Original Article

'Attract FDI!' — A universal golden rule? Empirical evidence for OECD and selected non-OECD countries

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Abstract In this paper we investigate the host-country effects of foreign direct investment (FDI). We extend the abundant existing literature on this topic in three ways. First, we explicitly acknowledge a potential endogeneity in the relationship between a country's economic performance (measured by labour productivity) and FDI by estimating a system of simultaneous equations. Second, we consider direct and additional indirect effects, which can be tracked through the system of equations when deriving our conclusions. Third, we base our estimations on a sample including OECD as well as selected non-OECD countries for seven manufacturing industries over the period 1981–2000. The results suggest a positive relationship between FDI and output as well as productivity and export growth, whereas there is also evidence for a downward pressure on wage growth as a result FDI. However, the magnitude of effects is surprisingly small.

Dans cet article nous étudions les effets des investissements directs étrangers (IDE) sur le pays d'accueil. Nous aprofondissons la litérature existante sur le sujet de trois façons: premièrement, nous admettons explicitement une endogénéité potentielle dans la relation entre la performance économique d'un pays (mesurée par la productivité du travail) et les IDE, en estimant un système d'équations simultanées. Deuxièmement, nous prenons en compte dans la conclusion, les effets directs et les effets additionnels indirects dont on peut suivre la trace à travers le système d'équations. Troisièmement, nous basons nos estimations sur un échantillon incluant aussi bien des pays de l'OCDE que des pays non membres de l'OCDE, pour sept industries manufacturières, sur la période 1981–2000. Les résultats suggèrent une relation positive entre les IDE et la production ainsi que la productivité et la croissance des exportations, alors qu'il y a, par ailleurs, des preuves d'une pression à la baisse sur la croissance des salaires due aux IDE. Cependant, l'ampleur des effets est curieusement faible.

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Introduction

'Attract FDI!' is one of the most widely recommended policy measures. This is true even for quite divergent aims such as increasing productivity or spurring productivity growth, curing unemployment, boosting output growth in general and in individual industries, and so on.

The most frequently mentioned advantages of attracting foreign direct investment (FDI) are the increase in the capital stock in general and foreign capital in particular. The latter is assumed to be more productive, or more efficiently managed, and able to exploit economies of scale and scope, which is seen to be beneficial to the donor as well as the host

country. Further, an increase in the stock of capital enables a country or region to employ more people and thus reduce unemployment, boost output growth, and so on Finally, FDI inflows are seen – from the point of view of a less developed host country – as a medium of technology transfer and thus as contributing to higher production efficiency and productivity not only to the foreign-owned firms but also, via spillovers, to locally owned firms and establishments. This increases the competitiveness of a particular industry, region or country, which again is of importance in industries facing global competitive pressures. In a broader sense FDI is also often seen as a remedy against unionization on the labour market side, characterized by high and rigid wages, and as a remedy against monopoly power on the product market side. A higher share of FDI is expected to increase wage flexibility and product market competition, which again raises competitiveness. Similar advantages also hold from the sending country's or firm's perspective, where FDI allows for outsourcing particular activities (for instance, labour-intensive activities can be performed more cheaply in other, for example, labour-abundant, countries), exploiting economies of scale and scope more efficiently or entering or penetrating a foreign market (market-seeking FDI).

But there are as well a number of drawbacks related to FDI, from both the host's as well as the sending country's perspective. First, an increase in the share of foreign capital does not necessarily mean that the capital stock is increasing. With respect to technological advantage, it is commonplace for average productivity to increase if a higher than average productive unit of capital is added (or if a takeover raises the efficiency of capital usage). However, FDI may also drive out local firms. If it does so at the lower end of the productivity range, the average productivity level of domestic firms increases (while there may be negative effects on overall employment); however, if FDI drives out the best domestic firms (because these are the firms serving the same market segments as the incoming firm), average productivity of the domestic firms may decrease and the effect on overall productivity becomes ambiguous. Second, FDI may also discourage local firms from further investments, for example, by increasing the cost of capital, by attracting skilled workers who are no longer available for other firms, and so on. Third, higher productivity – in particular higher labour productivity – may imply a reduction of employment (rather than an increase via the higher capital stock). Rising unemployment together with a tendency towards lower or less strongly rising wage rates (see the unionization argument above) and a rising wage spread (favouring the more skilled workers) may impact negatively on overall demand with a dampening effect on output and employment growth in general. This becomes even more problematic if the particular sector is export-oriented and uses a high share of intermediates from imports (which decreases the output and employment multipliers).

This brief summary of the pros and cons of FDI inflows calls for an empirical effort to address the questions above. In this paper we use industry-level data for a number of OECD and non-OECD countries over the period 1981–2000 to analyse the effects of FDI inflows. The inclusion of non-OECD members into the sample is a new addition to the literature that is based on industry-level data. We focus specifically on a set of Eastern European and East Asian countries, which are characterized by substantial FDI inflows over the past one to two decades. The use of industry-level data is to be recommended, because the effects of FDI may well differ not only according to the characteristics of the economy receiving the foreign capital but also with respect to the characteristics of individual industries. We further account for the endogeneity between FDI and economic performance (measured by either output or labour productivity growth) in our estimation

through the use of a system of simultaneous equations. This allows us to calculate both the direct and the indirect effects of FDI on productivity growth, with the latter arising from the simultaneous effects of FDI on exports, wages, and so on.

