Can Emerging Economies rely on Foreign Direct Investment for Growth?

Dynamic Heterogeneous Panel Analysis of Latin America

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Abstract

Such questions as 'does FDI assist growth? how important is foreign relative to domestic investment? what is the relative importance of FDI and trade openness?' are clearly important, given developing and emerging countries' need to respond to the overtures of investors from abroad. One key characteristic in favor of FDI is its stability relative to the highly volatile capital movements that have characterised financial crises. In contrast to such volatility, FDI has been remarkably persistent across all sectors of the economy and is clearly a candidate for having boosted growth above that which would otherwise have occurred. On the other hand, a pessimistic view might accuse FDI of serving merely to transfer ownership from domestic to foreign agents, so that its effect on growth is, at best, neutral or, at worst, immiserising.

Despite the scale and persistence of FDI, and the weighty literature that has emerged in the area of economic growth, only a small number of studies have investigated empirically the relationship between the two. Moreover, there has been relatively little investigation of the effects on individual economies, as opposed to more aggregate groupings. A further issue concerns the methodologies that have been used to investigate the growth effects of FDI. Most studies of economic growth have involved panel data, using period averages, typically of five or ten years. The choice of start and end dates has often been arbitrary, despite the fact that alternative dates can produce considerable differences in the estimated results.

This paper will examine the effects of FDI on growth using the case of Latin American countries. The paper will also examine the effects of other variables including trade openness, human capital, terms of trade and international debt. The paper will employ an innovative methodology, pooled mean group (PMG) estimation, that will overcome a number of problems. First, PMG makes full use of all available information in the form of individual observations, rather than period averages for each country, and also allows for short run growth responsiveness to differ between the individual Latin American countries. This dynamic modelling methodology permits the speeds of adjustment to the steady-state to differ between the countries. Second, the paper will use a new approach, termed rolling panels, to provide quantitative estimates of the sensitivity of the results to changes in the period averages stemming from alternative choices of start and end dates.

The results demonstrate that the choice of time period does, indeed, matter as the results are far from invariant with respect to many of the time periods examined. FDI, in isolation from human capital, did not have a positive effect on growth in the Latin American countries. However, it did have a positive though small effect when interacted with human capital. Trade openness also had a significant positive effect on growth for some specifications. The results for Latin America show that the economic behavior of regions can differ considerably from the average behavior of wider groups. Hence, the paper demonstrates that it is inappropriate to generalize from the more aggregate level to smaller groups, such as all developing countries compared with different regions, at least in relation to the magnitudes of the effects of different variables on economic growth.

**JEL Classification**: C23, F3, O4, O54
**Key words**: Economic growth, Foreign Direct Investment, Latin America, Panel Data, Pooled Mean Group Estimation
1. Introduction

Has foreign direct investment assisted past growth? Is it a strategy for growth revival? How important is foreign relative to domestic investment? These questions are clearly important given developing and emerging countries’ need to respond to the overtures of investors from abroad. One key point in favour of foreign direct investment (FDI) is its stability relative to the highly volatile capital movements which have characterised the financial crisis. In contrast to the massive short-run outflows which have affected most developing and emerging economies, FDI has been remarkably persistent across all sectors of the economy and is clearly a candidate for having boosted growth rates above the levels to which they might otherwise have sunk. On the other hand, a pessimistic view might accuse FDI of serving merely to transfer ownership from domestic to foreign agents, so that its effect on growth is, at best, neutral or, at worst, immiserising.

The need for an empirical response to questions about the direction and size of the effects of FDI on growth is reinforced by the large scale of the flows which have occurred. In 1996, FDI flows accounted for 2.3% of world GDP compared with 1% in 1980, and FDI stocks were 21% of world GDP compared with 10% in 1980 (UNCTAD, 1998). By 1997, global FDI inflows amounted to $400 billion, of which approximately 37% went to developing and emerging economies. Latin America was a major recipient region, accounting for around 10% of global inflows in the same year. Indeed, the role of FDI in this region has been underpinned by the asset sales which occurred during the debt crisis of the 1980s, as well as the more recent financial crisis, via rationalisation and privatisation in the manufacturing and service sectors.

