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CAPITAL FLOWS AND GROWTH  
IN DEVELOPING COUNTRIES:  
RECENT EMPIRICAL EVIDENCE

by

Marcelo Soto

Research programme on:  
Capital Movements and Development

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## TABLE OF CONTENTS

ACKNOWLEDGEMENTS .....	5
PREFACE .....	6
RÉSUMÉ .....	7
SUMMARY .....	7
I. INTRODUCTION .....	8
II. ECONOMETRIC APPROACH .....	10
III. DATA ISSUES .....	13
IV. EMPIRICAL RESULTS .....	16
V. FINAL REMARKS .....	24
APPENDIX. THE GMM APPROACH AND THE CHOICE OF INSTRUMENTS .....	25
NOTES .....	27
BIBLIOGRAPHY .....	28
OTHER TITLES IN THE SERIES/AUTRES TITRES DANS LA SÉRIE .....	30

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## PREFACE

The debate about how to solidify the global financial architecture, the appropriate monetary-financial policy mix in emerging markets and debt relief for poor countries is in full swing. The Centre's research activity "Capital Movements and Development" aims to help design elements for a more stable and development-friendly global regulatory infrastructure, and to assist policy makers to formulate policies for their strategies of financial opening in a world of intense capital mobility.

The virulence, speed and contagion of emerging-market crises during the 1990s has shifted the burden of proof of the gains from free capital flows to their proponents, as there has been more advertisement than hard evidence on the benefits of financial globalisation. In this context, the present study investigates how developing economies can benefit from financial integration. The main findings show that there are large benefits from foreign direct investment and portfolio equity flows. On the other hand, bank inflows may have damaging effects in countries with fragile financial systems.

These results suggest first-best and second-best conclusions for growth-conducive policies of financial opening. First-best policies are to encourage equity rather than debt inflows, namely foreign direct investment and portfolio equity inflows. All forms of capital inflows should be welcome in developing countries, on condition that their banking systems are well-capitalised and supervised. Where that condition has not yet been achieved, selective measures to reduce debt-related inflows can be called for as a second-best policy. This paper by Marcelo Soto thus provides comprehensive empirical shape to determine the extent to which the basic tenets of OECD policy advice enshrined in its Codes of Liberalisation can be transferred to the developing world.

Jorge Braga de Macedo  
President  
OECD Development Centre  
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## RÉSUMÉ

Les entrées de capitaux vont-elles de pair avec une accélération de la croissance des revenus ? Nombreuses sont les études empiriques qui identifient les principaux déterminants du taux de croissance d'un pays. Néanmoins, ces travaux n'ont pas étudié l'incidence sur la croissance des différents types d'entrées de capitaux. Ce Document analyse les effets sur la croissance des diverses composantes des entrées de capitaux privés pour 44 pays en développement. Une série dynamique de données annuelles est estimée sur la période 1986-97. Après neutralisation des variables généralement utilisées dans les régressions de croissance, plusieurs conclusions se dégagent : tout d'abord, l'investissement direct étranger et les prises de participation (flux de portefeuille en actions) sont corrélés de façon positive et robuste avec la croissance. Ensuite, les flux de portefeuille en obligations ne montrent pas de liens significatifs avec la croissance. Enfin, dans les économies dont le système bancaire n'est pas suffisamment capitalisé, les entrées de capitaux bancaires sont corrélées négativement avec le taux de croissance, et ce autant pour les capitaux bancaires à court terme qu'à long terme. Il ressort de ces résultats que les économies émergentes devraient adopter des politiques favorables aux prises de participation, et que, dans le cas de systèmes financiers vulnérables, elles devraient décourager l'endettement privé à l'étranger. Cette option n'est toutefois qu'un pis aller, l'idéal étant plutôt de renforcer le système financier.

## SUMMARY

Are capital inflows associated with faster income growth? There are a large number of empirical studies that identify the most relevant determinants of a country's growth rate. However, this literature has not explored the growth impact of the various types of capital inflows. The present study analyses the effects of the different components of private capital inflows on the growth of 44 developing countries. A dynamic panel with yearly data is estimated during the 1986-97 period. After controlling for the variables traditionally used in growth regressions, the following main conclusions emerge. First, foreign direct investment and portfolio equity flows exhibit a robust positive correlation with growth. Second, portfolio bond flows are not significantly linked to economic growth. Finally, in economies with undercapitalised banking systems, bank-related inflows are negatively correlated with the growth rate. This result holds for both short- and long-term bank-related inflows. These findings provide empirical support for the proposition that emerging economies should encourage equity flows, and in cases of fragile financial systems, they should discourage foreign private debt. However, this policy should be considered second best, the strengthening of the financial system being the first best.

# I. INTRODUCTION

Since the Mexican devaluation of 1994 and the subsequent financial crises in several emerging economies, there have been a growing number of studies aimed at identifying the causes of these crises. Theoretical works and policy-oriented studies increasingly examine the financial system's role when faced with massive foreign capital flows<sup>1</sup>. Rodrik and Velasco (1999) note that: "*There is a growing agreement that excessive build-up of short-term debt was a proximate cause of the recent crises...[however] we have little theoretical and empirical work linking short-term debt, vulnerability and crises*". It can be added that there is no empirical work exploring the link between the different kinds of capital flows and growth.

One possible explanation for the lack of empirical studies is that massive capital flows to developing economies are a relatively new phenomenon which began at the end of the 1980s, while the period analysed in growth empirics typically ends in 1989. The main empirical research on capital flows and growth has pointed towards the effects of foreign direct investment, like Borensztein, De Gregorio and Lee (1998). But there is little evidence concerning portfolio and debt flows. Consequently, an investigation of the correlates between growth and capital flows is of interest, especially in the light of the magnitude of the economic recessions suffered by developing countries after the financial crises. Moreover, assessing the individual growth effects of private capital flows should provide a valuable input for designing the appropriate macroeconomic and institutional approach towards inflows in developing countries.

On theoretical grounds, one the most straightforward benefits of capital market integration is the possibility of separating saving and investment decisions (some examples are Blanchard and Fischer, 1989; Obstfeld and Rogoff, 1994; etc.). In these models, countries can eliminate the savings investment constraint and achieve higher utility levels by borrowing abroad to finance domestic investment. As a consequence capital-poor countries can increase their growth rate by investing more without needing to reduce consumption.

The concept of risk sharing is also one of the pillars on the rationale behind financial integration. In a well-known article, Obstfeld (1994) develops a model in which international financial integration can lead to higher growth rates in a single-good and frictionless world. In this model there is a distinction between two broad types of assets — safe low-yield and risky high-yield assets. Higher growth rates are achievable thanks to risk-sharing possibilities that emerge in a financially integrated world. Dumas and Uppal (1998) extend Obstfeld's model by allowing for segmentation in goods markets. In the calibration of their model, they find that although the gains from financial integration are lower than in the frictionless world they are still considerable.

