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FDI and trade—Two-way linkages?

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Abstract

We investigate the intertemporal linkages between foreign direct investment and disaggregated measures of international trade. We outline a model exemplifying these linkages, describe methods for investigating two-way feedbacks between various categories of trade, and apply them to recent data. We find that the strongest feedback between the sub-accounts is between FDI and manufacturing trade. For the first time, we decompose causality using Geweke's [Geweke, J. (1982). Measurement of linear dependence and feedback between multiple time series. *Journal of the American Statistical Association 77*(378), 304–313] decomposition method. We find that most of the linear feedback between trade and FDI can be accounted for by Granger-causality from FDI gross flows to trade openness (50%) and from trade to FDI (31%).

JEL classification: F15; F21; F36; H21

Keywords: Financial openness; Commercial openness; Trade; Foreign direct investment

1. Introduction

A growing literature has recognized the existence of two-way feedbacks between financial flows and trade for developing countries. Yet, it is clear that aggregate measures of both financial flows and trade openness mask important differences between the various components of both measures. It is reasonable to expect that the linkages between FDI and trade in goods will be strong (and possibly bi-directional), but it is less evident whether the impact of trade on FDI should be different for, for example, countries in different stages of development or whether inflows and outflows of FDI react differently with different types of trade flows. This paper aims to provide

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preliminary answers to such questions with the help of both theoretical modeling and an empirical estimation of these relationships.

Growing literature on trade and the multinational firm identified conflicting association between international trade and FDI—see Blonigen (2005) for a recent review. Trade frictions (commercial policy, distance and transportation cost, etc.) encourage foreign producers to "jump" trade barriers by replicating similar plants in different markets. Such investment patterns are referred to as horizontal FDI. In contrast, cost gaps may encourage producers to fragment the production process, putting labor intensive stages of production in low wage countries, and the more capital intensive stages of production (R&D, assembly, headquarter services, etc.) in industrialized countries. Such investment patterns are referred as vertical FDI. An important difference between these two patterns deals with the association between trade and FDI: horizontal FDI tends to substitute trade, whereas vertical FDI tends to create trade. Economic reasoning suggests that vertical FDI are more prevalent between the industrialized and developing counties, whereas horizontal FDI are more prevalent among the industrialized countries. In practice, one expects hybrid patterns, where multinationals opt for both vertical and horizontal mixture.

Most of the empirical literature investigating FDI patterns focuses on cross-country variation.[1] The purpose of this paper is to investigate possible intertemporal feedback effects between international trade flows and FDI. Specifically, we propose a new explanation for a positive intertemporal feedback between trade and FDI, and show that the data is consistent with the presence of such feedback. Using our theoretical model, we point out that a developing country experiencing rapid improvement in its productivity will attract growing inflows of vertical FDI, increasing thereby its international trade. In circumstances where the multinational employs skilled workers in the developing country, the greater volume of trade that comes with the vertical FDI ought to increase the demand for skilled workers, increasing thereby the return to human capital in the developing country. This in turn will lead to an increase in the supply of skilled workers, potentially increasing future FDI. We view this channel as only one part of a hybrid of complex intertemporal links between trade and FDI that are also discussed. In the empirical part we focus on identifying strong two-way positive feedbacks between trade and FDI.

A number of recent papers have examined the empirically identifiable interactions between financial flows and trade (Albuquerque, Loayza, & Servén, 2005; Do & Levchenko, 2004; Lane & Milesi-Ferretti, 2004, 2005; Rose & Spiegel, 2004; Swenson, 2004). Most prominent in this literature is the argument that larger inflows of FDI will lead to higher volume of trade as well as other benefits such as increased rates of total factor productivity growth or higher output growth rates.

Aizenman and Noy (2004) examine de facto measures of financial and trade openness, and show that aggregate financial and commercial openness measures are closely linked. They empirically decompose causality and find strong effects in both directions. Another approach linking trade and financial openness is Portes and Rey (2005), showing that both international trades in goods and in assets are explained by similar gravity regressions. Their work highlights the role of information flows and frictions in accounting for trade in goods and assets. Aviat and Coeurdacie (2004) extend the methodology of Portes and Rey (2005), and investigate the geography of trade in goods and asset holdings. They find that the causality between bilateral asset holdings and trade in goods runs significantly in both ways and that these effects are strong.[2]

[1] See Lipsey (2002) and Blonigen (2005).

[2] Other recent papers that discuss financial flows or FDI more specifically are Agénor (2003), Blonigen and Wang (2004), Chan and Gemayel (2004), Harrison, Love, and McMillan (2004), Lane (2004) and Razin, Rubinstein, and Sadka (2003).

We investigate linkages between capital flows and trade with more disaggregated measures of both. Such disaggregation allows us to identify the salient features of the feedback effects. We describe several methods for investigating two-way feedbacks between categories of trade (goods, services and income) and apply them to the recent experience of developed and developing countries since we hypothesize that FDI might be linked differently to these differing trade measures with the interactions also possibly different for developed and developing countries.[3] We find that the strongest feedback between the sub-accounts is between FDI and trade in goods and focus on this specific link in this work.[4] Specifically, applying Geweke's (1982) decomposition method, we find that most of the linear feedback between trade in goods and FDI (81%) can be accounted for by Granger-causality from FDI gross flows to trade openness (50%) and from trade to FDI (31%). The rest of the total linear feedback is attributable to simultaneous correlation between the two annual series. Similar results are obtained when we instead investigate causality between trade openness and net FDI flows or net inflows. We also consider other linkages between the sub-accounts of the current and the financial accounts and generally find them significantly less important suggesting the importance of FDI in generating export led development.

In Section 2 we discuss the theoretical literature and present a theoretical model of some of the possible links between FDI and trade. In Section 3 we present the data while Section 4 outlines the empirical model and our findings for disaggregated measures of FDI and trade flows. Section 5 focuses on the question of causality and Section 6 concludes with further interpretive remarks and by outlining several avenues for future research.

2. Theory: possible links between trade and FDI

We start with a brief review of the background literature explaining feedbacks between trade and capital flows, and close the section with a model that describes feedbacks between trade in goods and foreign direct investment by focusing on the impact of FDI on future patterns of demand for human capital and production. We conclude that one should expect to find two-way feedbacks between trade and FDI.

The observed positive association between trade and finance may be attributed to political-economy factors. Rajan and Zingales (2003), for example, propose an interest group theory of financial development whereby incumbents oppose financial development because it breeds competition. In these circumstances, the incumbents' opposition will be weaker when an economy allows both cross-border trade and capital flows. They predict that a country's domestic financial development should be positively correlated with trade openness, and identify the time varying nature of this association.

Another channel, operating in the same direction from finance to trade, might be due to reliance of international trade on trade credits. Greater openness to trade credit flows, leads to a decrease in the cost of this credit and thereby increases international trade.[5]

[3] There is a large literature that aims to differentiate between different types of FDI flows and discuss the difference between these in developed and developing countries (for a partial summary of the former, see Gangnes, Noy, and Vu (2005), for the latter see Blonigen and Wang (2004)).

[4] Besides examining the relative importance of various commercial sub-accounts, we also investigated whether commercial openness is linked to the other financial openness measures (loans, equity and trade credits) and found it was not correlated with any of these measures in multivariate specifications similar to the ones reported below.

[5] See Helpman and Razin (1978) for an integrated theory of trade in goods and securities. For a similar argument on the impact of services liberalization on goods trade see Blyde and Sinyavskaya (2004).