The paper proceeds as follows. We first present a short overview of the existing empirical literature on the topic in the next section. In the subsequent section we introduce the data set and provide some descriptive statistics. We apply Granger causality tests in order to econometrically establish that the relationship between FDI and productivity growth is bi-directional, requiring an estimation procedure that is able to deal with endogeneity. These results, together with our empirical findings based on the estimation of a system of equations, are presented in the penultimate section. The last section summarizes the results and provides an outlook of further research in this area.

Overview of the Empirical Literature

Although in theory a number of channels exist that lead from FDI to positive effects on output and productivity, there are also potential risks for the host country, region or industry. The empirical evidence is as equally mixed as the theoretical arguments listed above. The higher productivity of foreign-owned firms or the productivity-enhancing effect of FDI at the macro-level is confirmed by many empirical studies (Rodriguez-Clare, 1996; de Mello, 1999; Bellak, 2004; Mayer-Foulkes and Nunnenkamp, 2005). On the other hand, some studies also find negative effects (Van Pottelsberghe and Lichtenberg, 2001; Akinlo, 2004). Most evidence for a positive effect also makes clear that this is conditional on a host of factors. One of the most frequently mentioned preconditions is the existence of strong (especially upstream) linkages with domestic firms (Weinhold and Klasen, 1991; Rodriguez-Clare, 1996; Javorcik, 2004; to mention just a few). Further, positive productivity effects from FDI are found to depend on outward-oriented as opposed to import-substituting policies in Balasubramanyam *et al* (1999).

The question of crowding in versus crowding out seems to be related to the stage of development; de Mello (1999) concludes that the impact of FDI on GDP growth depends on the degree of complementarity versus substitutability between FDI and domestic investment. A higher degree of complementarity, which he finds to prevail in technological laggards (that is, less developed countries), leads to a greater positive effect from FDI, whereas substitutability between FDI and domestic capital, often found in the more advanced countries, leads to crowding out. Blonigen and Wang (2005) also report different effects from FDI in developed versus less developed countries, finding evidence for a growth enhancing effect from FDI only in less developed countries as a result of a crowding in of domestic capital. Crowding out is more likely to take place in developed economies. Absorptive capacity plays another important role in the relationship between FDI and growth. Borensztein *et al* (1998) identify threshold levels in human capital that have to be reached before a positive relationship is observed. This implies a nonlinear relationship between FDI and economic development, where catching-up economies that are endowed with sufficient absorptive capacity (in terms of human capital, and so on) are most likely to benefit from FDI.

An important issue in the empirical literature is therefore the necessity to control for cross-country heterogeneity. Countries differ not only with respect to their human capital endowments and thus in their absorptive capacity but also in terms of market structure, legal conditions, trade and industrial policies, quality and vintages of the capital stock.

The empirical literature has recently paid explicit attention to the importance of heterogeneity in the relationship between FDI and economic performance. Not least because of improvements in estimation methods and data availability, controls for heterogeneity can be incorporated in the estimation through the use of panel data sets and corresponding estimators. Nair-Reichert and Weinhold (2001) confirm the importance of correctly dealing with cross-country heterogeneity using a specifically developed estimator (the mean–fixed–random effects estimator).

In addition to cross-country heterogeneity, also industry-specific characteristics have recently been identified as playing an important qualitative role in the relationship between FDI and output growth. For a sample of OECD members, Alfaro and Charlton (2007) find, that the positive relationship between FDI and growth in value-added is stronger for industries with higher skill requirements and for industries being more reliant on external capital. Including also non-OECD members in their analysis at the expense of using a coarser industry breakdown, Fillat and Woerz (2006) find evidence for more significant effects of FDI in catching-up economies as opposed to high-income countries. They further identify the biggest effects from FDI in these countries in resource-based industries. This makes clear that the country and the industry dimension are jointly influential in shaping the specific host-country effects of FDI. In our analysis we therefore control for both sources of heterogeneity.

Finally, the direction of causation between FDI and output growth (or productivity growth) is far from being resolved. The empirical literature is mostly based on models with output or productivity growth as the dependent variable and FDI as one of the exogenous variables. This is especially true for many studies based on macroeconomic data. However, as is also acknowledged by most authors, there is potentially a high degree of endogeneity between output (or productivity) growth and FDI growth. Choe (2003) uses a panel vector autoregression (VAR) model to investigate this issue and finds that while FDI Granger-causes economic growth, also the reverse is true, and the effects are even stronger for the causation from economic growth to FDI. There is also evidence for endogeneity from firm-level data. Summarizing the results of selected studies on the performance gaps between multinational enterprises and their domestic counterparts, Bellak (2004) confirms that foreign-owned firms are more productive than purely domestic ones; however, he also observes that foreign investors tend to select more productive firms as investment targets.

In this paper, we address some of the issues mentioned above, in particular the endogeneity in the relationship between output, productivity and FDI as well as the issue of heterogeneity. We deal with the problem of endogeneity by estimating a system of equations where FDI, output and labour productivity are endogenous. We also account for two sources of heterogeneity: heterogeneity across countries and heterogeneity across industries. Because factors such as market structure, trade and investment policies as well as the degree and type of linkages differ widely across individual manufacturing activities, we consider cross-industry heterogeneity to be an important omitted factor in previous FDI regressions. The results point, however, towards a much stronger role for cross-country heterogeneity.

