Infrastructure Project Finance and Capital Flows:

A new perspective

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The success with which middle income indebted developing countries have gained access to private international finance in the 1990s is a tribute to their own domestic economic performance, international policy in dealing with the debt crisis of the 1980s, and innovations in international financial markets. This paper emphasizes the role of private infrastructure investment as a vehicle for attracting foreign capital to developing countries in the 1990s. The paper examines the determination of credit risk premium on infrastructure projects in the country risk environment of developing countries, and provides tentative quantitative evidence of the importance of macroeconomic and project-specific attributes of project risk. The key finding is that the market seems to impose a high risk premium on loans to countries with high inflation, and to projects in the road sector.

I. Introduction

Recent debate on the causes of the upsurge in capital flows to developing countries in the 1990s has offered three different perspectives. First, it is argued that the main factors motivating capital flows have been external to developing countries and have been related in particular to decline in the US interest rates (Calvo et al. 1993; Fernandez-Arias, 1994). The second line of argument is that the surge in capital flows has been the result of domestic economic reforms, including privatization of public enterprises, liberalization of currency and capital accounts, and that these trends, along with macroeconomic stabilization, have improved creditworthiness and have expanded investment opportunities (Chuhan et al. 1994; and Haque et al. 1996). Third, it is observed that financial innovations, including the securitization of creditor commercial bank loans by conversion into bonds, with partial multilateral guarantees, under the Brady Plan, were critical in lifting the "debt overhang," and stimulating investment and growth in debtor developing countries. (Claessens, et al. 1996; Dornbusch and Werner, 1994).

These perspectives have important implications for the sustainability of capital flows and hence for policy design both at the national and international level. Thus, if the surge in capital flows has been driven mostly by lower international (US) interest rates, as is argued by some

researchers, then a reversal in such rates would threaten the sustainability of capital flows.[1] By contrast, if the magnet for capital flows has been the process of domestic economic reform and stabilization in the developing countries themselves, sustainability would then be a function of the continuation of such reforms. However, if the key to the successful return to creditworthiness of indebted (middle income) developing countries and their ability to access international private finance in the 1990s has been the policy-induced financial innovation and engineering under the Brady Plan, there exists ground for official intervention in the credit relationship between developed and developing countries. Such interventions could address specific agency problems related to the asymmetry of information, market overreaction, and coordination failure in international finance and/or transitional problems as developing countries move to forge closer integration into global capital markets.[2]

In this paper we offer a new perspective, emphasizing the role of private infrastructure investments in developing countries as a vehicle for attracting foreign capital. Our motivations are two. First, infrastructure investment has been the fastest growing component of capital flows to developing countries, increasing from $1.3 billion in 1986 to $27 billion in 1996 (see Table 1). Though the volume of such flows remains small (12% of total external gross flows in 1996), the potential for future growth is substantial.[3] Second, we draw on certain characteristics of infrastructure investments, including their complex risk profile, long pay-off period, and sensitivity to country risk factors to establish links between capital flows to infrastructure and the behavior of international interest rates, domestic reforms and liberalization, and financial innovation. In essence, the financing of infrastructure in capital markets captures the key elements of the above three explanations of capital flows.

Our treatment of infrastructure finance as a vehicle of capital flows to developing countries assigns a central role to financial evaluation of foreign investment projects in the country risk environment of developing countries. With a few exceptions, most developing countries are still rated as "non-investment grade" by major credit rating agencies (See Annex I). And while many countries have made substantial progress in macroeconomic stabilization by reducing inflation and government deficits dramatically, especially in high-inflation Latin American countries (see Annex I), and moved to liberalize their capital accounts, they still

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[1] This interpretation places the burden of management of international capital flows on the shoulders of industrial countries' monetary authorities in promoting policies conducive to low inflation and low interest rates.

[2] The case for official intervention in the event of financial distress by borrowing countries along these lines is elaborated by Eichengreen and Portes (1994), and Portes (1996).

[3] Estimates of developing countries' infrastructure financing needs are huge, although precise magnitudes are difficult to establish. For East Asia and Latin America, however, average annual investment requirements for infrastructure are estimated to be in the neighborhood of $150 billion and $70 billion, respectively, from the mid-1990's to 2005, of which 25 to 40% is expected to come from foreign sources. In India, for example, a government- appointed commission has estimated total infrastructure investment requirements of about US$115 to 130 billion over the next five years, rising to US$215 billion in the following five years.

remain vulnerable to external financial shocks, leading to sudden and dramatic currency devaluation and financial distress once domestic policies go off course. As demonstrated by the experience of Mexico in 1994/95 and the South East Asian countries in recent months, exposure to such currency/financial difficulties has its roots in part in the dramatic increase in the volatility of capital flows and speed of reaction of emerging market investors. While international support through, for instance, the recently approved IMF's Emerging Financial Mechanisms, provides some assurance in limiting the disruptive impact of a financial crisis, the damage to the creditworthiness of private entities with foreign currency debt obligations could be serious. In the event of a currency crisis, the creditworthiness of local borrowers is likely to be adversely affected, not only because of deterioration in business environment i.e. rising domestic interest rates, falling stock market prices, and economic recession which seems to characteristically follow a financial crisis, (see Calvo, 1996, Mishkin; 1997), but also because of a higher likelihood of governments intervening in foreign exchange markets, and imposing controls on currency convertibility and transferability. Such a risk, moreover, is compounded by a lack of certain forms of risk insurance and hedging instruments for managing interest and exchange rate risks.[4]

The existing literature on the determinants of country creditworthiness is vast. This literature, whether in its traditional debt-service capacity approach (Feder and Uy, 1994; Lee, 1993; see also McDonald, 1992 for a survey of the literature), or in its most recent strategic and bargaining framework (Eaton and Gersovitz, 1981; Eaton, 1989; Bulow and Rogoff, 1989; Ketzer, 1989; Gennotte, Kharas, and Sadeq, 1987; and Schwartz and Zurita, 1992) has treated country risk at an aggregate level, with no distinction between the entity receiving foreign capital and the broader country/sovereign risk considerations. The focus of attention has been on whether a country is able or willing to service its foreign debt obligations, or on the incentives for loan renegotiation or repudiation under distress. The basic underlying assumption has been that the public sector is the main borrower in foreign capital markets, which seems to have been valid in the 1970s and 1980s. In the 1990s, however, when the borrowing entity is likely to be the private sector, we must rethink this assumption.[5]

Indeed, in contrast to the general obligation borrowing public sector and publicly guaranteed type which dominated commercial external finance in the 1970s, recent capital flows have been to private entities, raised to meet specific project or corporate financing needs. In

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[4] The necessary capital and Forex market institutions that should underpin integrating into global capital markets, have not developed sufficiently in many developing countries. For instance, with the exceptions of Malaysia, Brazil, and Mexico, where currency swap and forward markets have grown in the past two years, exchange markets in developing countries suffer from a number of institutional shortcomings, including illiquidity in the spot and forward markets and a lack of derivative instruments to hedge exchange rate risk beyond a short-term horizon afforded by forward cover.