The literature on diffusion of technology has stressed the role of the "*international knowledge flows*". Grossman and Helpman (1991) underline that countries may increase their growth rate by interacting with foreign countries, thereby acquiring a greater body of knowledge. In a related line of research, Goodfriend and McDermott (1998) emphasise the role of the *familiarity* with the foreign economy in achieving income convergence. Arguably, foreign direct investment may be one of the channels behind the concept of knowledge flows or familiarity with the foreign economy. Borensztein, De Gregorio and

Lee (1998) propose a model in which foreign direct investment spurs growth thanks to a reduction of the cost of introducing new capital goods, and thus speeding up its accumulation rate.

Recent theoretical work has focused on the threats associated with financial integration. McKinnon and Pill (1997) stress that foreign financing may stimulate domestic banks to incur excessive lending if moral hazard problems are present. The consequences of this may be widespread loan default that requires a costly bailout or leads to a disruption of the banking system. In a similar line, Rodrik and Velasco (1999) emphasise the negative effects that short-term flows may have in the economy. In their model, if domestic banks incur excessive short-term debt, they may face liquidity problems and suffer runs. The consequences are costly asset liquidations and hence a reduction in income and welfare. But bank inflows do not represent the only source of threats in financial integration. Razin, Sadka and Yuen (1999) develop a model in which foreign direct investment may give wrong signals about the social rates of return of domestic capital. In some circumstances, the “bad signalling” effect may even lead to a decline of welfare in the domestic economy.

As these examples suggest, the theoretical literature already contains analyses of the effects of different sorts of capital flows. However, empirical studies are more scarce and they have focused mainly on foreign direct investment (see Bende-Nabende *et al.*, 1997; Borensztein *et al.*, 1998; and de Mello, 1999).

This paper attempts to go forward in this field by estimating a dynamic panel for 44 developing countries with annual observations from 1986 to 1997. The next section presents the approach employed for the estimations, as well as the problems that it poses. In Section III, the data used are briefly described. The main results are discussed in Section IV, followed by the conclusions in the last section.

## II. ECONOMETRIC APPROACH

Considering that the construction of a model linking capital flows and economic growth goes beyond the scope of this article, the analysis is built on a purely econometric model, itself based on a simple neo-classical framework. The most basic version of Solow's (1956) model will make possible the introduction of some standard notation and the presentation of the findings in the context of the existing empirical literature. Solow's model establishes that:

$$Y(t) = F( K(t) ; L(t) ) \quad (1a)$$

$$\dot{k} = sf(k) - pk \quad (1b)$$

where  $Y(t)$  is total production at time  $t$ ;  $F(\cdot)$  is a production function, homogenous of degree one;  $K$  is the stock of physical capital;  $L$  is the labour force;  $k$  is capital per capita;  $\dot{k}$  is the derivative of  $k$  with respect to time;  $s$  is a constant saving rate;  $f(k)$  is production per capita; and  $p$  is the population's growth rate<sup>2</sup>. It can be shown that this setting leads to the following per capita production growth rate  $\gamma_t$ ,

$$\gamma_t = -\Phi(k) y(t) + \Phi(k) y^* , \quad (2)$$

where  $\gamma_t \equiv \frac{\dot{y}}{y(t)}$ ; and,  $y(t)$  and  $y^*$  represent, respectively, the natural logarithm of production per capita at date  $t$  and in steady state. The steady state  $y^*$  depends on a number of variables, which include the constant saving rate  $s$  and the population's growth rate  $p$ . The form of the function  $\Phi(\cdot)$  depends on the production function  $F(\cdot)$  and on the parameters of the equation system (1). In the special case when  $F(\cdot)$  is a Cobb-Douglas function,  $\Phi(k)$  is equal to  $p(1 - \theta)$ , where  $\theta$  is capital's share in total production. In that case, (2) is a differential equation with solution,

$$y(t) = e^{-\lambda t} y(0) + (1 - e^{-\lambda t}) y^* \quad (3)$$

where  $\lambda = p(1 - \theta)$ . A useful and widely discussed interpretation given to  $\lambda$  is as a convergence speed parameter. For a given steady state, the higher the parameter  $\lambda$  is the faster the economy will converge towards its steady state level. If  $\lambda$  is 0, there is no convergence and the economy will remain stuck in its initial production level  $y(0)$ , independently of its level. If  $\lambda$  tends to infinity the economy reaches its steady state instantaneously.

In empirical studies, a time-discrete version of equation (3) is estimated. Some authors estimate 25-year average cross-section regressions (Mankiw, Romer and Weil, 1992), while later studies analyse two-decade panel data (Barro and Sala-i-Martin, 1995; Borensztein, De Gregorio and Lee, 1998) or even five-year average panel regressions (Barro and Lee, 1994; Caselli, Esquivel and Lefort, 1996). The core source of information in these studies is Summers and Heston's (1993) data set.



The standard approach in panel data regressions is based on the assumption that the path of the growth rate is consistent with the following process,

$$y_{it} - y_{it-1} = \alpha y_{it-1} + X_{it-1}\beta + v_i + \tau_t + \varepsilon_{it} \quad (4)$$

where  $y_{it}$  is the logarithm of production per capita in country  $i$  during period  $t$ ,  $\alpha$  is a negative parameter reflecting the convergence speed,  $X_{it-1}$  is a row vector of determinants of the steady state level measured at date  $t - 1$  with associated parameter  $\beta$ ,  $v_i$  is a country-specific effect,  $\tau_t$  is a period-specific effect common to all countries, and  $\varepsilon_{it}$  is a residual. The steady state level has been traditionally explained by the investment rate, government consumption, the degree of openness to international trade, measures of domestic distortions in the economy, and political stability.

As Caselli, Esquivel and Lefort (1996) have pointed out, several empirical studies have neglected the consistency problems that arise when this kind of regression is estimated by fixed- or random- effect models. On the one hand, in fixed-effect models the specific effect  $v_i$  may be eliminated by subtracting from each variable its country average ("within" estimation). The inconvenience of this approach is that the within estimator entails a serious consistency problem when the lagged dependent variable is included among the regressors. In fact, by construction, the error term will be correlated with the lagged dependent variable and there is no obvious instrumental variable for getting rid of this simultaneity. On the other hand, in the random effect model the specific effect  $v_i$  and the residual are grouped together and equation (4) is estimated by generalised least squares (GLS). The problem again is the contemporaneous correlation that exists between the lagged dependent variable and the new residual.

