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Table of Contents

Abstract[1]

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 for a sample of 67 developing countries. Whilst all results are not entirely robust, the consistent finding is that volatility of FDI has a negative effect on growth. The evidence for a positive effect of FDI is not robust, nor is that for any effect of human capital. For the developing countries in the sample, there is evidence of convergence and the principal factors retarding growth appear to be policy distortions and the volatility of FDI, interpreted as a proxy for factors causing economic instability.

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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 on a sample of developing countries, we find that the volatility of such flows has a consistent negative effect on growth. There are a number of reasons why volatility of FDI inflows may be negatively associated with growth. A first 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. While FDI is considered 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.

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 in developing countries. 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. Aizenman and Marion (1999) find that indicators of macroeconomic volatility have a robust, significant and negative effect of levels of private investment. If we conjecture that FDI has similar determinants to private investment, then FDI volatility may be a proxy for growth-retarding instability.

The aim of this paper is to examine the impact of FDI on growth in developing countries, specifically accounting for volatility. Section 2 briefly reviews some of the relevant existing literature on FDI. Section 3 presents a model incorporating volatility of FDI. The data and measures used 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 generates 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.

Investment, Volatility and Uncertainty

Most theoretical analysis of the relationship between uncertainty and investment is based on how the expected marginal revenue product of capital is affected by the uncertain variable. Under the assumptions of risk neutrality and a convex profit function, Jensen's inequality ensures that the effect of uncertainty on investment is positive (Hartman, 1972); if one introduces risk aversion the sign on the effect is ambiguous (Zeira, 1987). Caballero (1991) derives a negative effect of uncertainty on investment by introducing imperfect competition and/or decreasing returns to scale. Aizenman and Marion (1999) show that under generalized expected utility (disappointment aversion) and/or market imperfections, one can derive a negative link between investment and

volatility. However, there is no general theoretical prediction on the sign of the relationship.

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. Aizenman and Marion (1999) use four measures of volatility (government spending, money growth, real exchange rate and an index of all three) and also find a significant, negative impact on private investment for a sample of developing countries. Interestingly, volatility has no significant effect on total investment, and is significantly negatively related to public investment, according to their results. One implication is that if macroeconomic volatility has an adverse impact on growth via its effect on investment this must be through the effect on private investment (in this scenario, it is implied that private investment is more productive, in terms of enhancing growth, than public investment). Thus, volatility of private investment (or FDI in our case) may 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. Guillaumont and Chauvet (1999) address the implications of including a measure of the 'vulnerability' of the economic environment (or economic uncertainty) in an aid-growth regression. They find that growth is lower in more vulnerable economies, i.e. where macroeconomic volatility is greater. Dehn and Gilbert (1999) look specifically at instability of commodity prices and find evidence that vulnerability to commodity price variability reduces growth, although much depends on how governments respond. Thus, in addition to the potential direct negative effect on growth, volatility of FDI may also proxy for other factors that retard growth.

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 (see chapters 6 and 7 of Barro and Sala-I-Martin, 1995) it is possible to present a formal model which shows how FDI may increase growth. 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.[2]

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, innovators and consumers. Each final goods' producer rents N varieties of capital good from specialised firms that produce a type of capital good (the innovators). The producer has monopoly rights over the production and sale of the capital goods. The

[2] A more complete derivation of the model and a comparison of our results (for a sample including developed countries) with those of Borensztein *et al* (1998) can be found in Lensink and Morrissey (2001).

purchase price P_j of the capital good is set by optimising the present value of the returns from inventing (and producing in several periods), *V(t)*. This leads to a fixed mark-up over production costs. Barro and Sala-I-Martin (1995: 218), assuming free entry of inventors, show that in equilibrium with positive R&D (at cost η) and increasing N, the (constant) rate of return (interest rate, r) is given by:

$$r = (1/\eta)LA^{1/(1-\alpha)}(\frac{1-\alpha}{\alpha})\alpha^{2/(1-\alpha)} \qquad (1)$$

where α measures capital's share of income (coefficient in Cobb-Douglas production function) and L is labour input.

