FOREIGN DIRECT INVESTMENT: FLOWS, VOLATILITY AND GROWTH

by

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Abstract
This paper contributes to the literature on FDI and economic growth. We deviate from previous studies by introducing measures of the volatility of FDI inflows. As introduced into the model, these are predicted to have a negative effect on growth. We estimate the standard model using cross-section, panel data and instrumental variable techniques. Whilst all results are not entirely robust, there is a consistent finding that FDI has a positive effect on growth whereas volatility of FDI has a negative impact. The evidence for a positive effect of FDI is not sensitive to which other explanatory variables are included. In particular, it is not conditional on the level of human capital (as found in some previous studies). There is a suggestion that it is not the volatility of FDI *per se* that retards growth but that such volatility captures the growth-retarding effects of unobserved variables.

Outline

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1. Introduction

There is now a considerable literature on the impact of foreign direct investment (FDI) and growth. The contribution of this paper is to take the effect of volatility of FDI flows on growth into account. Using a variety of econometric techniques, we find that while FDI as such has (the expected) positive effect on growth, volatility of such flows has a negative effect. There are a number of reasons why volatility of FDI inflows may be negatively associated with growth. A first possibility is that volatility itself has a negative effect on growth. The recent endogenous growth literature on FDI provides some arguments why this might be so. This literature shows that FDI positively affects growth by decreasing the costs of R&D through stimulating innovation. If FDI inflows are uncertain, costs of R&D are uncertain, which negatively affects incentives to innovate. It may then be the case that volatility of FDI undermines investment, and thus has an adverse effect on growth.

A second possibility might be that the volatility of FDI flows is a proxy for economic or political uncertainty; FDI volatility may reflect underlying uncertainty (political and economic) in a country. Lensink and Morrissey (2000) and Guillaumont and Chavet (1999) suggest that economic uncertainty is an important determinant of both growth and the productivity of investment. By ‘economic uncertainty’ they refer to the tendency of some developing countries to be particularly vulnerable to shocks that have the immediate effect of reducing income and, if recurrent, tend to reduce growth (or constrain the ability of an economy to reach its steady state growth rate). These shocks may be external, such as terms of trade shocks or financial crises induced by the volatility of capital flows, or ‘acts of nature’, such as severe drought or floods. While FDI tends to be less volatile than other private flows, it is possible that sudden changes in the volume of FDI inflows can have a destabilising impact on the economy.

The aim of this paper is to examine the impact of FDI on growth, specifically accounting for volatility. Section 2 briefly reviews some of the existing literature on FDI. Section 3 presents a model incorporating volatility of FDI. The data and measures used, for a sample of 88 countries (about 20 of which are developed) are described in Section 4 and the results are discussed in Section 5. The conclusions are in Section 6.

2. A Brief Overview of the Literature

The contribution of FDI to economic growth has been debated quite extensively in the literature. The 'traditional' argument is that an inflow of FDI improves economic growth by increasing the capital stock, whereas recent literature points to the role of FDI as a channel of international technology transfer. There is growing evidence that FDI enhances technological change through technological diffusion, for example because multinational firms are concentrated in industries with a high ratio of R&D relative to sales and a large share of technical and professional workers (Markusen, 1995). Multinational corporations are probably among the most technologically advanced firms in the world. Moreover, FDI not only contributes to imports of more efficient foreign technologies, but also generate technological spillovers for local firms.

In this approach, technological change plays a pivotal role in economic growth and FDI by multinational corporations is one of the major channels in providing developing countries (LDCs) with access to advanced technologies. The knowledge spillovers may take place via imitation, competition, linkages and/ or training (Kinoshita, 1998; Sjoholm, 1999). Although it is in practice rather difficult to distinguish between these four channels, the underlying theory differs.

The *imitation* channel is based on the view that domestic firms may become more productive by imitating the more advanced technologies or managerial practices of foreign firms (the more so the greater the technology gap). In the absence of FDI, acquiring the necessary information for adopting new technologies is too costly for local firms. Thus, FDI lowers the cost of technology adoption and may expand the set of technologies available to local firms. The *competition* channel emphasises that the entrance of foreign firms intensifies competition in the domestic market, encouraging domestic firms to become more efficient by upgrading their technology base.

The *linkages* channel stresses that foreign firms may transfer new technology to domestic firms through transactions with these firms. By purchasing raw materials or intermediate goods a strong buyer-seller relationship may develop that gives rise to technical assistance or training from the foreign firm to the domestic firm. Finally, the *training* channel arises if the introduction of new technologies requires an upgrading of domestically available human capital. New technologies can only be adopted when the labour force is able to work with them. The entrance of foreign firms may give an incentive to domestic firms to train their own employees. If labour moves from a multinational to a local firm (through labour turnover), the physical movement of workers causes knowledge to move between firms.

Empirical evidence that FDI generates positive spillovers for local firms is mixed (see Saggi, 2000, for a survey). Some studies find positive spillover effects, some find no effects and some even conclude that there are negative effects (on the latter see Aitken and Harrison, 1999). This does not necessarily imply that FDI is not beneficial for growth (for a survey of FDI and growth in LDCs, see De Mello and Luiz. 1997). It may be that the spillovers are of a different nature. Aitken *et al* (1997), for instance, point to the importance of the entry of multinationals for reducing entry costs of other potential exporters. Moreover, FDI may also contribute to growth by means of an increase in capital flows and the capital stock.

Some recent studies have argued that the contribution of FDI to growth is strongly dependent on the circumstances in recipient countries. Balasubramanyam *et al* (1996) find that the effect on growth is stronger in countries with a policy of export promotion than in countries that pursue a policy of import substitution. In a very influential paper, Borensztein *et a*l (1998) suggest that the effectiveness of FDI depends on the stock of human capital in the host country. Only in countries where human capital is above a certain threshold does FDI positively contribute to growth.

Borensztein *et al* (1998) develop a growth model in which technical progress, a determinant of growth, is represented through the variety of capital goods available. Technical progress is itself determined by FDI as foreign firms encourage adoption of new technologies and increase the production of capital goods, hence increase variety. Thus, FDI leads to growth via technology spillovers that increase factor productivity. Certain host country conditions are necessary to ensure the spillover effects. In particular, human capital (an educated labour force) is necessary for new technology and management skills to be absorbed. This is discussed in Appendix B.

Investment, Volatility and Uncertainty

Where the issue is addressed, empirical studies consistently find a negative effect of uncertainty (measured in various ways) on investment. Serven (1998) uses seven measures of uncertainty for five variables (such as growth, terms of trade) and finds evidence for all having a negative impact on levels of private investment for a large sample of developing countries. As investment is a robust determinant of growth we hypothesise that uncertainty will have a negative impact on growth.