The standard methodology for handling equation (4) is the following. First, the time effect  $\tau_t$  is eliminated by subtracting from each variable  $w_{it}$  its average in period  $t$ :

$$w_{it} \equiv w_{it} - \frac{1}{n} \left( \sum_{i=1}^n w_{it} \right)$$

where  $n$  is the total number of countries in the sample. Italicised characters represent variables corrected by their average in period  $t$ . With this correction, equation (4) becomes:

$$y_{it} - y_{it-1} = \alpha y_{it-1} + X_{it-1}\beta + v_i + \varepsilon_{it} \quad (5)$$

Then taking the first difference of equation (5) eliminates the individual effect. Regrouping terms, the result is:

$$\begin{aligned} (y_{it} - y_{it-1}) &= (\alpha + 1)(y_{it-1} - y_{it-2}) + (X_{it-1} - X_{it-2})\beta + \varepsilon_{it} - \varepsilon_{it-1} \quad \text{or,} \\ \gamma_{it} &= (\alpha + 1)\gamma_{it-1} + (X_{it-1} - X_{it-2})\beta + \mu_{it} \end{aligned} \quad (6)$$

where  $\gamma_{it}$  represents the production growth rate in country  $i$  and date  $t$ , measured as  $y_{it} - y_{it-1}$  and  $\mu_{it} \equiv \varepsilon_{it} - \varepsilon_{it-1}$ .<sup>3</sup>

In this last expression, the country effect  $v_i$  has been eliminated. However, by construction, the growth rate  $\gamma_{it-1}$  is correlated with the new residual  $\mu_{it}$ . Still, as opposed to the case of within and GLS estimation, consistent estimators may be obtained by using the lagged values of the dependent variable  $y_{it-j}$  ( $j \geq 2$ ) as instruments. In fact, these lagged values are correlated with  $\gamma_{it-1}$  (at least in the case of  $j = 2$ ) and are not *necessarily* correlated with the residual  $\mu_{it}$ , which makes them suitable as instruments. Whether these instruments

are actually correlated or not with  $\mu_{it}$ , will be tested later, but the lagged values of the dependent variable are *by construction* correlated with the residual in within and GLS estimations.

A second potential source of inconsistency is the possibility that some of (or all) the regressors in  $X_{it-1}$  be correlated with  $\mu_{it}$ . Imagine that foreign investors make their investment decisions as a function of, among other variables, expected future income growth. If their expectations are correlated with actual growth, then some of the variables included in  $X_{it-1}$  (the ones measuring capital inflows), would be correlated with the error term. In this case, the estimates would be inconsistent as well.

The simultaneity problem of  $\gamma_{it-1}$  with  $\mu_{it}$  as well as the potential contemporaneous correlation of  $X_{it-1}$  with  $\mu_{it}$  is solved using the generalised method of moments (GMM) estimation. See the Appendix for further details on this approach and the selection of instruments. Note that equation (6) could have been set directly without having recourse to the neo-classical model. After all, it is simply an autoregressive representation of the growth rate. However, this way of proceeding provides a basis to justify the estimation of equation (6) and offers an insight on the dynamic properties of the growth rate.

As mentioned, empirical panel data studies on growth are generally carried out using periods of around 30 years with five-year average observations. However, considering the lack of comprehensive information on private capital inflows and that these have reached a significant magnitude only since the end of the 1980s, the period of study in the present Paper goes from 1986 to 1997. This means that the analysis is based on ten years of observations, given that the first two years are lost for the reasons explained in the appendix. Because of the short length of the sample, annual data are used instead of five-year data as in traditional panel data growth studies. Working with such a short time span and high frequency data, in the scope of growth regression, raises the problem of cyclical disturbances. Indeed, longer-range studies assume that business cycle effects are averaged out in each five-year observation. In a sample of yearly data, that assumption cannot be made.

In equation (4), the presence of a cyclical component  $\tau_t$  common to all countries in period  $t$  has been taken into account explicitly, but it is still possible that a cyclical component specific to each country is present in the series. If part of the cyclical components is caused by foreign shocks, as is often the case in small economies, the terms of trade and capital inflows may capture them. If this is not the case, any remaining cyclical effect specific to each country that is not captured by the regressors, will be contained in the residuals. If this effect is correlated with the regressors, there will be a source of inconsistency in the estimates. In order to cope with this potential problem, estimations are carried out by GMM. In a second stage, it is tested whether the estimates are consistent or not.

### III. DATA ISSUES

The countries included in the sample correspond to all non-OECD countries at the beginning of the period under analysis (1986). Following this criterion, the number of countries with available information during the full period is 44. These countries are listed in Table 1<sup>4</sup>. Roughly half of them belong to the lower middle-income group according to the 1997 World Bank's classification. A third corresponds to the upper middle-income group. Only one country belongs to the high-income group and the remaining countries in the sample are classified as low-income. Since there is a potential selection bias, the results are applicable only to this particular sample of countries, and it is not attempted to obtain any conclusions for countries with higher income levels.

Table 1. **Countries Selected**

Income Level	Country
High income (1 country)	Republic of Korea.
Upper middle income (15 countries)	Argentina, Brazil, Chile, Colombia, Gabon, Grenada, Hungary, Malaysia, Mauritius, Mexico, Poland, Trinidad and Tobago, Turkey, Uruguay, Venezuela.
Lower middle income (20 countries)	Belize, China, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Guatemala, Indonesia, Jamaica, Jordan, Panama, Paraguay, Peru, Philippines, Sri Lanka, Swaziland, Syrian Arab Republic, Thailand, Tunisia.
Low income (8 countries)	Bangladesh, Ghana, Honduras, India, Kenya, Nepal, Nigeria, Pakistan.

The larger part of the data set is built from the 1999 *World Development Indicators* (WDI) and *Global Development Finance* (GDF), provided by the World Bank. Some variables, described below, are built from the 1998 *International Banking Statistics* of the Bank for International Settlements (BIS), and the *International Financial Statistics* from the IMF. The production series used is GNP per capita measured at purchasing power parity (PPP) in terms of 1997 dollars<sup>5</sup>. As opposed to the bulk of previous empirical research, which employ GDP series, here the variable considered is GNP because conceptually this is the correct measure of income for the citizens of a given country.

The categories of capital flows introduced are foreign direct investment (FDI), portfolio equity flows (PEF), portfolio bond flows (PBF), bank credits (BCRED) and trade-related credits (TCRED). This is a comprehensive classification of private capital inflows — non-guaranteed and publicly guaranteed — compiled by the World Bank<sup>6</sup>. However, debt figures, i.e. portfolio bond flows and bank and trade-related credits, correspond to long-term debt only. Long-term debt refers to debt with an *original* or *extended* maturity of more than one year.

The World Bank points out that short-term debt — with an original maturity up to one year — is difficult to monitor and it is available only for a small number of developing countries. Where countries do not report information on short-term debt, the World Bank

has recourse to the International Banking Statistics of the BIS. Considering this, this paper uses BIS's series on short-term bank lending. The BIS provides semi-annual series on its reporting countries' claims vis-à-vis their borrowing countries, classified according to the residual maturity. This makes it possible to build short-term (STBIS) and long-term (LTBIS) debt inflow figures from a single source. These series correspond to changes in end-of-year stocks. Claims with maturity of up to one year are included in STBIS and those of over one year, in LTBIS.