Despite the scale and persistence of FDI, and the weighty literature which has emerged in the area of economic growth, only a small number of studies have investigated, empirically, the relationship between the two. The effect on growth of foreign direct investment found to be positive in both OECD and non-OECD countries by de Mello (1999) and greater in export-promoting than
import-substituting developing countries by Balasubramanyam et al. (1996). The role of human capital and FDI in developing countries was considered by Borensztein et al. (1998), who found that FDI only had a positive effect on growth when interacted with human capital of above a minimum level. What is not known is whether these aggregate results are applicable to developing countries from different regions, as it is possible that considerable disparities in the nature and size of response are ‘averaged out’ in the results from the larger group.

A further issue concerns the methodologies which have been used to estimate the growth effects of FDI. Most recent studies of economic growth have involved panel data, and have used period averages, typically of five or ten years, for the estimation of the panels. The choice of the particular period length and starting date has been based on such criteria as data availability, giving rise to results which are specific to the choice of the start and end dates for the calculation of each of the period averages. The periods selected constitute only one of many possible sets of time periods and may be atypical, for example, by capturing a particular set of phases of cyclical activity or events in the debt arena. The choice of alternative start and end dates can produce considerable differences in the estimated results, as indicated by investigation of the sensitivity of the estimated parameters to changes in the period averages associated with alternative start and end dates.

These problems point to the desirability of panel data studies of different regions, based on a methodology which avoids the use of arbitrary period averages. An innovative methodology in this respect is that of pooled mean group (PMG) estimation (Pesaran et al., 1998). PMG estimation is particularly advantageous in that it makes full use of all available information in the form of individual data observations, rather than averages, for each country and also allows for short-run variations in growth responsiveness between the countries included in the larger regions. The model is superior to the procedures which have previously been used for panel data estimation in that, unlike traditional pooled estimators, including fixed and random effects models, it allows not only
the intercepts but also the short-run coefficients and error variances to differ between countries. It differs from the alternative mean group estimator procedure, which estimates separate equations for each country and examines the distribution of the estimated coefficients across countries, thereby treating all the parameters for the countries within a region as completely unrelated. While constraining the long-run coefficients to be the same across countries, as might be predicted from growth models which allow for intra-regional technology transfers, PMG estimation permits the speeds of adjustment to the steady-state to differ between countries.

This paper will use PMG estimation to examine and compare the short-run and long-run effects of FDI on growth in Latin America countries. Before using this new estimation procedure, the following section of the paper will use a new approach, termed rolling panels, to provide quantitative estimates of the sensitivity of the results to changes in the period averages, stemming from alternative choices of start and end dates. The approach is, thus, a test of the robustness of the results provided by the methodology which is standard within most recent studies of growth, involving the use of five and ten year period averages in panel data growth regressions. Section 3 will consider PMG estimation in more detail and Section 4 will present and discuss the results obtained by using the new methodology. Section 5 will provide some conclusions.

2. FDI and growth estimation using period averages

The methodological underpinning for empirical studies of economic growth has shifted away from the cross-country regressions which characterised the resurgence of interest in growth in the latter half of the 1980s and early 1990s (critically reviewed by Levine and Renelt, 1992; Levine and Zervos, 1993; Barro and Sala-i-Martin, 1995), towards a panel data approach which can take greater account of the time dimension of the growth process (for example, Fischer, 1993; Easterly et al., 1997; Carkovic and Levine, 2003). The earlier cross-country regressions, based on long run
averages, give rise to results which are almost invariably fragile with respect to small changes in the conditioning variables and with respect to the estimation procedure and time periods.

