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BRAZIL: WIDENING THE SCOPE FOR BALANCED GROWTH

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Projecting future growth possibilities for the Brazilian economy based on dismal performance of the eighties can prove as dangerous as simply ignoring its most recent performance and concentrating on the fast growth experience which has dominated the Brazilian economic history in the previous seventy years. Factors such as the use of unexplored natural resources, including the addition of new land to agriculture and cattle raising activities, which help to explain the past dynamism, are harder to be reproduced in the environment-aware today's world. On the other hand, a better understanding of the limits to government action in the promotion of economic growth may lead to a better assessment of the country's growth possibilities.

From 1900-1973 Brazilian GDP per capita annual growth rate reached 2.5%. During the same period, only Japan and Finland had a better performance, with GDP per capita having an annual increase of 3.1% and 2.6%, respectively. Rates of growth varied considerably by sub period: 1.4% in 1900-1913, 2% in 1913-1950 and 3.8% in 1950-1973. Performance in relation to other countries was especially good in 1913-1950, as Canada and Argentina ceased to grow fast and GDP per capita in Asia either grew very slowly or contracted.[2]

Real GDP was multiplied by a factor of five from 1940 to 1980 -- exhibiting a rather steady annual average growth rate of 7% -- while population trebled. In only six of the forty years, growth rate was below 4%, and only in 1942 there was a decline in GDP due to war-time shortages. Much ground was lost since 1981. The annual growth rate of GDP per capita averaged 4.6% in 1973-1980 but only -0.4% in 1980-1993. Per capita income fell during the latter period in spite of a sharp slowing down of population growth, to only 1.9%. There were negative GDP growth rates in 1983, 1988, 1990 and 1992.

[2]See Maddison (1989) for data 1900-1973.

The conflict between the political pressures leading to expansionist fiscal policies to compensate for the short-run contractionist effects of exchange rate devaluation and increases in the real interest rate implied by adjustment policies is one powerful reason behind this dramatic change in economic performance. The dismal growth record of the 1980's was the result of the conflicts between policy actions aimed at stimulating supply response and the urgent need to control domestic absorption the within the narrow limits defined by a negative capital inflow. Thus it was virtually impossible to flag long-run adjustment by means of increases in interest rates and real devaluations in order to transmit the adjustment-induced price signals to savers, investors, exporters and importers, since such macroeconomic policies failed to foster the political support needed to sustain them.

In practice, attempts at controlling domestic absorption restricts GDP growth as real devaluations and restrictions on domestic consumption are not obtained unless some measures are taken (such as nominal devaluations and cuts in public spending) which contract the level of activity at least in the short run. Stop-and-go stabilization policies, increasing uncertainty and slower growth have therefore been the outcome of such conflicts in the eighties, in contrast with the seventies, when growth-oriented state initiative was justified by the scenario dominated by high oil prices and growing world trade and credit flows. The difficulties of finding political support to adjustment policies are thus better understood when one recalls what was the dominant view on the role public expenditures were expected to play in the restoration of economic growth following the first oil crisis.

Public expenditure was the main policy instrument for supply-oriented adjustment in the second half of the seventies. Federal government funds were then abundantly used for the redirection of investment aiming to diversify exports and contract imports. Fiscal incentives encouraged (through subsidies and tax expenditures) private investors to commit themselves with an ambitious investment program aimed at adjusting supply to the projected path of energy prices prompted by the oil price prospects. As results from supply adjustment delayed more than it was expected, such policies had after the late seventies an unfavorable impact on government finances. With the recession of the early eighties, budget prospects worsened as tax revenues fell, while public investment requirements were still very high. With the recession, growing public debt signaled the risk of default. The external debt crisis of 1982 opened the way to the domestic collapse of government's ability to raise non-inflationary finance.

The nexus between problems derived from the external-debt crisis and the fiscal constraint to economic growth became increasingly recognized in the eighties. It is only natural therefore that the macroeconomic logic of the two-gap models in the tradition of Chenery-Bruno (1962) has been widely revived in the late eighties in order to analyze policy conflicts following the debt crisis.[3]

The usual criticism of two- and three-gap approach, however, is that it misses the role price corrections are likely to play in structural adjustment policies. However, a combination of elasticity-pessimism, disbelief of policy-makers in both the allocative and the demand-contractionary effect of interest-rate movements, as well as the difficulties to change relative prices under generalized indexation contributed to minimize the role of devaluation and interest rate adjustments in favor of long run government-made direct allocation of credit and foreign exchange. Within reasonable limits of foreign-exchange scarcity, pressures for devaluation may be managed and usually have been replaced by administrative allocation of foreign exchange, but the increase in real interest rates are harder to avoid. The several frustrated stabilization attempts of the eighties have not lasted long enough to allow tests of market allocation

[3] See for example, Bacha (1982), Bacha (1990), Carneiro and Werneck (1989) and Taylor (1993). Sá (1993) presents a rather complete review of the more recent literature and uses the approach to interpret the turning points of the Brazilian economy in the eighties.

of savings because of the dominating effect of high uncertainty following macroeconomic shocks and their breakdown. As suggested elsewhere -- Abreu, Carneiro and Werneck (1994) and Carneiro (1994) --, the two-gap methodology may provide useful insights on the nature of relative price shifts in growth-oriented adjustment policies.

The aim of this paper is to explore issues which will bear upon the growth prospects for the Brazilian economy, assessing both the importance of the constraints to economic growth and the scope for government policies designed to attenuate them in the coming years. Following this introduction, the next section presents a short appraisal of Brazil's recent economic history. In section 2, the workings of the Brazilian economy are described in a simple model which highlights the effects of trade liberalization and the new pattern of public spending on the country's growth possibilities. In section 3, the main issues which are relevant for an analysis of the trade-offs between growth and environmental conservation in Brazil are presented. Finally, in section 4, medium-term growth prospects are examined using simulations based on the model, first without considering the effects of environment protection policies and then taking the impact of those policies into account.