[5] It is also useful to distinguish between the steady-state and crisis situations. In the latter (e.g. Argentina in the post-Maquila environment) the private sector exited quickly, despite its longer-term exposure, by refusing to honor past commitments or renew credit lines, and it fell to the public sector to restore confidence in international markets (see Caprio et. al. 1996).

1996, for example, total private net capital flows to developing countries amounted to $244 billion,[6] which represents a five-fold increase since 1990, and accounts for 86% of total aggregate net long-term flows (see Figure 1). Furthermore, as reported in Dailami and Klien (1997), between 1990 and 1996, public sector borrowing from private sources rose from $63 billion to only $85 billion, barely offsetting the drop in official development finance. In contrast, private capital to private recipients rose from $38 billion to $200 billion. In such a situation, should there be a currency crisis, the private sector is likely to be rationed out and its demand for foreign exchange subordinated to that of the public sector.

The remainder of the paper proceeds as follows: Section II elaborates on reasons that capital flows to infrastructure have grown so quickly in recent years, despite the perceived high risk of such transactions. Section III develops an analytical framework for valuation of foreign currency denominated loans to infrastructure projects, incorporating explicitly both project and country risk. Section IV presents the empirical results of an econometric analysis of the credit risk premium associated with foreign loans extended to a sample of infrastructure projects. Finally, Section V provides some policy recommendations.

Table 1. Infrastructure financing raised by developing countries 1986-95

Type of borrower and instrument	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total	1,351	2,543	910	3,503	2,641	6,312	8,835	18,027	23,314	22,297
Public sector	1,251	2,378	773	2,586	639	2,803	3,079	5,760	7,580	6,690
Private sector	100	165	137	917	2,002	3,509	5,756	12,267	15,734	15,607
Loans	100	165	137	767	1,380	126	1,536	6,271	6,007	11,086
Bonds	0	0	0	150	500	740	1,155	3,867	5,810	3,262
Equity	0	0	0	0	121	2,643	3,065	2,130	3,918	1,259

Source: World Bank, 1977

II. Reasons for increases in capital flows to infrastructure

At first glance, infrastructure finance does not seem to be a viable vehicle for attracting foreign capital to developing countries. First, exposure to currency risk, which for foreign investment in export-oriented manufacturing industries is of a relatively minor concern, is a

[6] According to World Bank estimates (Global Development Finance, 1997).

critical feature of infrastructure project investment. Project revenues are often generated in local currencies, while servicing of foreign capital, whether debt or equity, involves payment in foreign currency. Fluctuations in the exchange rate of the domestic currency, as well as capital controls limiting currency convertibility and transferability, pose a particularly difficult problem for foreign investors and financiers.

Secondly, infrastructure investments are typically up-front, with a high degree of asset specificity (although the extent of sunk investment varies from sector to sector) and risky revenue streams stretching many years into the future. As recognized in the recent literature on specific investments (Dasgupta and Sengupta, 1993; and Elden and Reichstein, 1996), investors are hesitant to make investments in such circumstances without adequate contractual protection. Once the investment is sunk, the incentive system and the bargaining power of contracting parties change vis-à-vis each other. This leads to special contracting and risk sharing problems, perhaps best exemplified by the dominant use of BOT and BOO arrangements in international infrastructure project finance transactions. A typical BOT structure is made up of a number of agreements set forth in the concession agreement concluded between the host government and the project company, formed often by a consortium of major international developers, contractors, equipment supplier and engineering companies.

Third, the scope for divesting equity holdings in infrastructure projects through IPOs is limited in many developing countries. As a result, project promoters would be locked in their investments for several years.[7]

Fourth, infrastructure investments are distinguished by the pattern according to which project risks are resolved over time.[8] The combination of a high concentration of project risks in the early phase of the project life cycle, i.e. the pre-completion phase, and relatively identifiable sources of risk once the project is completed, e.g. credit risk under off-take agreements in power projects or market risk with telecom and toll road projects, gives substantial value to early information. Thus, information about governments' policies, strategies, and political stability, as well as project parameters and benchmarks such as tariff rates, prices, and cost of capital, possesses tremendous economic value. There is also a premium on name recognition and reputation in the field which explains why in the power sector, for example, large, well-known companies such as Hopewell, Seimens, ABB, and Enron dominate the market for independent power producers.

Against this background we rely on two sets of factors to explain the increase in capital flows to infrastructure in developing countries: the worldwide move towards private participation in providing and financing infrastructure services; and the capacity of international

[7] This contrasts with the normal corporate finance situation in which firms shift their business risks to the general public through the issuance of securities.

[8] This phenomenon is generally referred to in the literature as "the sequential resolution of risks" (see Wilson, 1982).

capital markets to supply long-term debt capital, which is critical for the financing of infrastructure projects with long-term assets whose costs may take 10 to 30 years to recoup.

A. Private Participation

The commitment to private sector participation in infrastructure services is a common policy objective in countries as diverse as China, India, Indonesia, Australia, UK, Colombia, Chile, and Argentina. Driven by fiscal austerity and widespread disenchantment with the performance of state-owned utilities, many governments are turning to the private sector to build, operate, finance, own, and transfer new power plants, toll roads, telecommunication facilities, ports, and airports. In the developed countries the trend is toward restructuring or unbundling integrated industry structures, introducing competition and choice, particularly in the electricity and telecommunications industries, and regulating those sectors where elements of natural monopoly, associated with the increasing return to scale, exist. In developing countries the picture is mixed, presenting a diverse portrait of different levels of achievements in institutional, regulatory, and policy developments.

Private investors have been hesitant to invest unless supported by host governments through tax incentives, direct financing and guarantees intended to improve the project's cash flow or reduce risk. Such supports have varied in scale and mix from country to country and from project to project. Four distinct types of government support emerge from a cursory review of recent infrastructure projects closed or negotiated: direct financing, guarantees, tax incentives, and subsidies. Direct financing refers to government or government agency equity contribution to the project through a joint venture participation (as was most common in China, before the most recent liberalization changes), or provision of a local currency term loan[9], often provided in the form subordinated loans to other creditors, and as an inducement to foreign banks (Bangkok Second Stage Expressway project in Thailand). Tax incentives provided to private infrastructure projects include most frequently favorable tax treatment of income, special depreciation allowances, and lowering/ exemption of import duties on imported machinery and equipment. Such incentives have been provided either as part of government's strategy of promoting foreign direct investment (subject to the applicable tax codes and provisions, most notably in Indonesia, China, and Mexico), or specifically designed to promote private investment and financing in infrastructure,as in India and the Philippines.

Guarantees are the most important form of government support to private infrastructure projects. They are intended to mitigate risks faced by creditors and project promoters, ranging

[9] The largest number of projects with government equity participation are in China, where until recently, 100% foreign ownership in the power sector, for instance, was not allowed. An example here would be the Rhizao Power Project in China, where Shandong Power invested US$100m in the project. Also, strategic consideration as in the case of Paguthan power in India, where the Gujarat Power Corporation invested US$23 million equivalent, accounting for 12% in the project.

from the commercial risk of non-payment of government entities to policy and regulatory risks. Guarantees have been particularly prominent in power projects in developing countries. In reality, governments have relied on a range of explicit guarantees, comfort letters, and other forms of insurance, encompassing a broad range of characteristics in the extent of coverage provided, types of events guaranteed, the nature of the underlying risk, and whether such guarantees are explicitly incorporated in contractual arrangements or are implicit, with no contractual basis defining the government's liability (Dailami and Klein, 1997).

