Output per empl.	Export Efficiency	High tech exports %	Manuf. Value added %	GDP per employee
Manuf. Outs. % GDP	-0.114	0.036	-0.628	0.147	0.045
	(0.68)	(0.34)	(0.88)	(6.35)**	(1.40)
Manuf. FDI % GDP	-0.088	0.176	0.381	-0.071	-0.088
	(0.31)	(1.49)	(0.76)	(2.95)*	(0.54)
GDP per unit of energy	1.487	-0.238	-4.225	0.213	0.487
	(3.37)**	(0.68)	(1.48)	(2.19)*	(1.94)
Tertiary enrollment	0.629	0.36	1.03	-0.162	0.334
	(1.73)	(2.22)*	(1.14)	(5.58)**	(4.17)**
_cons	17.062	-0.762	7.449	2.891	7.174
	(14.51)**	(1.02)	(1.83)	(16.73)**	(12.84)**
R2	0.55	0.47	0.09	0.58	0.70
N	67	102	101	102	93

Table 13. Dynamic models for developing countries in Asia using relative measures of outsourcing and FDI (% of GDP)

Dynamic models (Arellano-Bond)	Manuf. Output per empl.		Export Efficiency		GDP per employee		Manuf. Value added %		High tech exports %	
	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags
Manuf. Outs. % GDP	0.339	0.279	0.059	0.065	Test could not be perfomed as variance matrix was nonsymmetric or highly singular		0.078	0.086	-0.41	-0.353
	(3.77)**	(2.58)**	(2.04)*	(2.37)*			(3.12)**	(2.92)**	(0.94)	(0.76)
L.Manuf. Outs. % GDP	-0.288	-0.266	-0.076	-0.064			-0.054	-0.05	0.047	0.067
	(3.06)**	(3.52)**	(2.32)*	(1.27)			(1.91)	(1.66)	(0.13)	(0.21)
Manuf. FDI % GDP	-0.19	-0.17	-0.098	-0.168			-0.054	-0.053	-0.784	-1.404
	(2.19)*	(1.72)	(1.59)	(2.46)*			(1.02)	(1.05)	(0.86)	(0.97)
L.Manuf. FDI % GDP	0.192	0.341	0.157	0.249			-0.05	-0.02	1.619	1.978
	(2.72)**	(3.54)**	(3.21)**	(2.59)**			(1.05)	(0.47)	(1.12)	(1.17)
L2.Manuf. Outs. % GDP		0.04		0.013				-0.002		-0.001
		(0.62)		(0.33)				(0.11)		(0.01)
L2.Manuf. FDI % GDP		-0.154		-0.112				-0.024		-0.082
		(1.69)		(2.61)**				(0.91)		(0.43)
L.Manuf. Output per empl.	1.047	0.996								
	(26.34)**	(18.07)**								
L.Export Efficiency			0.989	1.034						
			(15.92)**	(20.47)**						
L.Manuf. Value added %							0.403	0.556		
							(2.36)*	(4.00)**		
L.High tech exports %									1.446	0.899
									(1.69)	(1.32)
_cons	-1.001	0.048	-0.038	0.078			1.94	1.461	-1.417	-0.134
	(1.39)	(0.04)	(0.56)	(2.21)*			(3.56)**	(3.36)**	(1.20)	(0.18)
N	66	59	109	95			113	99	106	93

Table 14. Fixed-effects models for developing countries in Asia using absolute measures of outsourcing and FDI (USD per employee in manufacturing)

Fixed-effects models	Manuf. Output per empl.	Export Efficiency	High tech exports %	Manuf. Value added %	GDP per employee
Manuf. Outs. per employee	0.257	0.111	-0.375	0.065	0.009
	(5.11)**	(2.99)*	(2.23)	(2.29)	(0.17)
Manuf. FDI per employee	0.529	0.078	0.328	-0.043	0.176
	(5.53)**	(1.02)	(1.07)	(1.43)	(1.16)
GDP per unit of energy	0.564	-0.163	-1.593	-0.019	-0.254
	(2.81)*	(0.83)	(1.69)	(0.21)	(1.24)
Tertiary enrollment	-0.064	0.35	-0.551	-0.067	0.115
	(0.63)	(3.04)*	(1.11)	(1.32)	(1.04)
_cons	18.141	-1.072	6.988	3.309	8.902
	(29.21)**	(1.64)	(2.30)	(10.87)**	(12.80)**
R^2	0.96	0.74	0.55	0.52	0.49
N	24	24	24	24	24