Panel data studies have a number of advantages relative to the cross-country regressions approach. They allow for heterogeneity between countries which differ in terms of their histories, institutions and social and political regimes, along with a time dimension which is, evidently, crucial within a growth context. Panel data provide more information, more degrees of freedom and greater efficiency than cross-section or time series data alone, preclude some sources of aggregation bias and avoid many of the problems of multicollinearity that can arise with time series. Hence, a panel data approach permits the relatively efficient estimation of growth effects that could remain unidentified by studies relying solely on cross-section or time series data.

Nonetheless, the use of period averages in panel data studies provides results which are specific to the periods selected and fails to reveal the responsiveness of growth during alternative periods which may, for example, include differing phases of expansionary or deflationary activity. The use of an arbitrary set of period averages is of no economic importance if the estimated parameters are robust to the substitution of alternative sets, but can be misleading if the parameters display a high degree of sensitivity to the periods selected. It is, therefore, necessary to explore the sensitivity of the estimated parameters to alternative period averages.

The model which is used to estimate the parameter sensitivity for FDI and other determinants of growth, using period averages, is consistent with Borensztein et al.’s (1998) view that economic growth depends upon technological progress, which may be constrained by absorptive capacity, particularly within developing countries (Benhabib and Spiegel, 1994). ‘Environmental’ variables, such as government consumption, are also considered. Technological progress can occur in a variety of forms, notably capital deepening in the form of new varieties of capital goods and/or
improvements in the quality of these goods, differing from Aghion and Howitt’s (1992) random sequence of quality improvements. Producers who provide the capital goods obviously aim to maximise the rental rate on the goods, net of maintenance and set-up costs, which may be considerable in the context of the adaptation of the technology for developing countries. The most obvious means by which technology is transferred across borders is via FDI and the great advantage of Borensztein et al.’s model is that it takes explicit account of the contribution of FDI to the growth process. The role of FDI is to decrease the cost of capital accumulation in the form of new varieties of capital goods, thereby raising their rate of introduction, furthering capital-deepening and raising technical progress. Thus, the contribution of FDI to growth is likely to be higher in countries with a high level of human capital but may be insignificant in countries whose stock of human capital is low. A further possible outcome is that FDI may crowd-out domestic investment, with immiserising consequences. Hence the model takes account of differences in recipient economies’ abilities to take advantage of international technology diffusion via FDI in accordance with their different absorptive capacities in the form of human capital.

The equation which was used for the estimation of the rolling panels takes account of FDI and absorptive capacity by including FDI and the interaction of FDI with human capital, $FDI_H$, as separate regressors and is given by

$$ g = c_0 + c_1 \ln Y_0 + c_2 FDI + c_3 FDI_H + c_4 H + c_5 FI + c_6 GCON $$

where $g$ is the growth rate of GDP per capita, $\ln Y_0$ is the log of GDP per capita in the base year, $t$; $FDI$ is foreign direct investment as a share of GDP; $H$ is the stock of human capital; $FDI_H$ is the interaction between $FDI$ and $H$; $FI$ is fixed investment as a share of GDP; $GCON$ is government consumption as a share of GDP. The countries for which the panels were estimated were Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Paraguay, Peru and Venezuela, which account for the vast majority of foreign direct investment in
the region. Initially, panels were estimated for the years 1970-79 and 1980-89 and, subsequently, rolling panels were estimated for decades starting with year $t+n$, where $n = 1, \ldots, 6$. The observations included in each of the estimated equations were the log of GDP per capita for the base year and the decade averages for all of the remaining variables.

The data for the growth rate of GDP per capita, for GDP per capita in the base year, fixed investment as a share of GDP and government consumption as a share of GDP were obtained from the World Bank’s *World Development Indicators*. Annual estimates of human capital stocks were obtained by interpolating, linearly, between Barro and Lee’s (1993) five yearly data for completion ratios for secondary schooling for males and females, and extrapolating for the final five years. Data for FDI stocks were obtained from UNCTAD’s *World Investment Report* (1992-1997) and the stock of FDI as a share of GDP was calculated using GDP data from the World Bank.