The most important feature of BIS's series is that they are built mainly from creditor sources, while the World Bank's data are based on debtor sources. Corsetti, Pesenti and Roubini (1998, pp. 30-35) show that there are considerable differences between the information published by the World Bank and the BIS on Asian countries' debt stocks during the 1990s, especially for short-term debt. However, part of these differences may be due to the fact that the World Bank's series are built on an original maturity basis and the BIS's data on a residual one. In any case, with BIS's series the information that is not considered by official country reports, especially concerning private debt, may be measured in a more reliable way. Using the BIS's information presents a shortcoming as it refers only to claims owned by BIS's reporting banks. Thus it does not include claims owed to non-bank foreign creditors.

All financial inflow variables are measured as a ratio to GNP. They are net inflows, i.e. net equity acquisition plus reinvested earnings in the case of FDI and PEF; disbursements minus principal repayments in the case of PBF, BCRED and TCRED; and variations in claim stocks in the case of STBIS and LTBIS.

The other variables included are measures of physical capital accumulation, openness to international trade, government consumption and the variation of the terms of trade. These correspond roughly to the main variables used in the empirics of growth<sup>7</sup>.

Some observations about other variables traditionally used in growth regressions are in order. In their empirical research, Barro and Sala-i-Martin (1995) have proposed a certain number of *state* variables, which determine the initial conditions of the economy, and *control* variables, those which determine the steady state. The state variables are the initial level of physical and human capital. The authors argue that physical capital may be replaced by the level of GDP, since there are no reliable series on physical capital stocks. For human capital stocks, they use years of schooling at various levels, as constructed by Barro and Lee (1993). In the present study, it is assumed that the information on human and physical capital stocks is already contained in the lagged level of GNP, as is implicit in the neo-classical model.

Concerning *control* variables, in addition to some of the variables already included, some series that have been used are measures of human capital accumulation, financial development, political instability and measures of market distortions. In this Paper, it is assumed that the variation of these variables is small during the (relatively short) time span. If this assumption is true, the effects of these variables will not be revealed in the time dimension, but in the cross-country dimension. Then these effects will be embodied in the country-specific effect, which disappears in expression (6).

The data used are summarised in Table 2. GNP figures show that the range of income per capita in the sample is rather large, going from \$750 a year to over \$13 000. Obviously, this diversity reflects not only differences across countries, but growth over time as well. Although the level of the GNP is not included among the regressors, these numbers shed some light on the heterogeneity of the observations included in the sample. The average

growth rate is 2.1 per cent, which is 0.3 points higher than in high income countries during the same period. The variation of capital inflow variables is relatively small compared to the standard deviation of GNP growth. However, bearing in mind that these figures represent a mix of variation across countries and over time, no conclusion about the volatility of capital inflows can be drawn from these statistics. For example, the low portfolio flows received by many countries in the sample may explain the small standard deviation. Actually some countries did not have any portfolio inflows at all. On the other hand, the most highly variable inflows correspond to short- and long-term debt, measured by the BIS. Finally, the steady decline in the terms of trade of 7 per cent a year should be noted.

Table 2. **Data Statistics**

Variable	Mean	Max	Min	Standard deviation
Gross national product (per capita)	4604	13430	750	2586
GNP change	0.021	0.207	-0.272	0.057
Gross national saving	0.219	0.448	0.036	0.078
Gross domestic investment	0.245	0.457	0.065	0.072
Current account	-0.026	0.195	-0.221	0.053
Exports + imports	0.796	2.503	0.166	0.470
Foreign direct investment	0.019	0.114	-0.029	0.023
Portfolio equity flows	0.003	0.105	-0.004	0.009
Portfolio bond flows	0.003	0.088	-0.030	0.010
Bank credits	0.001	0.057	-0.052	0.013
Trade credits	0.000	0.089	-0.021	0.008
Short-term flows (World Bank)	0.006	0.219	-0.234	0.028
Short-term flows (BIS)	0.001	0.257	-0.792	0.051
Long-term flows (BIS)	0.001	0.324	-0.243	0.042
Government consumption	0.127	0.284	0.030	0.048
Terms of trade change	-0.070	0.605	-0.965	0.242
Bank capitalisation	0.188	0.972	0.000	0.119

*Note:* GNP is measured at PPP in terms of 1997 dollars. Change in the GNP and terms of trade is the yearly variation of their logarithms. Bank capitalisation is the ratio of bank reserves to total assets (see main text for further details). All the remaining variables are ratios to GNP. The statistics for the GNP and changes in the GNP correspond to the 1987-97 period. For the other variables, the statistics correspond to the 1987-96 period.

## IV. EMPIRICAL RESULTS

### Capital Flows and Growth

First, a standard specification is used. The variables included are one-year lagged values of the growth rate, investment rate, government consumption, change in the logarithm of the terms of trade and the degree of openness to international trade<sup>8</sup>. The results are reported in regression (1) of Table 3. The investment rate displays a non-significant and negative sign, which is in direct contradiction with the theory and existing empirical studies.

Table 3. **Dependent Variable:  $\log(\text{GNP}_t) - \log(\text{GNP}_{t-1})$**

Variable <sup>a</sup>	Regression (Standard errors in parenthesis)		
	(1)	(2)	(3)
log(GNP)	0.663*** (0.045)	0.662*** (0.034)	0.665*** (0.033)
Investment (I)	-0.057 (0.056)		
National saving (S)		-0.245*** (0.039)	0.236** (0.105)
(National saving) <sup>2</sup>			-1.038*** (0.205)
Current account (CA)		0.049 (0.037)	0.027 (0.033)
(Current account) <sup>2</sup>			0.040 (0.205)
(Exports + imports)	0.040*** (0.015)	0.043*** (0.011)	0.026** (0.011)
Government consumption (GOV)	-0.091 (0.092)	-0.228*** (0.053)	-0.186*** (0.049)
Log (terms of trade)	0.064*** (0.017)	0.090*** (0.014)	0.101*** (0.014)
Efficient-saving threshold	—	—	0.227
Convergence parameter	0.411	0.412	0.408
Explained variance <sup>b</sup>	0.470	0.453	0.467
Sargan test (prob. value) <sup>c</sup>	0.447	0.683	0.859
Arellano-Bond test (prob. value) <sup>d</sup>	0.611	0.488	0.621

*Notes:*

- a) All the variables are taken in differences. The regressors are lagged one period. In regression (1) the instruments are log (GNP), I, GOV and log (terms of trade), all in levels. In regression (2) and (3), I is replaced by S and CA. There are 44 countries in the sample and the period studied is 1986 to 1997 (i.e. there are 440 usable observations).
  - b) The explained variance is the ratio of the fitted value's variance to the dependent variable's variance.
  - c) The Sargan statistic tests the null hypothesis of no correlation between the instruments and the residual.
  - d) The Arellano-Bond statistic tests the null hypothesis that the residuals are not second-order correlated.
- \*\*, \*\*\* The coefficient is significant at a 5% and 1% level, respectively.