Table 2 provides a classification of guarantees offered by developing country governments to private projects. Salient examples include Pakistan's practice of providing a full guarantee of state-owned power purchasers and fuel suppliers in power projects, as well as a universal fixed tariff rate (at US 6.5 cents per kWh for the first 10 years and US 5.9 cents averaged over the life of the plant); India's practice of guaranteeing the payment obligations of state electricity boards for selected fast track projects; and Indonesia's partial indexation of power tariffs, where the Indonesian state power company, PLN, assumes part of the exchange rate risk of electricity tariffs. In Colombia, protection against currency risk is incorporated into the project documents and contractual agreements, as in the case of the Mamonal Private Power Project, which stipulates an inflation-index clause in the power purchase agreement. To the extent that changes in the value of the local currency vis-à-vis foreign currencies are related to domestic inflation, foreign creditors/investors will be covered, even if project revenues are in local currency.

Table 2: Types of Government Guarantees to Private Infrastructure Projects

I. Contractual Obligations of Government Entities

- ⇨ Guarantee of off-take in power projects
  - Birecik Hydro Power Plant, Turkey
  - Electricidad de Cortes, Honduras
  - Paguthan & Dabhol Power Plants, India
  - Mt. Apo Geothermal Plant, Philippines
- ⇨ Guarantee of fuel supply in power projects
  - Termopaipa Power Plant, Colombia
  - Lal Pir Power, Pakistan

II. Policy/Political Risk

- ⇨ Guarantee of currency convertibility and transferability
  - Lal Pir Power, Pakistan
- ⇨ Guarantee in case of changes of law or regulatory regime
  - Rousch Power, Pakistan
  - Izmit Su Water Treatment Plant and Pipeline, Turkey

III. Financial Market Disruption/Fluctuations

- ⇨ Guarantee of interest rate
  - North-South Expressway, Malaysia
- ⇨ Guarantee of exchange rate
  - North-South Expressway, Malaysia
- ⇨ Debt Guarantee
  - 4 Toll Roads, Mexico
  - Termopaipa Power Plant, Colombia

IV. Market Risk

- ⇨ Guarantee of tariff rate / Sales risk guarantee
  - Don Muang Tollway, Thailand
  - Western Harbour Tunnel, Hong Kong
  - Buga-Tulua Highway, Colombia
  - Mexico Toll Roads (Leon- Aguascalientes, Mazatlan-Culiacan, Mexico City- Toluca)
- ⇨ Revenue guarantee
  - South Access to Concepcion, Chile

M5 Motorway, Hungary

B. Supply of long-term debt capital

A major requirement of infrastructure project financiability is the availability of sufficiently long-term debt capital. The basic intuition behind this proposition is the casual industry practice of "matching maturities," i.e., that long-term assets should be funded through long-term debt, and short-term assets through short-term debt. Theoretically, the validity of this proposition rests on various manifestations of capital market imperfections in the form of taxes, agency costs, and asymmetry of information that result in conflicts of interest between shareholders and creditors.[10] Generally speaking, the availability of longer maturity debt reduces the risk that a project's cash flows may fall short of the required amounts to service debt obligations when such payments come due. In the particular case of project financing, where loans would have to be paid from a project's cash flows, and where creditors have no or limited recourse to the assets of the sponsoring company, loan maturity plays an important role in ensuring project financiability. Figure 1 below illustrates this point by way of a simple example. The figure shows how the probability of loan default is related to project risk (as measured by

[10] Under perfect market conditions, debt maturity is irrelevant, as shown in a seminar paper by Stiglitz (1974). For a detailed review of literature on choice of debt maturity in corporate finance, see Ravid (1996).

the standard deviation of cash flows) for two alternative loan maturity and terms: (i) a loan with a maturity of 5 years and interest rate of 7% per year; and (ii) a loan with a maturity of 15 years and interest rate of 8% per year. As expected, the probability of default increases with the project risk. But it is interesting to note that the probability of default is almost twice as high with a 5- year loan maturity than with a 15 year loan maturity, even though the latter carries a higher interest rate.

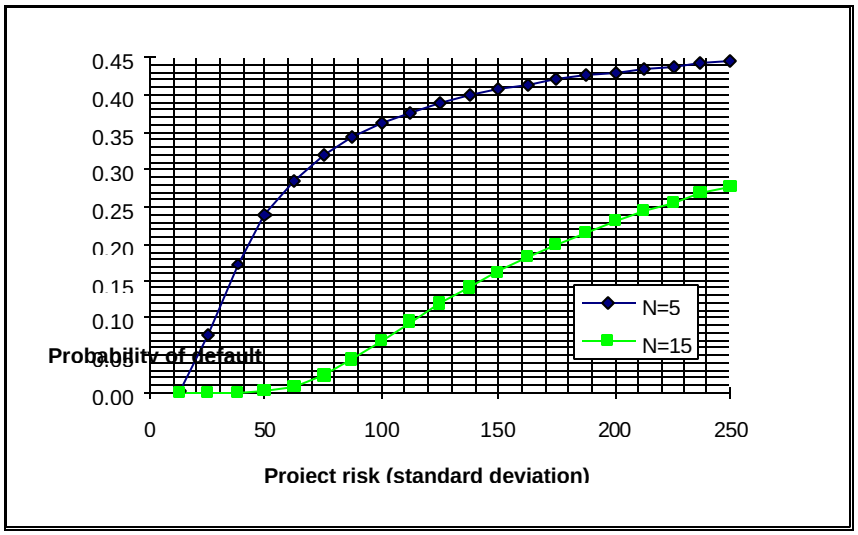
In practice, most private infrastructure projects closed or under preparation in developing countries are financed with a sizable amount of foreign capital. A typical financing mix consists of 20% to 40% equity provided by project promoters and the rest raised in the form of debt in a combination of syndicated commercial bank loans, bond issues, bridge and backup facilities, and multilateral and export credit agency loans and guarantees (see Table 3). Within debt category, bank loans, principally in the form of floating rate loans, priced off a particular benchmark, such as the U.S. treasuries or LIBOR, account for the bulk of debt financing. Thus, in 1995, about 60% of total cross boarder infrastructure finance was in the form of bank loans, 20% bonds, and the rest in the form of equity capital.

Given the underdeveloped state of local bond markets in emerging market economies, infrastructure projects have had to tap international financial markets for long-term finance. Compared to the size and depth of local equity markets, debt markets are much smaller, less liquid, and have a narrower investor base. Typically, the bulk of trade and transactions are centered on government papers, and corporate issues tend to be of short maturity, perhaps five to seven years.[11] However, with the entry of foreign institutional investors and liberalization of domestic interest rates, debt markets in most Asian and Latin American countries have witnessed considerable growth in recent years. Recent estimates put the total size of Asian local markets at about US$477 billion compared to US$7429 billion in the U.S. and US$366 billion in the United Kingdom.