The results of the rolling panel estimations, based on Eq. (1) are given in Table 1. It is clear that the use of alternative start and end dates for the calculation of the period averages used in the panel data regressions results in considerable changes in a number of the estimated parameters in the growth regressions. For example, the parameter for FDI varies between -0.18 for the decades 1970-79, 1980-89 and -0.38 for the decades 1972-81, 1982-91. The foreign direct investment and human capital interaction parameter for the periods 1973-82, 1983-92 is twice that for the periods 1976-85, 1986-95, while the fixed investment parameter for 1970-79, 1980-89 is nine times greater than that for 1972-81, 1982-91!

Such variability gives rise to two options. First, if the use of the period averages panel data methodology is to avoid presenting only a partial picture of the possible determinants of growth, the results obtained from alternative sets of period averages should be presented. Our results suggest that it is useful to subject such models to this form of sensitivity analysis, which casts doubt on the reliability of any single set of estimates. In the case of dynamic models, Pesaran and Smith (1995,
p.81) show that “the familiar practice of running cross-section regressions based on single or a few years of observations is not likely to yield unbiased or consistent estimates”, whereas mean group estimation is consistent for large numbers of groups and time periods. The second option of using an alternative methodology, based on mean group estimation with a degree of pooling, will, therefore, be pursued in the remainder of the paper.

3. Pooled Mean Group Estimation

This section considers the way in which PMG estimation can be used to examine the effects of FDI on growth in individual countries and regions, in both the short-run and the long-run. As a point of departure, we accept the case for using dynamic panels in growth estimation. It is clear that the analysis of growth effects using dynamic panels has the advantage, relative to the earlier cross-country panel models pioneered by Barro (1991) and Mankiw et al. (1992), of allowing for cross-country heterogeneity in the determinants of growth per capita via the introduction of individual country intercepts (ie. fixed effects), as exemplified by Islam (1995, 1998). However, the latter type of dynamic panel modelling does not allow for the possibility that the determinants of growth rates differ across countries, particularly in the short-run, owing, for example, to imperfections in international technology transfers. The economic significance of cross-country heterogeneity in growth rates is fundamental, as noted by Lee et al. (1998), in that it deprives the concept of beta convergence of its economic meaning.

The empirical question which is posed is whether the determinants of growth rates (slope heterogeneity) do, in fact, vary across countries and, if so, how. This question is not tackled by recent panel data studies involving pooled estimation, which takes account of fixed and random effects, allowing the intercepts to vary across countries, but which impose homogeneity on all other
parameters. An alternative methodology which has been applied to panel data, termed the mean group (MG) estimator (Pesaran and Smith, 1995), involves separate estimation of the regression equation for each country (conditional on sufficient degrees of freedom) and the subsequent calculation of the mean of the parameters across the set of countries. The MG estimator involves the assumption that all of the parameters can differ across countries and does not allow for the possibility that some of the parameters may converge across regional country sets over the long-run.

An innovative model for investigating the empirics of slope heterogeneity across countries involves PMG estimators, and incorporates neither the extreme assumption of cross-country homogeneity of slope parameters, as in standard fixed or random effects panel data models, nor the alternative limiting assumption that the country parameters are unrelated. PMG estimation, instead, allows the intercepts, short-run parameters and error variances to differ across countries, within an overall constraint of long-run parameter homogeneity across the set of countries. The model, thus, takes account of short-run dynamics, permitting quantification of individual countries’ differing rates of adjustment to the long-run steady-state.