Data

Up-to-date empirical studies of FDI effects have often remained on the aggregate, economy-wide level or focused on firm-level data sets for particular countries, while there are

fewer studies done at the industry level. Firm-level studies allow for an in-depth analysis of the specific links that lead to spillovers or other effects from FDI but are most often confined to data for one single country. By contrast, macro-level studies allow for comprehensive cross-country comparisons and may as such be considered as a check of generality of the results obtained from individual firm-level data sets. Explicitly focusing on the industry dimension allows for the control of important industry-specific characteristics in the relationship between FDI and growth. For the present paper we have collected data from various sources on variables such as FDI, output, employment, wages, exports and imports extending along three dimensions: across industries, across countries and over time. As will be explained below, in our econometric analysis we are working with long-run average annual growth rates of these variables over the entire period, thus collapsing the data set to two dimensions: across industries and across countries.

The data set (see Woerz (2005) for a detailed description) includes all OECD member countries plus the Central and Eastern European countries that have acceded the EU in 2004 (CEECs), as well as the five original ASEAN member countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) and India, Hong Kong, Taiwan and South Korea. It contains indicators such as output, employment, gross fixed capital formation, wages, FDI, exports and imports at the industrial level from different sources (UNIDO, OECD, wiiw, UNCTAD, ASEAN Secretariat, Timmer (2003) and the Taiwanese Investment Commission – MOEA). The industrial breakdown follows the OECD International Direct Investment database (IDI), which classifies the manufacturing sector into seven broad activities: food; textiles and wood; petroleum, plastics, rubber and chemicals; metal and mechanical products; office machinery; transport equipment and other manufacturing industries. The mineral and leather industries are not allocated in this scheme and are thus included in the 'other manufacturing' sector. In addition, a remainder category exists that we labelled 'NA' (not allocated). The grouping of countries is based on geography on the one hand and the level of economic development on the other. Thus, we have five country groups: advanced OECD members, catching-up OECD members (the cohesions countries, Turkey and Mexico), the four Asian Tiger countries, East Asia and CEECs. The original time period extends from 1981 to 2000 (1993 to 2002 for CEECs). In the subsequent analysis we consider the following variables: output, FDI inward stocks, labour productivity (output per employed person) relative to US labour productivity, exports, imports, gross fixed capital formation and wage rates relative to United States. All variables are expressed in growth rates as mentioned above. All of these variables are expressed at constant (2000) prices and made internationally comparable by using 2000 PPP rates. Only the growth rate of the wage gap is expressed at current exchange rates.

Because we are interested in the long-run effect of FDI on economic performance, we consider it to be appropriate to calculate long-run average annual growth rates over the entire period. Long-run annual averages are calculated by regressing each indicator (in logarithms) on a linear time trend. This eliminates the time dimension but leaves us with country- and industry-specific information on long-run developments in each variable. It also results in a balanced panel data set with an industry and a country dimension and no missing observations. Individual growth rates are as such not fully comparable across countries. However, we are interested here in the long-run relationship between FDI and output (productivity growth). On the assumption that this relationship does not show significant structural breaks in the period 1988–2000, we can thus use these growth rates in the regressions.

Figures 1 and 2 relate the average annual long-run growth rates of FDI inward stock to output growth and productivity growth, respectively. In order to make the growth rates fully comparable across countries, the underlying data points for Figures 1 and 2 were calculated over the period 1995–2000 only (that is, covering all countries over the same time period). We see a positive relationship between the two variables. We can further identify certain industries that seem to be characterized by higher growth rates in both FDI and output (productivity). This type of growth is seen, for instance, in the production of transport equipment and electrical machinery, whereas the food industry appears to have systematically lower growth rates in both indicators. In a regional perspective (not identified in the picture), we observe particularly high growth rates for East Asia in general and for catching-up OECD members and CEECs in the case of the aforementioned industries (transport equipment and electrical machinery).

The apparent correlation between FDI and output/productivity growth is however comparably small and not always significant, as reported in Table 1. Although a simple pairwise correlation coefficient of 0.35 between FDI growth and output growth is still significant at the 5 per cent level, it is far smaller than the correlation coefficient between output growth and productivity growth (0.86), exports (0.74) or imports (0.78). The results differ between country groups. The group of East Asian countries is mainly driving the correlation between FDI and output growth.

In order to assess the validity of our casual observations, we clearly need to investigate more thoroughly the relationships between FDI and economic performance, which is done in the next section.

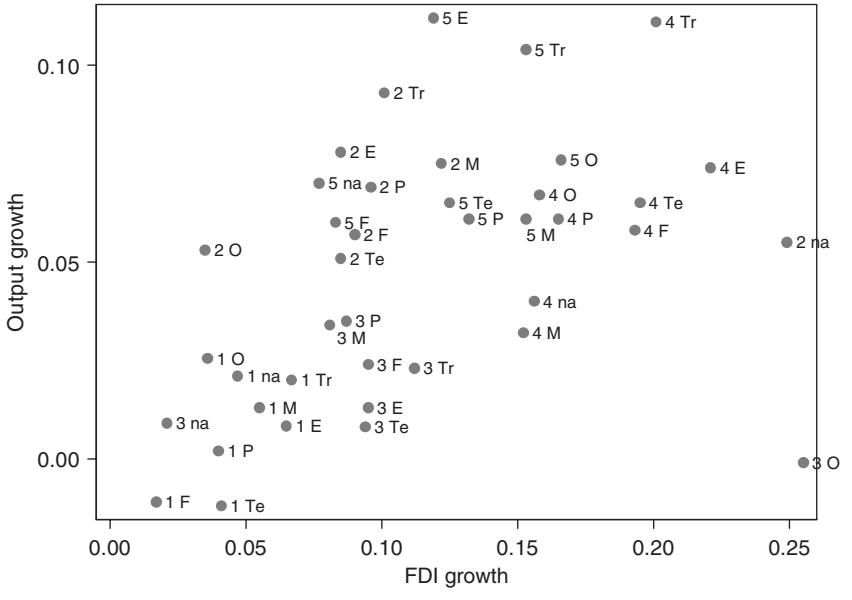

Figure 1: Average annual growth of FDI inward stock and output by industry, 1995–2000.
Note: Each data point represents one combination of geographic region and industry. 1, advanced OECD; 2, catch-up OECD; 3, Tiger; 4, East Asia; 5, CEEC. Industries are denoted by F, food; Te, textiles/wood; P, petroleum/chemicals; M, metals and machinery; E, electrical machinery; Tr, transport equipment; O, other manufacturing; NA, not classified.