A number of recent papers have begun to address aspects of risk and vulnerability in the context of the aid-growth relationship (and we note that investment is the principal mechanism through which aid enhances growth). Lensink and Morrissey (2000) argue that aid instability, measured as a residual of an autoregressive trend estimate of aid receipts, can proxy for two forms of uncertainty that may be growth-reducing. First is recipient uncertainty regarding future aid receipts, which may have adverse effects on investment. Second, is economic uncertainty, as the incidence of shocks will tend to attract unanticipated aid, hence increase measured instability of aid flows. Lensink and Morrissey (2000) find that the coefficient on the aid instability measure is negative and significant and infer that economic uncertainty is growth-retarding. This result is robust for the sample of African countries and the full sample of developing countries.

Guillaumont and Chauvet (1999) address the implications of including a measure of the 'vulnerability' of the economic environment (what we term economic uncertainty) in an aid-growth regression. They construct an index of a 'good environment' comprising four variables. First is the instability of agricultural value added, to capture the effect of climatic shocks. This is weighted by the ratio of agricultural value added to GDP to represent the significance of the shock. Long-term trade shocks are represented by the trend of the terms of trade, while the index of instability of the real value of exports represents short-term shocks. The logarithm of population captures the degree of exposure to trade shocks. All of these instabilities are inverted and weighted to construct the index.

They find that growth is lower in more vulnerable economies and present evidence that aid flows in greater amounts to countries suffering from adverse shocks (and aid mitigates the adverse effects of vulnerability), which lends support to the interpretation of Lensink and Morrissey (2000). Dehn and Gilbert (1999) look specifically at instability of commodity prices (highly positively correlated with export commodity concentration) and how this impacts on growth. They test the hypothesis that vulnerability to commodity price variability reduces growth, and find supporting evidence although much depends on how governments respond. An appropriate government response can reverse the adverse effects of commodity price variability, although an inappropriate response exacerbates the adverse effects.

3. Theoretical Framework

In this section we present a simple endogenous growth model in which FDI has a positive effect on growth, whereas the volatility in FDI flows has a negative effect. In the model FDI, as well as the volatility in FDI, affects growth via the cost of innovation. The model is in line with the recent theories emphasising the importance of FDI in enhancing technological change through technological diffusion. This model provides an illustrative framework, which explains a possible channel by which the volatility in FDI flows negatively affect growth.

Using the framework of the technological change models it is possible to present a formal model which shows how FDI may increase growth. The endogenous growth literature distinguishes two types of technological change models: models with an expanding variety of products, or models with improvements in the quality of products (see chapters 6 and 7, respectively, of Barro and Sala-I-Martin, 1995). The models with an expanding variety of products assume that technological progress is brought about by an increase in the number of types of intermediate goods, or capital goods (capital deepening). In these models the quality or productivity of each type good is assumed to be constant. The second group of models assumes that the number of types of goods is constant and that technological progress comes from quality improvements in the different types of goods, often referred to as quality ladders.

We use a model with an expanding variety of products, adapted from Barro and Sala-i-Martin (1995, chapter 6) and following Borensztein *et al* (1998), so that we can be brief about its structure. The model assumes that technical progress is represented through the variety of capital goods available. There are three types of agents in the model: final goods producers who rent capital goods; innovators who produce capital goods, and consumers. Final goods producers are assumed to have a production function of the form:

$$Y_i = AL_i^{1-a} \sum_{j=1}^{N} K_{ij}^{a} \qquad (1)$$

By assumption 0<α<1, and *A* is the exogenous state of the environment, *Y* is output, *L* is labour input (Borensztein *et al* use human capital instead) and K_j stands for service flows from each capital good *j*. Each final good' producer *i* rents *N* varieties of capital good from specialised firms that produce a type of capital good (the innovators). For convenience, we assume that capital goods depreciate fully in each period, so that they behave like non-durable intermediate goods.

$$Y_i = AL_i^{1-a} NK_i^{a} \qquad (2)$$

It is easy to see that an increase in the amount of varieties *N* (technological change in the form of increased variety) increases growth. The demand for capital goods by final good producers is determined by equating the marginal productivity of the capital good to the purchase price P_j.

$$\partial Y_i / \partial K_{ij} = AaL_i^{1-a} K_{ij}^{a-1} = P_j \qquad (3)$$

The demand for capital good *j* by firm *i* is then:

$$K_{ij} = L_i (Aa / P_j)^{1/(1-a)} \qquad (4)$$

Assume the producer has monopoly rights over the production and sale of the capital goods. Assume also that the production costs of *K*, *after it has been invented*, equal 1 in each period, and that the rate of return (interest rate, *r*) is constant between times *v* and t (this holds in equilibrium, see Barro and Sala-I-Martin, 1995: 217). The present value of the returns from inventing (and producing in several periods), *V(t)*, for the capital good j equals (where K_j is the total quantity produced at each date):

$$V(t) = \int_t^{\infty} (P_j - 1) K_j e^{-r(v-t)} dv \qquad (5)$$

The innovator sets P_j by optimising *V(t)*. As K_j is independent of time, this comes down to optimising $(P_j\text{-}1)K_j$, where K_j is the total quantity demanded by different producers i ($K_{j.}=\Sigma_i K_{ij}$). The solution of the optimisation procedure can be shown to be $P_j = P = 1/a > 1$ (where $1/a$ is the mark-up). Using this result, the quantity demanded for each variety K can be written as:

$$K_i = K = LA^{1/(1-a)} a^{2/(1-a)} \qquad (6)$$

Using the value for P_j and (6), (5) can be rewritten as:

$$V(t) = LA^{1/(1-a)} \left(\frac{1-a}{a}\right) a^{2/(1-a)} \int_t^{\infty} e^{-r(v-t)} dv \qquad (7)$$

Barro and Sala-I-Martin (1995: 218) show that in equilibrium with positive R&D (at cost h) and increasing N, then $V(t) = h$, hence (7) can be solved to:

$$r = (1/h) LA^{1/(1-a)} \left(\frac{1-a}{a}\right) a^{2/(1-a)} \qquad (8)$$

We can now introduce FDI. The costs of production contain two parts. Each period there are fixed maintenance costs, assumed equal to 1. In addition there are fixed set up costs (R&D costs, h). The costs of discovering a new variety of a good (costs of innovation) are assumed to be the same for all goods. Moreover, assume that the costs of discovering new goods depend on the ratio of goods produced in other countries to those produced domestically. This ratio is a proxy for FDI. A higher ratio of goods produced in other countries, and so more FDI, would lead to a decline in the costs of innovation. This reflects the idea that it is cheaper to imitate than to innovate (Borensztein *et al*, 1998), and that the possibility to imitate increases if more goods are produced in other countries (i.e. when FDI is higher). The costs of discovering a new good can be modelled as (using FDI = F): $h = f(F)$, where $\partial h/\partial F < 0$.