The model is derived, following Pesaran et al. (1998), using an autoregressive distributed lag (ARDL) model, providing a generalised error-correction specification of the type:

\[
\Delta y_i = \phi_1 y_{i,-1} + X_i \beta_i + \sum_{j=1}^{q-1} \lambda_j \Delta y_{i,j}^* + \sum_{j=0}^{q-1} \Delta X_i \delta_j^* + D_i \gamma_i + \varepsilon_i, \quad (2)
\]

where \(i\) represents the \(i\)th country and \(i = 1, \ldots, N\); \(y_i = (y_{i1}, \ldots, y_{iT})'\) is a vector of \(T \times 1\) of the observations for the growth rate of country \(i\) over time periods, \(t = 1, \ldots, T\), and, for simplicity, it is assumed that \(T\) has the same value for each country; \(X_i = (x_{i1}, \ldots, x_{iT})'\) is a matrix of \(T \times k\) of observations for a vector of regressors, \(x_i\) \((k \times 1)\), that vary across countries and time periods; \(D = (d_1, \ldots, d_T)'\) is a matrix of \(T \times s\) of observations for a vector of regressors, \(d_i\) \((s \times 1)\), that vary over
time but not across countries; \( y_{i,j} \) and \( X_{i,j} \) are \( j \) period lagged values of \( y_i \) and \( X_i \); \( \Delta y_i = y_i - y_{i,-1}, \Delta X_i = X_i - X_{i,-1} \). \( \Delta y_{i,j} \) and \( \Delta X_{i,j} \) are \( j \) period lagged values of \( \Delta y_i \) and \( \Delta X_i \); \( \lambda_{ij} \) is a scalar; \( \delta_{ij} \) and \( \gamma_i \) are \( k \times 1 \) and \( s \times 1 \) vectors of unknown parameters; the disturbances are \( \varepsilon_i = (\varepsilon_{i,1}, \ldots, \varepsilon_{i,T})' \) with zero means, variances, \( \sigma_i^2 \), and finite fourth order moments.

It is assumed that: (1) the disturbances are distributed independently across countries and time and independently of the regressors \( x_{it} \) and \( d_{it} \); (2) the underlying ARDL model is stable, so that \( \phi_i < 0 \) and, for \( i = 1, \ldots, N \), over the long-run, \( y_{it} = -(\beta_i / \phi_i)x_{it} + \eta_{it} \), where \( \eta_{it} \) is a stationary process; (3) there is cross-country equality of the long-run parameters on \( X_{it} \), given by \( \theta_i = \theta, i = 1, \ldots, N \).

Using these assumptions, linearising with respect to \( \phi_i \) and \( \theta \) and assuming that the disturbances \( \varepsilon_{it} \) are normally distributed, the following concentrated log-likelihood function is obtained:

\[
\ell_T(\varphi) = -\frac{T}{2} \sum_{i=1}^{N} \ln 2\pi \sigma_i^2 - \frac{1}{2} \sum_{i=1}^{N} \frac{1}{\sigma_i^2} (\Delta y_i - \phi_i \xi_i(\theta))' H_i (\Delta y_i - \phi_i \xi_i(\theta)),
\]

where \( H_i = I_T - W_i(W_i' W_i)^{-1} W_i' \); \( I_T \) is an identity matrix of order \( T \); \( \xi_i = y_{i,-1} - X_i \hat{\theta} \) and \( \varphi = (\theta, \phi, \sigma)' \).

The long-run parameters, \( \theta \), and the individual country short-run (error correction) parameters, \( \phi_i \), are obtained by maximising Eq. (3) with respect to \( \varphi \). The resulting parameters, termed PMG estimators, can be computed by two methods. The first method requires the use of the Newton-Raphson algorithm. The second uses a back-substitution algorithm involving an iterative procedure to solve the following equations:

\[
\hat{\theta} = - \left\{ \sum_{i=1}^{N} \frac{\hat{\phi}_i^2}{\sigma_i^2} X_i' H_i X_i \right\}^{-1} \left\{ \sum_{i=1}^{N} \frac{\hat{\phi}_i^2}{\sigma_i^2} X_i' H_i (\Delta y_i - \hat{\phi}_i \hat{\xi}_i) \right\},
\]

\[
\hat{\phi}_i = \left( \hat{\xi}_i' H_i \hat{\xi}_i \right)^{-1} \hat{\xi}_i' H_i \Delta y_i, \quad i = 1, \ldots, N,
\]

\[
\hat{\sigma}_i^2 = T^{-1} (\Delta y_i - \hat{\phi}_i \hat{\xi}_i)' H_i (\Delta y_i - \hat{\phi}_i \hat{\xi}_i), \quad i = 1, \ldots, N.
\]
The PMG estimators can be calculated using the same algorithm in the case of either stationarity or non-stationarity of the regressors, although the asymptotic theories upon which the two cases differ (Pesaran et al., 1998).