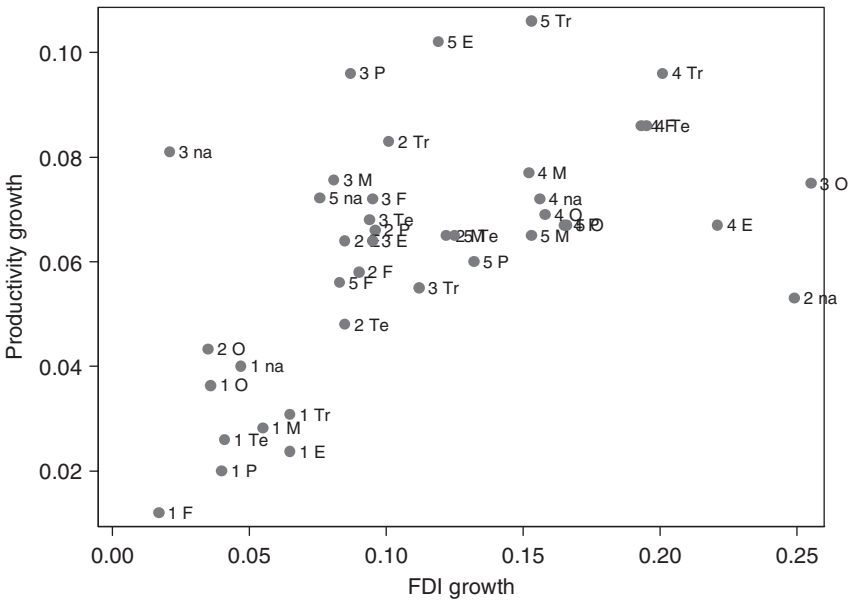

Figure 2: Average annual growth of FDI inward stock and productivity by industry, 1995–2000.
Note: Each data point represents one combination of geographic region and industry. 1, advanced OECD; 2, catch-up OECD; 3, Tiger; 4, East Asia; 5, CEEC. Industries are denoted by F, food; Te, textiles/wood; P, petroleum/chemicals; M, metals and machinery; E, electrical machinery; Tr, transport equipment; O, other manufacturing; NA, not classified.

Table 1: Correlation with long-run average annual growth rate of output

	Total sample	*Advanced OECD*	*Catch-up OECD*	*4 Tiger*	*East Asia*	*CEEC*
Labour productivity	0.86***	0.73***	0.96***	0.48**	0.83***	0.82***
FDI	0.35***	0.17*	0.09	−0.29	0.77***	0.08
Exports	0.74***	0.65***	0.45***	0.39*	0.79***	0.86***
Imports	0.78***	0.61***	0.55***	0.51**	0.78***	0.83***

Note: ***, ** and * denote significance at the 1, 5 and 10 per cent level, respectively.

Econometric Results

Because the question about the causality between output and FDI crucially influences the choice of the most appropriate estimation procedure, we first try to establish the direction of causation with the help of Granger causality tests. Based on these results, we will apply econometric estimation techniques to obtain an empirical assessment of the statistical and economic significance of FDI for the receiving country/industry.

Granger causality

Granger causality is a time series concept and relates to a test on the question of whether lagged information on a variable Y provides any statistically significant information about a variable X in the presence of lagged X. If this is the case, then Y is said to Granger-cause X.

Granger causality tests can be performed in different forms. The most common way is based on an autoregressive specification of a bivariate VAR model, like the following:

$$\begin{aligned} X_t &= \alpha_1 + \beta_{11} X_{t-1} + \beta_{12} X_{t-2} + \delta_{11} Y_{t-1} + \delta_{12} Y_{t-12} + \varepsilon_t \\ Y_t &= \alpha_2 + \beta_{21} Y_{t-1} + \beta_{22} Y_{t-2} + \delta_{21} X_{t-1} + \delta_{22} X_{t-12} + \omega_t \end{aligned} \quad (1)$$

The test is essentially based on the hypothesis that all coefficients on Y and its lags are jointly zero in the estimation of X, including lags of X on the right-hand side. Thus, Granger causality is a pure time series concept, which is often considered to be a shortcoming. Apart from this, two caveats are given by the fact that, first, Granger causality tests are very sensitive to the choice of lag length and, second, they are sensitive to the methods used in dealing with any non-stationarity of the time series. To address the first problem we tested each country for three different lag lengths (an optimal one, according to information criteria, and the previous and the following lag length) and marked those cases where no unique conclusion could be reached. Further, we removed non-stationarity in the series by differencing the data. According to Kang (1985), de-trending the time series may weaken or remove the evidence for causal relationship. Based on Monte Carlo experiments, Zapata *et al* (1988) find that differencing bivariate processes does not significantly impact on the test results and allows the correct identification of the relationship between the two variables.