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, η). 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): $\eta = f(F)$, where $\partial\eta/\partial F < 0$

To account for uncertainty with respect to F, we assume that F is stochastic, and modelled as $F = \mu(F)+\varepsilon$, where $\mu(F)$ is the mean of FDI and ε is an error term with $\varepsilon \sim N(0, \varepsilon^2)$. The certainty equivalent of the expected value of FDI is given by $E(F) = \mu(F)-0.5B\sigma^2(F)$ where B is the coefficient of absolute risk aversion (B is positive for risk-averse innovators) and $\sigma^2(F)$ 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, (1) can be written as:

$$r = \left(\frac{L}{f[\mu(F) - 0.5B\sigma^2(F)]}\right) A^{1/(1-\alpha)} \left(\frac{1-\alpha}{\alpha}\right) \alpha^{2/(1-\alpha)} \qquad (2)$$

Equation (2) 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, subject to the budget constraint. This gives the well-known Euler condition for the growth rate of consumption, $g_C = (1/\theta)(r - \rho)$, where $-\theta$ is the elasticity of marginal utility and ρ is the discount rate. In the steady state the growth rate of consumption equals the growth rate of output, g.

Using the expression for r from (2) we finally get:

$$g = (1/\theta)\left[\left(\frac{L}{f[\mu(F) - 0.5B\sigma^2(F)]}\right) A^{1/(1-\alpha)} \left(\frac{1-\alpha}{\alpha}\right) \alpha^{2/(1-\alpha)} - \rho\right] \qquad (3)$$

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

In this paper we use World Bank data on the FDI/GDP ratio (*GFDI,* in percentages), as this provides wide coverage for a reasonably long period (1975-97). More importantly, for our purposes, the *GFDI* data is annual (this is essential to calculate volatility). We have observations for a total of 67 developing countries (not all countries are used in all regressions). 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.

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 (three years) and a time trend. This equation is estimated for all countries over the 1975-1997 period. This is, admittedly, only an approximate measure of volatility, although it is standard in the literature (see Lensink and Morrissey, 2000). Given that the time series available are rather brief, more sophisticated measures of volatility are not justified. 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.

Table 1: Descriptive Statistics, Cross-Section Data

	GRO	*LNGDPPC1*	*LNSEC1*	*GFDI*	*RATIO*
Mean	1.000	7.219	2.537	0.813	0.559
Median	0.896	7.202	2.565	0.498	0.465
Maximum	6.364	8.967	4.127	0.498	0.465
Minimum	-3.701	5.832	0	0.008	0.177
Std. Dev	1.892	0.748	0.990	1.035	0.348
Skewness	0.184	0.352	-0.559	2.672	2.193
Kurtosis	3.471	2.599	2.748	10.748	9.160
Observations	67	67	67	67	67

Note: statistics are based on averages used in cross-section estimates. They refer to statistics with common samples.

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 range 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 and Table 2 gives a correlation matrix.

Table 2: Correlation Matrix, Cross-Section Data

	GRO	*LNGDPPC1*	*LNSEC1*	*GFDI*	*RATIO*
GRO	1.000				
LNGDPPC1	-0.047	1.000			
LNSEC1	0.399	0.659	1.000		
GFDI	0.033	0.348	0.121	1.000	
RATIO	-0.244	0.050	0.143	0.147	1.000

Note: As for Table 1.

5. Econometric Results

We begin with a simple OLS growth regression including foreign direct investment. We use a linear version of the equation derived in Section 3 and estimate variants of the following general equation:

$$g = c_0 + c_1 FDI + c_2 Volatility + c_3 H + c_4 Y_0 + e \qquad (4)$$

As indicated in Section 4, FDI is as a ratio of GDP, two measures of volatility are used, H is the measure of human capital and Y_0 is initial income. Where appropriate, other control variables are included in the regression, as indicated in the tables of results.

Table 3 shows that FDI has a positive effect on growth, although this result is not robust and only weakly significant, whereas volatility of FDI has a negative effect, as predicted. The latter holds both for *UGFDI* and *RATIO* (this relative measure is the preferred indicator of volatility as *UGFDI* is highly correlated with FDI) and is consistently significant. The coefficient on initial GDP is negative and significant, suggesting convergence, while that on initial education is positive and significant. The main results are robust to including *BMP* and *GOV.* The explanatory power, at almost 50%, is quite good for such types of regressions.