To account for uncertainty with respect to F, we assume that F is stochastic, and modelled as $F = m(F)+e$, where $m(F)$ is the mean of FDI and e is an error term with e~N(0, e^2). The certainty equivalent of the expected value of FDI equals:

$$E(F)= m(F)-0.5Bs^2(F)$$

where B is the coefficient of absolute risk aversion (B is positive for risk-averse innovators) and $s^2(F)$ refers to the variance in FDI inflows. Taking into account the certainty equivalent value of FDI, and assuming that the rate of return on assets (r) is constant and there is free entry, (8) can be written as:

$$r = \left(\frac{L}{f[m(F) - 0.5Bs^2(F)]}\right) A^{1/(1-a)} \left(\frac{1-a}{a}\right) a^{2/(1-a)} \qquad (9)$$

Equation (9) shows that an increase in FDI leads to an increase in r (remember $f'(F)<0$) whereas an increase in the variance of FDI leads to a decrease in r. To introduce the link to economic growth we close the model by considering behaviour of households. Households maximise a standard inter-temporal utility function:

$$U = \int_t^\infty \left(\frac{c^{1-q} - 1}{1-q}\right) e^{-rt}\, dt \qquad (10)$$

Where c denotes consumption and r is the discount rate. This optimisation process, subject to the budget constraint for households, can be shown to give the well-known result for the growth rate of consumption, $g_C = (1/q)(r - r)$, where $-q$ is the elasticity of marginal utility. In the steady state the growth rate of consumption equals the growth rate of output, *g*. Using the expression for *r* from (9) we finally get:

$$g = (1/q)[(\frac{L}{f[m(F) - 0.5Bs^{2}(F)]})A^{1/(1-a)}(\frac{1-a}{a})a^{2/(1-a)} - r] \quad (11)$$

It is now easy to see that an increase in FDI leads to an increase in the growth rate of output (*g*). An increase in FDI lowers set-up costs (for technology adaptation) and raises the return on assets (*r*). This leads to an increase in saving and so a higher growth rate in consumption and output. However, an increase in the volatility of FDI negatively affects growth as it decreases the certainty equivalent value of FDI and consequently increases set-up costs and decreases the rate of return on assets.

4 Data and Measures of Uncertainty

There are a number of sources of data on FDI. The widest coverage is provided by IMF balance of payments data on capital inflows, although direct investment and loans are not consistently recorded. A more reliable series on FDI is provided by the OECD, but only covers flows from OECD members. Both sources are combined in UNCTAD's *World Investment Reports*, the basic published source for cross-country data. Other data are either from host countries' reports of inflows of investment, or compiled from surveys of investment activity. Such data are better suited to country case studies. In this paper we use World Bank data on the FDI/GDP ratio (*GFDI*), as this provides wide coverage for a reasonably long period (1975-97).[1] We use the average value of *GFDI* for the 1975-1998 period in the cross-section estimates and average values for the sub-periods in the panel estimates. The total sample of 88 countries includes about 20 developed countries.

For our cross-section estimates volatility of *GFDI* (*UGFDI*) is measured by taking the standard deviation of errors from the autoregressive equation for *GFDI* with lagged values over three periods and a time trend (see Lensink and Morrissey, 2000). This equation is estimated for all countries over the 1975-1997 period. This is, admittedly, only an approximate measure of volatility. However, given that the time series available are rather brief, more sophisticated measures of volatility are not justified. By saving the error terms from this regression, we can measure volatility as the standard deviation of the errors. We also use a relative measure of volatility (*RATIO* = *UGFDI*/*GFDI*). For our panel estimates the volatility in FDI is estimated similarly. However, in order to have enough degrees of freedom we do not take into account the second and third order autoregressive terms in the autoregressive equation for *GFDI*. We estimate this equation for all countries, as well as all sub-periods, distinguished in the panel estimates.

The dependent variable in the basic cross-section regressions is the per capita growth rate of GDP over the 1970-1998 period (*GRO*). In the panel estimates we distinguish three periods: 1970-1980; 1980-1990 and 1990-1998. Per capita growth rates are calculated for these sub-periods. Following the empirical growth literature, a number of 'standard' explanatory variables are included in addition to the FDI variables. The most important of these are the initial values of GDP per capita (*LNGDPPC1*) and the secondary school enrolment rate (*LNSEC1*), both measured in logs (for 1970 in the cross-section estimates and for 1970; 1980 and 1990 in the panel estimates). Other variables are the black market premium (*BMP*) and government consumption expenditure as a share of GDP (*GOV*).

A number of political and institutional indicators are also used in estimating the instruments equations; these are discussed below when introduced. Definitions and sources for all variables are provided in Appendix A. Table 1 presents descriptive statistics of the main variables used in the analysis. It is evident that volatility can be quite high, as the average value of *RATIO* is 50%. Table 2 gives the correlation matrix for the same variables. Volatility is negatively correlated with growth and with FDI, whereas FDI is positively correlated with growth (as would be expected).

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[1] For comparability, we also use the Borensztein *et al* (1998) data on FDI (derived from OECD). This

Table 1: Descriptive Statistics

	GRO	*LNGDPPC1*	*LNSEC1*	*GFDI*	*RATIO*
Mean	1.381	7.600	2.946	1.297	0.508
Median	1.387	7.495	3.113	0.636	0.432
Maximum	6.476	9.284	4.625	9.538	2.140
Minimum	-3.701	5.832	0	0.008	0.148
Std. Dev	1.886	0.968	1.136	1.637	0.321
Skewness	1.321	0.171	-0.551	2.410	2.476
Kurtosis	3.591	1.921	2.545	10.075	11.107
Observations	88	88	88	88	88

Note: These statistics are based on averages used in cross-section estimates and refer to common samples. Initial GDP per capita (*GDPPC1*) and education (*SEC1*) are measured in logs, other variables measured as percentages except *RATIO* (as defined in text).

Table 2: Correlation matrix

	GRO	*LNGDPPC1*	*LNSEC1*	*GFDI*	*RATIO*
GRO	1.000				
LNGDPPC1	0.171	1.000			
LNSEC1	0.482	0.807	1.000		
GFDI	0.273	0.504	0.387	1.000	
RATIO	-0.305	-0.227	-0.281	-0.238	1.000

Note: See Table 1.