1. RECENT ECONOMIC HISTORY

With guidelines established by the ambitious investment program of the Second National Development Plan -- that aimed at long-run supply adjustment to the external disequilibrium generated by the first oil shock in the 1970's -- Brazilian economic growth was made possible thanks to the abundance of cheap finance provided by private financial markets. It has also been helpful the fact that in 1974, the growth-oriented adjustment strategy was backed by total public savings of around 7% of GDP. By the end of the Geisel government in 1979, the strain on government finance was clear as public savings had been cut to one half whereas the investment outlays were only halfway through. The second oil crisis and the trebling of external lending interest rates to Brazil and domestic macroeconomic inconsistency led to an acute balance of payments crisis leading the government in the early eighties to finally increase real interest rates and devalue the currency.[4] Tables 1.1 and 1.2 summarize the overall economic performance for the variables of interest here.

Table 1.1
Brazil: Growth, Inflation and Investment

Periods	Growth rate (%)	Inflation rate (%)	Investment growth rate (%)	Investment Ratio (%) (constant prices)
1978	4.9	40.8	4.8	23.52
1979-1980	8.5	93.0	8.6	23.22
1981-1982	-1.7	97.4	-9.5	20.80
1983	-2.9	211.0	-16.3	17.22
1984-1986	6.9	161.7	10.0	17.17
1987-1989	2.2	933.8	-1.7	17.18
1989-1991	-0.4	1098.7	-4.5	15.73
1990-1993	-0.3	1240.8	-3.7	14.69*
1991-1993	1.2	1170.2	-1.2	14.40*

(*) Preliminary estimates. Source: IBGE - National Accounts Department

The extent to which growth constraints affecting the Brazilian economy had switched in the eighties has been estimated by Luciana Sá (1993, Chapter 3) using a three gap simulation model with stylized parameters for the Brazilian economy. According to her calculations (reproduced in Table 1.3 below), public investment, the most important instrument for the promotion of economic growth was bound by the

[4] The periods are analyzed in Carneiro (1989) and Carneiro and Modiano (1989). And the changes in the relative positions of the private and the public sector are analyzed in Carneiro and Werneck (1993).

fiscal constraint at the end of the Geisel government (1978), due to the strain investment expenditures and domestic debt posed on the public sector borrowing requirements.

Table 1.2
Brazil: Selected Items of the Capital Account
(as % of GDP at current prices)

PERIODS	Public Sector Savings	Foreign Savings	Gross Investment
1978	5.34	3.47	22.26
1979-1980	3.48	5.13	23.46
1981-1982	2.47	5.12	23.65
1983	1.29	3.37	19.93
1984-1986	1.02	0.69	18.98
1987-1989	-2.69	-0.34	24.79
1989-1991	-2.07	-0.34	23.13
1990-1993	-2.34	-0.01	20.62*
1991-1993	-3.37	-0.33	19.87*

(*) Preliminary estimates. Sources: IBGE - National Accounts Department and Central Bank.

The estimated figures for 1979/80 reveal the implications of the radical change in the external scene for macroeconomic equilibrium, with the dramatic increase in interest rates and the doubling of oil prices. The strictness of the foreign constraints during the 1979-82 period implied that macroeconomic equilibrium would require a radical (and politically hard) reduction of public investment. This was in sharp contrast with the fact that most projects were close to maturity (a variable ignored in such simplified models) and therefore the costs of shutting down construction sites which were near completion and would contribute to alleviating the balance of payments constraints to growth impelled the government to curtail investment less than required by the (short run) external constraint. The deterioration of the economy's external position occurred amid a swarm of domestic policy errors which contributed to aggravate the macroeconomic disequilibria. In 1982/83 balance of payments deficits had to be "financed" by bridge loans and arrears.

These figures also confirm the consequences of the deterioration of the financial position of the public sector undermining its role as promoter of economic growth. At the same time reluctance to resort to relative price shifts as an instrument became increasingly expensive. As the possibilities of accommodating, through higher public debt the costs of keeping “wrong prices” in the public sector were exhausted and voluntary finance for public deficits became more scarce, the need to resort to relative prices for the long-run adjustment became imperative.

Table 1.3

Brazil: Estimated Binding Constraints to Economic Growth

Periods	Relevant Constraint	Maximum Public Investment	Excess of Public Investment
1978	fiscal	5.7	2.5
1979-1980 *	foreign	-23.4	-
1981-1982 *	foreign	1.3	3.1
1983	fiscal	1.9	4.1
1984-1986	fiscal	2.0	4.4
1987-1989	fiscal	1.1	4.9

(*) Loss of foreign reserves in 1980 and 1982 is not considered as part of desired deficit financing. Source: Sá (1993, chapter 3).

After the second oil crisis, conflicting claims for priority projects became even harder do accommodate without busting the federal budget. Since there was no foreign exchange to finance further supply shifts, the Figueiredo government (1979-85) promoted a drastic change in relative prices through an increase in the real interest rate (1981) and an exchange rate devaluation (1983). After the Mexican default, restoration of the economy's growth capability required the administration of the dramatic recessive costs of the change in relative prices. This meant accommodating a 200% annual inflation, in view of which recovery of growth in 1984 and 1985 had to be admittedly precarious.

The solution was thus to finance the excess of public investment over government savings essentially by higher inflation as well as the transference of private sector external debt to the Central Bank up to 1985.[5] In the second half of the eighties, the failure of repeated stabilization attempts, from the Cruzado Plan in 1986 to the Collor Plans in 1990/91, based on increasingly discretionary intervention on private contracts, led to growing uncertainty in asset markets, a disruption of the pricing mechanisms, a total disarray in the public budget administration and finally a scarcity of private funds to finance public deficit on a voluntary basis leading the country to the verge of hyperinflation.

There were certainly other factors behind the interruption of the Brazilian long-run economic growth performance, besides the above described financial inconsistencies. The economic debate on the nature of adjustment policies during the debt crisis by and large ignored that there was also a gap between the role that was expected from government institutions in the process of resource allocation in the

[5] See Carneiro (1986) on the nature of the adjustments of the economy following the two oil shocks and Carneiro and Werneck (1993a) for the analysis of the effects of the disappearance of foreign finance on the composition of savings and investment in the 1980's. As the risk of devaluation increased, private debtors deposited their repayments (cruzeiros equivalent to their dollar-denominated debts) transferring the external debt to the Central Bank, thereby nationalizing the debt.

economy and the role the Brazilian state in its post-1980 configuration has actually been able to play. As this important fact is taken into consideration, its consequences lead to a radical change of the role public investment is likely to play in the next phase of economic growth. This is taken up in the next section.