A number of hypotheses may explain this unexpected result. It is possible that growth regressions based on yearly data are affected by the presence of adjustment costs for investment. If adjustment costs were important, there would be a specification error in the regressions. A second reason that may explain a negative coefficient for domestic investment is the existence of over-investment. Corsetti, Pesenti and Roubini (1998) present several measures of investment profitability in Asian countries during the 1990s. They show that the profitability rates of domestic investment have been very low in these countries. The authors suggest that “*several forms of investment in the Asian economies may have simply been a disguised form of consumption*”. In general, one of the roots of over-investment is moral hazard. If financial intermediaries are poorly supervised, some investment projects may find the financing that they would not get in a well-supervised financial system. In this case, the increased investment will not necessarily lead to faster income growth. As a matter of fact, many countries in the sample have carried out major institutional reforms (mainly in Asia and Latin America), but the reforms have not always led to a better economic performance, at least in the short run. For example, Kaminsky and Reinhart (1999) report that in three-quarters of the cases they studied, financial liberalisation precedes a banking crisis within less than five years. This evidence supports the hypothesis that economic reforms that have encouraged domestic investment have not necessarily led to faster economic growth.

In regression (2), the investment rate is split into the national saving rate and the current account so that the effects of national saving and foreign saving can be distinguished<sup>9</sup>. It is found that the negative sign associated with national saving persists. In addition, the coefficient associated with the current account is not significant.

It has already been mentioned that both adjustment costs and fragile financial systems may be the source of decreasing returns on saving. Under these circumstances, wastefulness would grow with deficiencies in the financial system and increases in funds transferred from savers. A way to model this *excessive saving* hypothesis would use a non-linear relationship between the saving rate and growth. Non-linearity indicates that beyond a certain threshold, additional savings cannot be productively absorbed by the domestic economy. One advantage of considering a non-linear link is that the threshold, if it exists, is determined endogenously by the data and not in an *ad hoc* way. This tentative assumption represents a departure from traditional growth regressions.

The threshold hypothesis is tested in regression (3), Table 3. There, a squared term for the saving rate is introduced. It can be seen that, while the saving rate recovers its positive sign, the squared term has a negative one. Both coefficients are highly significant; thus the result is consistent with the non-linearity hypothesis. Moreover, taking both coefficients together, the estimates suggest that a national saving rate in emerging countries above roughly 23 per cent of the GNP has a total negative impact on growth. This is a sensible figure which strengthens the excessive saving hypothesis. However, the marginal return to saving is positive when the saving rate is lower than 11.4 per cent, which seems too low a level to be plausible. Conversely, the inclusion of a squared term for the current account does not improve the ability of foreign saving to explain growth.

The other results in the regression agree with theory and existing empirical evidence. First, the lagged GNP has a coefficient slightly less than 0.67, which implies a convergence parameter around 40 per cent<sup>10</sup>. This value is considerably higher than the results of Caselli, Esquivel and Lefort (1996) who, using a different data set, found a convergence coefficient

around 10 per cent. However, a comparison is not possible since squared terms for savings have been introduced and thus the neo-classical framework has been implicitly abandoned. Consequently, this parameter is used only as a reference value for the following results.

Second, the degree of openness displays a significant and positive link with growth. This result is in line with the findings of Frankel and Romer (1999), who find a positive correlation between trade openness and growth. The point estimate suggests that a 10 percentage point increase in the ratio of exports plus imports to GNP is associated with a 0.26 per cent growth of the GNP in the short run and a 0.78 per cent in the steady state per capita income<sup>11</sup>.

Third, government consumption presents a negative sign, which is in agreement with the hypothesis of Barro and Sala-i-Martin (1995) about the distortions introduced in the economy by the government intervention. The point estimate indicates that a rise of one percentage point of government consumption in the total GNP is associated with a 0.56 per cent fall in the steady state income level.

Finally, the terms of trade present a strong positive sign, significant at a one per cent level. The magnitude of its coefficient shows that a 10 per cent increase of the terms of trade has a short run positive impact of around 1 per cent in the GNP per capita.

Overall, the main changes after the inclusion of the squared terms concern the coefficient and the significance of the national saving rate. Comparing regressions (2) and (3), it can be seen that the other coefficients remain roughly the same in both magnitude and significance.

For evaluating the performance of the estimation three different statistics are computed. The first one is the explained variance, i.e. the ratio of the fitted values' variance to the dependent variable's variance. In ordinary least square estimation this is equivalent to the  $R^2$  statistic. However, in GMM estimation this equivalence does not hold necessarily and the  $R^2$  may even be negative. Although the explained variance is not bound to have a value less than one, it may be used as benchmark for the following regressions. The two other statistics evaluate the validity of the instruments used in the estimates. The Sargan, or overidentifying restriction, statistic tests the hypothesis that the instruments are not correlated with the residuals. This hypothesis is essential for the consistency of the estimators. See Newey and McFadden (1994, pp. 2231) for further details on this test. A complementary test has been proposed by Arellano and Bond (1991), which they call the m2 test. The Arellano-Bond, or m2, test examines the hypothesis that the residuals from equation (6) are not second-order correlated. It can be seen that if the residuals  $\varepsilon_{it}$  are first-order correlated, then  $y_{it-2}$  would be correlated with  $\mu_{it}$  and it could not be used as an instrument. The same is true with any regressor from  $X_{it-1}$  that is correlated with  $\varepsilon_{it}$ . One way to check that  $\varepsilon_{it}$  is not first-order correlated is to verify that  $\mu_{it}$  is not second-order correlated. Both the Sargan and the Arellano-Bond tests reject the hypothesis that the residuals are correlated with the instruments and that they are second-order correlated.

In regression (4), Table 4, the results after substituting capital inflows for the current account are presented. In a first step, net inflows are decomposed into foreign direct investment, portfolio equity flows, long-term portfolio bond flows, long-term bank credits, long-term trade-related credits and short-term debt inflows. The most remarkable result is the different response of growth depending on the type of inflow. While foreign direct investment and portfolio equity flows present a positive and significant correlation with growth, debt inflows display a negative one. For example, a one percentage point increase in the FDI to GNP ratio is accompanied by a rise in income of 0.16 per cent in the short run and 0.6 per cent in the steady state level<sup>12</sup>. An interesting finding is that the estimated effect of FDI on growth is higher than the average yield of national saving. Moreover,



portfolio equity flows exhibit a surprisingly high coefficient. The estimates suggest that a 1 point increase in the PEF to GNP ratio leads to a 0.68 per cent economic growth in the short run. It is possible that this large coefficient reflects the productive capacities of fast growing industries in developing countries. In several cases, these industries may find it hard or too expensive to obtain in local markets the financing required for developing their new projects. If local firms are allowed to use foreign equity, portfolio equity flows may ease the development of these and so have an important role in stimulating growth. A different explanation concerns market liquidity. It has been argued (Levine, 1997), that higher stock market liquidity may stimulate the acquisition of information, hence resource allocation and economic growth. Extending the argument, portfolio equity flows may spur growth indirectly through its impact on local stock market liquidity.