5. Econometric Results

The data set described in Section 4 has two number advantages over that of Borensztein *et al* (1998). First, the coverage is up to 115 countries, although usually we only have all data for 77-90 countries. Second, the *GFDI* data is annual (essential to calculate *UGFDI*). As we have a different sample and incorporate volatility, our results are not directly comparable to Borensztein *et al* (1998); we present an attempt to replicate their results in Appendix B.

covers somewhat fewer countries for a shorter time period.

Cross-section Estimates

We begin with a simple OLS growth regression including foreign direct investment. We use a linearised version of equation (11) derived above and estimate variants of the following equation:

$$g = c_0 + c_1 FDI + c_2 Volatility + c_3 H + c_4 Y_0 + e$$

Table 3 shows that FDI has a positive effect on growth, whereas volatility of FDI has a negative effect, as predicted by the model. The latter holds both for *UGFDI* and *RATIO* (this relative measure is the preferred indicator of volatility as *UGFDI* is highly correlated with FDI). The coefficient on initial GDP is negative and significant, suggesting convergence, while that on initial education is positive and significant. The table shows that the result is robust for including *BMP* and *GOV*. The explanatory power, at just over 0.5, is quite good for such types of regressions, and roughly twice the value obtained in Borensztein *et al* (1998) regressions (see Appendix B).

Borensztein *et al* (1998), in a very influential paper, argue that certain host country conditions are necessary to ensure the spillover effects of FDI. In particular, human capital (an educated labour force) is necessary for new technology and management skills to be absorbed. As indicated above (see Appendix B), they include the interactive term *FDI.H* (where *H* is the measure of schooling) to capture this effect. They find that the coefficient on FDI is negative (when significant) but the coefficient on the interaction term (*FDI.H*) is positive and consistently significant. This is interpreted as implying that FDI has a positive impact on growth but this is only realised when *H* is above some critical level (estimated as 0.52); at low levels of *H* FDI has a negative impact on growth.

The last column in Table 3 presents an estimate in which we take the complementarity of FDI and our schooling variable into account. It appears that our basic result still holds: FDI has a positive effect on growth and the volatility in FDI has a negative effect. Note that we do not confirm the Borensztein *et al* results: the interaction term between schooling and FDI is insignificant.

Table 3: FDI and Growth: OLS Cross-Country Regressions

	1	2	3	4	5	6
LNGDPPC1	-1.519 (-6.10)	-1.353 (-4.83)	-1.499 (-5.91)	-1.484 (-5.80)	-1.379 (-4.76)	-1.317 (-4.74)
LNSEC1	1.026 (3.11)	0.911 (3.83)	0.906 (2.82)	0.900 (2.82)	0.900 (2.83)	1.005 (2.91)
GFDI	0.307 (2.51)	0.693 (3.94)	0.2672 (2.11)	0.249 (1.88)	0.289 (2.40)	0.855 (2.22)
UGFDI		-1.174 (-1.98)				
RATIO			-1.125 (-2.80)	-1.118 (-2.74)	-1.072 (-2.55)	-1.067 (-2.42)
BMP				-0.002 (-1.74)		-0.002 (-1.69)
GOV					-0.049 (-1.21)	-0.058 (-1.43)
*GFDI*LNSEC1*						-0.165 (-1.66)
Constant	10.595 (6.25)	9.724 (5.37)	11.491 (6.46)	11.451 (6.46)	11.276 (6.21)	10.648 (5.99)
REGECA	-1.256 (-2.26)	-1.132 (-4.83)	-1.371 (-2.44)	-0.901 (-1.35)	-1.474 (-4.76)	-1.205 (-1.70)
REGLAC	-1.156 (-3.52)	-1.050 (-3.36)	-1.241 (-3.88)	-1.232 (-3.84)	-1.434 (-3.90)	-1.594 (-4.26)
REGSSA	-2.111 (-3.20)	-2.078 (-3.15)	-2.330 (-3.34)	-2.226 (-3.16)	-2.202 (-3.20)	-2.211 (-3.11)
adj. R^2	0.51	0.53	0.54	0.54	0.55	0.56
F	16.05	15.24	15.32	13.67	14.08	12.07
n	89	89	88	88	88	88

Notes: t-values in parenthesis are based on White Heteroskedasticity-Consistent Standard Errors. Only significant region dummies (dummies for REGECA; REGLAC and REGSSA) are taken into account.

In Appendix B (table B1) we attempt to estimate the Borensztein *et al* (1998) model: we use the same variables as they employ, although do not have an identical sample. Again, we fail to find a significant coefficient on the interactive term. We note that the results in Table 3 are based on a larger sample (of countries and over time) and have a higher explanatory power.

Panel Estimates

A major drawback of the cross-section estimates in Table 3 is that time series properties are not taken into account; they should be interpreted as representing aggregate correlations over the long period. We therefore run regressions for a panel in which three, roughly 10-year, periods are considered (1970-1980; 1980-1990; 1990-1998). Using panel estimates, we are able to address fixed effects, an important omitted variable in cross-country growth regressions. Table 4 presents the results.

The results concerning FDI and the volatility of FDI are consistent with the cross-country estimates: FDI has a positive effect on growth, whereas volatility negatively affects growth. Note that the human capital variable is now insignificant, or significant but with the 'wrong' sign. The reason might be that there simply is not enough variation in *LNSEC1* and that the variable behaves like a fixed effect. We estimate an equation in line with Borensztein *et al*, including our volatility measure and an interactive term (column 6). Again it appears that we do not confirm the Borensztein *et al* result. Note that the volatility in FDI is still significantly negative, although FDI is no longer significant. The reason might be that due to including the interactive term a lot of multicollinearity enters the model, making the independent FDI variable insignificant.

It might be relevant to further assess the sensitivity effect of FDI and the volatility in FDI on growth by using alternative measures of FDI, as well as alternative measures for the other variables in the equation. As far as we could we used the data set of Borensztein *et al* (1998) for these alternative estimates. The definitions of their variables differ from ours on the following points: 1) they only have FDI data for two ten year periods (1970-1980 and 1980-1990). 2) their FDI data are based on OECD data, whereas we use World Bank sources. 3) they scale the FDI data by using real GDP data (from Penn World tables), whereas we used the FDI/GDP data from World Bank sources in which nominal FDI is scaled by nominal GDP. 4) their *H* variable is average years of secondary schooling for males (*schooling)*. 5) they added the logarithmic value of 1+BMP instead of BMP, and 6) they used real government expenditures over real GDP (*GOVB)* as proxy for government expenditures (from the Barro-Lee data set), whereas we used government expenditures as a percentage of GDP from World Bank sources.