2. THE WORKINGS OF THE ECONOMY

In order to analyze the growth issues addressed in this paper, the workings of the Brazilian economy are described in a simple model which highlights the effects of trade liberalization and the new pattern of public spending on the country's growth possibilities. The point of departure is a three-gap model previously applied to the Brazilian economy by Carneiro and Werneck (1989), as described in Taylor (1993). Amendments to the original model are mainly based on the new role of public investment, the capital/output ratio easing effects of redirected government expenditures and the possibilities opened up by the productivity-enhancing effects of trade liberalization, through access to lower cost and technologically up-to-dated equipment and construction services imports.

The stylized facts which have inspired the changes made in the model are the following. First, as the privatization program advances to its next phase, reaching public utilities, railroads, highways and port authorities, the composition of public investment will in all likelihood radically change, as it becomes mostly confined to those areas where strict complementarity between private and public capital is unequivocal. In such a context, public investment requirement is bound to be determined by the level and composition of private investment, and not the other way around, as it used to be the case in the past experience described in Carneiro and Werneck (1989, 1990), when state-led investment, both in private firms and through state-owned enterprises, were the mainspring of capacity growth.

Second, following the deterioration of traditional government functions during the past ten years or so, there is a movement to restore those functions and, therefore, to increase the importance of expenditures in education, public health, environment, urban security and science and technology -- a large portion of which is usually classified in the accounting practices as government *consumption*. Such a movement is bound to be accompanied by a decentralization of public responsibilities from the federal level to state and local governments.

Third, in the wake of a series of trade liberalization measures, adopted particularly since 1990, the country's average import tariff was brought down from 51% in 1988 to below 14% at present.[6] Non-tariff barriers were almost totally eliminated. Liberalization of imports of capital goods -- especially of computers -- had a substantial impact on the domestic prices of machinery and equipment. The resulting reduction in investment costs is expected to be further amplified in the near future as the liberalization process reaches construction services and government procurement policies.

The impact of such changes in the pattern of government spending and in trade policy on growth prospects will be modeled in a very simple manner, which underlines their direct effects on the productivity of investment and on private savings.

A variable (λ) is introduced to measure the amount of government consumption (as a proportion of GDP) in technical education, modern technology dissemination, technological research support and other productivity-enhancing expenditures. And hypotheses on the way (λ) may influence growth through both higher investment productivity and higher savings are made. The first simplifying assumption is that (λ)

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[6] See GATT (1993, pp. 104-105). Such rates do not take into account recent sizable reductions in import tariffs, which became effective after the announcement of the Real Plan.

will exert a direct negative impact on the incremental capital-output ratio. Accordingly, that kind of government expenditure-programs, measured by (λ), will be labeled "capital-output ratio easing activities" (K.O.R.E.A. for short).

It will be assumed as well, that after decades of strong protection of the capital-goods and construction industries, liberalization of imports of equipment and construction services and less discriminatory public-sector procurement rules will have a direct negative impact on the incremental capital-output ratio. The higher the import-content of aggregate investment the higher its efficiency.

Another assumption concerns the effect of (λ) on savings. Personal savings being directed mainly to finance private acquisition of homes and durable consumption goods, the fraction of private savings which is relevant for the financing of productive capital accumulation is composed of two sources: retained profits and institutional funds, such as pension funds and the technical reserves of insurance companies. Retained profits is the component on which attention should be focused. The simplifying assumption to be made at this point is that a positive effect on private savings available for the acquisition of physical capital will occur through a substitution of public spending for private spending in technical education and in-firm training.[7] Public expenditures would replace part of the relatively inefficient private sector's expenditures on training, for example.

Given those assumptions, the model may be described as follows. All level variables are defined as a proportion of GDP. Public sector savings are given by equation [2.1]. The variable (t) refers to the net-tax revenue: total taxes, net of subsidies, transfers and interest payments on government's debt.[8] Public consumption

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[7] Amadeo et al. (1993) estimate that around 1% of GDP is spend annually by firms in the industrial sector in training both **in situ** and in technical schools in courses of short duration.

[8] Public-enterprises' aggregate surplus is also included in (t).

expenditures are broken down into two parts: expenditures in productivity-enhancing programs (λ), which were labeled K.O.R.E.A. above, and other public consumption (c_g). The effect of an eventual fiscal-adjustment effort is given by a separate variable (τ).

$$s_g = t + \tau - \lambda - c_g \qquad [2.1]$$

Private savings (s_p) is a function of private sector's disposable income. The marginal propensity to save out of disposable income is itself a function of the government expenditures in K.O.R.E.A., following what was discussed above, with $\sigma'_1(\lambda) > 0$ and $\sigma''_1(\lambda) < 0$:

$$s_p = \sigma_o + \sigma_1(\lambda).(1 - t - \tau) \qquad [2.2]$$

Foreign savings are defined in equation [2.3] as the balance of payments' current account deficit (ϕ).

$$\Gamma_o + \Gamma_1 (i_p + i_g) + m + j - x = \phi \qquad [2.3]$$

Exports are designated by (x) and interests on the external debt by (j). Capital-goods imports are given by

$$\Gamma_o + \Gamma_1 (i_p + i_g) \qquad [2.4]$$

where total investment ($i_p + i_g$) is written as the sum of private and public investments and Γ_1 is the import-coefficient of capital goods and construction services. All other imports and the algebraic sum of other current account items are included in (m).

Private investment is determined by the available financing funds, which are given by the excess of the sum of private savings (s_p) and the current account deficit ϕ over the amount absorbed by the government to finance its deficit (d).

$$i_p = s_p + \phi - d \qquad [2.5]$$

Public investment (i_g) is divided into two components. An autonomous component (i_o) and another one which represents a fixed proportion (Ω) of private investment (i_p).

$$i_g = i_o + \Omega \, i_p \qquad [2.6]$$

The public sector deficit may be written as the difference between public investment (i_g) and savings (s_g):

$$i_g - s_g = d \qquad [2.7]$$

The average annual growth rate (g) is determined in the equation [2.8] as a function of aggregate investment. The parameter (k) is the output-capital ratio and (g_o), which would usually be negative, may be associated to a depreciation allowance.