Table 4. **Dependent Variable:  $\log(\text{GNP}_t) - \log(\text{GNP}_{t-1})$**

Variable <sup>a</sup>	Regression (Standard errors in parentheses)		
	(4)	(5)	(6)
Log(GNP)	0.725*** (0.017)	0.724*** (0.016)	0.658*** (0.020)
National saving (S)	0.182*** (0.034)	0.184*** (0.031)	0.148** (0.056)
(National saving) <sup>2</sup>	-0.812*** (0.065)	-0.810*** (0.062)	-0.746*** (0.123)
Foreign direct investment (FDI)	0.164*** (0.020)	0.169*** (0.018)	0.164*** (0.034)
Portfolio equity flows (PEF)	0.679*** (0.054)	0.701*** (0.047)	0.603*** (0.061)
Portfolio bond flows (PBF)	-0.065 (0.063)		
Bank credits (BCRED)	-0.179*** (0.045)	-0.159*** (0.040)	-0.207*** (0.064)
Trade-related credits (TCRED)	-0.380*** (0.075)	-0.386*** (0.073)	-0.463*** (0.139)
Short-term debt inflows, BIS (STBIS)	-0.002 (0.007)	-0.002 (0.007)	
(Exports + imports)	0.036*** (0.004)	0.036*** (0.003)	0.037*** (0.006)
Government consumption (GOV)	-0.163*** (0.022)	-0.171*** (0.021)	-0.192*** (0.038)
Log (terms of trade)	0.051*** (0.006)	0.053*** (0.006)	0.081*** (0.009)
Efficient-saving threshold	0.225	0.227	0.198
Convergence parameter	0.322	0.323	0.419
Explained variance	0.557	0.559	0.471
Sargan Test (prob. value)	0.999	0.998	0.996
Arellano-Bond test (prob. value)	0.510	0.520	0.488

a) All the variables are taken in differences. The regressors are lagged one period. In regressions (4) and (5) the instruments are  $\log(\text{GNP})$ , S, FDI, BCRED, TCRED, STBIS, GOV and  $\log(\text{terms of trade})$ , all in levels. In regression (6) STBIS is eliminated from the instrument list. See notes to Table 3 and text for further explanations of this table.

\*\* , \*\*\* The coefficient is significant at a 5% and 1% level, respectively.

On the other hand, long-term bank and trade-related credits display negative and significant coefficients, while the other inflow variables — portfolio bonds and short-term debt — do not show any significant correlation with growth. The interpretation of these findings is difficult for borrowing-constrained economies, which is the case of most of the countries in the sample. Indeed, a poor country facing borrowing constraints would have problems in financing domestic investment, and hence its growth prospects would be hindered. This implies that higher foreign credits should be correlated with faster growth. Nevertheless, the previous finding of an efficient saving threshold suggests that borrowing constraints are not necessarily binding for all developing economies in the sense that in some circumstances, for instance, deficient financial systems, additional funds may be not used productively. From this perspective, the finding of negative or non-significant coefficients associated to foreign debt is consistent with the excessive saving hypothesis.

The coefficients of the other variables in the regression maintain their signs and suffer little variation. In particular, the convergence parameter drops to 32 per cent and the productive saving threshold holds at around 22 per cent. Only the magnitude of the coefficient of the terms of trade declines sharply to half its previous level, but it is still highly significant. In regressions (5) and (6), PBF and STBIS are dropped sequentially. Eliminating these variables does not have important effects on the estimates. On the whole, it is found that the estimates are robust to the substitution of capital inflow variables for the current account.

These findings are consistent with the view that categorising capital inflows matters. Indeed, previous empirical research has focused on whether the labelling of capital flows provides any information about their time-series properties. Some authors (Claessens, Dooley and Warner, 1995) conclude that the distinction between “short-term” and “long-term” or even foreign direct investment inflows is meaningless. On the other side, the evidence found by Sarno and Taylor (1999) reveals that foreign direct investment has permanent components only — i.e. FDI is not reversible — while portfolio equity flows, bond flows and official flows consist mainly of temporary components.

Regressions (4) to (6) show that some components of foreign saving are distinguishably correlated with growth, while other components seem to be neutral or even have a negative effect. This information is lost when the different channels by which foreign savings may flow towards developing economies are not taken into account. In fact, as it is shown in regression (2), when these mechanisms are aggregated in a single variable, the current account, foreign savings do not exhibit a significant impact on growth. The distinction between different sorts of capital inflows provides different and significant links with income growth.

## **Weak Financial Systems and Capital Flows**

Although a number of studies analyse the origins of financial crises<sup>13</sup>, few explore empirically the connection between financial strength and growth. Rodrik and Velasco (1999) report that the ratio of short-term debt to reserves is a robust predictor of financial crises, but they do not study directly the relationship with growth. Similarly, the empirical analysis of Kaminsky and Reinhart (1999) suggests that capital flows are often the origin of booms in economic activity, which are later followed by financial crises. But again, the full empirical link between capital flows, financial soundness and growth is missing.

One major difficulty in assessing the role of financial health empirically is defining an appropriate measure of it. This Paper proposes using the ratio of capital to claims in the banking system. Since the accord of the Basel Committee on Banking Supervision (1988) and its revisions suggested in 1999 are based on capital ratios, it seems reasonable to choose bank capitalisation as a measure of financial health. Nonetheless, it is worth keeping in mind two evident caveats related to this measure. First, banks do not necessarily hold the minimum capital required by national authorities and they actually often hold more. Thus in practice, a country with loose financial regulation may exhibit higher capitalisation ratios. A second problem associated with this measure is that it does not distinguish between the different risks of each bank claim. In order to reflect varying degrees of risk, arbitrary weights are given to broad groups of claims. The weights assigned here are zero per cent for reserves and claims on government or government-related entities; 50 per cent for foreign assets; and 100 per cent for private sector claims. These weights are inspired by the Basle accords on capital adequacy. However it is a weak measure of banks' health, given the little information on the composition of bank claims. Proceeding in this way only broad groups of debtors are distinguished. Nevertheless, a major advantage of this method is that it provides a measure of financial health for a wide range of countries throughout the period studied. The series is built from the IMF's *International Financial Statistics*.

The consequences of massive long- and short-term debt inflows in the presence of a fragile financial system are investigated by including the product of bank capitalisation with each bank-related credit inflow. The bank-related variables are BCRED, TCRED and STBIS. This is done in regression (7) and (8) of Table 5. Taken alone, each bank-related inflow again exhibits a statistically significant and negative coefficient. However, when the interaction terms are considered, bank-related inflows may be positively correlated with growth. This occurs if the capitalisation ratio reaches a minimum level. The implicit level varies according to the inflow item. It is 29 per cent for long-term bank credits, 38 per cent for trade-related credits and 13 per cent for short-term lending. Whereas the minimum level associated with short-term inflows looks reasonable and is not far from BIS's standards, the minimum capitalisation ratios inferred from the coefficients of bank and trade-related credits is quite high. This is somewhat intriguing considering that short-term inflows are presumed to be more volatile than long-term ones and so should require higher capitalisation ratios.