Alternative channels explaining the feedback between FDI and trade deal with the endogenous determination of patterns of production and investment in human capital. Below we describe a model of production by multinationals that fragment their production optimally, and benefit from the cost advantage associated with locating labor-intensive production stages in labor abundant countries.[6] A by-product of this fragmentation is the growth of two-way trade: higher imports of primary and intermediate products, followed by higher exports of the improved/final products. Multinationals will opt to locate the production in the developing countries that offer the highest productivity/wage ratio.[7] A developing country experiencing rapid improvement in its productivity, due to accumulation of human capital, learning by doing, or better institutions will attract growing inflows of vertical FDI, increasing thereby its international trade. In circumstances where the multinational employs skilled workers in the developing country, the greater volume of trade that comes with the vertical FDI ought to increase the demand for skilled workers, increasing thereby the return to human capital in the developing country. This in turn will increase the supply of skilled workers, further increasing future FDI.

We consider a global economy composed of two blocks of countries, H and F, each consuming two types of final goods—a homogeneous one, Z, and n heterogeneous goods, denoted by $Y_{t,i}$, $i = 1, \ldots, n$. The F block is composed of developing countries, differing in labor productivity. Asterisks signify F variables. The utility of the H consumers at time t is a semi-additive function of the two goods

$$u_t = Z_t + \frac{A}{\delta}\sum_{i=1}^{n}[Y_{t,i}]^{\delta}, \quad 0 < \delta < 1. \tag{1}$$

The intertemporal utility is the conventional net present value of the temporal utilities, discounted applying the subjective rate of time preferences. Similar preferences characterize consumers in country F. The supply of labor in each block is inelastic and good Z is produced using a simple Ricardian technology. In H, this technology is

$$Z = L_z, \tag{2}$$

where L_z denotes the labor employed in the production of the homogenous sector. We normalize the price of good Z to 1, so the real wage is 1 in the competitive equilibrium.

We focus on a developing country, where the technology in the homogenous sector is

$$Z^* = a^* L_z^*, \tag{3}$$

where the parameter a^* is the productivity of foreign labor and the real wage is $w^* = a^*$. The homogenous good, Z, is a composite good, characterized by stable and mature technology, with limited prospects for future productivity improvements. In contrast, Y goods are relatively high tech goods, the outcome of multinationals' R&D. Unlike good Z, producing intermediate Y inputs in country F is likely to increase F's productivity over time. Due to the reasons elaborated in the literature dealing with vertical FDI, multinationals producing Y goods frequently fragment vertically their production line.[8] Specifically, we assume that goods Y are produced in a vertical mode, where production is fragmented geographically. The final production stage is done at H,

[6] Hanson, Mataloni, and Slaughter (2001) show that vertical FDI from the OECD to developing countries has increased substantially in the last 20 years.

[7] A recent thorough survey on the locational choices of multinationals' FDI is Blonigen (2005).

[8] See Feenstra (2003) for a useful overview.

using intermediate inputs produced in F at an earlier stage, in the developing country that offers the most cost effective production line. The intermediate input, M_i, can be produced in the foreign country at time t using a Cobb–Douglas production technology:

$$M_{t,i} = \sqrt{b_t^* L_{t,i}^*}, \tag{4}$$

where $L_{t,i}^*$ is the labor employed and $b_{t,i}^*$ is the labor productivity in the foreign intermediate-good sector. The final production stage combines the intermediate input $M_{t,i}$ and H value added using a Leontief technology to supply the final output, $Y_{t,i}^{\mathrm{s}}$:[9]

$$Y_{t,i}^{\mathrm{s}} = \mathrm{Min}\left[M_{t,i}; \sqrt{b_i L_{t,i}}\right]. \tag{5}$$

The fragmented production process requires the multinational to invest in two plants, resulting in a periodic set-up cost of C_i at each country. This cost may be viewed as the periodic investment needed to sustain the production capacity. We assume that goods Y_i are ordered such that a higher index i is associated with higher periodic set-up cost. We consider the case where, due to learning by doing and accumulation of human capital, the developing country's labor employed in activities Y_i becomes more productive—$b_t^* < b_{t+1}^*$. To simplify, we take first the productivity improvement as an exogenous process. Each period, the multinational allocates the production of the intermediate output $M_{t,i}$ to the developing country that is the most cost effective. To simplify notation, we henceforth suppress the time subscript.

Applying (1), the demand for good Y in each country is

$$Y_i^{\mathrm{d}} = \left(\frac{A}{P_{y,i}}\right)^{\eta}, \quad \eta = \frac{1}{1-\delta} > 1. \tag{6}$$

The total demand facing the multinational is qY_i^{d} where q stands for a scale measure of the number of countries composing the global economy.

Assuming that good i is produced, it follows from (4) and (5) that employment levels in the final and the intermediate production stages of good i are

$$L_{y,i} = \frac{(Y_i^{\mathrm{s}})^2}{b}, \qquad L_i^* = \frac{(Y_i^{\mathrm{s}})^2}{b^*}. \tag{7}$$

The monopoly profits are

$$\Pi_i = qY_i^{\mathrm{d}} p_{y,i} - L_{y,i} - w^* L_i^* - 2C_i. \tag{8}$$

Substituting (6) and (7) into (8), we find that

$$\Pi_i = \bar{A}(Y_i^{\mathrm{s}})^{\delta} - \frac{(Y_i^{\mathrm{s}})^2}{b} - w^*\frac{(Y_i^{\mathrm{s}})^2}{b^*} - 2C_i, \quad \text{where } \bar{A} = A(q)^{1/\eta}. \tag{9}$$

The first-order condition characterizing optimal output ($\tilde{Y}$) and the resultant profits are

$$\tilde{Y}_i = \left[\frac{0.5\bar{A}\delta}{(b)^{-1} + w^*(b^*)^{-1}}\right]^{1/2-\delta}, \quad \Pi_i = k_i - 2C_i, \tag{10}$$

[9] The analysis can be extended to a general constant elasticity of substitution (CES) function. Of course, the Leontief technology simplifies the math. It may be also a reasonable assumption in manufacturing industries where, by design, there are fixed proportions between the different inputs (like auto body produced in Mexico, engine in the US, etc.).

where

$$k_i = (1 - 0.5\delta)\bar{A}\left[\frac{0.5\bar{A}\delta}{(b)^{-1} + w^*(b^*)^{-1}}\right]^{1/2-\delta}. \tag{11}$$

Hence, k_i is determined by the real wages and by the efficiency of the labor in H and F, where

$$\frac{\partial \Pi_i}{\partial b^*} > 0, \qquad \frac{\partial Y_i}{\partial b^*} > 0. \tag{12}$$

The multinational allocates the production of the intermediate product i to the developing country characterized by the highest normalized productivity/wage ratio (i.e., the highest b^*/a^*). Hence, a developing country that gains productivity in activity i at a rate that exceeds its competitors will attract more FDI. The exports of such a country would increase both due to the higher production level of the infra marginal goods, and the introduction of new, relatively high C_i goods.