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

	1	2	3	4	5	6
LNGDPPC1	-1.550	-1.181	-1.447	-1.389	-1.353	-1.292
	(-4.83)	(-3.46)	(-4.17)	(-3.81)	(-3.75)	(-3.67)
LNSEC1	0.927	0.699	0.829	0.828	0.830	0.947
	(2.56)	(1.93)	(2.34)	(2.34)	(2.35)	(2.43)
GFDI	0.386	1.480	0.319	0.277	0.464	0.944
	(1.60)	(4.11)	(1.22)	(0.98)	(1.87)	(1.72)
UGFDI		-2.529				
		(-3.84)				
RATIO			-1.092	-1.110	-1.008	-1.048
			(-2.33)	(-2.31)	(-2.06)	(-2.09)
BMP				-0.002		-0.002
				(-1.37)		(-1.40)
GOV					-0.081	-0.079
					(-1.62)	(-1.58)
*GFDI*LNSEC1*						-0.209
						(-1.25)
Constant	10.828	8.878	11.137	10.828	11.433	10.806
	(4.32)	(3.53)	(4.36)	(4.15)	(4.69)	(4.54)
ECA	-0.895	-0.786	-1.125	-0.727	-1.266	-0.996
	(-1.23)	(-1.25)	(-1.55)	(-0.98)	(-1.61)	(-1.18)
LAC	-0.893	-.999	-1.112	-1.156	-1.406	-1.370
	(-1.89)	(-2.08)	(-2.14)	(-2.17)	(-2.43)	(-2.34)
SSA	-2.123	-2.080	-2.255	-2.155	-2.101	-2.034
	(-2.98)	(-3.02)	(-3.15)	(-2.95)	(-2.96)	(-2.76)
R^2 (adjusted)	0.41	0.49	0.44	0.45	0.47	0.47
F	8.88	10.15	8.56	7.62	8.41	6.92
N	68	68	67	67	67	67

Notes: Estimates are simple OLS; *t*-statistics in parenthesis based on White Heteroskedasticity-Consistent Standard Errors. Only significant region dummies are included – former communist economies (ECA), Latin America and Caribbean (LAC) and sub-Saharan Africa (SSA).

Borensztein *et al* (1998) argue that human capital (an educated labour force) is necessary for new technology and management skills to be absorbed. They include the interactive term *FDI.H* 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 interaction 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. However, the interaction term between schooling and FDI is insignificant.[3] Lensink and Morrissey (2001) present results for the same regression but with a sample also including some 20 developing countries. The coefficient on *GFDI* is robustly positive and significant, while the regional dummies are more significant. Otherwise the results are unaltered.

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 the volatility of FDI are consistent with the cross-country estimates: volatility negatively affects growth and the

[3] Lensink and Morrissey (2001) present a variety of attempts to estimate the Borensztein *et al* (1998) model, using the same variables as they employ but not with an identical sample. They fail to find a significant coefficient on the interactive term.

significance is robust. However, the coefficients of *GFDI* and human capital are not robust and mostly insignificant. There is no evidence that *GFDI* determines growth, in contrast to Lensink and Morrissey (2001) who find the coefficient to be positive and significant when developed countries are included. On the two occasions when the coefficient on schooling is significant, the sign is negative. The reason might be that there simply is not enough variation in *LNSEC1* over periods in the panel and that the variable behaves like a fixed effect (especially as initial period GDP is included).

Table 4: FDI and Growth: Panel Regressions

	1	2	3	4	5	6
LNGDPPC1	-6.336	-6.108	-5.626	-5.072	-5.284	-4.953
	(-8.50)	(-7.18)	(-6.51)	(-5.64)	(-6.46)	(-6.89)
LNSEC1	-0.861	-0.036	-0.123	-0.279	-0.234	-1.012
	(-2.91)	(-0.10)	(-0.31)	(-0.71)	(-0.59)	(-2.45)
GFDI	0.213	0.903	0.255	0.361	0.236	-0.632
	(0.99)	(2.19)	(1.08)	(1.34)	(0.99)	(-1.62)
UGFDI		-2.387				
		(-1.94)				
RATIO			-2.676	-2.641	-2.272	-1.867
			(-5.03)	(-5.21)	(-3.53)	(-2.81)
BMP				-0.003		-0.003
				(-3.24)		(-3.33)
GOV					-0.106	-0.163
					(-1.40)	(-2.11)
*LNSEC1*GFDI*						0.470
						(2.06)
R^2 (adjusted)	0.51	0.49	0.47	0.53	0.47	0.56
F	161.62	88.40	78.15	66.17	58.28	48.11
N	224	183	166	159	165	158

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

The interesting results are in column 6. We obtain a result partly in line with Borensztein *et al* (1998) as the interactive term is significant and positive and the coefficient on *GFDI* is negative, but not significant. However, the coefficient on schooling is significant and negative. 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. Consequently, we should not draw strong conclusions from theses results. The suggestion is that developing countries require both human capital and FDI together if either is to contribute to growth. It is worth remarking that column 6 does not represent an improvement over the regression in column 4. Taking the latter as the preferred regression, we could conclude that there appears to be convergence (or slowing down of growth) among developing countries and neither human capital nor FDI have contributed to growth. The principal factors we identify as retarding growth in developing countries are *BMP* (a measure of policy distortions) and the volatility of FDI. The latter can be interpreted as a proxy for factors causing economic instability.