We tested for Granger causality between labour productivity and FDI inward stocks for each country separately, providing a long enough time series (31 countries). The optimal lag length – mostly approximately 4 years – was chosen according to Lütkepohl's likelihood ratio test. The lag length in the VAR models reveals also some interesting information about the typical lag structure between the two variables. Table 2 has to be read as follows: A significant value of the chi-squared test in the first column indicates that removing the FDI variable from the productivity equation changes the results, thus indicating a significant influence from FDI on productivity (or, FDI Granger-causes productivity growth). Likewise, the third column gives the value of the test statistic when productivity is removed from the FDI equation. A significant value in column 4 can be interpreted as evidence for Granger causality from productivity growth on FDI. The last column reports the lag length chosen in the VAR model. For most countries, the original time series before taking differences had 20 observations (1981–2000); for the Asian countries, they were often shorter (1987–2000).

The results of the Granger tests suggest that the relationship is a circular one, that is, causality runs in both directions. Almost all models yield a highly significant relationship running in both directions. In nine out of the 31 cases above, this result was stable to introducing a different lag structure as well as to differencing the series. There were a few cases where the endogeneity between FDI and productivity growth could only be established for the reported lag length. When fewer lags were included, evidence for a uni-directional causality running from FDI to productivity growth was found for a few, mostly Asian countries (Japan, New Zealand, Spain, Indonesia, Malaysia and the Philippines). These positive host-market effects are researched extensively in the empirical literature. In more cases, however, including fewer lags resulted in evidence for a uni-directional causality running from productivity to FDI. In this case, we might rather view FDI as a consequence of good economic performance rather than a cause. It is interesting to note that countries where this type of relationship emerged in the shorter-run were mostly highly developed countries, such as Australia, Austria, Canada, the Netherlands,

Table 2: Granger causality tests

Group	*Country*	*Productivity equation*		*FDI equation*		*Lag length*
		Chi^2	$Prob > Chi^2$	Chi^2	$Prob > Chi^2$	
OECD members	Australia	55.44	0.000	1002	0.000	4
	Austria	11.68	0.039	25.82	0.000	5
	Canada	131.54	0.000	24.81	0.000	4
	Denmark	19.31	0.001	16.93	0.002	4
	Finland	16.43	0.006	11.05	0.050	5
	France	142.90	0.000	13.70	0.003	3
	Germany	35.66	0.000	3.07	0.215	2
	Greece	70.84	0.000	256.53	0.000	5
	Iceland	13.83	0.003	82.64	0.000	3
	Ireland	630.47	0.000	341.23	0.000	5
	Italy	48.35	0.000	35.65	0.000	3
	Japan	47.41	0.000	87.34	0.000	5
	Mexico	0.47	0.926	16.00	0.001	3
	the Netherlands	35.89	0.000	31.74	0.000	5
	New Zealand	171.40	0.000	196.70	0.000	4
	Norway	32.83	0.000	30.17	0.000	5
	Portugal	92.61	0.000	76.16	0.000	4
	Spain	208.12	0.000	33.845	0.000	5
	Sweden	10.40	0.034	26.33	0.000	4
	Switzerland	2.12	0.347	1.33	0.513	2
	Great Britain	35.03	0.000	8.52	0.074	4
	USA	15.67	0.004	57.53	0.000	4
Asia	Taiwan	3.55	0.170	1.29	0.526	2
	Hong Kong	31.21	0.000	16.22	0.006	5
	India	20.04	0.000	24.48	0.000	4
	Indonesia	14.55	0.000	8.27	0.000	4
	Korea	13.52	0.009	43.74	0.000	4
	Malaysia	157.48	0.000	29.89	0.000	4
	Philippines	66.90	0.000	9.89	0.042	4
	Singapore	80.56	0.090	10.05	0.040	4
	Thailand	17.63	0.003	3998	0.000	5

Note: A probability of the chi-squared value less than 0.05 (0.01) indicates that lagged FDI is significant in explaining productivity (and vice versa in the FDI equation) at the 5 per cent (1 per cent) level of significance. To remove non-stationarity, time series have been differenced.

Sweden and Great Britain, but that it also emerged in Singapore and Thailand. Only for two countries, Norway and the United States, no causality was found when reducing the lag length.

To summarize, the results from the Granger tests point towards a substantial degree of endogeneity between the two variables, FDI and productivity, in the longer run. The sensitivity of the results to reductions in the lag length in the model can be discussed; however, most information criteria suggested using higher lag lengths, supporting the mutual causation between the two variables. Because our subsequent analysis is concerned with the long-run relationship between economic performance and FDI, we see the results from the Granger causality tests as a justification for our choice of method in the next section. In order to account for the endogeneity present in the relationship, we will work here with a system of simultaneous equations.

System estimation

In this section we use econometric analysis to have a closer look at these aforementioned relationships. From the results above, we have to take into account that FDI and output and some other variables such as exports, gross fixed capital formation, and so on should be considered as a system of simultaneous equations. Ordinary least squares (OLS) will, however, give biased and inconsistent results, as the right-hand-side regressors are correlated with the error term. We thus also estimate the relationships as a simultaneous equation model using three-stage least squares (3SLS). In this econometric analysis we consider the following variables as endogenous: output (out), FDI inward stocks (fdi), labour productivity gap relative to United States (gap), exports (exp), imports (imp), gross fixed capital formation (gfcf) and wage gap relative to United States (wag), where all variables are expressed in growth rates (see above). The number of observations used in this analysis is reduced to only 183 (from potentially $8 \times 41 = 328$) due to missing observations (note that for each country and industry all variables have to exist to be included). Consequently, the system in equation (2) consists of seven equations and, correspondingly, has seven endogenous variables.