Concerning the national saving rate, the non-linearity associated with it is still a valid representation of the growth path, with an efficient-saving threshold raising to about 25 per cent of the GNP. It is worth noting that the introduction of bank capitalisation induces a slight increase in the efficient saving threshold. Moreover, given that only 29 per cent of the observations in the sample exhibit a saving rate superior to this level, correcting for bank capitalisation ensures that the estimated yield to total national saving is positive in 71 per cent of the observations.

The coefficient of foreign direct investment slightly decreases to 12 per cent but it is still highly significant. This figure indicates that the yield of foreign direct investment is somewhere between the maximum and the minimum return to national saving. Portfolio equity flows again have a very large coefficient. Finally, there is little variation in the other variables in the regression. Whereas trade openness and the terms of trade are still positively linked to economic expansion, government consumption has a negative coefficient.

Table 5. **Dependent Variable:  $\log(\text{GNP}_t) - \log(\text{GNP}_{t-1})$**

Variable <sup>a</sup>	Regression (Standard errors in parenthesis)			
	(7)	(8)	(9)	(10)
Log(GNP)	0.687*** (0.017)	0.686*** (0.016)	0.662*** (0.019)	0.665*** (0.019)
National saving rate (S)	0.215*** (0.037)	0.220*** (0.037)	0.145** (0.056)	0.143** (0.055)
(National saving rate) <sup>2</sup>	-0.872*** (0.072)	-0.880*** (0.071)	-0.841*** (0.109)	-0.833*** (0.106)
Foreign direct investment (FDI)	0.122*** (0.026)	0.119*** (0.025)	0.093*** (0.028)	0.102*** (0.026)
Portfolio equity flows (PEF)	0.601*** (0.036)	0.602*** (0.033)	0.474*** (0.075)	0.470*** (0.073)
Portfolio bond flows (PBF)	-0.057 (0.064)		-0.038 (0.081)	
Bank credits (BCRED)	-0.505*** (0.098)	-0.504*** (0.089)		
Trade-related credits (TCRED)	-0.605*** (0.172)	-0.638*** (0.183)		
Long-term debt inflows, BIS (LTBIS)			-0.148*** (0.038)	-0.146*** (0.037)
Short-term debt inflows, BIS (STBIS)	-0.073** (0.029)	-0.075** (0.028)	-0.129*** (0.038)	-0.132*** (0.037)
BCRED × bank capitalisation	1.720*** (0.455)	1.823*** (0.404)		
TCRED × bank capitalisation	1.606* (0.952)	1.662* (0.972)		
LTBIS × bank capitalisation			0.712*** (0.248)	0.700*** (0.245)
STBIS × bank capitalisation	0.564*** (0.214)	0.585*** (0.206)	0.935*** (0.304)	0.944*** (0.294)
(Exports + imports)	0.037*** (0.004)	0.037*** (0.004)	0.052*** (0.007)	0.050*** (0.007)
Government consumption (GOV)	-0.193** (0.027)	-0.194*** (0.027)	-0.205*** (0.040)	-0.204*** (0.039)
Log (terms of trade)	0.056*** (0.005)	0.057*** (0.005)	0.075*** (0.009)	0.074*** (0.009)
Efficient-saving threshold	0.247	0.250	0.173	0.172
Convergence parameter	0.375	0.377	0.412	0.408
Explained variance	0.514	0.516	0.486	0.491
Sargan test (prob. value)	1.000	1.000	0.999	0.998
Arellano-Bond test (prob. value)	0.600	0.609	0.651	0.656

a) All the variables are taken in differences. The regressors are lagged one period. The instruments are log (GNP), S, FDI, BCRED, TCRED, STBIS, LTBIS, GOV and log (terms of trade), all in levels. See notes to Table 3 and text for further explanations on this table.

\*, \*\*, \*\*\* The coefficient is significant at a 10%, 5% and 1% level, respectively.

A final verification of the results is carried out in the last two regressions of Table 5. The long-term bank-related series used in regressions (4) to (8), i.e. BCRED and TRECD, were built by the World Bank. As discussed earlier, these series are quite different from long-term series provided by the BIS (LTBIS). For instance, the maximum values for BCRED and TCRED are 5.7 per cent and 8.9 per cent of GNP respectively, while that for LTBIS is 32.4 per cent (Table 2). A similar observation may be done for minimum values. In regressions (9) and (10), BCRED and TCRED are replaced by LTBIS. It is observed that

the previous main qualitative results hold. Nevertheless, there are some differences in the magnitude of the coefficients associated with foreign lending. The coefficient of long-term credits falls sharply, but it is still highly significant. Interestingly, the coefficient of STBIS rises to the level of LTBIS. These estimates suggest that, holding everything constant, increased bank inflows representing 5 per cent of the GNP are followed by a 0.7 per cent decline in the income level, if banks are not capitalised. This exercise might seem meaningless because it is unlikely that an economy with an undercapitalised banking system would receive any private credit, but it gives an idea of the consequences associated with debt inflows in the presence of poorly capitalised domestic banks. Finally, the minimum capitalisation ratio needed so that long-term bank inflows have a positive effect on growth falls to 21 per cent, and that for short-term is now 14 per cent.

In summary, these findings suggest that bank-related credits may have negative effects on growth if the domestic banking system is poorly capitalised. The corollary is that if banks are sufficiently capitalised foreign bank's lending can promote growth. These findings are important since they provide an empirical basis for a strong supervisory power with the ability to enforce minimum capital standards.

## V. FINAL REMARKS

This paper has explored the income growth determinants of developing countries during the 1986-97 period. This choice permits an up-to-date revision of the empirical results of growth literature. Moreover, in examining this period, the role played by private capital inflows can be investigated. The estimates show first that lagged foreign direct investment and portfolio equity flows exhibit a positive, significant and robust correlation with income growth in developing countries. This link is quite stable as it holds for the different specifications that have been estimated. Secondly, short- and long-term bank-related inflows show significant negative correlation with growth. However this negative link holds only when domestic banks have low capitalisation ratios. When bank capitalisation is large enough bank related inflows may be growth enhancing. This finding holds regardless whether World Bank or BIS series on long-term debt are used. In addition, this paper identifies a threshold beyond which national saving is unproductive. This result is consistent with the hypothesis of limited capacity of developing economies to transfer resources efficiently from savers to borrowers. Different reasons may explain this inability: moral hazard, investment in projects motivated by political reasons (not necessarily socially productive), distorted prices, etc.

Finally, the main results concerning the variables traditionally used in previous studies are verified. Namely, poorer countries grow faster, conditional to their steady state level, which is consistent with the well-known conditional convergence hypothesis.

The evidence reported in this paper endorses policies encouraging foreign equity investment. In fact, based on their strong growth-enhancing properties, equity related inflows represent the most suitable component of foreign investment. The sources of these benefits may come directly through the contribution of equity investment to the process of domestic capital accumulation or indirectly through technology diffusion and increased market liquidity. Moreover, as found in previous research, FDI presents little volatility, and so it does not constitute a threat to macroeconomic stability.