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 consider as instruments indicators of the legal system and the regulatory environment. Six indicators for the regulatory environment or 'governance' are explored in Lensink and Morrissey (2001). Here we use only one of these - *GRAFT* is an indicator that measures perceptions of corruption, interpreted as the exercise of public power for private gain. This would be expected to be relevant to investment in developing countries, and performs reasonably well in Lensink and Morrissey (2001). The limited availability of such

data implies that the IV estimates can only be conducted for the cross-section.

Table 5: FDI and Growth: 2SLS Regressions

	1	2	3	4	5	6
LNGDPPC1	-1.648	-1.057	-1.236	-0.952	-0.941	-0.702
	(-4.92)	(-1.84)	(-3.47)	(-1.68)	(-1.58)	(-1.05)
LNSEC1	0.932	0.655	0.638	0.613	0.588	0.756
	(2.26)	(1.47)	(1.45)	(1.39)	(1.23)	(1.36)
GFDI	0.479	0.301	1.743	0.247	0.178	0.933
	(1.80)	(0.90)	(3.53)	(0.67)	(0.38)	(0.86)
RATIO		-4.357		-4.646	-5.306	-5.939
		(-1.83)		(-1.86)	(-1.78)	(-1.53)
UGFDI			-2.754			
			(-2.83)			
BMP				-0.001		-0.001
				(-0.64)		(-0.54)
GOV					0.032	0.064
					(0.33)	(0.53)
LNSEC1						-0.388
**GFDI*						(-0.78)
Constant	11.514	10.535	9.337	10.153	10.043	8.029
	(4.25)	(3.38)	(3.42)	(3.22)	(3.03)	(2.03)
R^2 (adjusted)	0.38	0.28	0.48	0.36	0.48	0.07
F	7.55	5.28	7.33	4.52	10.40	2.92
N	62	56	57	56	56	56

Notes: Instrument list: (1) *LNGDPPC1, LNSEC1, GFDI1, GRAFT* 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*. (6) same as (2) but includes *GOV, BMP* and *LNSEC1*GFDI1*. In all equations significant regional dummies (ECA, LAC and SSA) are taken into account as in Table 3. The *t*-values are based on White Heteroskedasticity-Consistent Standard Errors.

Consequently, we use *GRAFT*, *LNGDPPC1*, the lagged value for *GFDI* (*GFDI1*) as well as the lagged value for the relative uncertainty (*UGFDI1/GFDI*) as instruments for *GFDI* and *RATIO* in 2SLS regressions. Table 5 presents the results. Again, FDI has no significant effect on growth, but nor do any of the variables in a robust manner. The

use of instruments has given 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. However, volatility of FDI has a consistently negative effect on growth, it is usually weakly significant and the coefficient is reasonably stable. The evidence for convergence among developing countries is also reasonably consistent. These results are broadly comparable to those of Lensink and Morrissey (2001); although the significance of FDI increases, the inclusion of developed countries in the sample does not alter the pattern of results.

The coefficients on instrumented *RATIO* in Table 5 are much higher than in Table 3 but only significant at the 10% level, probably because the instrument regression is a poor fit. The decline in significance of the coefficients on *RATIO* suggests 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 (Table 5), 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). The low explanatory power for column 6 reinforces the earlier argument that the inclusion of the interactive introduces excessive multicolinearity.

6 Conclusions

This paper contributes to the literature on FDI and economic growth in developing countries by incorporating effects due to the volatility of FDI inflows. Volatility was introduced into the model as affecting 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. Volatility of FDI is found to have a consistent negative impact on growth, and this result is quite robust. The pattern of results suggests that there appears to be convergence (or slowing down of growth) among developing countries but neither human capital nor FDI have contributed to growth. The principal factors we identify as retarding growth in developing countries are the black market premium (a measure of policy distortions) and the volatility of FDI. The latter can be interpreted as a proxy for factors causing economic instability. One possibility is that economies with high levels of economic uncertainty tend to have lower and/or more variable growth rates, and may also appear less attractive to foreign investors. One issue to be pursued in future work is to examine the underlying reasons for the volatility of FDI.

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 the data (the measure of volatility is the major constraint here).

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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 enrolment 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 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.
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).

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