$$g = g_o + k\,(i_p + i_g) \qquad [2.8]$$

As seen above, the output-capital ratio (k) is supposed to be a positive concave function of both (Γ_1), the import-coefficient of capital goods and construction services in [2.4] and (λ), the government expenditures in K.O.R.E.A.:

$$k = k\,(\Gamma_1, \lambda) \qquad [2.9]$$

According to equation [2.6] above, there is a fixed marginal proportion between private investment and public investment. But if private investment is too high, government may be financially unable to make a proportional public investment effort. Private investment would thus become restricted by the fiscal constraint. Substituting [2.1] and [2.6] into [2.7], and solving for i_p, one may write (i_h), the maximum level of private investment allowed by an exogenously given sustainable public sector deficit (d), as:

$$i_h = (t + \tau + d - c_g - \lambda - i_o)/\Omega \qquad [2.10]$$

Private investment may also be constrained by savings. Substituting [2.2] and [2.7] into [2.5], using the expression for (s_g) given by [2.1] and the one for (i_g) given by [2.6] and rearranging terms, one may obtain equation [2.11]. For any exogenously given feasible current account deficit (ϕ), it establishes the maximum level (i_s) of private investment allowed by aggregate savings.

$$i_s = [\sigma_o + \sigma_1(\lambda).(1 - t - \tau) + \phi + t + \tau - \lambda - c_g - i_o]/(1 + \Omega) \qquad [2.11]$$

Finally, a high level of private investment may lead to capital-goods imports which would imply an excessively high current account deficit. Substituting equation [2.6] into [2.3] one may determine (i_f), the maximum level of private investment consistent with an exogenously given feasible current account deficit (ϕ):

$$i_f = (x + \phi - m - j - i_o \Gamma_1 - \Gamma_o)/[\Gamma_1 (1+ \Omega)] \qquad [2.12]$$

If the maximum values i_h, i_s and i_f, given by equations [2.10], 2.11] and [2.12], are substituted, on at a time, into the equation which results from substituting [2.6] and [2.9] into [2.8], one may get three other equations which establish the average annual growth rates implied by each of those previous three consistency equations. In [2.13],

g_h establishes the maximum average annual growth rate allowed by the fiscal constraint:

$$g_h = g_o + k\,(\Gamma_1,\lambda).[i_o + (1 + \Omega)\, i_h] \qquad [2.13]$$

In [2.14], g_s is the maximum average annual growth rate consistent with the savings constraint:

$$g_s = g_o + k\,(\Gamma_1,\lambda).[i_o + (1 + \Omega)\, i_s] \qquad [2.14]$$

And g_f, given by [2.15], determines the maximum average annual growth rate allowed by the external constraint.

$$g_f = g_o + k\,(\Gamma_1,\lambda).[i_o + (1 + \Omega)\, i_f] \qquad [2.15]$$

The most interesting policy variables to which attention should be focused in the analysis of the interplay of equations [2.13] to [2.15] are τ, Γ_1 and λ. The first one is the fiscal adjustment variable. The value of Γ_1 depends on the degree of import liberalization of both capital goods and construction services. And λ is determined by the volume of government expenditures in K.O.R.E.A..

The effects of a change in τ are quite obvious. Both the fiscal constraint [2.12] and the savings constraint [2.14] are slackened by an increase in τ. And the external constraint is not affected by it. That means that

$$\partial g_h/\partial\tau > 0; \quad \partial g_s/\partial\tau > 0; \quad \partial g_f/\partial\tau = 0$$

The impact of a change in Γ_1 is also easy to perceive. Again, both the fiscal constraint [2.12] and the savings constraint [2.14] are relaxed by an increase in Γ_1:

$$\partial g_h/\partial \Gamma_1 > 0; \ \ \partial g_s/\partial \Gamma_1 > 0$$

The effect on the external constraint is given by

$$\partial g_f/\partial \Gamma_1 = (\partial k/\partial \Gamma_1)\, i - k\, [i_o + (1 + \Omega)\, i_f]/\Gamma_1 \qquad [2.16]$$

where $i = i_f + i_g$ is the maximum total investment allowed by the external constraint. It may be shown that the external constraint would be slackened by an increase in Γ_1 only if $(\Gamma_1/k)\, \partial k/\partial \Gamma_1 > 1$, a most implausible assumption for the value of this elasticity. Therefore it may be assumed that $\partial g_f/\partial \Gamma_1 < 0$.

Finally, there are the effects of a change in λ. The external constraint is positively affected by λ, exclusively through k. The effect on the fiscal constraint is given by

$$\partial g_h/\partial \lambda = (\partial k/\partial \lambda)\, i - k\, (1 + \Omega)/\Omega \qquad [2.17]$$

where $i = i_h + i_g$, is the maximum total investment allowed by the fiscal constraint. It may be shown that this effect will be positive if

$$(\lambda/k)\, \partial k/\partial \lambda > [(1 + \Omega)/\Omega]\, \lambda/i \qquad [2.18]$$

For sufficiently low values of (λ), the condition established by [2.18] will hold and an increase in (λ) will release the fiscal constraint. But as the volume of government expenditures in productivity-enhancing programs rises, a point will be reached in which an increment in (λ) will eventually have the effect of tightening up the fiscal constraint.

What remains to be examined is the effect of a change in λ on the savings constraint [2.14], which is given by

$$\partial g_s/\partial\lambda = (\partial k/\partial\lambda)\, i - k\, [1 - (1 - t - \tau)\, \partial\sigma_1/\partial\lambda] \qquad [2.19]$$

where $i = i_f + i_g$ is the maximum total investment allowed by the savings constraint. This derivative will be positive if

$$(\lambda/k)\, \partial k/\partial\lambda \; > \lambda/i - [\sigma_1(1 - t - \tau)/i]\, (\lambda/\sigma_1)\, \partial\sigma_1/\partial\lambda \qquad [2.20]$$

Again, if the value of the elasticity $(\lambda/\sigma_1)\, \partial\sigma_1/\partial\lambda$ is sufficiently low, that condition will hold for low values of (λ). Under such circumstances, an increase in λ, would slacken the savings constraint. But as λ becomes higher, the sign of the effect may eventually change.

3. THE ENVIRONMENT AND THE ECONOMY

Ideally, trade-offs between growth and environmental conservation in Brazil should be dealt with by analyzing development sustainability through the use of counterfactuals implying non-declining capital stocks and including different types of natural capital stocks with a varying degree of substitutability in relation to man-made or human capital. This is, however, prevented by the lack of information on the relevant capital stocks. Attention here will concentrate instead on the study of trade-offs between growth and environmental conservation in Brazil taking into account environmental targets not necessarily consistent with sustainable development.