On the other hand, emerging economies should count with capitalised financial institutions as a precondition to fully benefit from financial integration. Indeed, high-capitalised banks are likely to make efficient resource allocation, from a private and social point of view. Thus, with healthy financial institutions developing countries can benefit from foreign lending to stimulate domestic investment. However, if domestic financial institutions are inadequately capitalised, foreign lending may stimulate resource misallocation. In this case, a second-best policy would be the establishment of capital controls on foreign lending. However, given their limited efficacy (see De Gregorio, Edwards and Valdés, 2000 and Valdés-Prieto and Soto, 1998), and the possibility of diverting indefinitely the economy from its first-best option, capital controls should be considered transitorily and only in a scenario of poorly capitalised banks.

Transparency standards are helpful as well. Indeed, foreign investors may be more willing to invest in those countries where they have better information about the fundamentals of the economy. On the other hand, because of default risk, foreign capital is less likely to flow into economies where foreign investors know that domestic banks are undercapitalised. Thus, transparency may act as an automatic mechanism to reduce the readiness of damaging flows to pour into these economies.

## APPENDIX. THE GMM APPROACH AND THE CHOICE OF INSTRUMENTS

The generalised method of moments (GMM) approach uses the hypothesis that the error term and a set of variables (the instruments) are not correlated<sup>14</sup>. Based on equation (6) this hypothesis corresponds to the following condition,

$$E(Z_{it}\mu_{it})=0 \quad (\text{A.1})$$

where  $\mu_{it} = \gamma_{it} - (\alpha + 1)\gamma_{it-1} - (X_{it-1} - X_{it-2})\beta$  and  $Z_{it}$  is a vector of instruments measured at time  $t$ . One way to exploit this condition and obtain consistent estimates is to choose values for  $\alpha$  and  $\beta$  that minimise the function  $Q(\alpha, \beta)$  defined as:

$$Q(\alpha, \beta) = \left( \frac{1}{n} \sum_1^n Z_i' \mu_i \right) \times W \times \left( \frac{1}{n} \sum_1^n Z_i' \mu_i \right) \quad (\text{A.2})$$

where  $Z_i' = [Z_{i1} \ Z_{i2} \ \dots \ Z_{iT}]$ ,  $\mu_i = (\mu_{i1} \ \mu_{i2} \ \dots \ \mu_{iT})'$  and  $W$  is a positive semi-definite matrix. Thus, the GMM estimation can be described as a minimisation of a weighted average of the sample moments  $Z_i' \mu_i$ . It is clear from the definition of  $Q(\alpha, \beta)$  that the parameter estimates will vary according to the choice of the weighting matrix  $W$  and the instruments  $Z_i$ . For instance, when  $W$  is the identity matrix and  $Z_i$  is formed by the regressors, the GMM estimation corresponds to ordinary least squares. The optimal matrix  $W$  yielding efficient estimates is

$$W = \left( \sum_{i=1}^n Z_i' \hat{\mu}_i \hat{\mu}_i' Z_i \right)^{-1}$$

where  $\hat{\mu}_i$  are a first step estimation of the residuals.

In the discussion following equation (6), it has been seen that  $\gamma_{it-1} \equiv y_{it-1} - y_{it-2}$  is correlated with  $\mu_{it} \equiv \varepsilon_{it} - \varepsilon_{it-1}$  by construction. In addition  $X_{it-1}$  is potentially correlated with  $\mu_{it}$ . In order to obtain consistent estimates of the parameters in (6) a set of instruments correlated with  $\gamma_{it-1}$  and  $(X_{it-1} - X_{it-2})$ , and not correlated with  $\mu_{it}$  is needed. Natural candidates are  $y_{i1} \dots y_{it-2}$  and  $X_{i1} \dots X_{it-2}$ . Arellano and Bond (1991) -AB- suggest using all lagged values of each regressor as a different instrument. This suggestion leads to the following matrix of instruments  $Z_i$ :

$$Z_i = \begin{bmatrix} [y_{i1} \ X_{i1}] & & & & \mathbf{0} \\ & [y_{i1} \ y_{i2} \ X_{i1} \ X_{i2}] & & & \\ & & \ddots & & \\ \mathbf{0} & & & [y_{i1} \dots y_{iT-2} \ X_{i1} \dots X_{iT-2}] & \end{bmatrix} \quad (\text{A.3})$$





## NOTES

1. Some examples of theoretical works are McKinnon and Pill (1997) and Rodrik and Velasco (1999). For a policy-oriented discussion, see Fischer (1998), Reisen (1999), International Monetary Fund (1999) or World Bank (1997).
2. In an extended version of Solow's model, the parameter  $p$  is interpreted as the sum of the rates of population growth, depreciation and labour-enhancing technological progress.
3. In the special case of a Cobb-Douglas production function, it can be shown that  $(\alpha + 1) \equiv e^{-\lambda}$ , where  $\lambda$  is the convergence speed parameter described earlier. However, the specification in equation (6) may be obtained from any neo-classical production function.
4. Although Turkey has been an OECD Member since the establishment of the organisation in 1961, its income level in 1986 was about half that of Ireland's, the next poorest OECD country in that year. As a matter of fact, the level was even lower than in some non-OECD members in that year (for example, Argentina, Brazil, Korea, Mexico, etc.). Consequently, it is considered that Turkey's economy shares common characteristics with these countries and therefore is included in the sample.
5. Because the World Bank has published the GNP series at PPP in terms of current dollars, in this study the series are adjusted by the US GNP deflator with base in 1997.
6. Multilateral or bilateral loans are not included.
7. See for instance Barro and Lee (1994), Caselli Esquivel and Lefort (1996), Frankel and Romer (1999) and Rodriguez and Rodrik (1999).
8. The lagged values of the following variables are used as instruments: log (GNP), investment rate, government consumption and log (terms of trade). It is not necessary to include trade openness since the other instruments perform well enough and so it is avoided to overload the matrix of instruments.
9. In this and the next regression, the investment rate is replaced by the national saving rate and the current account among the instruments.
10. The convergence parameter is calculated by computing  $-\log(\alpha + 1)$  from the estimation of equation (6).
11. This value may be obtained by inspecting equation (4). Note that for any country, the steady state level, conditional to  $(X, v, \tau)$ , may be written as:  $y^*(X, v, \tau) = - (X\beta + v + \tau) / \alpha$ .
12. Borensztein, De Gregorio and Lee (1998) also find a positive effect of FDI on growth. Nonetheless, they include an *interaction* variable, which is the product of FDI times the average years of male secondary schooling. Without this variable in their regressions, the estimated effect of FDI on growth is not statistically significant.
13. Caprio (1998), Goldstein and Turner (1996) and Kaminsky and Reinhart (1999) are some examples.
14. Hansen (1982) first introduced GMM estimators. A thorough presentation of their properties is given by Newey and McFadden (1994).

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