The panel model is, thus, an extension of the ARDL approach to the estimation of single-equation dynamic models where, with augmentation of the order of the ARDL model, consistent estimates of long run parameters may be obtained even if the explanatory variables are endogeneous and regardless of whether they are I(0) or I(1) (Pesaran, 1997). A bounds test for the existence of a long run relationship is derived in Pesaran and Shin, 1996), but has not yet been further developed for panel applications. Attempts to apply this test to individual countries in the Latin American region were unsatisfactory due to lack of degrees of freedom when panel features of the data were not used. For the moment, we therefore assume the existence of such relationships in our panel.

The PMG estimation model was used to investigate the significance and scale of the effects of foreign direct investment as a determinant of economic growth in Latin America. The general specification of the equation which was estimated using the model takes account of physical and human capital and the interactions between them, as discussed in Section 2, as well as of a range of additional conditioning variables suggested by earlier growth studies and is given by:

$$g = c_0 + c_1 FDI + c_2 FDIH + c_3 H + c_4 FI + c_5 FIH + c_6 A$$  \hspace{1cm} (7)$$

where $FI$ is fixed investment as a share of GDP, $FIH$ is the interaction between fixed investment and human capital and $A$ is a set of possible additional determinants of economic growth, including population growth, $POP$; inflation, $INF$; the black market exchange rate premium, $BMP$; openness, $OP$, the terms of trade, $TOT$, and the ratio of debt to GDP, $D$. All other variables and data sources are as defined in Section 2. The data source for openness, the terms of trade, population growth and debt is the World Bank’s World Development Indicators. Data for the inflation rate were based on the consumer price index in the International Monetary Fund’s International Financial Statistics.
The black market premium was calculated from data in *Pick’s Currency Yearbook*, 1955-78, and the *World Currency Yearbook*, 1984-93.

4. Empirical Results

Different specifications of equation (7) were estimated, including alternative sets of variables within the term $A$. The main results are provided in Table 2. The estimates in the table are based on cross-section demeaned data to remove common unobserved time-specific components, assuming that the common component has identical effects in each country. Estimates were also obtained using world or regional growth rates as common time-specific variables but are not provided as they appeared to be poor proxies for the possibly large set of common components.

Perhaps the most interesting set of results is provided by Eq. 7.1, in which only the core set of physical and human capital variables was homogeneity-constrained over the long run. The results indicate that although FDI, *per se*, had a negative but insignificant effect on the growth of Latin American countries during the period 1970-95, it had a significant positive effect when interacted with human capital, indicating that a minimum level of schooling is necessary if recipient countries are to benefit from FDI. The results are similar to those of Borensztein *et al.* (1997), who also found a negative and only sometimes significant relationship between FDI and growth in 1970-89, but positive and significant interaction effect, for their wider group of developing countries. Our results differ in that the magnitudes of the effects are considerably lower than those which were estimated for the wider group but we would argue that the lower estimates are more plausible for the case of Latin American countries than the higher, average estimates that were obtained in the earlier study. Our results are also consistent with the recent finding that US companies have a preference for investing in countries with a relatively highly skilled labour force (Cooke and Noble, 1998).

The variables which appear to have dominated the growth process in the Latin American
region are human capital, followed by fixed investment. Increases in both variables affected growth positively and, usually, significantly. The direction and significance of these effects are in line with Borensztein et al.’s results for the wider group of developing countries, although it is interesting that the magnitudes of the effects, again, differ. The interaction between fixed investment and human capital had an unexpected, although smaller negative effect on growth, akin to the negative but insignificant effect found by Borensztein et al.