It is important to consider separately domestic externalities, which affect economic agent inside national borders, from global externalities, which affect economic agents across national borders, because the latter raise more complex redistributive questions. The design of an adequate system of incentives faces problems raised by the lack of a common legal background and the visibility of international, rather than interagent, transfers. Under the heading of domestic externalities are treated mainly non-crossborder costs entailed by industrial and agricultural pollution, including cleanup of the cumulative effects of pollution in the past, improved access to water and sanitation as well as other mainly poverty-related externalities.[9]

There is no comprehensive information on industrial and agricultural pollution. Air pollution is a significant problem in the larger metropolitan areas and while industrial air pollution control has improved conditions in the recent past - the curtailment of pollution in Cubatão being the best example - the problem remains significant. Water pollution is relevant in almost all big metropolitan areas because both of industrial discharge and the lack of sewage treatment. It is also important in or near the Amazon region[10], due to tin mining, and in many agricultural areas due to the misuse of pesticides and other agrochemicals[11].

Cleanup of the Tietê basin in the state of São Paulo is estimated to cost US$ 2.6 billion.[12] Implementation of whole complete project to cleanup Guanabara Bay in Rio is thought to require US$ 2 billion[13]. In Jaguaribe et al. (1989) it is suggested very tentatively that expenditure of the order of 0.3% of GDP will be required by the "introduction and enforcement of international environmental standards"[14]. This seems somewhat underestimated if contrasted with the rough projections of the World Bank for estimated yearly costs of environmental programs for developing countries and with the sparsely available estimates concerning specific clean up projects[15]. A mid-

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9 Some of these, however, such as noise pollution in metropolitan areas are not necessarily related to poverty.

10 North of Manaus, south of Porto Velho and in South Pará. See IBGE (1988), p. 72.

11 Contraction of agricultural credit also resulted in an improvement of the position in the 1980s. For data on sales of agrochemical products by state and type of crop see IBGE (1988), pp. 123 e 125.

12 **Financial Times**, 16.10.91.

13 Câmara de Comércio Brasil-Canadá (1991), p. 81.

14 The unpublished report by F. A. de Almeida quoted by Jaguaribe et al. (1989), which is the source for the estimate, does not throw additional light on the methodology used to suggest 0.3% of GDP.

15 World Bank (1992), pp. 173-4.

range estimate is more likely to be around 0.6% of GDP yearly in conjunction with closely related expenditures related to water supply and sanitation of 0.8% of GDP yearly.

The convergence between substandard social indicators and minimum thresholds in a given time span for Brazil has been examined Abreu (1987) and led to the proposal of criteria based on the application of ideas advanced by Sen (1980) on the comparability of heterogeneous experiences in achieving social policy targets. The basic principle is to distribute evenly over time the relative effort to improve given social indicators taking as target the steady reduction of a certain proportion of the gap between actual levels and desired levels of indicators. This is especially useful in the cases where biologically determined asymptotic patterns exist as in the case of infant mortality or life expectancy but can also be applied to determine desired paths for the evolution of input indicators such as water and sewage connections.

Inter and intra-regional differences of social indicators are very substantial in Brazil. Infant mortality in the poorest region - the Northeast - is roughly 60% higher than in the richest. The same heterogeneity applies to the availability of basic services such as water supply and sewage. The proportion of households having access to adequate water supply and sewage in the Northeast is 35% and 75%, respectively, below such ratios for the Southeast[16]. National average indicators are substantially below those which would be predicted based on cross section data on GDP per capita: Brazilian average infant mortality rate at 57 per 1,000 live births is still above South Africa's[17].

16 Data from IBGE (1991) and (1992).

17 Improvement since 1970 in Brazil has been, however, faster than in South Africa. See World Bank (1993), appendix tables. See Abreu (1987) for the a comparison of Brazilian social indicators and social policies with those of other developing countries.

In Jaguaribe et al (1989) a mixed target for the year 2000 was established so that the poorest region reached the 1987 level of water and sewage connections for the Southeast region in the year 2000 and that the other regions would improve their indicators at the same rate these had been improving in the recent past. With information on the cost of water and sanitation it was then possible to roughly estimate in 0.6% of GDP the level of expenditure required to reach the year 2000 target[18]. If account is taken of the shortcomings of investment in water and sanitation in the recent past this estimate needs to be increased to 0.8% of GDP if the initial target in the year 2000 is maintained.[19]

There are other poverty-related externalities such as those related in certain conditions to housing and transportation standards, educational standards of specific social groups, crime and contagious diseases are unrelated or not necessarily related to the inadequate standards of water supply and sanitation[20]. A reasonable range of guesses, reflecting the generalized ignorance on the subject, would span from 0.6 to 1.0% of GDP to cope with modest improvement in primary education and health standards, curbing poverty-related crime, controlling poverty-related diseases, improving housing conditions and public transportation.

Global externalities, understood as externalities which affect economic agents not only across borders, but also on a global planetary basis are of great importance in the analysis of growth prospects for Brazil because of the great relative size of the

[18] Given certain assumptions about GDP growth. See Guimarães (1989), pp. 39 and 42, Rodrigues (1985), chapter 5. Guimarães (1989) estimates water connection costs to be around US$ 420 of 1987 per household and sewage system connections around US$ 600 per household. These are in the mid-range of World Bank (1992), chapter 5, estimates.

[19] After the year 2000 efforts would be concentrated in bringing substandard areas into line with the those Southeast. It should be noted that these estimates refer to connections of the estimated number of dwellings to sewage and water systems. To the extent that some effort is directed to providing roof for those homeless additional efforts are also required in connection with water and sanitation programs.

[20] AIDS is likely to be especially serious as it will impose severe strains on the already inadequate public health services which are unable to cope with diseases for which there is known effective treatment. See Cuddington (1993) for the growth implications of AIDS in Tanzania.

Brazilian rain forest and the established causality link between deforestation and global warming/reduction in biodiversity. The preservation of Indian cultures is also an important joint product of global warming control through preservation of the rain forest.