Efforts to improve local bond markets' liquidity and lengthen their maturity profile would require actions on three fronts: first, removal of the various policy, regulatory and tax constraints that have impeded development of secondary trading in private debt instruments; secondly, development of bond insurance mechanisms to enhance the attractiveness of local currency bonds to a wider range of investors, including foreign investors; and thirdly, upgrading the infrastructure of markets through the establishment of efficient securities clearing, settlement, and depository systems with scripless book-entry trading.

[11] Historically, however, the development of local bond markets and infrastructure have reinforced each other -- for instance, in the U.S., the need to finance rail roads and canals in the 19th century helped create the U.S. debt market.

Figure 1: Loan Maturity and Project Risk



Parameter assumptions are: i) Initial investment =$1000, financed with a mix of $200 equity and $800, debt; ii) Loan payment = end-of-period equal amount; iii) Rate of return on the project = 25%; iv) Distribution of project revenues, net of all non-capital production expenses, assumed to be normal with mean = 250 and with standard deviation that is assumed to vary from 12.5 to 250 with an increment of 12.5; and v) Debt service ratio = 1.1.

Table 3

Leverage Ratio of Private Infrastructure Projects (by sector)		
Sector	Mean (standard deviation)	Sample Size
Power	73.07 (8.15)	28
Roads	63.07 (15.43)	15
Transport	77.86 (8.09)	7
Telecoms	61.25 (2.50)	4
Waste/Water	75.00 (12.25)	4
Gas	67.00	1

* Percentage ratio of total debt (book value) to a project's investment cost

Source: Authors' estimates based on a sample of infrastructure projects closed between 1994 and 1996 (see below).

III. Analytical Framework

In discussing the determinants of risk premia on private foreign currency loans to infrastructure projects in developing countries, we begin with a highly simplified model of bank lending with exogenously specified probability of country default, or financial distress. The key factor that distinguishes a foreign loan from a domestic one is the presence of country risk. The importance of country risk in internationally-funded infrastructure projects is asserted by the fact that even if a project is commercially viable, its ability to service its foreign debt or equity depends on broader host country policies regarding capital mobility and currency convertibility, which are beyond the control of the project entity. Technically, consider the required return to creditors, or cost of debt capital, from a particular project in a given country. Denoting this required rate of return by i, it can be expressed as: $i = r + s$, where r is the risk-free rate of interest, and s is a variable reflecting the market's combined assessment of country and project risk. In what follows, we discuss how, s, is determined as a function of specific project and country risk factors.

Assessment of a country risk premium can rely on ratings assigned by credit rating agencies to the country's foreign currency debt obligations, and/or information on secondary market trading of sovereign bond issues, if available. In assigning such ratings, rating agencies are known to take into account numerous economic, social, and political factors. In a study of the behavior of two US credit agencies, the Moody's and Standard and Poor's, Cantor and

Packer (1996) found that six factors appear to play an important role in determining a country's rating: per capita income, GDP growth, inflation, external debt, level of economic development, and default history. The authors also found evidence of a strong relationship between ratings and market-determined credit spreads of sovereign bond issues. Furthermore, as demonstrated by Haque (1996) a close correlation exists between country credit ratings and capital flows across all country groupings, including heavily indebted countries.[12]

In its most general form, the risk premium demanded by creditors from an infrastructure project is a function of their own risk perception, availability of third-party guarantees, and other contractual arrangements contained in the loan security package, as well as broader country risk factors. To disentangle the influence of country and project risk, we postulate the conditions under which the project and or the country runs into financial distress. For the project, we adopt the standard corporate finance practice in defining default as the condition in which the project's revenues are less than the face value of its outstanding debt obligations. The definition of financial distress at the country level is not straightforward, however. The traditional approach to country risk assessment has focused on credit/default risk. In this approach, the nature of risk relates to the country's ability or willingness to service its external debt obligations in a timely manner. The basic financial contractual relationship is one of a fixed debt obligation, with the government serving as the borrower.

In the new environment of large capital flows with a broad investor base, encompassing banks, mutual, hedge, and pension funds, as well as insurance companies, the traditional concept of country/sovereign risk arising primarily from the government external debt obligations is no longer relevant. A more relevant concept would need to encompass the most recent types of financial/currency difficulties experienced by Mexico in 1994, or South East Asian countries in recent months. Thus, we use financial distress as a general term which includes not only default in the traditional country credit risk sense[13], but also as a term to refer to circumstances and factors contributing to a country's vulnerability to external financial shocks which could be due to overinvestment, as elaborated by McKinnon and Pill (1997, a and b) and or speculative attack on the host country's currency and foreign exchange reserves Obstfeld (1995).

This definition of financial/currency distress seems to be more relevant in describing the exposure of private entities to the changed global financial landscape currently facing the

[12] Country ratings by major rating agencies show a consistent overall improvements in creditworthiness. This improvement has been particularly marked over the past four years: the average country risk in the Euromoney's ranking has increased from 43.56 in March 1993, to 50. 72 in March 1996, and the ratings of 16 countries in Asia, LAC, and Eastern Europe were upgraded between September 1994, and December 1996, at least by one of the two US major agencies, Moody's and Standard & Poor's.

[13] For an insightful discussion of the concept of loan default in international credit markets, see Eaton, Gersovitz, and Stiglitz, 1986.

emerging market economies. Factors and circumstances which bear upon the creditworthiness of private entities relate to direct or indirect measures adopted by the governments in response to a situation of financial distress. Such measures would include contractionary macroeconomic policy stances and or direct intervention in the foreign exchange markets, resulting in controls on currency convertibility or transferability.

Technically, our analysis is based on a simple two-period model of bank lending with no taxes, transaction cost, and third party guarantee and focuses only on default risk. Thus, consider a bank extending a foreign currency denominated loan to a company to finance an investment project. The loan is contracted in the first period with the face value D dollars to be paid back in the next period. The investment project yields an uncertain cash flow $\tilde{X}$ dollars (in foreign currency equivalence) in the second period. We define $\tilde{X}$ to include liquidation value of assets but net of operating costs. The promised payment to debt, i.e. interest plus principal, needs to be serviced entirely from the project's cash flows i.e. no recourse to the credit of project promoters. To incorporate country risk, we assume that the project is domiciled in a country with a risk of financial distress represented by a random variable *z*. For simplicity, we assume z takes only two alternative values of z=0, with the probability *p*, indicating that the project's host country is in financial distress at the time of loan maturity, and value z=1 with the probability 1-p. In the event of financial distress, the project's ability to service its foreign currency loan obligations in a timely manner is adversely affected. Two events are important: (i) a general deterioration in business and economic environment associated with country financial distress, and (ii) imposition of government control and interference with access to foreign exchange, resulting in less than 100% loan recovery, even if the project itself is financially viable. In such a situation, we denote the fraction of the project's loan repayment that can be recovered by the parameter α, where $0 \leq \alpha \leq 1$. For a value of $\alpha=1$, the loan is fully recovered and for $\alpha=0$, the loan is totally lost.