Our analysis assumed so far that the productivity improvements are exogenous, as will be the case if productivity is only impacted by exogenous accumulation of human capital. One can extend our model to account for endogenous accumulation of human capital, allowing for heterogonous labor force. Specifically, suppose that the there are two labor types, skilled and unskilled. Unskilled labor is employable only in sector Z, whereas skilled workers have the option of employment at sector Y. The economy starts with relative scarcity of skilled labor. Unskilled workers may become skilled workers following the accumulation of human capital, a process that is associated with time and resource costs. In an economy that receives vertical FDI, higher trade implies also higher demand for skilled workers, inducing more unskilled workers to acquire human capital. Consequently, greater abundance of skilled workers would increase the economy's attractiveness to multinationals. Higher trade would tend to increase the demand for skilled workers, increasing over time the supply of skilled workers, increasing thereby the future attractiveness of the country for multinational FDI. Appendix A outlines a specific example of a model where such feedbacks are at work. We consider the case where mobility of workers from sector Z to Y is limited and costly. Specifically, we assume that workers in the developing country can move from to the Y sector only after paying a switching cost, the sum of investment in human capital and other reallocation costs. These costs are worker specific, and are assumed to be known to each agent. In these circumstances, the supply of labor in activity Y is segmented in the short run from the supply of labor in activity Z, and wages are sector specific, $a^*, w^*_{t,y}$. Workers would switch from sector Z to Y when the net present value of the future wage gap, $w^*_{t,y} - a^*$ exceeds the switching costs. In an economy where the wage gap is anticipated to grow in favor of sector Y, agents with lower switching costs will move earlier. The supply of labor in sector Y is composed of workers that have switched already. Consequently, higher productivity in sector Y (induced by higher investment in that sector Y, learning by doing, etc.) would increase wages in sector Y. This in turn would induce more agents to switch to sector Y, encouraging further investment in that sector.

India's recent trade history exemplifies the possible links between trade, FDI flows and investment in human capital. The education system in India has been known for producing highly qualified engineers. In the 1970s–1980s, the options available to these engineers in India were rather limited, implying that relatively low domestic demand imposed a constraint on the effective supply of engineers.[10] The recent advances of telecommunication and the Internet reduced drastically the cost of trade in information services. The direct outcome has been a sizable increase in

[10] This also led to significant brain drain from India to OECD countries. The recent surge in demand for qualified workers in India has possibly reversed the brain drain, inducing some workers that left India in the 1980s–1990s to return.

trade in services, putting in motion a two-way feedback process. The greater export of services from India increased the return for education in India, increasing the supply of human capital, and the attractiveness of India for future FDI.

3. Data

A priori, we see no reason to restrict our sample and therefore attempted to include all 205 countries and territories for which all data are available in the 2001 edition of the World Bank's *World Development Indicators* (*WDI*). Our control variables, though, are available for only a subset of this group. Most importantly, most of the data on FDI flows are typically available only from the 1980s and only for a much smaller set of countries while the political data is available only up to 1998. Our data set is therefore an annual panel of 81 countries for the years 1982–1998.

Blonigen and Wang (2004) argue that pooling developed and developing countries in empirical studies of this type is inappropriate and likely to lead to misleading results. We also hypothesize that results for industrialized/developed countries might be different from those for developing countries as the nature of FDI in these groups might be different; for example vertical versus horizontal FDI. We thus conduct our empirical investigation for developed economies – which we define as those economies that were members of the OECD in 1990 – and developing countries separately.[11] For a summary of the information described in this section including detailed data sources and sample sizes, see Appendices B and C.

We measure gross financial flows (de facto financial openness) as the sum of total capital inflows and outflows (in absolute values) measured as a percent of gross domestic product. Capital flows are the sum of FDI, portfolio flows, trade credits and loans. We construct an openness index for each one of these four components and briefly describe them below. We then focus on FDI openness in our estimations. The data on financial flows is taken from the IMF's *Balance of Payments Statistics* dataset. These measures of financial openness are exactly analogous to the standard measure of commercial openness (sum of exports and imports as percent of GDP), which we investigate as well.

We sub-divide the standard measure of commercial openness into openness for trade in goods, trade in services and trade in incomes following the classification adopted by the World Bank.[12] We further divide trade in goods into openness measures for trade in foodstuffs, in fuel, in manufacturing and in metals/ores. This data is from the World Bank's *World Development Indicators*. We provide descriptive statistics in Tables 1 and 2.

Specifically, Table 1 presents averages for financial openness disaggregated by type (FDI, loans, trade credits and equity flows) for the 1980s and 1990s.[13] We divide our country sample into industrialized and developing countries. A number of observations merit discussion at this point. First, one can observe a dramatic increase (doubling) of FDI in the 1990s as compared to the previous decade. This trend is more pronounced for the developing countries whose inflows

[11] Developing countries are defined by excluding OECD countries and island economies (as these are often used as off-shore banking centers and their level of de facto openness to financial flows is often dramatically different from other countries with the same income level).

[12] Trade in income (net income) "refers to receipts and payments of employee compensation for nonresident workers, and investment income (receipts and payments on direct investment, portfolio investment, and other investments and receipts on reserve assets)". *World Bank Development Indictors*, 2005.

[13] The 1990s include data up to and including 1998. Because we limit our data to 1998, our data does not completely reflect the slowdown in capital flows following the Asian crisis.

Table 1
Financial openness by type—descriptive statistics

	Developing countries		Industrialized countries	
	1980s	1990s	1980s	1990s
FDI	1.71	3.44	1.97	3.76
FDI inflows	1.07	2.85	1.03	1.87
FDI outflows	0.29	0.40	1.13	1.92
FDI net-flows	0.92	2.60	0.13	0.06
Trade credits	1.49	1.68	0.67	0.51
Portfolio flows	1.18	2.20	2.90	6.41
Loans	5.97	5.44	3.26	3.18

The table presents averages of sum of financial inflows and outflows (divided by types) as percent of GDP. Data from the *Balance of Payments Statistics*.

Table 2
Trade openness by type—descriptive statistics

	Developing countries		Industrialized countries	
	1980s	1990s	1980s	1990s
Trade in incomes	9.14	9.07	9.19	12.51
Trade in services	20.79	22.76	15.36	17.36
Trade in goods	66.31	61.69	52.25	51.80
Trade in manufacturing	28.84	37.78	34.85	38.95
Trade in foodstuffs	13.42	11.19	7.73	6.95
Trade in fuels	24.09	9.82	6.94	3.37
Trade in metals/ores	2.98	2.46	2.09	1.79

The table presents averages of sum of commercial inflows and outflows (divided by types) as percent of GDP. Data from the *World Development Indicators*.

of FDI went up from an average of about 1% of GDP to almost 3% (most of this increase appears to have come from a large increase in FDI outflows from the industrialized countries). Portfolio flows have also seen a dramatic increase (more pronounced for the industrialized countries) while trade credits and the amount of loan flows have not changed that much in the last two decades (as % of GDP).

Table 2 records descriptive statistics for trade flows, disaggregated by types, income levels and decades. Apparent is the relative stability of most measures of trade openness in both developing and developed countries. Exceptions are a large increase in the volume of trade in manufacturing for developing countries and a large decrease in trade in fuels for both samples.[14] Interestingly, in our sample, developing countries, on average appear to be more open to trade in both goods (across all types) and services than industrialized countries.

Table 3 presents correlation coefficients between the financial openness measures and the commercial/trade openness measures disaggregated by types of flows. The only notable correlations are a significant correlation of FDI flow measures with goods and services trade (especially trade in manufacturing and fuels) for developing countries and a much weaker association between FDI flows and trade in industrialized countries. Other significant and noteworthy correlations are

[14] At the very least, part of the reason for this decline is average lower oil prices during the 1990s.