In the long term energy absorbed by the earth from solar radiation must be balanced by outgoing radiation from the earth and its atmosphere. Energy is emitted by the earth and atmosphere through long-wave radiation which is partly absorbed by the greenhouse gases.[21] The most important of the anthropogenic gases is CO_2. A doubling of the CO_2 content of the atmosphere could raise temperatures by 4 degrees. This is called global warming.[22]

The contribution of deforestation in the Brazilian Amazon to global warming, contrary to what is frequently thought, is not very significant. The share of CO_2 in the generation of greenhouse gases is of about 50%. Deforestation accounts for roughly 25% of CO_2 generation and deforestation in the Brazilian Amazon is about 25% of world deforestation. A mid-estimate of about 3% for the contribution of deforestation in Brazil to global warming seems reasonable.[23] Reis and Margulis (1992) presented updated estimates of CO_2 emissions caused by burning logtrees in the Brazilian Amazon which are in the range of 0.29-0.41 gigaton per year, that is from 4.7 to 6.6 % of global CO_2 emissions and 2.4 to 3.3% of the greenhouse effect. These are based on downward revisions of estimated areas affected by deforestation and are consequently lower than previous estimates.[24]

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21 The greenhouse gases are respectively carbon dioxide, methane, chlorofluorcarbons-11 and 12, water vapor, tropospheric ozone and nitrous dioxide.

22 See Solow (1992) and Nordhaus (1992), pp. 34-9. The estimated temperature range due to global warming is subject of much disagreement in the literature.

23 See Reis and Margulis (1992), p. 335. Such contribution seems to be rising since the early 1980s.

24 Reis and Margulis (1992), p. 335 and, for other estimates, p. 349.

Deforestation also reduces biodiversity and affects the preservation of Indian cultures. The Amazon forest is estimated to hold between 0.8 and 5 million species, corresponding to 15 to 30% of the estimated total number of existing species[25]. A high of proportion of plant (33%), insect (97%) and other invertebrate and microorganism species (91%) are thought not to have been identified. Most of these are in tropical moist forests[26]. It is, however, extremely difficult to assess even roughly the aggregate benefits of maintaining biodiversity as well as of preserving Indian cultures.

Roughly 95% of CO emissions are generated by the energy sector and deforestation. CO_2 emissions due to fuel use are equivalent to the deforestation of one Amazonia per decade but what is relevant here is cost effectiveness. In principle the most economic way to reduce emissions is by discontinuing deforestation. This is cheaper than reforestation and much cheaper than controlling the use of fossil fuels. But the comparison may be misleading unless difficulties concerning the effectiveness of side payments as an instrument to control deforestation are properly faced.

There is much disagreement concerning the costs of reducing deforestation in Brazil. The upper bound is a scenario corresponding to interrupting all agricultural activities in the region, including cattle raising. The share of agriculture and livestock in the region's GDP is around 17% but linkages with industry and services would amplify the consequences, halving the region's GDP. This upper bound would be around 2% of Brazil's GDP. There are many reasons to believe that this an overestimation, among other things because it is unreasonable to believe that present agricultural activities are wholly unsustainable, that is, dependent on continuous deforestation, or that agriculture would be totally unable to adjust to deforestation control. In other extreme, Cline (1992a) and (1992b) has suggested first US$ 4/ton,

[25] Alternatively Amazonian biodiversity is indicated by comparative data: in an area of 0.2 hectares near Manaus ten times more species of trees of more than 2.5 meters were found than in the whole of France, see Reis and Margulis (1992), p.343.
[26] World Bank (1992), pp. 59-61.

then US$ 1/ton of carbon as the opportunity cost of retaining carbon in the Brazilian Amazon, entailing total costs of 0.4% and 0.1% of GDP, respectively[27]. It is however unlikely that only 25% of agricultural GDP would be affected or that the shrinkage in agriculture would not affect other sectors.

Estimates by Pearce (1992)[28] are roughly midway between the upper bound and Cline's lowest. On a "damage avoided" approach, which would also have to be taken into account to discuss the outcome of deforestation control negotiations, Pearce (1992) suggests that to stop deforestation altogether would be worth around US$ 6.5 billion yearly[29]. An estimate of 1.2% of GDP yearly has been adopted as a mid-range value.[30] Since attention in this paper is concentrated on the cost side, preservation of biodiversity and of alternative cultures can be thought as being jointly produced with the freezing of deforestation.

The Brazilian Amazon plays a major global role in the retention of CO_2. If on a global basis it is cheaper to reduce such CO_2 emissions by freezing deforestation rather than only by controlling the use of fossil fuels it makes sense not to consider the services provided by the forest as free. It is in this context that it seems reasonable to consider as a possible scenario one in which Brazil would be a major recipient of international yearly payments as a country with a high forest/CO_2 emission ratio. Main payers would be those countries with a low forest/CO_2 emission ratio. The range of possible payments is an open question but relevant data include the costs (for Brazil) of interrupting deforestation and the costs (for the world) of inaction in relation to

27 Cline (1992b), pp. 220-221 also quotes Darmstadter and Plantinga (1991) who suggest a cost of US$ 2.30/ton.

28 All mining, ranching and logging activities would cease and crop production reduced by half. This would be equivalent to around US$ 5.8 billion in 1980.

29 Pearce (1992) also includes considerations based on "willingness to pay" criteria.

30 In principle effects on hydroelectricity generation could impose additional costs but the average area of reservoir/generating capacity ratio of 0.6 Km^2/MW indicates that this a problem of a different order of magnitude if compared to deforestation due to agricultural activities. Envisaged investment programs of 1,000 MW/year would entail deforestation equivalent to 2-3% of that related to agricultural activities. See Serra (1989).

global warming. There are very complex problems to solve in relation to enforcement of agreed limitations.

The already complex difficulties of providing adequate incentives for freezing deforestation even in a closed system are significantly increased when transborder or global externalities are involved. The control of global externalities require multilateral agreements and naturally invite cross-country comparisons of efficiency in the use of natural resources and effectiveness of enforcement. There is a permanent temptation to oversimplify in the search for corrective solutions by choosing unilateral decisions rather than multilateral cooperation and failing to recognize that in developing economies concern with the global environment faces competition of concern with basic needs, that is, the income elasticity of demand for environmental quality is very high.[31] Sovereign-encroaching solutions tend to obscure the difficulties of design and implementation of incentives even if transborder problems were eliminated.

Environmental questions are certain to occupy a very important place in trade negotiations in the post-Uruguay Round era. From past experience and recent policy statements it is likely that developed countries, and particularly the United States, will increasingly press for across-country "policy harmonization". Environmental policies are very high in the list of candidates for such harmonization. Closely related to misconceptions on "policy harmonization" are recommendations on instruments to be used to enforce the adoption of standards more often than not unilaterally defined.