In the case of no country default, the pay-off to foreign creditor is determined solely by the project's own financial viability, in the sense that whether its cash flows are sufficient and adequate to meet its contracted loan repayment obligations.

Taking all possibilities into account, and bearing in mind that a debt contract is a fixed obligation which does not entitle debt investors, beyond a certain point, to the success of the project, the return, or pay-off to the creditor $\tilde{Y}$, will be a function of both project and country risk, i.e., $\tilde{Y} = \pi(z, \tilde{X})$, which can be succinctly expressed as:

$$\tilde{Y} = \pi(z, \tilde{X}) = \begin{cases} \min(D, \tilde{X}) \text{ if } z = 1 \\ a\min(D, \tilde{X}) \text{ if } z = 0 \end{cases} \quad (1)$$

where

$$\min(D, \tilde{X}) = \begin{cases} D & if \quad \tilde{X} \geq D \\ \tilde{X} & if \quad \tilde{X} < D \end{cases} \tag{2}$$

The expected value of $\tilde{Y}$ can be expressed as:

$$E(\tilde{Y}) = \{1 - p + ap\}\{D - \int_0^D (D - x) f(x) dx\}, \tag{3}$$

where $f(x)$ is the density probability function of $\tilde{X}$.

Under the assumption that creditors are risk-neutral, the market value of the loan V, is the present value of $E(\tilde{Y})$,discounted at the risk free rate of interest, r. That is

$$V = \frac{E(\tilde{Y})}{1 + r}, \tag{4}$$

Given that the loan has a maturity of one year with a promised value *D,* and market value *V*, its expected market rate of return, *i,* is given:

$$i = \frac{D}{V} - 1, \tag{5}$$

From equations 3,4, and 5, it is possible to derive an expression for the risk premium on the loan, *s=i-r,* which can be shown to equal

$$i - r = \frac{(1 + r)(1 - l)}{l} + L \tag{6}$$

where λ and *L* are defined as:

$$l = 1 - p + ap \tag{7}$$

$$L = \frac{1}{V}\int_0^D (D - X) f(x) dx \tag{8}$$

Equation (6) describes the risk premium on a foreign currency loan to a project as a function of both project and country risk attributes. Country risk is captured through the parameters, α and p, and project risk through L. In the case that there is no country risk , i.e. $\lambda = 1$, which can happen when either $p = 0$ or $\alpha = 1$, then $s = L$. On the other hand, if there is no project risk, i.e., $L = 0$, which could happen if the loan was, for instance, fully guaranteed by the government, then $s = \frac{(1+r)(1-l)}{l}$.

In equation (8), L defines the average loan loss on the project which will be zero for full pay-off outcomes and positive in the case of default. Figure 3 illustrates how L is related to project risk (standard deviation of project return), through an empirical simulation exercise. The simulation is undertaken based on the following assumed parameter values: we take an initial investment of $100, leverage ratio of 0.8, contracted loan value of $88 and assume that X is normally distributed with mean of $125 and standard deviation raging from 20 to 35 with an increment of 0.5 to reflect projects with different degrees of risk. As shown in figure 3, the higher the riskiness of the project, the higher the average expected loss. Thus, for a risky investment, i.e. standard deviation equal to 35, the corresponding value of L would be 4%.

Figure 4 demonstrates a simulated value of $s = i - r$ for various project risk values, and a (the share of foreign currency loan paid back in the case of country default) set to 80% of the amount due. As expected, the risk premium increases with project risk. It is also interesting to note how highly sensitive $i - r$ is with regard to the variation in the probability of country default. Raising p, the probability of country default, from 5% to 10% will result in an upward shift in $i - r$ by about 150 bps.

Finally, the role of risk-free rate of interest, r, in the determination of the credit risk premium, s, deserves attention. From equation (6), it is evident that, s, depends positively on r, implying a second-order influence of variation in the level of risk-free interest rates on the cost of borrowing to the projects. This second-order effect stems from the fact that as international interest rates decline, the market value of outstanding foreign currency loans increases. Given the dominance of U.S. dollars in international loan markets, it is reasonable to take as a good proxy for r, a particular U.S. Treasury rate (short-term Treasury bill rate). Thus, when U.S. rates increase, the cost of capital to projects in developing countries increases both directly and also indirectly through a higher credit spread.