Table 3
Correlations for trade and financial flows

	Equity flows	Trade credits	Loan flows	FDI flows	Trade in goods	Trade in services	Trade in incomes	Trade in manufacturing	Trade in foodstuffs	Trade in fuel	Trade in metals
Developing countries											
Equity flows	1	0.06	0.40	0.23	0.21	0.23	0.26	0.13	−0.04	0.13	−0.02
Trade credits		1	0.02	0.18	0.07	0.07	0.02	0.07	0.12	0.07	−0.03
Loan flows			1	0.15	0.13	0.21	0.72	−0.05	0.03	0.01	−0.07
FDI flows				1	0.60	0.55	0.22	0.60	0.23	0.46	0.22
Industrialized countries											
Equity flows	1	0.03	0.26	0.63	0.13	0.09	0.30	0.34	0.03	−0.20	0.01
Trade credits		1	0.13	0.04	0.15	0.15	−0.16	0.20	0.03	0.23	0.07
Loan flows			1	0.30	0.17	0.17	0.44	0.28	0.04	−0.07	−0.01
FDI flows				1	0.20	0.05	0.33	0.36	0.17	−0.01	0.15

Table 4
Phillips-Perron test for unit root

	(1) Developing countries	(2) Industrialized countries
Financial openness index		
FDI	−123.8***	−47.7***
Loans	−863.8***	−162.1***
Equity	−500.3***	−68.7***
Trade credits	−293.5***	−160.7***
Trade openness index		
For services	−123.7***	13.1**
For incomes	−181.4***	−4.26
For goods	−331.6***	1.82

The table lists the z-statistic for ρ with the asterisks denoting statistical rejection of the unit-root hypothesis. The two columns denote the developing countries and industrialized countries samples.
** Significance levels at 5%.
*** Significance levels at 1%.

between trade in goods and trade in services (for both samples) and a high correlation between equity flows and FDI flows for the industrialized countries sample.

Since results from all the estimation procedures described below will be biased if the FDI series has a unit root, we first establish stationarity. We conduct the common Phillips-Perron (1981) test for unit root financial openness variables as well as the trade openness measures. Results are presented in Table 4. We reject the existence of unit root in almost all cases.[15]

In our multivariate estimations, we include several control variables that are described below. This list is based on our previous research on financial openness (Aizenman & Noy, 2004) and recent empirical work on FDI (especially Albuquerque et al., 2005; Blonigen & Wang, 2004). In order to ensure our results are not driven by a 'missing variables' bias, we include a host of macroeconomic control variables. In all regressions we use per capita gross domestic product (measured in PPP dollars), a domestic interest rate spread (from a world rate of interest),[16] and a weighted average of G3 growth rates. In an initial specification, we also included the government's budget surplus (as % of GDP), the inflation rate (CPI), a world interest rate (US 1-year T-bill rate), gross domestic product (in $1995), and government consumption (as % of GDP). None of these were significant and all were dropped from the specifications we report. The macroeconomic data are taken from the World Bank's *World Development Indicators* and the IMF's *International Finance Statistics*.

For the political-economy determinants of financial openness, we concentrate our empirical investigation on two political and institutional measures, an index of the political regime in place and a measure of corruption. We first include a variable that measures the degree of democratic rule. Our democracy index is taken from the *Polity IV* project and ranges from −10 (fully autocratic) to +10 (fully democratic).[17]

[15] We fail to reject a unit root in the case of the openness measure for trades in goods and incomes in the industrial countries sample.

[16] We measure the spread between a domestic deposit rate and the IMF's special drawing rights (SDRs) interest.

[17] The "Polity IV database includes annual measures for both institutionalized democracy (DEMOC) and autocracy (AUTOC). A third indicator, POLITY, is derived simply by subtracting the AUTOC value from the DEMOC value; this procedure provides a single regime score that ranges from +10 (full democracy) to −10 (full autocracy)" (Marshall & Jaggers, 2000, p. 12). We use the POLITY variable in our regressions. For further discussion, see Aizenman and Noy (2004).

In addition, for our second political-economic control, following the work of Wei (2000) and Dreher and Siemers (2003), we examine whether corruption matters for the degree of financial openness. We use a measure of corruption that is taken from the *International Country Risk Guide* (*ICRG*). The data are available in monthly observations. We obtain annual observations from 1982 onward by averaging the monthly data points for each year. This index ranges from −6 (low probability/risk of encountering corruption) to 0 (high risk of corruption). Two other political variables that were initially included but later dropped due to their insignificance were a measure of political risk (from the *ICRG* data) and a measure of government unity (taken from the World Bank's *Dataset on Political Institutions* 2000).

In order to examine whether the occurrence of financial crises contaminates our result, as they might systematically change the relationship between financial openness and our control variables, we also include crises measures in a number of regressions.[18]

As the theoretical discussion in Aizenman and Noy (2004) suggests, one of the determinants of de facto financial openness should be the legal impediments to financial flows (de jure financial openness). Accordingly, we also include in our multivariate analysis a binary measure for restrictions on the capital account taken from the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*. This binary measure is the only internationally comparable measure of de jure financial openness available for a large sample of countries and over the entire sample period.

4. Modeling the relationship between capital flows and trade: methodology and results

4.1. Causality from trade to capital flows

In order to investigate whether past trade openness Granger-causes FDI gross flows, we start by positing a linear structure for the determination of the level of financial openness whereby:[19]

$$\mathrm{FDI}_{it}^{Q} = \alpha_i + \beta_1 X_{it} + \beta_2 \overline{\mathrm{CO}_{it-1}^{T}} + \varepsilon_{it}. \tag{13}$$

The dependent variable FDI_{it}^{Q}, FDI openness for country i at time t and type Q (gross, net, inflow, or outflow), is assumed to be dependent on separate country intercepts, a vector X_{it} of macroeconomic and political and institutional control variables, a vector of average lagged trade openness measure ($\overline{\mathrm{CO}_{it-1}^{T}}$) for country i, time t and type T (goods, services, etc.) and an error term.

While in Aizenman and Noy (2004), we found strong evidence of autocorrelation in the aggregate financial openness measure; this is not the case for estimations of the FDI component of financial openness as is evident in the estimated autocorrelations included in the tables below, therefore lagged values of FDI_{it}^{Q} are not included in the model's specification. In order to examine

[18] We utilized a number of variants of these binary indicators (currency crisis and banking crisis, their onset year only, and these separately or together in the same specification) and we never reject the null (no effect). For currency crises, our indicator is identified by periods in which a monthly index, composed of a weighted average of the real exchange rate and foreign reserves, changes by more than 2 standard deviations (data is taken from the *IFS*). The banking crisis binary indicator is taken from Caprio and Klingebiel (1999) and is analyzed in Arteta and Eichengreen (2002) and Hutchison and Noy (2005). See Hutchison and Noy (2006) for more on the identification of various types of financial crisis episodes.

[19] See Granger (1969) and Sims (1972) for a definition of G-causality.

Table 5
Estimation of FDI openness index

	(1) Developing	(2) Industrialized	(3) Developing	(4) Industrialized
Per capita GDP	0.25*** (3.97)	0.17*** (6.06)	0.28*** (5.32)	0.17*** (4.72)
The 1990s	0.71*** (3.98)	−0.24 (1.05)	0.72*** (4.10)	0.38 (1.11)
Trade openness index (average for $t-1, \ldots, t-4$)	0.02*** (6.98)	0.01 (1.53)		
For services			0.00 (0.27)	0.00 (0.06)
For incomes			0.01* (1.62)	0.07** (2.06)
For goods			0.02*** (3.39)	0.10*** (5.37)
Akaike IC	4.70	3.25	4.78	4.30
Estimated autocorrelation	0.47	0.50	0.47	0.29
Observations	1341	318	1446	468
Adjusted R^2	0.47	0.63	0.47	0.52

t-Statistics for all variables are given in parentheses. The LHS variable is the sum of FDI net inflows and outflows (as % of GDP). Estimation using least squares with country fixed effects. For definitions of variables, see Appendix B.

* Significance levels at 10%.

** Significance levels at 5%.

*** Significance levels at 1%.

the suitability of fixed versus random assumption for the country-specific effects we examine the standard Hausman χ^2 statistic for the benchmark regression of Table 5, column 1. The statistic, at 12.35, strongly indicates rejects the null of uncorrelated errors necessary for unbiased random-effects estimation. We therefore conduct all estimations with a fixed-effects specification.