$$
\begin{aligned}
out_i^c =& \alpha_1 + \beta_{12} fdi_i^c + \beta_{13} gap_i^c + \beta_{14} exp_i^c + \beta_{15} imp_i^c \\
&+ \beta_{16} gfcf_i^c + \beta_{17} wage_i^c + \varepsilon_i^c \\
fdi_i^c =& \alpha_2 + \beta_{21} out_i^c + \beta_{23} gap_i^c + \beta_{24} exp_i^c + \beta_{25} imp_i^c \\
&+ \beta_{26} gfcf_i^c + \beta_{27} wage_i^c + \varepsilon_i^c \\
gap_i^c =& \alpha_3 + \beta_{31} out_i^c + \beta_{32} fdi_i^c + \beta_{34} exp_i^c + \beta_{35} imp_i^c \\
&+ \beta_{36} gfcf_i^c + \beta_{37} wage_i^c + \gamma_{31} gap0_i^c + \varepsilon_i^c \\
exp_i^c =& \alpha_4 + \beta_{41} out_i^c + \beta_{42} fdi_i^c + \beta_{43} gap_i^c + \beta_{45} imp_i^c \\
&+ \beta_{46} gfcf_i^c + \beta_{47} wage_i^c + \varepsilon_i^c \\
imp_i^c =& \alpha_5 + \beta_{51} out_i^c + \beta_{52} fdi_i^c + \beta_{53} gap_i^c + \beta_{54} exp_i^c \\
&+ \beta_{56} gfcf_i^c + \beta_{57} wage_i^c + \varepsilon_i^c \\
gfcf_i^c =& \alpha_6 + \beta_{61} out_i^c + \beta_{62} fdi_i^c + \beta_{63} gap_i^c + \beta_{64} exp_i^c \\
&+ \beta_{65} imp_i^c + \beta_{67} wage_i^c + \varepsilon_i^c \\
wage_i^c =& \alpha_7 + \beta_{71} out_i^c + \beta_{72} fdi_i^c + \beta_{73} gap_i^c + \beta_{74} exp_i^c \\
&+ \beta_{75} imp_i^c + \beta_{77} gfcf_i^c + \gamma_{71} wage0_i^c + \varepsilon_i^c
\end{aligned}
\tag{2}
$$

Here, i stands for industry and c for country; $gap0$ denotes the initial gap in labour productivity to the United States and $wage0$ the initial wage gap to the United States. In general we expect a positive influence between output, productivity growth and FDI running also through exports and investment. This implies positive coefficients on β_{12}, β_{14}, β_{16}, β_{21}, β_{23}, β_{24}, β_{26}, β_{21}, β_{32}, β_{41}, β_{42}, β_{43}, β_{61} and β_{62}.

As mentioned above, OLS on each single equation might result in a potentially biased and inconsistent estimate due to endogeneity. However, it can also be more robust, especially in small samples (see Ullah, 2004). We thus first report the results of estimating the equations individually by OLS, using robust standard errors in Table 3. (We have also calculated a range of other estimators including the fixed and random effects model and 2SLS that broadly confirm the results reported below).

Table 3: Results of OLS estimation

	Dependent variable						
	Output	*FDI*	*Productivity gap*	*Exports*	*Imports*	*Gross fixed capital formation*	*Wage gap*
Output	—	0.906**	0.583***	0.429***	0.019	0.924***	−0.190***
	—	*2.02*	*9.32*	*3.17*	*0.19*	*5.54*	*−4.04*
FDI	0.021*	—	0.013	0.040**	−0.040**	−0.001	−0.028***
	1.68	—	*1.27*	*2.54*	*−2.40*	*−0.03*	*−4.59*
Productivity gap	0.646***	0.386	—	−0.520***	0.278***	0.187	0.114***
	9.19	*0.07*	—	*−4.12*	*3.42*	*1.07*	*2.87*
Exports	0.182***	0.737**	−0.223***	—	0.544***	−0.067	−0.054*
	4.04	*2.36*	*−5.07*	—	*8.29*	*−0.56*	*−1.67*
Imports	0.014	−1.291*	0.175***	0.959***	—	0.241*	−0.092**
	0.19	*−1.81*	*2.80*	*9.53*	—	*1.77*	*−2.06*
GFCF	0.241***	−0.006	0.080*	−0.041	0.084*	—	0.098***
	4.06	*−0.03*	*2.06*	*−0.57*	*1.97*	—	*4.13*
Wage gap	−0.190	−2.434**	0.217*	−0.462**	−0.257	0.570**	—
	−1.30	*−2.58*	*1.88*	*−2.27*	*−1.47*	*2.02*	—
Initial productivity gap	—	—	−0.032***	—	—	—	—
	—	—	*−4.85*	—	—	—	—
Initial wage gap	—	—	—	—	—	—	−0.034***
	—	—	—	—	—	—	*−6.05*
Constant	0.031***	0.217***	−0.012	−0.018*	0.049***	−0.034***	0.066***
	3.70	*3.27*	*−1.34*	*−1.76*	*6.21*	*−2.66*	*11.54*
F value	353.12***	8.09***	130.70***	76.21***	99.81***	221.76***	42.98***
R^2	0.910	0.272	0.872	0.823	0.849	0.794	0.502
Obs.	183	183	183	183	183	183	183

Note: Each column represents one separate equation estimated by OLS; dependent variable is indicated by the column heading; *t*-values of robust standard errors are given below coefficients; *, ** and *** indicate significance of the coefficient at 10, 5 and 1 per cent level of significance, respectively.