Figure 3

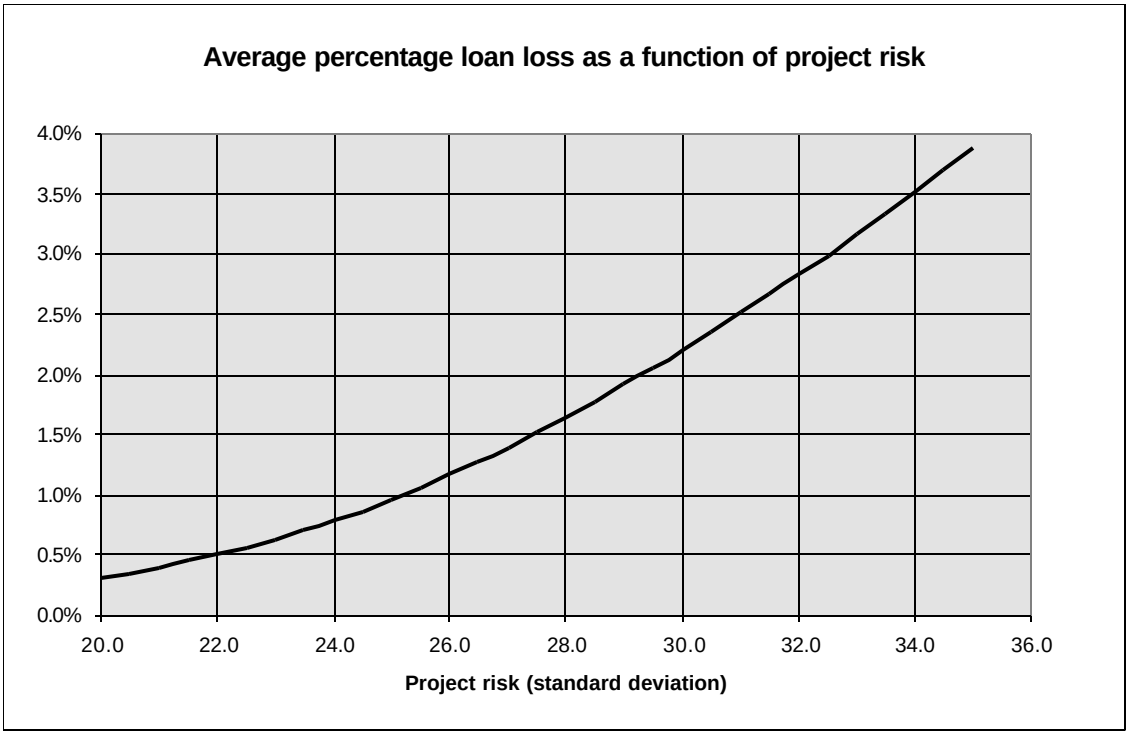
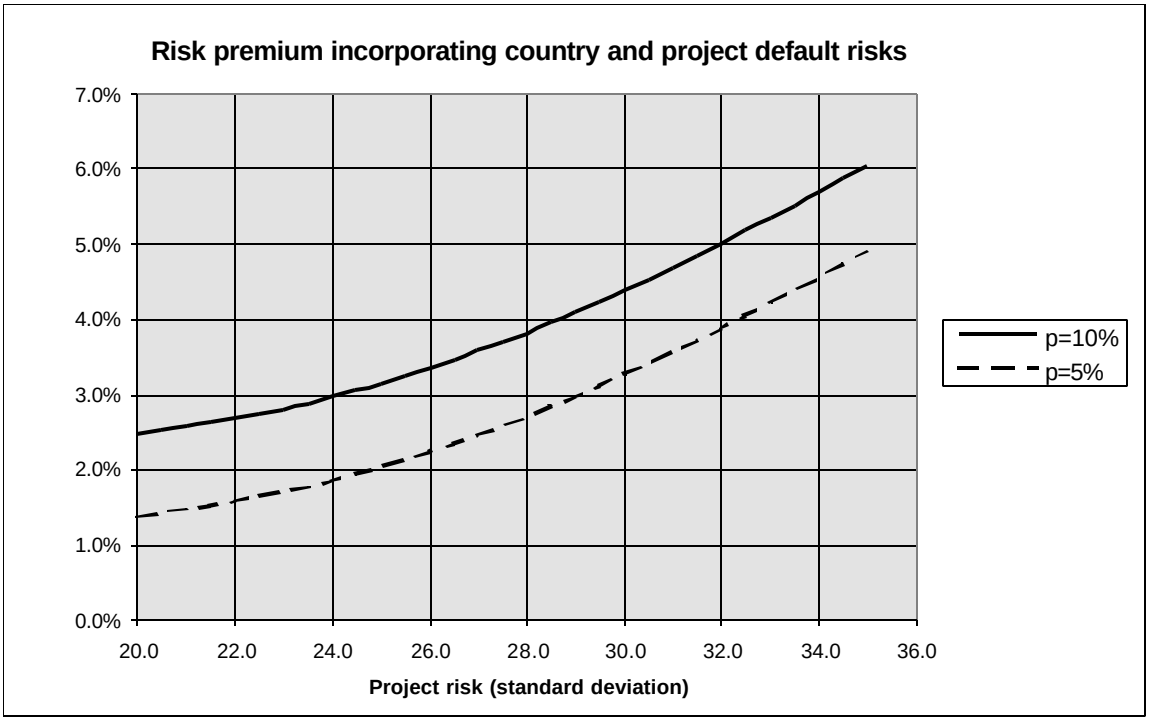


Figure 4



IV. Some Econometric Results:

The model developed in this article offers an intuitive perspective on the relationship between default risk premium on foreign currency loans to projects in emerging market economies and the country and project risk attributes. The quantitative simulation results provided are appealing and reasonable. To provide further empirical elaboration, this section undertakes a cross-sectional/econometric analysis, drawing on a sample of infrastructure projects having reached financial closure between 1994 and 1996 in developing countries. Based on a broader database containing a sample of 78 greenfield infrastructure projects, we were able to compile detailed information regarding financing mixes, terms, size, sector, and country for only 26 (for more details on the larger project database, see Dailami and Klein, 1997). This information was compiled from published industry trade sources and communication with major developers, investment banks, export credit agencies, ECAs, and multilateral financial institutions.

We measure the credit risk premium as the spread over a benchmark (e.g. LIBOR or US treasuries) of foreign currency private loans to infrastructure projects.[14] We focus on private dollar-denominated loans advanced to projects in the core infrastructure sectors of power, road, telecom, transport, and water in emerging market economies. Since most projects had more than one private foreign currency loan, the spread used was the weighted average of constituted loans. As summarized in Table 4, the spreads vary both across countries and projects, within a range of 100 bps to 530 bps, with higher spreads associated with loans to road projects.

We relate this measure of the risk premium to a set of macroeconomic and project-specific explanatory variables, through a semi-log linear regression analysis. The main macroeconomic variables include: rate of inflation, GDP per capita, and ratios of external debt to exports, short-term debt to foreign exchange reserves, and reserves to imports. On the project side, we have included project size, leverage ratio, and a set of dummy variables to distinguish projects in different sectors. Table 6 reports the main regression results under various model specifications.

Our regression results are mixed. While the R-square values are reasonable, most estimates are not highly statistically significant, presumably due to the limited number of country observations. One striking finding however, is the dominant role of inflation in explaining the spread on foreign loans to infrastructure projects which emerges with clarity. The estimated coefficient for inflation is statistically significant in all equations. Furthermore, the relationship between credit risk premium and inflation seems to be non-linear -- including a dummy variable for countries with domestic inflation rates higher than 50% per anum proved to be statistically significant. Thus, countries with domestic rates of inflation exceeding a benchmark have been further penalized. The estimates for other macroeconomic variable, with the exception of short-

[14] Dummy variables are included to capture differences in the magnitude of risk premia for two types of benchmarks: LIBOR and US treasuries.

term debt to foreign exchange reserves ratio (which seems to be weakly significant), are not statistically significant. This finding is not robust and mostly due to data limitation rather than reflecting a genuine economic phenomenon. With regard to project-specific variables, it is evident that road projects have commanded the highest risk premium, followed by power projects.

This importance attached to inflation in determining risk premiums on foreign currency loans deserves attention. Three hypothesis could be advanced to explain this finding. First, it is conceivable that the market views inflation as a proxy for the overall fiscal and monetary policy management of governments. In the current environment of low global inflation, countries with higher than average inflation are particularly "singled out" and penalized in the international capital markets. Secondly, countries with high inflation are likely to have high domestic interest rates, thus creating an incentive for borrowing even at higher spreads.[15] Thirdly, higher spreads could reflect the impact of longer maturity, independent of country and project risk. While most loans in our sample are of long-term maturity, some variations exist which could be correlated with the loan spreads. Including maturity as an independent variable in the regression analysis proved not to be significant.[16] There exists a trade-off involved between spreads and maturity in a loan contract. Ideally, both maturity and spread should be determined endogenously (see Leland and Toft, 1996 for a theoretical approach along this line), but this is beyond the scope of this paper.

[15] This demand side factor has probably been less influential in the case of infrastructure projects where project promoters are often foreign companies with access to international capital markets. Thus, it can be concluded that inflation operates mostly as a country risk variable.

[16] It is difficult to account for the impact of maturity in a single equation regression analysis due to the problem of simultaneity, i.e., maturity is not an exogenous variable.