Tables 5 and 6 include results for our basic regressions. The adjusted R^2 is between 0.47 and 0.71; these depend on the macroeconomic controls that are included in the estimation, the specific dependent trade variable used and the sample (developed or developing countries). In Table 5, we report results of regressions that exclude the macroeconomic and political control variables. Only GDP per capita and a dummy for the 1990s are included besides the trade variables of interest to us in this paper. We find that the coefficient for per-capita GDP is always positive and statistically significant—i.e., an increase in domestic per capita GDP of PPP$1000 will facilitate 0.2–0.4% points increase in the volume of gross FDI flows (as percent of GDP). A dummy variable for the 1990s is consistently positive and significant for the developing countries and negative but only occasionally significant for the industrial countries sample.

The association between FDI gross flows and trade is positive and significant at the 1% level for the developing countries sample and is positive but insignificant for the developed countries (columns 1 and 2 in Table 5).[20] A decomposition of our measure of trade openness into trade in goods, in services, and in incomes however, yields very similar statistically significant results for the two samples; with trade in goods dominating the association between trade and FDI flows (columns 3 and 4 in Table 5). Services trade is never statistically significant for either sample nor in the different specifications for Tables 5 and 6. Interestingly, in columns 3 and 4 of Table 6, the association between goods trade and FDI openness and trade in incomes and FDI openness is twice as strong and statistically significant while that is no longer the case for the industrial economies.

[20] Using exports/GDP ratio instead of the trade/GDP measure as a proxy for trade openness does not change this result.

Table 6
Estimation of FDI openness index—full specification

	(1) Developing	(2) Industrialized	(3) Developing	(4) Industrialized
Per capita GDP	0.35*** (3.30)	0.28*** (4.95)	0.40*** (3.62)	0.32*** (5.19)
Interest rate spread	−0.08 (0.76)	0.10* (1.57)	−0.09 (0.81)	0.03 (0.36)
Foreign growth rate	0.20** (1.96)	−0.12 (1.48)	0.26*** (2.53)	−0.05 (0.53)
Democratic regime	−0.04 (1.04)	0.05 (0.09)	−0.02 (0.36)	−0.19 (0.29)
Corruption	−0.37* (1.60)	−0.01 (0.05)	−0.13 (0.54)	0.03 (0.11)
The 1990s	0.61* (1.80)	−0.91*** (2.63)	0.75** (2.18)	−0.61* (1.57)
Trade openness index (average for $t-1, \ldots, t-4$)	0.02*** (3.84)	0.02** (2.53)		
For services			−0.06 (1.49)	0.06 (0.71)
For incomes			0.05*** (4.48)	0.00 (0.05)
For goods			0.03** (1.98)	0.04 (1.33)
Akaike IC	4.72	3.22	4.74	3.58
Estimated autocorrelation	0.16	0.34	0.19	0.17
Observations	533	193	541	235
Adjusted R^2	0.58	0.71	0.55	0.67

t-Statistics for all variables are given in parentheses. The LHS variable is the sum of FDI net inflows and outflows (as % of GDP). Estimation using least squares with country fixed effects. For definitions of variables, see Appendix B. In an initial specification, we also included the government's budget surplus (as % of GDP), the inflation rate (CPI), a world interest rate (US 1-year T-bill rate), government consumption (as % of GDP).

* Significance levels at 10%.

** Significance levels at 5%.

*** Significance levels at 1%.

Results for other macroeconomic and political control variables are reported in Table 6. The coefficient for the interest rate spread is negative for developing countries and positive for industrial ones but is rarely statistically significant. Foreign growth rates are positive and significant for developing countries but negative and insignificant for developed ones. The political-economy determinants of international financial flows, corruption levels and the democracy measure are never statistically distinguishable from zero in our regression specifications. The democratic regime variable is consistently negative, in line with Aizenman and Noy's (2004) findings on aggregate measures of financial openness. Since we use a fixed-effects specification these results are not surprising, as these measures tend to be fairly constant over time.[21]

In Table 7, we re-estimate our benchmark specifications with different left-hand side FDI variables. In columns 1 and 3 we examine FDI inflows while in columns 2 and 4, outflows. For the trade openness measures, the only variable that is consistently significant, as before, is goods trade for the inflows specifications (columns 1 and 3). Trade does not appear to explain FDI net outflows.

In addition to the specifications discussed above, we tested a number of alternative specifications of our empirical model in order to verify the robustness of our results. Because of space considerations we do not include the full specifications in our tables but all these results are available upon request. We started by decomposing the measure for goods trade into trade in foodstuffs, fuel, manufacturing and metals/ores. For the developing countries sample, we consistently find that FDI is positively correlated with trade in foodstuffs and manufacturing but negatively corre-

[21] In Aizenman and Noy (2004), we present significant results for these measures when fixed effects are not included.

Table 7
Estimation for the FDI inflows/outflows

	(1) FDI net inflows developing	(2) FDI net outflows developing	(3) FDI net inflows industrialized	(4) FDI net outflows industrialized
Per capita GDP	0.24*** (2.57)	−0.27*** (10.84)	0.10*** (4.32)	−0.20*** (6.05)
Interest rate spread	0.00 (1.30)	0.01 (1.20)	0.03 (1.02)	0.00 (0.07)
Foreign growth rate	0.06 (0.97)	−0.01 (0.23)	−0.01 (0.41)	0.00 (0.03)
Democratic regime	0.03 (0.85)	0.02* (1.68)	−0.15 (0.70)	−0.47 (0.77)
Corruption	0.27 (1.48)	0.18*** (2.91)	−0.04 (0.41)	−0.03 (0.24)
The 1990s	0.62** (2.09)	0.01 (0.05)	0.10 (0.55)	0.66*** (2.60)
Trade openness in (average for $t-1, \ldots, t-4$)				
Services	−0.03 (0.91)	0.01 (0.83)	0.01 (0.18)	−0.06 (0.95)
Incomes	0.01 (0.79)	0.00 (0.00)	0.02 (1.37)	0.01 (0.48)
Goods	0.06*** (4.66)	0.00 (0.74)	0.04*** (2.73)	0.01 (0.66)
Akaike IC	4.81	1.90	2.43	2.98
Estimated autocorrelation	0.17	−0.02	0.34	0.29
Observations	635	318	283	254
Adjusted R^2	0.39	0.66	0.58	0.59

t-Statistics for all variables are given in parentheses. The LHS variable is either FDI net inflows or net outflows (as % of GDP). Estimation using least squares with country fixed effects. For definitions of variables, see Appendix B.

* Significance levels at 10%.

** Significance levels at 5%.

*** Significance levels at 1%.

lated with trade in fuels. Qualitatively similar but somewhat weaker results are obtained for the developed countries sample.[22]

We first tested whether cross-sectional dependence might be biasing our coefficients and creating a spurious correlation. That will be the case if cross-sectional shocks that affect a number of countries will increase both FDI gross flows and gross trade flows at the same time. To account for cross-sectional dependence, we implement the 'principal components' procedure suggested by Coakley, Fuertes, and Smith (2002).[23] We implement this procedure for the baseline specification in column 1 of Table 5. Results for the variable of interest (i.e., trade openness) are very similar if slightly weaker—the coefficient is 25% smaller but is positive and significant at the 1% level.

Geweke, Meese, and Dent (1983) describe a number of alternative causality tests. Specifically, they suggest that a Wald test using the Granger or Sims specifications is superior to other alternatives they examine. We implement a variant of this test for the two data series (FDI and goods trade openness measures) and always reject the null of no causality with more than 1% statistical significance in both directions.