Table 4: FDI and Growth: Panel Regressions

	1	2	3	4	5	6
LNGDPPC1	-5.170 (-9.24)	-5.060 (-7.54)	-4.253 (-7.14)	-3.867 (-6.13)	-3.942 (-6.67)	-3.465 (-5.65)
LNSEC1	-0.959 (-3.28)	-0.201 (-0.59)	-0.236 (-0.68)	-0.465 (-1.34)	-0.342 (-1.02)	-0.377 (-1.97)
GFDI	0.322 (3.33)	0.689 (3.83)	0.278 (3.42)	0.304 (3.32)	0.269 (3.17)	0.121 (0.42)
UGFDI		-.1.172 (-2.11)				
RATIO			-2.716 (-5.47)	-2.668 (-5.64)	-2.143 (-3.66)	-1.897 (-3.20)
BMP				-0.003 (-3.44)		-0.004 (-3.26)
GOV					-0.141 (-2.16)	-0.193 (-3.05)
*LNSEC1*GFDI*						0.005 (0.734)
adj. R^2	0.54	0.53	0.56	0.59	0.57	0.61
F	232.45	131.30	134.15	104.84	104.32	75.59
n	292	247	230	220	229	229

Notes: t-values in parenthesis are based on White Heteroskedasticity-Consistent Standard Errors. All estimates incorporate fixed effects.

For all variables, but FDI, we could replicate their data set by following their remarks on data sources. We are grateful to Borensztein and Lee for providing their FDI data and that is the measure used in our regressions in Table 5 (*FDIB)*. We could not use their data to estimate the volatility in FDI as the data provided are for the period averages. The volatility measure used in Table 5 is the one we constructed ourselves.

Table 5: FDI and Growth: Panel Regressions using Borensztein *et al* Data

	1	2	3	4	5
LNGDPPC1	-7.103 (-10.76)	-7.075 (-9.72)	-5.599 (-5.57)	-7.383 (-8.23)	-6.742 (-6.77)
Schooling	-0.237 (-0.44)	-1.260 (-3.57)	-0.968 (-3.30)	-1.056 (-2.58)	-0.096 (-0.16)
FDIB	-0.169 (-1.45)	0.746 (2.04)	0.792 (2.10)	-0.584 (-0.33)	0.212 (0.37)
RATIO		-1.347 (-2.32)	-0.767 (-2.00)	-1.545 (-2.42)	
LN(1+BMP)	-1.947 (-2.95)	-3.863 (-5.37)	-3.554 (-4.99)	-3.509 (-4.18)	-1.825 (-2.68)
GOVB	-2.950 (-0.53)	28.21 (3.37)	26.656 (2.96)	29.755 (3.71)	-2.975 (-0.54)
*schooling*FDIB*				174.054 (0.78)	-21.350 (-0.71)
DUM70			0.862 (2.70)		0.315 (0.77)
adj. R^2	0.65	0.76	0.76	0.75	0.64
F	86.70	67.46	57.43	54.39	56.81
n	147	87	87	87	147

Notes: t-values in parenthesis are based on White Heteroskedasticity-Consistent Standard Errors. All estimates are with fixed effects. Panel of two 10-year periods. Note that due to differences in dimensions all coefficients, except those on *FDIB*, are multiplied by 100 to make them comparable to the earlier tables.

The estimates using the alternative data provide some interesting results. First, *FDIB* is only significant when the volatility in FDI is included (similar to our finding in column 6 of Table 4). Second, in line with Table 4, the schooling variable is always insignificant or significant with the ‘wrong’ sign. Third, again in line with Table 4, *FDIB* becomes insignificant when the interactive term *schooling*FDIB* is included. Fourth, the interactive term is always insignificant (in line with earlier tables). Even if we drop *RATIO*, and estimate the same equation as Borensztein *et al* (1998), by using their data, the interactive term remains insignificant. Note that they did not estimate the panel by using fixed effects, but used SUR and allowed for different constants for the two periods. We therefore also allowed for a time dummy for the 1970s (*DUM70*) but this did not change the results (see also Appendix B).

Incorporating Instruments

A potential problem with the estimates presented above is that FDI is in principle endogenous. This implies that OLS regressions are biased. The technique of instrumental variable (IV) estimation can be used to address this problem. The issue then is to find instruments for *GFDI* and volatility variables. We note that the IV technique introduces problems of its own. In particular, it is difficult to find instruments that are both good at predicting the variable of concern (FDI and its volatility) yet are not determinants of the dependent variable. Furthermore, and consequently, IV estimates tend not to be robust to choice of instruments.

There is a recent literature from proponents of a so-called ‘legal based view’ that may be helpful in deciding which instruments can be used. These writers point to the importance of establishing a legal environment in which financial markets can develop effectively (La Porta *et al.* 1997; Levine 1997; Levine *et al* 1999). The legal system determines the overall level and quality of financial services and hence improves the efficient allocation of resources and economic growth. Indirectly, the legal system is probably also important in explaining FDI inflows as better legal systems may improve protection of foreign investors. Similarly, the nature of the regulatory environment may also be an important determinant of the attractiveness of a country to foreign investors.

Following this literature, we use as instruments indicators of the legal system and the regulatory environment. Six indicators for the regulatory environment or 'governance' are used.[2] *GOVEFF* is an indicator of the ability of the government to formulate and implement sound policies. *GRAFT* is an indicator that measures perceptions of corruption, interpreted as the exercise of public power for private gain. *RULEL* is an indicator of the extent to which agents have confidence in and abide by the rules of society. *PINST* is an index that combines indicators of perceptions of the likelihood that the government in power will be destabilised or overthrown by possibly unconstitutional and/ or violent means. *REGBURD* is an indicator of the ability of the government to formulate and implement sound policies. Finally, *VOICE* is an index of indicators of the extent to which citizens of a country are able to participate in the selection of governments. These indicators are measured on a scale of about -2.5 to 2.5 with higher values corresponding to a 'better' regulatory environment. Appendix A shows that these indicators are highly correlated, so they are entered into regressions individually.

In addition to the three aggregate governance indicators, we also test the relevance of some legal origin indicators (from Easterly and Yu, 1999). These are whether the legal system is of British (*LEGBR*), French (*LEGFR*), Scandinavian (*LEGSC*) or German (*LEGGER*) legal origin. The literature distinguishes between common law and civil law countries. Civil law comes from Roman law and relies heavily on legal scholars to formulate its rules, whereas the common law originates from English law and relies on judges to resolve disputes. It is common to further distinguish between French, German and Scandinavian civil law countries. La Porta *et al* (1997) argue that common law countries offer more protection to both shareholders and creditors. French civil law countries give the least protection, whereas German and Scandinavian civil law countries are somewhere in between.

[2] Data for the six aggregate governance indicators was kindly provided by Pablo Zoido-Lobaton and are based on data for 1997 and 1998. Kaufmann, Kraay and Zoido-Lobaton (1999) provide a description and discussion.