Table 4 — Terms of foreign currency loans to infrastructure projects

	Country	Sector	Spread over benchmark, bps	Maturity, years
1	Argentina	Water/Waste	2.50	10
2	Bahamas	Waste/Water	2.75	
3	Chile	Power	2.00	7.5
4	China	Power	2.08	10
5	China	Roads	1.40	8
6	Colombia*	Gas	3.00	15
7	Colombia	Roads	5.30	4
8	Colombia	Telecom	1.75	7
9	Colombia*	Transport	3.40	15
10	Hungary	Roads	3.00	12
11	Hungary	Roads	3.00	12
12	India	Telecom	2.25	8
13	India	Telecom	2.25	8
14	Indonesia	Power	2.00	16.5
15	Indonesia	Power	1.15	12
16	Indonesia	Power	1.48	15
17	Indonesia	Telecom	1.85	9
18	Jamaica	Transport	4.42	14
19	Pakistan	Power	2.00	12
20	Pakistan	Power	2.11	12
21	Philippines	Power	1.06	16
22	Philippines	Power	0.90	9
23	Philippines	Telecom	2.35	8
24	Portugal	Roads	1.63	15
25	Thailand	Power	1.35	
26	Turkey	Power	1.50	15
27	Turkey	Waste/Water	2.25	7
	Average			**11.08**

* The benchmark used is US Treasuries, otherwise LIBOR

Table 5 — Descriptive Statistics for Data Used in the Regression Analysis

Variable	Mean	Standard Deviation
Dependent Variable:		
Spread (bps)	224.9	99.0
Explanatory Variables:		
Macroeconomic Indicators:		
Inflation per annum (%)	19.19	19.84
External debt/export (%)	158.36	63.58
GDP per capita, USD	2573.48	2903.26
Short term debt/Reserves (%)	76.88	42.94
Reserves /Import (month)	4.50	1.74
Project Variables:		
Project size (investment, mln USD)	707.04	749.08
Project leverage ratio, %	65.36	20.59
Project sector:		
Power	11	
Roads	5	
Transport	2	
Telecom	2	
Other	7	
Index Type:	Frequency	
Libor	25	
US Treasury	2	

Table 6 — Regression results explaining the determinants of risk premium[1]

Explanatory variables	equation 1	equation 2	equation 3	equation 4	equation 5
Intercept	-0.9613	-1.3104	-1.2403	-1.1550	-0.0823
	(-0.9300)	(-1.1820)	(-1.0740)	(-1.0790)	(-0.0960)
Inflation	2.9171**	3.2725**	3.2995**	2.7781**	2.9362**
	(3.6490)	(3.7090)	(3.6160)	(3.4140)	(3.5430)
ln(External debt/export)	0.2321	0.2333	0.2267	0.2988	
	(1.4050)	(1.2590)	(1.1820)	(1.7040)	
ln(GDP per capita)	-0.1013		-0.0524	-0.0440	-0.1234
	(-0.9750)		(-0.4530)	(-0.4040)	(-1.1590)
Ln(Short term debt/Reservs)	0.2544	0.0963	0.1491	0.0381	0.3562*
	(1.2520)	(0.5470)	(0.6910)	(0.1950)	(1.8110)
Reserves /Import	0.0904	0.0495	0.0738	0.0426	0.1077
	(1.3200)	(0.9420)	(0.9670)	(0.5870)	(1.5420)
ln(Project size (investment))	-0.0967				-0.0999
	(-1.7470)				(-1.7410)
Project leverage ratio, %		-0.0020	-0.0015		
		(-0.4370)	(-0.3170)		
Roads	0.1694	0.0251	0.0227	0.1140	0.1147
	(0.7720)	(0.1100)	(0.0960)	(0.5740)	(0.5120)
Power	-0.2071	-0.2125	-0.2483	-0.2172	-0.2665
	(-1.2350)	(-1.0140)	(-1.0780)	(-1.3170)	(-1.5830)
Index Type	0.0311	0.0189	-0.0037	0.1237	-0.0332
	(0.1240)	(0.0670)	(-0.0130)	(0.4810)	(-0.1300)
Intercept Inflation Dummy	-1.9616**	-2.3082**	-2.3219**	-1.9226**	-1.9774**
	(-3.2000)	(-3.6450)	(-3.5490)	(-3.2110)	(-3.1110)
R-square	0.761	0.7170	0.7190	0.6670	0.5480
Number of observations	23	23	23	26	23

[1] Independent variable is ln(s), estimation method OLS

Note: *t*-ratios are in parentheses
** significant at the 0.05 level
* significant at the 0.10 level

Variables Definition

Inflation	Average CPI growth rate (92-95)
External debt/export	Debt /Exports of G&S (%), end-year 1995
GDP per capita	GDP per capita, USD, 1995
Short term debt/International reserves	Short-term external debt to International reserves, %, 1995
Reserves /Import Coverage	International reserves to imports of goods and services in months.
Project size (investment)	Project's investment in millons of US$
Project leverage ratio, %	Percent of project is total debt to investment size
Roads	Dummy variable: 1 for a Road project, 0 otherwise
Power	Dummy variable: 1 for a Power project, 0 otherwise
Index Type	Dummy variable: 1 if the index type is US Treasury, 0 otherwise
Intercept inflation dummy	Dummy variable: 1 for countries with average CPI growth rate more than 50%

V. Concluding Remarks

The success with which middle- income indebted developing countries have been able to gain access to private international finance in the 1990s is a tribute to their own domestic economic performance, international policy in dealing with the debt crisis of 1980s, and innovations in international financial markets. Thus, private capital flows, in the form of foreign direct investment, portfolio investments in domestic stocks and bonds, and issuance of equity and bonds in offshore markets, have grown in the 1990s to dominate external finance to developing countries. In explaining this surge in capital flows previous research has emphasized the role of domestic economic reform, external factors such as the US interest rates, and official interventions, particularly under the Brady Plan.

In this paper we have emphasized the role of infrastructure finance in the process of capital flows to developing countries. Capital flows to infrastructure sectors in developing countries have witnessed a remarkable growth in recent years from $1.3 billion in 1986 to $27 billion in 1996. Such flows embody certain desirable features which bode well for their sustainability. In contrast to the short-term capital flows of the 1970s, flows to infrastructure projects are of a long-term nature, with debt maturities of 7 to 15 years, or permanent equity, and are invested in assets which underpin long-term economic growth and export expansion. Secondly, by virtue of the fact that most infrastructure financing is in the form of project financing, the claims of new creditors and investors are differentiated and are not subordinated to any existing claims, at the project level, although at the national level, the hierarchy of claims depend on the specific contractual arrangements.

A key element in understanding the recent surge in capital flows to infrastructure is the assessment of credit risks on infrastructure investments in the country risk environment of host countries. With a few exceptions, most developing countries are still rated as “non-investment grade” by major credit rating agencies, and as demonstrated by the experiences of Mexico and Thailand, vulnerability to speculate exchange rate attacks and sudden loss of investor confidence remain a feature of the current pattern of capital flows once policies go off course. We show in this paper that the risk premia on foreign currency loans to infrastructure projects can be related to country and project-specific risk attributes.

The results of our paper offer interesting insights into the determination of foreign borrowing costs to infrastructure projects in developing countries. Our regression results are most robust with regard to the role of inflation. Using both simulation and econometric analysis, our evidence indicates that the market demands a higher risk premium on loans to countries with high inflation and to road projects, and that the market seems to reward countries that have succeeded in lowering their inflation.