As we already noted in the previous section, we also tested the significance of a number of other control variables and found none to have any explanatory power. We also hypothesized that

[22] These results are presented in the working paper version of this paper, Aizenman and Noy (2005).

[23] The algorithm involves estimating a fixed effect model, obtaining the principal component of the cross-sectional error terms and then augmenting the original specification with these principal components. Coakley et al. (2002) show that coefficient estimates are then unbiased and consistent. Through simulations, they conclude that this algorithm leads to a substantial bias reduction if the panel does have cross-sectional dependence.

Table 8
Reverse specifications for goods/services trade openness indices

	(1) Goods developing	(2) Goods industrialized	(3) Goods developing	(4) Goods industrialized
US treasury bill rate	2.18*** (4.98)	0.92*** (6.65)	1.21*** (6.44)	0.94*** (8.21)
Real exchange rate appreciation index	−0.15*** (2.65)	−0.24*** (7.02)	−0.11*** (6.34)	−0.22*** (7.87)
Democratic regime	1.25*** (3.85)	1.73 (1.00)	0.38*** (3.21)	−0.11 (0.10)
The 1990s	4.00 (1.55)	1.97** (2.21)	7.24*** (6.72)	1.27* (1.84)
Financial openness in (average for $t-1, \ldots, t-4$)				
FDI	−0.04 (0.05)	0.39 (1.17)	0.80*** (2.62)	0.79*** (3.11)
Loans	−0.44*** (4.91)	−0.09 (0.81)	−0.30*** (5.94)	−0.04 (0.32)
Equity	0.79** (2.12)	0.30 (1.55)		
Trade credits	0.91 (0.62)	0.51 (0.67)		
Akaike IC	7.22	5.27	7.05	5.31
Observations	203	261	801	372
Adjusted R^2	0.97	0.89	0.93	0.89

t-Statistics for all variables are given in parentheses. The LHS variable is the sum of imports and exports of goods or services (as % of GDP). Estimation using least squares with country fixed effects with a correction for an autocorrelation (AR1). For definitions of variables, see Appendix B. Similar estimation for trade in services does not yield any significant coefficients for the financial flows variables.

* Significance levels at 10%.

** Significance levels at 5%.

*** Significance levels at 1%.

financial crises (either banking or currency crises) might significantly affect the level of financial openness in general and more specifically the use of financial repression for generating government revenues. Interestingly, in all iterations of the model we attempted, none of the coefficients for the crises variables comes out significant for the developing countries sample (nor for the other samples).

4.2. Causality from capital flows to trade

In the estimations described above, we have established that past trade openness Granger-causes FDI gross flows openness. As we already suggested that causality might also run from past financial openness to present trade openness we also estimate the opposite specification:

$$\mathrm{CO}_{it}[\text{goods}] = \gamma + \delta_1 X_{it} + \delta_2 \overline{\mathrm{FO}}^{Q}_{it-1} + \eta_{it}, \tag{14}$$

where the LHS variable is now the openness to goods trade while on the RHS we include a set of control variables (chosen incrementally with the Akaike Information Criterion) and various measures of financial openness (FDI, loans, equity and trade credits). The measures for trade credits and portfolio flows are not reported for many countries so we subsequently drop them in the specifications reported in columns 3 and 4 and thus increase the sample size significantly. We use the same assumptions, methodology, definition of variables and samples as before. Results are reported in Table 8. Gross FDI openness (sum of FDI inflows and outflows/GDP) appears to have a statistically significant, positive, and large effect on trade in goods (a 1% increase in gross FDI openness is associated with a 0.8% increase in trade openness). For the developing-countries sample the measure of gross loans appears to have the opposite effect (reducing goods trade).

5. Decomposition of causality between trade and capital flows

In Granger (1969), the possibility of simultaneous causality between the two time series is ignored by arguing that, at least in principle, it should be feasible to obtain higher frequency observations and thus identify accurately the exact chronology of effects and do away with the correlations in the contemporaneous data series. As we only have annual data, and since financial flows respond quickly to exogenous shocks, it is reasonable to expect that our data will also contain what appears to be instantaneous causality between trade and financial openness. Furthermore, Granger's (1969) approach does not allow us to estimate and compare the relative magnitudes of causality between the two time series, and is thus insufficient considering our interests.

Geweke (1982) suggests a method to distinguish between (temporal) causality from x to y, from y to x and simultaneous causality between the two. Below, we describe Geweke's (1982) methodology and provide results.[24] Readers may also consult Geweke (1984) and Granger (1988) for further description and discussion of this methodology.[25]

First we estimate the following equations using a panel fixed-effects least squares estimation:

$$\mathrm{FDI}_{it} = \alpha_i^1 + \sum_{s=1}^{p} \beta_{1s}^1 \mathrm{FDI}_{it-s} + \sum_{s=0}^{p} \beta_{2s}^1 \mathrm{CO}_{it-s} + \varepsilon_{it}^1, \tag{15}$$

$$\mathrm{FDI}_{it} = \alpha_i^2 + \sum_{s=1}^{p} \beta_{1s}^2 \mathrm{FDI}_{it-s} + \sum_{s=1}^{p} \beta_{2s}^2 \mathrm{CO}_{it-s} + \varepsilon_{it}^2, \tag{16}$$

$$\mathrm{FDI}_{it} = \alpha_i^3 + \sum_{s=1}^{p} \beta_{1s}^3 \mathrm{FDI}_{it-s} + \varepsilon_{it}^3, \tag{17}$$

$$\mathrm{CO}_{it} = \alpha_i^4 + \sum_{s=1}^{p} \beta_{1s}^4 \mathrm{CO}_{it-s} + \sum_{s=1}^{p} \beta_{2s}^4 \mathrm{FDI}_{it-s} + \varepsilon_{it}^4, \tag{18}$$

$$\mathrm{CO}_{it} = \alpha_i^5 + \sum_{s=1}^{p} \beta_{1s}^5 \mathrm{CO}_{it-s} + \varepsilon_{it}^5. \tag{19}$$

Next, following Geweke's (1982) notation we define $F_{\mathrm{CO}\to\mathrm{FDI}}$ as the linear feedback (i.e. G-causality) from trade openness to FDI openness, $F_{\mathrm{FDI}\to\mathrm{CO}}$ as the G-causality from FDI openness to trade openness, and $F_{\mathrm{FDI}\cdot\mathrm{CO}}$ as the instantaneous linear feedback between the two series. $F_{\mathrm{FDI,CO}}$, defined as the total measure of linear dependence between the two series is therefore given by

$$F_{\mathrm{FDI,CO}} = F_{\mathrm{FDI}\to\mathrm{CO}} + F_{\mathrm{CO}\to\mathrm{FDI}} + F_{\mathrm{FDI}\cdot\mathrm{CO}}. \tag{20}$$

Given these definitions, Geweke (1982) concludes the following:

$$F_{\mathrm{FDI}\to\mathrm{CO}} = \log\left[\frac{\mathrm{var}(\varepsilon_{it}^5)}{\mathrm{var}(\varepsilon_{it}^4)}\right], \tag{21}$$

[24] The only applications we are aware of which apply this methodology to macro-economic data series are Chong and Calderón (2000), Calderón and Liu (2003) and Aizenman and Noy (2004).