As will become clear from the comparison with the system estimation results below, in particular the FDI equation and the wage gap equation are plagued by a potential downward bias, arising from endogeneity between variables. Table 4 reports the results for the system of estimations using 3SLS. As mentioned above, we used country and industry effects as further exogenous variables not included in the system, which are used as instruments in the 'first stage'. We further report small sample statistics. This shifts the test statistics from z and chi-squared statistics to t and F statistics, respectively. Results are, however, almost identical when not correcting for small sample size. In the table, the variables are in the rows whereas the equations of the systems are in the columns. Finally, let us mention that the results are quite robust to some changes in the model specification (for example, omitting insignificant variables) and are largely in line with the results from OLS estimation reported above.

In the first equation [1] of the system, explaining output growth, most of the variables are significant and have the expected signs (that is, positive for the growth in the productivity gap, exports and gross fixed capital formation, and insignificant for imports and wages); FDI growth shows a strongly significant, yet economically small impact on output growth. In the second equation [2], with the growth rate of FDI as dependent variable, we find only an insignificant effect of output growth on FDI growth. This is, however, not confirmed by the OLS specifications reported above (Table 3), where the effect is significantly positive. The estimated parameter for export growth is always significantly positive. This underlines the strong connection between FDI and outward orientation, which is also reported in other studies in the context of the effects of FDI on output (Balasubramanyam *et al*, 1999; de Mello, 1999; Kinoshita, 2001). This is also supported by the size of the coefficient for export growth. Import growth and wage growth are negative. Foreign firms invest in sectors characterized by fast productivity catching-up and good export performance, which also tend to have lower wage growth; these are thus industries that may yield a high return to investments. With respect to the growth rate of the productivity gap (equation [3]), we find a significantly positive effect of output growth (the Kaldor–Verdoorn effect), of FDI growth and of the growth rate of imports; the latter may be explained by catching-up through technology embodied in the imported intermediates in successful catching-up sectors. Surprisingly, the growth rate of exports is significantly negative. In a pairwise correlation, the speed of closing the productivity gap and export growth show a positive correlation; however, in the system, the direct effect becomes negative. This negative effect of exports deserves further research. One potential explanation is that this result is driven by export specialization in industry segments with lower productivity growth (as we only have data at a relatively aggregated level). The wage gap and, surprisingly, also gross fixed capital formation remain insignificant as a direct route for closing the productivity gap.

In the equations explaining export growth [4], one finds again the unexpected negative effect of the growth rate of the gap. FDI growth has a positive effect on export growth as expected, thus pointing to a strong role for efficiency and cost seeking FDI. With respect to import growth in equation [5], we find a significantly positive effect of output, a faster closure of the productivity gap (that is, productivity growth uses imported inputs and embodied technology), exports and growth rate of fixed capital (again imports of embodied technology). On the other hand, FDI growth has a negative effect on import growth, which is in line with transfer of technology via FDI and substitution from imported goods. The negative coefficient in the import equation suggests a role for tariff jumping FDI in the case of intermediate inputs.

Table 4: Results of 3SLS, including all variables

	[1]	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*	*[7]*
	Output	*FDI*	*Productivity gap*	*Exports*	*Imports*	*GFCF*	*Wage gap*
Output	—	0.676	0.789***	0.421***	0.044	0.774***	−0.057
	—	*1.20*	*13.05*	*3.21*	*0.47*	*4.60*	*−0.95*
FDI	0.053***	—	0.036**	0.166***	−0.151***	0.087**	−0.076***
	3.00	—	*2.03*	*7.66*	*−10.13*	*2.40*	*−7.80*
Productivity gap	0.708***	1.234**	—	−0.807***	0.272***	0.149	0.033
	12.26	*2.28*	—	*−7.29*	*3.03*	*0.91*	*0.63*
Exports	0.183**	2.742***	−0.516***		0.614***	−0.172	0.014
	2.41	*6.85*	*−7.95*		*16.15*	*−1.09*	*0.30*
Imports	0.147	−5.268***	0.360***	1.248***	—	0.573***	−0.271***
	1.48	*−10.38*	*3.64*	*17.80*	—	*2.69*	*−4.36*
GFCF	0.139***	0.774***	0.038	−0.108	0.125***	—	0.168***
	3.58	*2.73*	*0.97*	*−1.63*	*2.55*	—	*6.76*
Wage gap	0.214	−5.527***	0.003	0.268	−0.578	1.345***	—
	1.49	*−6.94*	*0.02*	*1.36*	*−3.92*	*5.21*	—
Initial productivity gap	—	—	−0.005*	—	—	—	—
	—	—	*−1.92*	—	—	—	—
Initial wage gap	—	—	—	—	—	—	−0.021***
	—	—	—	—	—	—	*−4.63*
Constant	0.008	0.419***	−0.033***	−0.073***	0.062***	−0.076***	0.064***
	0.95	*9.79*	*−4.13*	*−6.80*	*8.38*	*−4.91*	*11.42*
Pseudo-R^2	0.8974	−0.1607	0.8125	0.7502	0.7775	0.7649	0.1853
F value	295.62	35.64	178.09	171.46	195.23	118.77	31.92
Obs.	183	183	183	183	183	183	183

Note: Each column represents one equation in the system; *t*-values (as using small sample correction) are given below coefficients; *, ** and *** indicate significance of the coefficient at the 10, 5 and 1 per cent level of significance, respectively.