Table 6a: Cross-Section Instruments Estimates for GFDI

	1	2	3	4	5	6	7
LNGDPPC1	0.335 (1.84)	0.230 (1.12)	0.366 (2.11)	0.513 (3.08)	0.543 (4.12)	0.658 (4.37)	0.129 (0.86)
GOVEFF	0.862 (2.52)						
GRAFT		0.989 (2.69)					0.741 (3.20)
RULEL			0.728 (2.38)				
PINST				0.538 (2.03)			
REGBURD					0.584 (2.09)		
VOICE						0.164 (0.99)	
LEGGER	-0.127 (-0.13)	-0.243 (-0.24)	-0.282 (-0.25)	0.210 (0.19)	0.324 (0.29)	0.135 (0.12)	-0.115 (-0.13)
LEGBR	0.702 (1.40)	0.435 (0.86)	0.640 (1.32)	0.966 (1.70)	0.638 (1.34)	0.562 (1.22)	-0.325 (-0.81)
LEGFR	-0.019 (-0.04)	0.018 (0.04)	0.096 (0.22)	0.175 (0.37)	-0.060 (-0.15)	-0.179 (-0.44)	-0.517 (-1.30)
LEGSC	0.044 (0.06)	-0.447 (-0.52)	0.222 (0.30)	0.600 (0.86)	0.666 (0.98)	0.578 (0.83)	-0.272 (-0.38)
GFDI1							0.576 (5.91)
Constant	-1.582 (-1.18)	-0.684 (-0.52)	-1.861 (-1.47)	-3.090 (-2.64)	-3.230 (-3.28)	-3.906 (-3.43)	1.271 (0.68)
Adj. R^2	0.40	0.40	0.36	0.33	0.31	0.29	0.67
F	12.51	12.76	11.29	9.62	9.37	8.62	27.67
n	106	105	112	105	112	115	105

t-values are based on White Heteroskedasticity-Consistent Standard Errors

Table 6b: Cross-Section Instruments Estimates for RATIO

	1	2	3	4	5	6	7
LNGDPPC1	0.020 (0.68)	0.017 (0.54)	0.003 (0.08)	0.009 (0.33)	-0.005 (-0.17)	-0.032 (-0.75)	0.019 (0.75)
GOVEFF	-0.126 (-3.17)						
GRAFT		-0.115 (-3.01)					-0.117 (-3.00)
RULEL			-0.138 (-3.07)				
PINST				-0.113 (-3.20)			
REGBURD					-0.193 (-3.19)		
VOICE						-0.097 (-2.13)	
LEGGER	0.021 (0.15)	0.031 (0.21)	0.102 (0.67)	-0.030 (-0.20)	-0.031 (-0.20)	0.057 (0.36)	-0.027 (-0.46)
LEGBR	0.118 (0.83)	0.153 (1.03)	0.144 (0.96)	0.054 (0.37)	0.128 (0.84)	0.146 (0.89)	0.078 (0.94)
LEGFR	0.084 (0.61)	0.092 (0.65)	0.067 (0.47)	0.028 (0.20)	0.070 (0.48)	0.105 (0.68)	0.004 (0.09)
LEGSC	0.232 (1.50)	0.278 (1.69)	0.272 (1.70)	0.153 (0.98)	0.187 (1.16)	0.249 (1.46)	0.215 (2.12)
UGFDI1/GFDI							0.219 (2.14)
Constant	0.238 (1.01)	0.245 (0.98)	0.381 (1.41)	0.368 (1.71)	0.484 (1.96)	0.644 (1.93)	0.255 (1.39)
Adj. R^2	0.08	0.06	0.09	0.08	0.31	0.07	0.13
F	2.55	2.07	2.85	2.54	9.37	2.36	3.07
n	105	104	111	104	112	114	95

t-values are based on White Heteroskedasticity-Consistent Standard Errors

Most of the variables we are to use as instruments are indices for which there is only one observed value for each country over the period. Hence, the instruments regressions can only be conducted for the cross-section (and not for the panel). Table 6a presents estimates for the determinants of *GFDI*. All governance indicators, except for *VOICE*, appear to perform well; the coefficients are positive and significant. None of the legal origin dummies are significant, although *LEGBR* is close in some regressions. The initial value of GDP per capita is important, as is the initial value of FDI (*GFDI1*). Log value of country size (LNAREA) was included as it is suggested by Borensztein *et al*. (1998) but is not significant.

Table 6b gives regressions for RATIO (relative volatility). The results show that an improvement in a governance indicator leads to a decrease in the relative volatility of FDI. Hence, improving governance helps in two ways: a) it increases FDI and 2) it decreases the relative variability in FDI. However, in general the explanatory power is extremely low, highlighting the difficulty of identifying good instruments for volatility.

On the basis of Tables 6a and 6b we use one of the governance indicators (*GRAFT*), *LNGDPPC1*, the lagged value for *GFDI* (*GFDI1*) as well as the lagged value for the relative uncertainty (*UGFDI1/GFDI*) as instruments in 2SLS regressions. Table 7 presents the 2SLS results. These results confirm our hypothesis: FDI has a positive effect on growth, but volatility of FDI has a negative effect on growth. The use of instruments has resulted in results that are generally weaker than those found earlier, as is often the case with IV techniques. Furthermore, the results confirm the sensitivity of parameter estimates to choice of instruments.

Aspects of the 2SLS estimates in Table 7 are revealing. The coefficient estimates on *GFDI* are generally around 0.3, quite similar to the estimates in Table 3. This suggests that the evidence for a positive impact of FDI on growth is quite robust and not very sensitive to the choice of other explanatory variables. The coefficients on instrumented *RATIO* are much higher than in Table 3 but only significant at the 10% level, probably because the instrumenting regression is a poor fit.

Table 7: FDI and Growth: Cross-Section 2SLS Regressions

	1	2	3	4	5
LNGDPPC1	-1.706 (-6.41)	-1.525 (-4.39)	-1.362 (-3.88)	-1.485 (-4.31)	-1.525 (-4.25)
LNSEC1	1.023 (2.91)	0.797 (1.99)	0.732 (1.80)	0.760 (1.94)	0.787 (1.90)
GFDI	0.470 (3.12)	0.366 (2.04)	1.334 (2.32)	0.340 (1.85)	0.357 (1.90)
RATIO		-2.743 (-1.84)		-2.901 (-1.88)	-2.877 (-1.69)
UGFDI			-2.446 (-1.93)		
BMP				-0.001 (-0.87)	
GOV					0.005 (0.11)
Constant	11.841 (6.23)	12.572 (6.33)	10.096 (4.45)	12.527 (6.26)	12.612 (6.25)
adj. R^2	0.47	0.49	0.44	0.48	0.48
F	14.20	12.07	11.24	10.58	10.40
n	83	77	78	77	77

Notes: Instrument list: (1) LNGDPPC1; LNSEC1; GFDI1; GRAFT; REGECA; REGLAC; REGSSA and a constant. (2) same as (1) but includes UGDFI1/GFDI. (3), same as (1) but includes UGFDI1. (4) same as (2) but includes BMP. (5) same as (2) but includes GOV.
In all equations significant continental dummies REGECA; REGLAC and REGSSA are taken into account. The t-values are based on White Heteroskedasticity-Consistent Standard Errors.