Alternative specifications of Eq. 7 were estimated on the basis of the assumption, common to panel data studies, that all of the conditioning variables are homogenous over the long run although, unlike past panel data studies, the PMG model allows the short run parameters to vary. The direction of the effects on growth of the core variables, $FDI$, $FDIH$, $H$, $FIH$ and $FI$ is robust with respect to the inclusion of variables which past studies have considered as further determinants of growth, namely population growth, inflation, openness and the terms of trade, although, as in Levine and Renelt (1992), there are some changes in the orders of magnitude and significance of the parameters of the core variables. Additional specifications including the black market premium and the ratio of debt to GDP were also estimated but provided results (not reported) which were generally insignificant. The adjustment parameter, ECM, in the final row of the table is consistently around -0.9 and significant, as is necessary for the existence of a long run relationship although, as in Borensztein et al., F tests indicated rejection of long run parameter homogeneity for all of the estimated equations, 7.1-7.5. However, the sets of results which were obtained by estimating the alternative and more commonly used static fixed effects model were notably inferior to those provided by the dynamic PMG approach.
5. Conclusions

The aims of this paper were to estimate the effects of FDI on economic growth in Latin American countries using two methodologies. The first is the panel data methodology which has been used in recent growth modeling and the second is the new pooled mean group estimation approach. In the first case, a rolling panels approach was used to estimate the responsiveness of growth to changes in FDI and other variables, and to quantify the sensitivity of the parameters to variations in the start and end dates of the panels. The results indicated that although the values and significance of the parameters were similar for some periods, they differed considerably for others. The implications of these results for empirical models of economic growth is that the choice of time period matters – parameter values are far from invariant with respect to many of the time periods selected. Therefore, rather than relying solely on one set of parameter estimates and interpreting economic meanings from them alone, it is preferable to consider the set of estimates obtained by using a rolling panels approach in order to assess the degree of variation in responsiveness which can occur.

The result which was consistent across all of the panels estimated was that FDI, in isolation from human capital, did not have a positive effect on growth in the Latin American countries. In contrast, its effect was positive but small when interacted with human capital. These findings lend support to the conclusion of the more aggregate study undertaken by Borensztein et al. (1998) that a minimum level of human capital is necessary in order for FDI to contribute significantly to economic growth. However, our results are considerably more pessimistic with respect to the scale of FDI’s contribution to growth.

The conclusions obtained from the rolling panels approach are supported by the results obtained from PMG estimation. The PMG methodology has a number of advantages relative to the static models which have been used in recent panel data growth modeling. In particular, it allows the short-run parameters to vary across countries, which would appear to be more plausible than the
usual assumption of short-run parameter constancy and, indeed, occurs for the Latin American countries considered. The outcome of an absence of support for long-run parameter homogeneity in the PMG estimates is consistent with the results obtained by testing the weaker assumption of long-run parameter homogeneity across panels of two decades, provided by such methods as seemingly unrelated regressions (SUR) estimation.

The parameter estimates which were obtained by applying the PMG methodology indicate, for the core set of variables, an insignificant effect of FDI on growth and a small positive effect when FDI is interacted with human capital. Once again, there appears to be little scope for relying on FDI, alone, as a growth salvation. On the other hand, the case for considering the effects of interactions between variables does appear to be strong. Human capital, in particular, may not contribute to growth in its own right (Pritchett, 1997) but can play an important role in conjunction with other variables. The results obtained for the Latin American countries also indicate that the economic behaviour of regions may differ considerably from the average behaviour of a wider group to which they are assigned. Hence, generalizations from the more aggregate level to smaller groups may be inappropriate, at least in relation to the magnitude of the effects of different variables on economic growth.

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References


# Table 1

## Latin America: Sure Rolling Panels of Two Decades

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**Notes:**
1. Common parameters are imposed (except the intercepts) for both decades.
2. The final column is a common-slope panel of four 5-year periods, 1970-1989.
### TABLE 2: POOLED MEAN GROUP ESTIMATES

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