The concepts of "policy harmonization" and its next of kin "level playing field" are difficult to reconcile with widely accepted ideas about comparative advantage. International organizations including the World Bank and GATT[32] have taken the stance that claims for compensation related to the use of cheaper and dirtier

31 See Low (1993).
32 GATT (1992), part III.

technologies in developing countries, the so-called ecological dumping, should be rejected as they are based on shaky economic grounds and will introduce a major element of disruption in the multilateral trading system. If global externalities are involved, the picture is, of course, different but given the overwhelming importance of fuel emissions to explain global warming it is difficult to see how corrective policies could be defined on a non-multilateral basis.

4. MEDIUM-TERM PROSPECTS

The model discussed in section 2 above was used to obtain a rough estimate of the relevant effects and an idea of the relative importance of the parameters for practical policy discussions. Plausible values were attributed to the parameters and exogenous variables. Typically, such values were obtained on the basis of known passage points and plausible elasticity values.

The chosen base year was 1996, on the assumption that carrying on the ongoing stabilization program will be the main first-year task of President Fernando Henrique Cardoso, who will take office in early 1995. Accordingly, the values of the exogenous variables (t) and (c_g) are consistent with a post-stabilization scenario in which the public sector will already have made a sizable adjustment. Big enough to assure the success of the stabilization program, but falling short of the fiscal adjustment required to allow a new sustainable rapid economic growth path. The role of the variable (τ) in the model is precisely to evaluate the magnitude of the additional -- post-stabilization -- fiscal effort. The value of the parameter (Ω), which establishes the link between private and public investment, was assumed to be equal to $^2/_3$.

The values of external-sector variables assume a successful closure of the external-debt negotiations and roughly reflect the 1993 sound foreign accounts values, corrected to allow for a probably much higher rate of capacity utilization in 1996.

Constant-elasticity functions were assumed for both $\sigma_1(\lambda)$ and $k(\Gamma_1,\lambda)$, writing

$$k = k_o \Gamma_1^{\mu 1} \lambda^{\mu 2} \qquad [3.1]$$

and

$$\sigma_1 = v_o \lambda^{v} \qquad [3.2]$$

The base-year value for (λ) was assumed to be .005 (i.e. .5% of the GDP). The value of v_o was established in such a way as to make $\sigma_1(\lambda)$ equal to 0.2 when (λ) assumes the base-year value. In the simulation discussed below (v) was assumed to be equal to 0.1. A similar treatment was given to (k). The value of k_o was determined in such a way as to make the incremental capital-output ratio (1/k) equal to 3.5 -- for any pair of assumptions about the elasticity values ($\mu 1$) and ($\mu 2$) -- when (Γ_1) and (λ) assume their base-year values. In the case of (Γ_1), the assumed base-year value was 0.15. In the simulations below, ($\mu 1$) was assumed to be equal to 0.25 and ($\mu 2$) to 0.1.

The simulation exercise described here explores the post-stabilization feasible average annual economic growth rate in a more open economy and under a more growth-oriented pattern of public expenditure. The constructed scenario assumes a considerable liberalization of imports of both capital goods and construction services; enough to increase the import coefficient (Γ_1) from 0.15 to 0.3 and give rise to a much more favorable k. The scenario also assumes a significant post-stabilization fiscal-adjustment effort, making (τ) equal to 3.6% of GDP. For an economy which would be emerging from fifteen-year long high inflation experience, it was prudently assumed that the sustainable public-sector deficit (d) would actually be negative. It was made equal to -0.8% of GDP. On the other hand, given the many years of very sound external accounts, and assuming the maintenance of the external liberalization policy adopted after 1990, it was reasonable to presume that (ϕ), the sustainable current account deficit, could be equal to 1.3% of GDP.

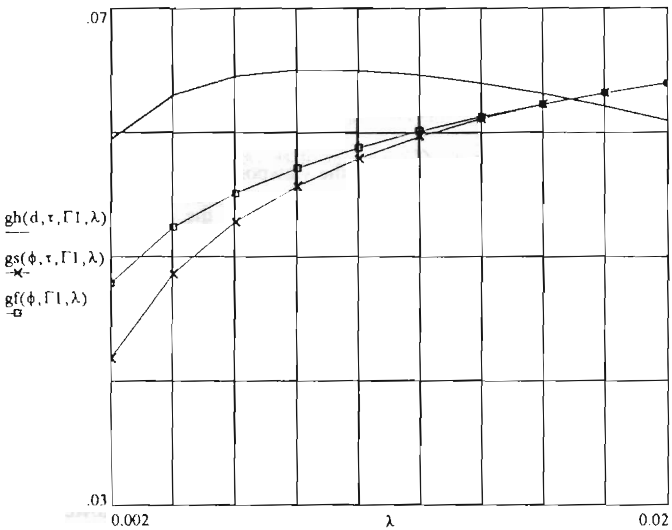
The growth possibilities of such scenario may be examined below in figure 4.1. It shows the maximum **average annual** GDP growth rates established by the constraints given by equations [2.13] to [2.15], for different assumptions about (λ), the volume of government expenditures in productivity-enhancing programs. The maximum feasible growth rate consistent with the three constraints taken together would be roughly 6.3%.

It is interesting to notice that, from the viewpoint of the fiscal constraint, given by the schedule (g_h) in the upper part of the graph, the level of (λ) that would maximize the average annual growth rate would be much lower than the one which makes (g_h) equal to approximately 0.063, or 6.3%. The derivative $\partial g_h/\partial\lambda$ eventually becomes negative (for (λ) values greater than approximately 0.01), as suggested by [2.17] above. This means that a budget-minded planner could be led to choose a value for (λ) so as to obtain maximum (g_h). Nevertheless, in the logic of gap-analysis when the savings (g_s) and external (g_s) constraints are also taken into account and prices are unable to adjust, it becomes clear that the maximum growth rate allowed by the (g_h) schedule alone would not be attainable under the assumed value for the parameters. Therefore it makes sense for a three-gap conscious K.O.R.E.A. planner to expand (λ) beyond 0.01 because that contributes to slacken the other two constraints.