[25] Other approaches to identifying causality in macroeconomics will typically rely on an instrumental variable methodology. An excellent book length treatment of the issue of causality in macroeconomics is Hoover (2001).

$$F_{\mathrm{CO}\to\mathrm{FDI}} = \log\left[\frac{\mathrm{var}(\varepsilon_{it}^{3})}{\mathrm{var}(\varepsilon_{it}^{2})}\right], \tag{22}$$

$$F_{\mathrm{FDI}\cdot\mathrm{CO}} = \log\left[\frac{\mathrm{var}(\varepsilon_{it}^{2})}{\mathrm{var}(\varepsilon_{it}^{1})}\right]. \tag{23}$$

Geweke (1982) shows that the null hypothesis (H_0: $F=0$) can be statistically examined using the χ^2 distribution. In estimating (15)–(19), we started with three lags ($p=3$) of the independent variables in each regression and reduced step-wise the number of lags using the Akaike Information criterion. In all cases, it turned out that a single lag ($p=1$) contained all the information required to estimate the model. Consequently, we set $p=1$ throughout. Table 9 provides our results for this decomposition of causality between the two series for the full sample. Most of the linear feedback between trade and Gross FDI openness (81%) can be accounted for by Granger-causality from FDI gross flows to trade openness (50%) and from trade openness to Gross FDI openness (31%).[26] Simultaneous correlation between the two only accounts for 19% of the total linear feedback between the two series.[27] Similar results are obtained when we instead investigate causality between trade openness and net FDI outflows or net FDI inflows.

Table 9
Decomposition of causality—full sample

	Percent of overall linear feedback		
	FDI gross flows	FDI net flows	FDI inflows
From FDI openness to commercial openness ($F_{\mathrm{FO}\to\mathrm{CO}}$)	50	58	57
From commercial openness to FDI openness ($F_{\mathrm{CO}\to\mathrm{FO}}$)	31	34	32
Simultaneous feedback ($F_{\mathrm{FO}\cdot\mathrm{CO}}$)	19	8	11

For the decomposition, we use the methodology outlined in Geweke (1982) and defined in Eqs. (15)–(23). The overall linear feedback is defined in Eq. (20).

6. Concluding remarks

This paper investigated linkages between capital flows and trade with disaggregated measures of both. We applied regression and two-way feedback analyses, identifying the salient features of these feedback effects. The results presented in this paper are consistent with the notion that the feedback effects between trade and FDI are stronger in developing than in industrialized countries. This is in line with the conjecture that the bulk of the FDI to developing countries has been vertical. This notion also provides a partial motivation for the deep trade and financial liberalizations undertaken by developing countries in recent years—the positive feedbacks between trade and FDI frequently hinge on low trade and financial barriers, and may intensify with further lowering

[26] Recall that gross FDI openness is sum of FDI inflows and outflows (% of GDP); similarly, trade openness is the sum of exports and imports (% of GDP). See Appendices B and C for further details.

[27] The apparent simultaneous correlation is interesting in and of itself, even though it accounts for significantly less of the linear feedback than the temporal measures. In order to identify the mechanisms at work for the simultaneous correlation, one would generally need higher frequency data. VAR methodology might be a promising avenue for future research on this topic.

of these barriers. Our analysis also suggests that in an era of rapidly growing trade integration countries cannot choose their capital account policies independently of their degree of openness to trade.

We close the paper by noting that our model and empirical work can be extended to account for more complex aspects of the association between FDI and trade. For example, we ignore the potential importance of private and public infrastructure investment as an input into the production process, and the role of financial intermediation in facilitating domestic investment. These considerations are left for future research.

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Appendix A. Heterogeneous supply of labor and switching costs

This appendix outlines a model where the supply of labor in each sector is determined by the anticipated wage path. We consider the case where workers in the emerging markets are drawn from the unity interval, $j \in [0,1]$. Agent j can switch to the heterogonous sector, Y, only after spending switching cost θ_j; $0 \leq j \leq 1$. This cost represents investment in human capital and other costs associated with moving from Z to Y. Workers are ordered according to the switching costs from sector Z to sector Y. Hence, for $1 \geq l > h \geq 0$, $\theta_l > \theta_h$. We simplify by assuming that the switching cost is known to each agent, and that it takes one period to make the switch. We assume that the productivity in sector Y increases over time due to learning by doing and technological improvements, while labor productivity in the homogenous sector remains constant at a^*. Recalling that the production function in sector Z is Ricardian, wages there are determined by productivity, $w^*_{Z,t} = a^*$. In contrast, productivity improvements in sector Y imply $w^*_{y,t} \leq w^*_{y,t+1} \leq w^*_{y,t+2} \cdots$. In a rational expectation equilibrium where the anticipated path of wages in sector Y is $w^*_{y,t}; w^*_{y,t+1}; w^*_{y,t+2} \ldots$, agent j will switch at a time t where

$$\theta_j - a^* = \mathrm{NPV}[w^*_{y,t+1} - a^*; w^*_{y,t+2} - a^*, \ldots]. \tag{A1}$$

We denote by $j(t)$ the marginal agent that is indifferent between switching at time t and time $t+1$. The anticipation of further increases in the wage offered in sector Y implies $j(t) \leq j(t+1) \leq j(t+2) \cdots$. In a discrete time model, the mass of workers reallocating to sector Y at t is $j(t) - j(t-1)$, and the supply of labor in the two sectors is

$$L^*_{y,t} = j(t-1); \qquad L^*_{z,t_j} = 1 - j(t). \tag{A2}$$

Let the aggregate demand for labor in sector Y at time t be $D^*_{L_y,t}$. It can be verified that

$$D^*_{L_y,t} = D^*_{L_y,t}(\overset{+}{w^*_{y,t}}; \overset{+}{b^*_t}; \overset{+}{n}), \tag{A3}$$

where n denotes the number of Y activities located in the emerging market at time t, and the signs above the variables correspond to the sign of the partial derivatives. Hence, $w^*_{y,t}$ is determined by the condition

$$D^*_{L_y,t} = j(t-1). \tag{A4}$$

Learning by doing and technological improvement in sector Y would induce higher wages, attracting more workers to switch to sector Y. These trends will also increase the multinationals investment in the economy, increasing n.

Appendix B. Data samples and definitions

Sample (1982–1998)[a]	
IND	Industrialized countries (21 countries): Australia, Austria, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA
DEV	Developing countries (60 countries): Algeria, Argentina, Bangladesh, Belize, Bolivia, Botswana, Brazil, Cambodia, Cameroon, Chile, China, Colombia, Costa Rica, Ivory Coast, Ecuador, Egypt, El Salvador, Gabon, Gambia, Ghana, Guatemala, Guyana, Honduras, India, Indonesia, Israel, Jamaica, Jordan, Kenya, Korea, Malaysia, Mauritius, Mexico, Morocco, Mozambique, Nepal, Nicaragua, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Senegal, Sierra Leone, South Africa, Sri Lanka, Swaziland, Syria, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Uruguay, Venezuela, Zambia, Zimbabwe
ALL	Both samples above (81 countries)
FDI data definitions	
FDI net inflows	Inflows of direct investment from foreigners minus direct investment from foreigners that was repatriated to the country of origin
FDI net outflows	Outflows of direct investment from domestic residents minus direct investment by residents to foreign countries that was repatriated to the domestic country
FDI gross flows	FDI net inflows + FDI net outflows

[a] Data availability further constrained our samples. Thus, the numbers reflect countries for which data were available for the aggregate financial flows but not necessarily for the whole 1982–1998 time period.