The decline in significance of the coefficients on *RATIO* in Table 7 suggest that it is not FDI volatility *per se* that retards growth, but that such volatility is itself a proxy for unobserved factors that retard growth. In column 3, when *UGFDI* (not instrumented) is included, the striking effect is the increased size of the coefficient on *GFDI*. This may simply be because the high correlation between *GFDI* and *UGFDI* persists even when we instrument for the former; the broad pattern of results is unaffected. The results in columns 4 and 5 are more difficult to interpret, but seem to suggest that BMP and GOV do not have an independent effect on growth other than their effect here picked up by FDI and its volatility (when they are included as instruments).

6 Conclusions

This paper contributes to the literature on FDI and economic growth, by attempting to incorporate effects due to the volatility of FDI inflows. Volatility was introduced into the model as affected the expected costs (returns) of innovation, and in this way is predicted to have a negative effect on growth. We estimate a standard growth model including FDI and volatility using cross-section, panel data and instrumental variable techniques. There is a consistent finding that FDI has a positive effect on growth whereas volatility of FDI has a negative impact. These results are robust to most, albeit not all, specifications. The evidence for a positive effect of FDI is not sensitive to the other explanatory variables included, although the significance of the estimated coefficient does vary according to the specification. In particular, it is not conditional on the level of human capital (as found in some previous studies). Having established that FDI appears to have a robust positive impact on growth, our next step is to address factors that may mediate or enhance this.

In this paper, the additional variable we introduce is the volatility of FDI, which is found to have a consistent negative impact on growth (although significance various according to specification). There is a suggestion that it is not the volatility of FDI *per se* that retards growth but that such volatility captures the growth-retarding effects of unobserved variables. One possibility is that economies with high levels of economic uncertainty will tend to have lower and/or more variable growth rates, and may also appear less attractive to foreign investors. This is consistent with the evidence of a weak negative correlation between FDI and its volatility. One interpretation of these findings is that certain types of FDI are less response to economic uncertainty (or political instability) than are other types. It is a component of FDI that is volatile, and this component is responsive to (and may therefore proxy for) economic uncertainty. This is one issue to be pursued in future work.

A general problem that plagues cross-country growth regressions is potential endogeneity between growth and the variables of concern, in our case FDI. We attempted to address this by instrumenting for FDI and volatility, but the resolution is only partial. Future work can attempt to find better instruments for FDI, and especially volatility. A particular problem with what we attempted here is that we were only able to instrument for the 'long-run' as data on instruments was not available for the panel sub-periods. One option for future work is to eschew instruments in favour of using lagged values (on the basis that current growth is not a determinant of past values of FDI and its volatility). In order to do this while preserving degrees of freedom, we need to develop the time series dimension of our data (the measure of volatility is the major constraint here).

African countries, especially those in sub-Saharan Africa (SSA) are particularly vulnerable to shocks, both external and natural. This vulnerability is related to the general tendency for SSA countries to perform relatively badly in cross-country growth regressions (an 'Africa' dummy is usually significantly negative, as transpires to be the case in our results). Collier and Gunning (1999) address in detail the features that may explain Africa's poor growth performance and susceptibility to risk is one specific adverse feature of Africa that they identify. First, relative to other regions, SSA is especially susceptible to climatic and agricultural risk, the effects of which are made worse by poor soil quality and decades of policies biased against agriculture. Second, export earnings are based on a narrow range of primary commodities and SSA is especially vulnerable to terms of trade shocks. Future work can attempt to address this issues, by identifying the unobserved factors that are picked up by volatility.

For low-income countries, especially SSA, a particular issue is that FDI is highly concentrated in natural resource sectors. The relationship between FDI and growth, and the volatility of FDI, may be related to the sector concentration. For example, FDI in resource extraction, and its impact on growth, may be less sensitive to economic uncertainty than investment in manufacturing or production of primary commodities. Unfortunately, we do not have data that disaggregates FDI by sector. By including 'country-specific' features in the next stage of analysis, we hope to be able to shed some light on these issues.

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Appendix A: Variables Used in the Study

Basic Variables

BMP = the average black market premium (%) for the 1970-1997 period. Source: Easterly and Yu (1999).

GFDI= the average gross foreign direct investment over GDP ratio over 1975-1997 period. Source: World Bank (1999).

GFDI1: lagged value for GFDI. As no data are available for GFDI before 1975, we took first available observation.

GOV = The average value of government consumption as a percentage of GDP for the 1970-1997 period. Source: World Bank (1999).

GRO*:* the average real per capita growth rate over 1970-1998 period . Calculated from real GDP *per capita* data in constant dollars. Source: Easterly and Yu (1999). Original source: Penn World Table 5.6 (Summers-Heston data). Missing data calculated from 1985 GDP *per capita* and GDP *per capita* growth rates (Global Development Finance & World Development Indicators).

LNAREA: a log value of area (the size of the country). Source: Easterly and Yu (1999).

LNGDPPC1 = The logarithm of the 1970 value of real GDP *per capita* in constant dollars (international prices, base year 1985). Source: Easterly and Yu (1999). Original source: Penn World Table 5.6.

LNSEC1= log of The 1970 secondary school enrollment rate. Source: Easterly and Yu (1999). Original source: Global Development Finance & World Development Indicators.

UGFDI= "variability" or uncertainty in GFDI, measured by taking standard deviation of errors of the equation GFDI= a_1 GFDI(-1)+ a_2 GFDI(-2) + a_3 GFDI(-3)+ a_4 TREND + C + e. This equation is estimated for all countries over the 1975-1997 period.

UGFDI1: is the lagged value of UGFDI. Since data for GFDI are not available before 1975, this is calculated by calculating the standard deviation of the error terms of an regression of GFDI on a constant, a trend, GFDI(-1), GFDI(-2) and GFDI(-3) for the 1975-1985 period.

RATO = UGFDI/GFDI.