Table 15. Dynamic models for developing countries in Asia using absolute measures of outsourcing and FDI (USD per employee in manufacturing)

Dynamic models (Arellano-Bond)	Manuf. Output per empl.		Export Efficiency		GDP per employee		Manuf. Value added %		High tech exports %	
	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags	one lag	two lags
Manuf. Outs. per employee	0.039	-0.245	0.019	-0.035	-0.007	-0.043	0.04	-0.024	0.168	0.322
	(0.29)	(2.73)**	(0.25)	(0.54)	(0.20)	(0.82)	(1.21)	(0.62)	(0.51)	(1.91)
L.Manuf. Outs. per employee	-0.159	-0.112	-0.05	0.008	-0.041	-0.003	0.007	0.032	0.167	0.618
	(4.32)**	(11.96)**	(2.96)**	(0.42)	(2.91)**	(0.10)	(0.40)	(0.81)	(1.76)	(1.98)*
Manuf. FDI per employee	0.916	1.339	0.202	0.092	0.139	0.165	-0.025	0.105	-0.79	-0.309
	(3.91)**	(5.82)**	(1.70)	(0.55)	(1.87)	(1.30)	(0.37)	(1.12)	(1.40)	(0.84)
L.Manuf. FDI per employee	-0.236	-0.298	0.031	0	0.001	0.011	-0.042	-0.109	0.275	-1.252
	(1.51)	(8.86)**	(0.72)	0.00	(0.02)	(0.13)	(2.44)*	(1.92)	(0.95)	(2.35)*
L2.Manuf. Outs. per employee		-0.183		-0.113		0.032		0.025		0.333
		(8.24)**		(5.41)**		(1.48)		(2.26)*		(3.34)**
L2.Manuf. FDI per employee		-0.112		0.048		-0.07		-0.101		0.091
		(1.25)		(0.69)		(1.39)		(2.81)**		(0.24)
L.Manuf. Output per empl.	0.347	0.16								
	(3.15)**	(2.80)**								
L.Export Efficiency			0.346	0.309						
			(2.31)*	(7.76)**						
L.GDP per employee					0.71	0.615				
					(7.17)**	(2.45)*				
L.Manuf. Value added %							-0.043	-0.056		
							(0.43)	(0.23)		
L.High tech exports %									-0.185	-0.269
									(1.20)	(1.50)
_cons	11.999	16.386	-0.519	0.159	2.418	3.326	3.334	3.543	3.043	3.411
	(6.40)**	(12.82)**	(1.92)	(2.74)**	(2.87)**	(1.46)	(13.02)**	(4.72)**	(2.51)*	(4.67)**
N	17	11	17	11	17	11	17	11	17	11

Table 16. Summary of static models for all developing countries

	GDP per employee in manufacturing	GDP per employee	Export efficiency
Outsourcing	A	A	A
FDI	A		R

Table 17. Summary of dynamic models for all developing countries

	GDP per employee in manufacturing	GDP per employee	Export efficiency	Manufacturing value added
Outsourcing	R **A**	R **A**	R	R
FDI	R	R A	**R** A	

Table 18. Summary of static models for developing countries in Asia

	GDP per employee in manufacturing	GDP per employee	Export efficiency	Manufacturing value added
Outsourcing	A		A	R
FDI	A			

Table 19. Summary of dynamic models for developing countries in Asia

	GDP per employee in manufacturing	GDP per employee	Export efficiency	High-tech exports
Outsourcing	R **A**	A	R **A**	A
FDI	R **A**		R	A

Figure 1. Average % of high-tech exports of total manufacturing exports, 2000-2013

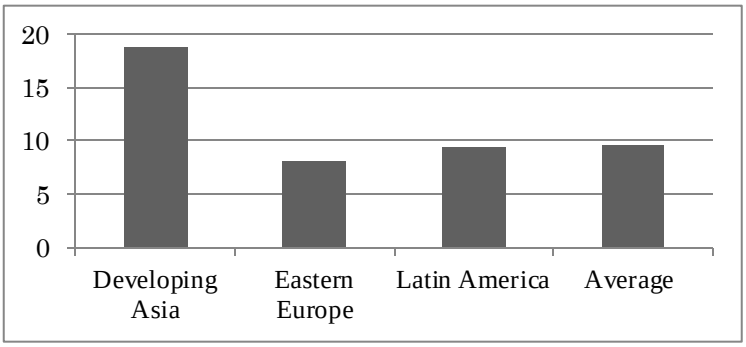

Figure 2. Average tertiary education enrollment ratios, 2000-2013