Appendix C. Data sources and samples

Code	Source	Description
KTOTAL	IMF-BOP statistics[a]	Sum of capital inflows and outflows (% of GDP)
FDITOT	IMF-BOP statistics	Sum of FDI inflows and outflows (% of GDP)
TRADTOT	IMF-BOP statistics	Sum of trade credit inflows and outflows (% of GDP)
LOANTOT	IMF-BOP statistics	Sum of loan inflows and outflows (% of GDP)
EQTOT	IMF-BOP statistics	Sum of portfolio inflows and outflows (% of GDP)
TRADG	WB-WDI[b]	Sum of exports and imports (% of GDP)
SERVG	WB-WDI	Sum of service exports and imports (% of GDP)
GOODG	WB-WDI	Sum of goods exports and imports (% of GDP)
INCOMG	WB-WDI	Sum of trade in incomes (% of GDP)
FUELG	WB-WDI	Sum of trade in fuels (% of GDP)
MANUG	WB-WDI	Sum of trade in manufacturing (% of GDP)
FOODG	WB-WDI	Sum of trade in foodstuffs (% of GDP)
METALG	WB-WDI	Sum of trade in metals and ores (% of GDP)
GDPPCPP	WB-WDI	GDP per capita, PPP (current international $)

Appendix C (*Continued*)

Code	Source	Description
DLCPI	WB-WDI	Inflation, consumer prices (annual %)
BDGTG	WB-WDI	Overall budget deficit (% of GDP)
USTBILL	IMF-IFS[c]	Interest rate on US treasury bill
CORRUPT	PRS: International Country Risk Guide	Level of corruption[d]
POLITY2	POLITY IV project	Political regime type[e]
KKCCAR	IMF-EAER[f]	Binary measure for current and/or capital account restrictions

[a] The IMF's *Balance-of-Payments Statistics*.
[b] The *World Bank's World Development Indicators*.
[c] The IMF's *International Finance Statistics*.
[d] This index runs from −6 (low probability/risk of encountering corruption) to 0 (highly corrupt).
[e] The index runs between −10 (fully autocratic) to +10 (fully democratic).
[f] The IMF's Annual Report on *Exchange Arrangements and Exchange Restrictions*; extended to 1998 by Glick and Hutchison (2005).

References

Agénor, P. R. (2003). Benefits and costs of international financial integration: Theory and facts. *World Economy*, *26*(8), 1089–1118.

Aizenman, J., & Noy, I. (2004). *Endogenous financial and trade openness: Efficiency and political economy considerations*. NBER Working Paper 10496.

Aizenman, J., & Noy, I. (2005). *FDI and trade*. NBER Working Paper 11403.

Albuquerque, R., Loayza, N., & Servén, L. (2005). World market integration through the lens of foreign direct investment. *Journal of International Economics*, *66*(2), 267–295.

Arteta, C., & Eichengreen, B. (2002). Banking crises in emerging markets: Presumptions and evidence. In M. Blejer & M. Skreb (Eds.), *Exchange rate and financial vulnerability in emerging markets*. Cambridge, MA: MIT Press.

Aviat, A., & Coeurdacie, N. (2004). *The geography of trade in goods and asset holdings*. Manuscript, Cnrs-Ehess-Ens.

Blonigen, B. A. (2005). *A review of the empirical literature on FDI determinants*. NBER Working Paper # 11299.

Blonigen, B. A., & Wang, M. (2004). *Inappropriate pooling of wealthy and poor countries in empirical FDI studies*. NBER Working Paper #10378.

Blyde, J., & Sinyavskaya, N. S. (2004). The impact of liberalizing trade in services on trade in goods: An empirical investigation. In *Paper presented at the LACEA 2004 Conference*.

Calderón, C., & Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of Development Economics*, *72*, 321–334.

Caprio, G., & Klingebiel, D. (1999). *Episodes of systemic and borderline financial crises*. Manuscript.

Chan, K. K., & Gemayel, E. R. (2004). *Risk instability and the pattern of foreign direct investment in the Middle East and North Africa region*. IMF Working Paper 04/139.

Chong, A., & Calderón, C. (2000). Causality and feedback between institutional measures and economic growth. *Economics and Politics*, *12*(1), 69–81.

Coakley, J., Fuertes, A. M., & Smith, R. (2002). *A principal components approach to cross-section dependence in panels*. Manuscript.

Do, Q. T., & Levchenko, A. A. (2004). Trade and financial development. In *Paper presented at LACEA 2004*.

Dreher, A., & Siemers, L. (2003). *The intriguing nexus between corruption and capital account restrictions*. Manuscript.

Feenstra, R. (2003). *Advanced international trade: Theory and evidence*. Princeton University Press.

Gangnes, B., Noy, I., & Vu, T. (2005). *Does FDI lead to growth: An answer from Vietnam*. Manuscript.

Geweke, J. (1982). Measurement of linear dependence and feedback between multiple time series. *Journal of the American Statistical Association*, *77*(378), 304–313.

Geweke, J. (1984). Measures of conditional linear dependence and feedback between time series. *Journal of the American Statistical Association*, *79*(388), 907–915.

Geweke, J., Meese, R., & Dent, W. (1983). Comparing alternative tests of causality in temporal systems: Analytic results and experimental evidence. *Journal of Econometrics*, *21*, 161–194.

Glick, R., & Hutchison, M. (2005). Capital controls and exchange rate instability in developing economies. *Journal of International Money and Finance*, *24*, 387–412.

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, *37*(3), 424–438.

Granger, C. W. J. (1988). Some recent developments in a concept of causality. *Journal of Econometrics*, *39*, 199–212.

Hanson, G. H., Mataloni, R. J., & Slaughter, M. J. (2001). *Expansion strategies of U.S. multinational firms*. NBER Working Paper 8433.

Harrison, A. E., Love, I., & McMillan, M. S. (2004). Global capital flows and financing constraints. *Journal of Development Economics*, *75*, 269–301.

Helpman, E., & Razin, A. (1978). *A theory of international trade under uncertainty*. Academic Press.

Hoover, K. (2001). *Causality in macroeconomics*. Cambridge, UK: Cambridge University Press.

Hutchison, M., & Noy, I. (2006). Sudden stops and the Mexican wave: Currency crises, capital flow reversals and output loss in emerging markets. *Journal of Development Economics*, *79*(1), 225–248.

Hutchison, M., & Noy, I. (2005). How bad are twins? Output costs of currency and banking crises. *Journal of Money Credit and Banking*, *37*(4), 725–752.

Lane, P. R. (2004). *Global financial trade: How far have we come*? Institute for International Integration Studies Discussion Paper #35.

Lane, P. R., & Milesi-Ferretti, G. M. (2004). *International investment patterns*. IMF Working Paper WP/04/134.

Lane, P. R., & Milesi-Ferretti, G. M. (2005). *A global perspective on external positions*. IMF Working Paper WP/05/16.

Lipsey, R. E. (2002). *Home and host country effects of FDI*. NBER Working Paper 9293.

Marshall, M., & Jaggers, K. (2000). *POLITY IV PROJECT—political regime characteristics and transitions, 1800–1999 dataset users' manual, Manuscript*. University of Maryland.

Portes, R., & Rey, H. (2005). The determinants of cross border equity flows. *Journal of International Economics*, *65*(2), 269–296.

Rajan, G. R., & Zingales, L. (2003). The great reversals: The politics of financial development in the 20th century. *Journal of Financial Economics*, *69*(1), 5–50.

Razin, A., Rubinstein, Y., & Sadka, E. (2003). *Which countries export FDI, and how much*? NBER Working Paper 10145.

Rose, A. K., & Spiegel, M. M. (2004). A gravity model of sovereign lending: Trade, default, and credit. *IMF Staff Papers*, *51*, 50–63.

Sims, C. A. (1972). Money, income, and causality. *American Economic Review*, *62*(4), 540–552.

Swenson, D. L. (2004). Foreign investment and the mediation of trade flows. *Review of International Economics*, *12*(4), 609–629.

Wei, S. J. (2000). How taxing is corruption on international investors? *The Review of Economics and Statistics*, *82*(1), 1–11.