Governance indicators

The six aggregate governance indicators described below were kindly provided by Pablo Zoido-Lobaton. See Kaufmann, Kraay and Zoido-Lobaton (1999) for an extensive description. Governance is measured on a scale of about -2.5 to 2.5 with higher values corresponding to better outcomes. The data are based on data for 1997 and 1998. The variables are:

1) *GOVEFF* = An indicator of the ability of the government to formulate and implement sound policies. It combines perceptions of the quality of public service provision, the quality of the bureaucracy, the competence of civil servants. the independence of the civil service from political pressures, and the credibility of the government's commitment to policies into a single grouping.

2) *GRAFT* = This indicator measures perception of corruption: the exercise of public power for private gain.

3*) RULEL* = Indicator which measures the extent to which agents have confidence in and abide by the rules of society. These include perceptions of the incidence of both violent and non-violent crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts. See Kaufmann, Kraay and Zoido-Lobaton (1999) for an extensive description. Data obtained from the authors.

4) *PINST* = This index combines indicators which measure perceptions of the likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/ or violent means.
5) *REGBURDEN*= An indicator of the ability of the government to formulate and implement sound policies. It includes measures of the incidence of market-unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development.
6) *VOICE* = This index includes indicators which measure the extent to which citizens of a country are able to participate in the selection of governments.

Legal Origin Indicators
The five legal system indicators are obtained from Easterly and Yu (1999). They are zero-one dummies.

1) *LEGBR* = National legal system from British origin.
2) *LEGFR* = National legal system from French origin.
3) *LEGGER* = National legal system from German origin.
4) *LEGSC* = National legal system from Scandinavian origin.

Table A1. Correlation Matrix Governance Indicators

	GOVEFF	GRAFT	RULEL	PINST	REGBURD	VOICE
GOVEFF	1.000					
GRAFT	0.929	1.000				
RULEL	0.890	0.877	1.000			
PINST	0.794	0.750	0.877	1.000		
REGBURD	0.761	0.684	0.744	0.682	1.000	
VOICE	0.768	0.758	0.715	0.685	0.751	1.000

Countries in the sample

All countries for which FDI data are given in World Bank (1999). Most are developing countries, but some developed countries are included.

Appendix B. How Robust is the Link between Schooling, FDI and Growth in Developing Countries?

Borensztein *et al* (1998) develop a growth model in which technical progress, a determinant of growth, is represented through the variety of capital goods available. Technical progress is itself determined by FDI as foreign firms encourage adoption of new technologies and increase the production of capital goods, hence increase variety. Thus, FDI leads to growth via technology spillovers that increase factor productivity. Certain host country conditions are necessary to ensure the spillover effects. In particular, human capital (an educated labour force) is necessary for new technology and management skills to be absorbed. They use the following basic estimating equation, where g is growth in real GDP, FDI is the ratio of FDI to GDP, H is a measure of schooling and Y_0 is initial GDP:

$$g = c_0 + c_1 FDI + c_2 FDI.H + c_3 H + c_4 Y_0 \quad \text{(B1)}$$

Various specifications of (B1) are estimated using panels of 69 developing countries over two periods, 1970-79 and 1980-89. They find that the coefficient on FDI is negative when significant but the coefficient on the interaction term (*FDI.H*) is positive and consistently significant. This is interpreted as implying that FDI has a positive impact on growth but this is only realised when H is above some critical level (estimated as 0.52); at low levels of H FDI has a negative impact on growth. If the Borensztein *et al* (1998) results confirm the complementarity of FDI and human capital in the process of diffusion, it is an important finding. The purpose of this Appendix is to question whether the finding is robust.

Insofar as we could we used the same data and estimation method to estimate the same equation as Borensztein *et al* (1998). We used SUR (with a different constant for each of the two periods, 1970-79 and 1980-89) to estimate the variant of (1) that includes government consumption and a measure of the black market premium.[3] The results are in Table B1; for comparison, column 2 reproduces the basic result from Borensztein *et al* (1998, Table 1, equation 1.3). Variable definitions and data sources are listed below the table.

[3] It is not entirely clear whether Borensztein *et al* (1998) used the initial value or ten year averages for these two variables. Our results are based on ten year averages. We also experimented with the starting values of these variables in each period but the results were unaltered.

Table B1 FDI, Human Capital and Growth

Independent Variables:	*BdGL*	*1*	*2*	*3*
Initial GDP	-0.0122 (0.004)	-0.0100 (0.0039)	-0.0117 (0.0039)	-0.0108 (0.0041)
Schooling	0.0128 (0.005)	0.0151 (0.0045)	0.0106 (0.0048)	0.0150 (0.0047)
Government Consumption	-0.0811 (0.03)	-0.0731 (0.0334)	-0.0803 (0.0358)	-0.0926 (0.0356)
Black market premium	-0.0185 (0.005)	-0.0199 (0.0058)	-0.0165 (0.0057)	-0.0198 (0.0059)
FDI	-0.8489 (0.12)	-0.4018 (0.2938)	-0.4092 (0.3049)	-0.3587 (0.6157)
*FDI*schooling*	1.623 (0.61)	0.1995 (0.9203)	0.1819 (0.2230)	0.1781 (0.4071)
R^2-adjusted, first period (N)	0.33 (69)	0.24 (75)	0.25 (68)	0.26 (70)
R^2-adjusted second period (N)	0.08 (69)	0.03 (72)	0.07 (65)	0.02 (70)

Variables and sources: Standard errors in parentheses.
Initial GDP: Log of initial GDP per capita from Barro-Lee data-set (1993).
Schooling: initial value of average years of male secondary schooling, from Barro-Lee.
Government Consumption: average over ten year periods of real government consumption as a proportion of real GDP, from Barro-Lee.
Black market premium): 1+ log(black market premium), average over ten year periods from Barro-Lee.
FDI: FDI/GDP ratio, data provided by Borensztein and Lee.

Our sample size over the two periods differs from Borensztein *et al* (1998), who report 69 observations in each period. Regression 1 (Table B1) uses all available data, giving 75 observations for the first period and 72 for the second period. Regression 2 uses data only for those countries defined as developing (according to World Bank publications), giving 68 observations for first period and 65 for second period. Regression 3 is based on a balanced panel of 70 observations for the two periods. Although we are not able to identify the precise sample used by Borensztein *et al* (1998), we note that our results are robust across the three different samples. Comparing our results with those of Borensztein *et al* (1998), we can note that in all respects except for the coefficients on *FDI* and *FDI*H*, the results are remarkably similar. However, we were unable to obtain a significant coefficient on either *FDI* or *FDI*H*. We did run the regressions with alternative measures of FDI, but the basic results were unaffected.[4]

[4] We are grateful to Borensztein and Lee for providing their FDI data, and that is the data used in our regressions in Table 1. We also used data on gross and net FDI from World Development Indicators and from OECD but were unable to find significant coefficients on *FDI* or on *FDI*H*.