Given the set of values used for the parameters, condition [2.20] will hold, for any value of (λ) in the considered range, making $\partial g_s/\partial\lambda > 0$. As seen above, the external constraint is always positively affected by (λ) through the effect on investment productivity .

FIGURE 4.1

THE THREE GROWTH CONSTRAINTS



A remark could be made regarding alternative closures for the model through the roles of the exchange rate or the interest rate using the situation explored in the above example. Lower expenditures in K.O.R.E.A. than is necessary for satisfying both the external and the savings constraint would mean that there would be pressures both for a real devaluation and for higher domestic interest rates relatively to international rates which would shift both constraints upwards and the fiscal constraint downwards, bridging the gap between the gaps. This suggests that the resulting equilibrium growth rate would probably lie somewhere between the fiscal-minded K.O.R.E.A. planner growth rate and the long-run rate that would be obtained by a three-gap conscious K.O.R.E.A planner. The ability of such price movements to perform their expected roles in the long-run adjustment depends, of course on assumptions concerning their dynamics which are far beyond the scope of this paper.

The model described in section 2 may be also used to study growth-environment trade-offs. Table 4.1 summarizes estimates of costs of environment abatement discussed in section 3. There has been an attempt to define low, mid-range and high cost estimates for externalities mentioned above.

All activities are supposed to be domestically financed, with the exception of global warming control and biodiversity protection for which alternative combinations of foreign and domestic funding are possible. The more likely scenarios are, of course, due to the problems raised by the inter-country appropriation of benefits, those in which most of the funding is foreign. To a large extent estimated costs for control of domestic externalities are net costs since the actual direct links between control of externalities and growth seem slight. There is implicit, however, the idea that growth sustainability depends on the achievement of a minimum level of improvement in the quality of life of the poor.

Table 4.1

Summary of Estimated Costs as % of GDP

	Low cost	Mid-range cost	High cost
Activities			
Reduction of global warming	0.4	1.2	2.0
Domestic externalities	1.6	2.2	2.8
Reduction of domestic pollution	0.4	0.6	0.8
Water supply and sanitation	0.6	0.8	1.0
Other poverty-related externalities	0.6	0.8	1.0

In order to evaluate the impact of the environment-related policies and their respective sources of finance, the three-gap model described in section 2 was adapted in a very straightforward way. The sources and patterns of financing of such activities are bound to have an impact on the economy's feasible growth rates inasmuch as they affect the fiscal constraint (e.g. requiring higher public expenditures), the savings constraint (e.g. requiring higher taxes), or the external constraint (e.g. giving access to external funds which are earmarked for environmental protection).

As seen above, the simulations based on the scenario described in the beginning of this section led to a maximum feasible economic growth rate of roughly 6.3%. The evaluation of the impact of environment-related policies was made in terms of changes in the economic growth possibilities that emerge from this basic scenario.

The impact on feasible growth rates of introducing the midrange cost estimates for global warming control and biodiversity protection (1.2% of GDP, wholly financed abroad) and domestic externalities, including domestic pollution, water and sewage, as well as other poverty-related externalities (2.2% of GDP), is that the external constraint ceases to be relevant (for the optimal level of increment in productivity-inducing public expenditures, the external-deficit-constrained rate of growth is 7.8%) and growth is limited by the fiscal constraint to 4.1% (the growth rate constrained by savings is 5.9%).[33] The intuition is clear: the slack in the foreign constraint results from the form of financing global warming control activities (100% externally) but other externality abatement costs have a direct impact on the fiscal constraint and, and to a lesser extent (also due to external financing) on the savings constraint, making both of them more restrictive.[34]

Increasing costs of domestic externalities control make the fiscal constraint (and to a lesser extent the savings constraint) increasingly binding. In the scenario of high costs of table 4.1 (2.8% of GDP), and supposing no global warming abatement domestically financed effort, the maximum GDP growth rate would decline to 3.6%. For the low cost scenario possible GDP growth rate would be of 4.7%.

For each additional 1% of GDP spent in the control of domestic externalities, the fiscal and savings-constrained growth rates are reduced by 0.96% and 0.38% respectively. As the fiscal constraint is binding, the midrange cost scenarios defined in table 4.1 lead to the following results: domestic pollution control entails a reduction in GDP growth of 0.6%; to assure defined targets for sanitation and water supply would cost 0.8% in GDP growth; and to cope with other poverty-related externalities would cost another 0.8% in GDP growth.

[33] The optimal value for λ, of 0.7 % of GDP rather than 1.7% without taking into account externalities, would make possible a GDP growth rate of 4.6%.

[34] The sensitivity of the maximum growth rate allowed by the fiscal constraint to the expenditure in environment and poverty-related externalities crucially depends on the value of parameter Ω, linking public and private investment ($i_g = i_0 + \Omega i_p$). The higher Ω the lower the sensitivity. In the basic scenarios the value of Ω was assumed to be 0.66.

These results would not be affected by considering the joint effect of programs related to domestic and global externalities as it is the fiscal constraint which is binding and this is invariant in relation to the costs of global warming control. In the midrange scenarios for both the control of domestic externalities and of global warming the binding fiscal constraint would limit the growth rate to 4.1%, as already mentioned, but this should not hide the fact that the growth rates bound by savings and the balance of payments increase from 6.4% to 7% and from 6.8% to 8.8%, respectively, when the low and high scenarios for global warming control are compared. Increasing the effort to control global warming with full external financing increases not only the slack concerning the foreign constraint but also makes the savings constraint less binding as the level of foreign savings is favorably affected.

Varying the proportion of global warming costs financed abroad has important consequences as for each 10% reduction in the share of costs financed abroad the impact on the relevant fiscal constraint is of 0.1% of GDP. This effect is entirely due to the impact of such reorientation on the fiscal constraint since there is no additional effect on the savings constraint.

In short, the average estimated net cost of controlling domestic externalities is in the region of 2.2% of reduced GDP growth. The rate of growth of GDP would be of 4.1% instead of 6.3%. Depending on negotiations on the financing of global warming control activities burden sharing could result in an additional reduction of GDP growth rates by up to one further percentage point, lowering the maximum feasible growth rate to around 3.1%. This underlines the difficulties that Brazil has to face to significantly contribute to global warming control, given competitive uses in relation to which there are much less serious externality appropriation problems. It also brings attention to the very significant reduction in achievable growth rates brought about by the implementation of policies designed to control poverty-related externalities.

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