With respect to the growth rate of gross fixed capital formation (see equation [6]), the positive effect of output growth, imports growth and wage catching-up is robust across specifications, while the positive effect of FDI growth has not been found in the single equations. The positive effect of wage growth can be explained by a capital-skill complementarity when introducing new technologies.

Finally, in equation [7], with the growth rate of wages as the dependent variable, all explanatory variables either have the expected sign or are insignificant (like growth rate of output, closing of the productivity gap and export growth). FDI shows a negative effect, suggesting that inward FDI flows often slow down wage growth, which however might depend on the specific country sample. This is simply the converse of the observation that industries with relatively lower wages (and slower wage growth) are more attractive for FDI. As in the productivity catching-up equation, we also find evidence for convergence. In other words, catching-up is faster the further an industry/country initially lagged behind in terms of wage rates (respectively, productivity levels in equation [3]).

Thus, the results broadly confirm a positive effect from FDI on output growth, both directly and indirectly, through faster productivity catching-up as well as increased export growth and investment. A puzzling observation is the negative direct correlation between export growth and productivity catching-up in the system. All indirect effects between the two variables (through output, FDI and import growth) are positive. We therefore tried to address a potential multicollinearity problem by including only the productivity gap variable or the output growth variable in each equation, but not both at the same time. The results are robust to this modification. The puzzle presented by the negative relationship between exports and productivity growth remains unchanged. More importantly, the positive relationship between FDI and output as well as productivity growth emerges as robust, too.

Interesting implications can be derived from a simple experiment. The system approach taken in this analysis allows us to assess both the direct and the indirect effects of FDI on output or wage developments (working, for example, through the effects of FDI on trade and investment). In a simple back-of-the-envelope calculation, we computed the full effect of changes in FDI growth rates on changes in output growth as well as wage growth. Table 5 reports these results, with the direct effect being simply the coefficient of FDI in the output and wage equation and the indirect effect being the sum of all direct FDI effects in all other equations multiplied by the respective variables' direct effect in the output and wage equation, respectively.

As a first observation, we see that the effects are almost negligible in magnitude. A one per cent increase in FDI growth results in a 0.12 per cent increase in output growth, taking into account all linkages through other variables. The largest fraction of this rather small

Table 5: Direct and indirect effects of FDI on growth rates of output and wage gap

	Output	*Wage gap*
Direct effect	0.053	−0.076
Indirect effect	0.068	0.055
Both effects	0.121	−0.021

Note: The size of the coefficient represents the percentage point increase of output and wages induced by a 1 per cent increase in FDI growth. Only significant direct effects were taken into account for the calculation of indirect effect.

impact arises however from indirect effects caused by FDI, working through a faster closing of the productivity gap, stronger export growth and higher investment. Even more interesting are the effects on wages. Here we see a negative direct impact, implying that the closing of the wage gap is slowed down in the presence of FDI. Thus, wages do not necessarily fall, but higher inward FDI stocks are associated with longer lasting price competitiveness in terms of wage costs. This result may arise due to the inclusion of the East Asian countries in the sample, which show both above-average FDI stocks and relatively lower wages compared with the sample average. However, this direct effect is counteracted by overall positive indirect effects. Thus, while FDI seems to hold back wage dynamics, the effect is dampened through indirect effects on trade and investment. As a result, FDI shows overall positive and significant effects on variables of prime economic interest, even if the magnitude of these effects is rather small. FDI can thus be seen as a vehicle to support prosperous economic development; however, it may not be a sufficient engine on its own to set in motion a process of prosperous economic development. To put it shortly, 'Attract FDI, but do not expect miracles' may be good advice for economic policy makers.

Conclusions

In this paper we have analysed the host-country effects of FDI by paying special attention to two issues that are not always accounted for in the existing literature. First, we explicitly control for heterogeneity in two ways: we allow for host-country characteristics and industry-specific characteristics. Second, we take account of the likely endogeneity in the relationship between FDI and output as well as productivity growth. In a first step, we use Granger causality tests to establish the direction of causation between the two variables. Based on these tests we cannot identify one of the variables as being purely exogenous; therefore, we estimate the relationship between the two in a system of simultaneous equations using 3SLS.

The results indicate that a system approach to modelling this relationship is useful because it includes indirect effects taking place through other variables (such as export orientation), which are quantitatively important in this relationship. We find mostly evidence for positive effects (through export growth, increased investment and closing of the productivity gap) but also some negative effects from FDI in the form of wage pressure. The effects, however, are small in magnitude, even when accumulating the direct and indirect effects. There is also a mutually reinforcing, negative relationship between FDI and imports, illustrating the different role of FDI for exports and imports. The positive relationship between FDI and output as well as productivity growth is robust to different specifications. Further, there is an element of circular causality between the two. Thus, for industries or countries with a generally weak growth performance in terms of output and productivity catching-up, it may be difficult to set in motion a process of mutually reinforcing patterns of strong output and FDI growth. Further, FDI exerts a relative downward pressure on wages. However, as mentioned in the main text, there are some unexpected results (mainly the relationship between export growth and closure of the productivity gap) as well. Here more in-depth research is necessary with respect to the specification of the simultaneous model, which should be addressed in future research. In this paper, we did not investigate the employment effects of FDI, but this is certainly another important aspect that has to be accounted for in further research. Our results

confirm, however, that both country-specific characteristics and industry-specific effects play an important role in the estimation. Therefore, future research should take a closer look at the differences between countries at different stages of development as well as the differences between industries. This may also shed more light on the nature of the link between FDI, productivity and growth, which is certainly positive but weak, in terms of economic effects.

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