Annex I — Developing Countries' Sovereign Ratings (as of April 1997)

	Standard & Poor's	Moody's
Investment Grade		
Chile	A-	Baa1
Colombia	BBB-	Baa3
Croatia	BBB-	Baa3
Czech Republic	A	Baa1
Egypt	BBB-	Ba2
Greece	BBB-	Baa1
Hungary	BBB-	Baa3
India	BB+	Baa3
Indonesia	BBB	Baa3
Latvia	BBB	*NR*
Oman	BBB-	Baa2
Poland	BBB-	Baa3
Slovak Republic	BBB-	Baa3
South Africa	BB+	Baa3
Tunisia	*NR*	Baa3
Non-Investment Grade		
Argentina	BB	B1
Brazil	BB-	B1
Bulgaria	*NR*	B3
Dominican Republic	B+	*NR*

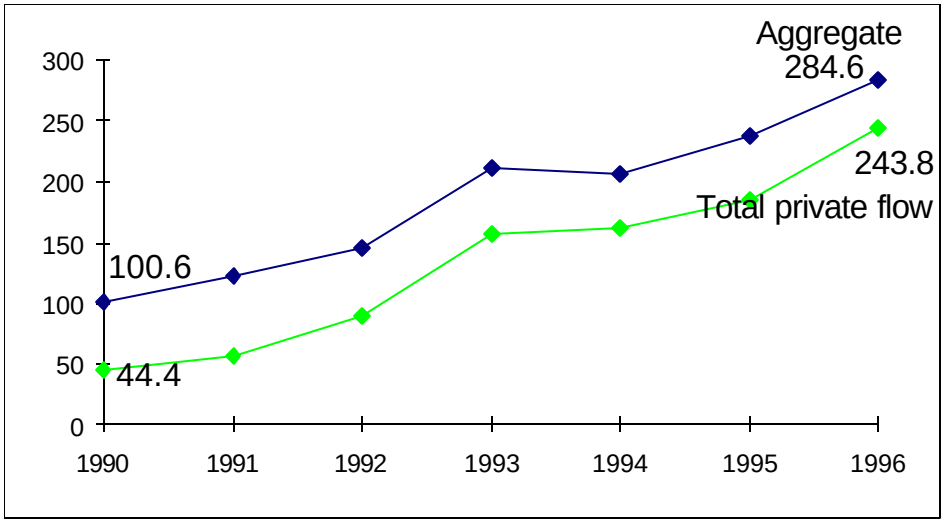
El Salvador	BB	*NR*
Jordan	BB-	Ba3
Kazakhstan	BB-	Ba3
Lebanon	BB-	B1
Lithuania	*NR*	Ba2
Mexico	BB	Ba2
Moldova	*NR*	Ba2
Pakistan	B+	B2
Panama	BB+	Ba1
Paraguay	BB-	*NR*
Peru	*NR*	B2
Philippines	BB+	Ba2
Romania	BB-	Ba3
Russia	BB-	Ba2
Trinidad & Tobago	BB+	Ba1
Turkey	B	B1
Uruguay	BB+	Ba1
Venezuela	B	Ba2

Source: Merrill Lynch, Emerging Markets Debt Monthly, 9 April, 1997.

Table 7 — Inflation[1] trends in Developing countries, 1985-1996

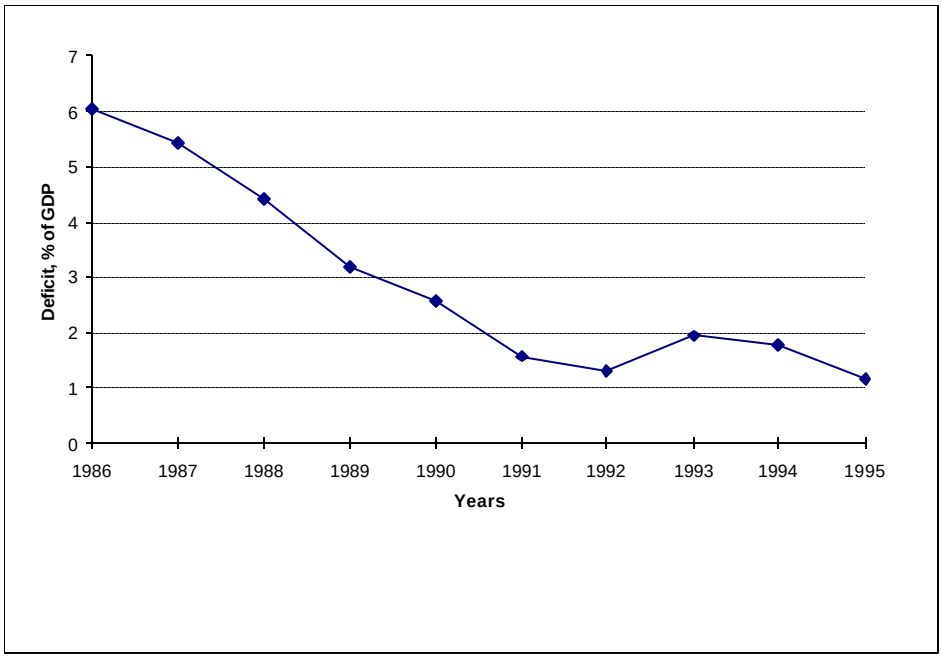
	1985-89	1990-94	1995	1996
	Average annual %		Annual %	
Latin America	**407.93**	**852.60**	**46.15**	**22.20**
Argentina	863.27	505.07	3.38	0.16
Brazil	514.21	1840.87	84.38	18.23
Chile	20.35	17.48	8.23	7.36
Colombia	24.03	26.60	20.96	20.24
Ecuador	42.88	44.80	22.89	24.37
Guatemala	18.03	21.42	8.41	11.06
Haiti	2.70	24.23	25.46	17.12
Honduras	4.91	19.71	29.46	23.84
Mexico	82.00	16.31	35.00	34.38
Nicaragua	3357.64	2096.43	10.95	11.61
Panama	0.49	1.11	0.99	1.26
Paraguay	25.56	23.27	13.43	9.80
Peru	878.57	1607.41	11.13	11.54
Venezuela	33.00	41.05	59.92	99.88
Others	**8.38**	**10.28**	**11.68**	**9.17**
India	7.73	10.24	10.22	8.98
Indonesia	6.86	8.59	9.43	7.92
Jordan	7.02	7.04	2.35	6.50
Nigeria	25.88	35.83	72.81	29.29
Pakistan	6.10	10.54	12.34	10.37
Philippines	9.72	11.68	8.09	8.41
Sri Lanka	8.55	13.05	7.67	15.94
Thailand	3.19	4.86	5.71	5.81
Uganda	155.25	25.89	8.55	7.31

Figure A1: Capital Flows to Developing Countries ($billion)



Source: Constructed based on data from World Bank, 1977.

Figure A2: Government Deficit in Developing Countries (weighted average of 20 developing countries' central government deficit % of GDP)



Source: Constructed based on data from World Bank, 1977.

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