A multisectoral distributional study of poverty reduction: The Bolivian PRSP

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1. Introduction

The Debt Initiative for the Heavily Indebted Poor Countries (HIPCs) entails action by the international financial community, including multilateral institutions, to reduce to sustainable levels the external debt burden of these countries. HIPCs participating in the Debt Initiative are encouraged to produce Poverty Reduction Strategy Papers (PRSPs), that is, wide documents in which the extent, nature and causes of poverty are analysed. PRSPs also formulate goals for poverty reduction, often on line with the United Nations Millennium Development Goals — of which the first is to halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day. However, PRSPs are usually not very specific about the policies necessary to attain the poverty reduction goals, and do not often include detailed analyses of the resources required and their availability. That is, the typical PRSP seldom contains a detailed feasibility analysis.

The Bolivian PRSP (EBRP, *Estrategia Boliviana de Reducción de la Pobreza*) contains an advanced study of poverty and its causes. It also includes ambitious goals for poverty reduction and other human development indicators. The incidence of extreme poverty, affecting 36 per cent of the population (according to the official definition) would for instance be more than halved by 2015. The EBRP is however rather parsimonious in relation to the measures and policies required to fulfil these ambitious targets. There are no projections of probable trajectories given present and intended policies, and no estimations of resulting income and poverty levels. That is, there is no formal macroeconomic framework estimating the resources — in particular, budgetary resources — necessary to attain stated poverty reduction goals.

The past pattern of growth, mainly based in primary production and natural resource extraction and export, was not effective in reducing poverty. In the last decades, poverty has been stagnant, in spite of a growth rate of about 4-5 per cent per annum (2.3 less in per capita terms). Output structure and the distributional (and class-) structure of the economy play a role in the resilience of poverty. The following section of this study contains a succinct characterization of Bolivian poverty. Section 3 is a summary description of the EBRP, particularly of those aspects that are relevant for the stylised picture of the EBRP that is needed for simulation purposes. Sections 2 and 3 are largely based in Buzaglo *et al.* (2002).

The fourth section presents the model used for simulating the effects of the EBRP. Sectoral investment is the dynamic principle of the model that links outputs in successive periods, thus determining sectoral output growth. Investment consists of an autonomous private component and a public component which represents the effects of different *investment policy* instruments. That is, investment policy influences the pattern of output growth. Another special characteristic of the model is that it includes a detailed description of income distribution at the sectoral level, i.e. the *income distribution policy* associated to a particular strategy. In order to determine with acceptable accuracy poverty levels resulting from different strategies (affecting output structure in different ways), an income distribution function by centiles in the distribution incomes by size (and by producing sector) is introduced. Incomes (by income class) determine consumption and savings. Total savings include an external component (equal to the trade balance), which adds to the external debt of the period. A mathematical and programming version, and a diagram of the model are presented in Appendix A. This fourth section also makes succinct reference to the estimated

values of the functions in the model, which are presented in Appendix B. A previous version of the model appears in Buzaglo *et al*. (2002).

The subsequent sections describe the results of analysing the EBRP by means of simulations with the model. Section 5 describes the consequences for the Bolivian (model) economy — particularly, for poverty reduction until 2015 — of assuming the investment and income distribution policies implicit in the EBRP, for the assumed stream of foreign savings resulting from the Debt Initiative for highly indebted poor countries. That is, the estimated model of Section 4 is solved for the investment policy sequence and income distribution parameters of a stylized EBRP, for assumed values of foreign saving. Given the negative answer of model simulation on the viability of the EBRP poverty reduction targets, Section 6 examines the question of how much foreign aid should Bolivia receive in order to fulfil the EBRP target for the reduction of extreme poverty. Assumption made of the EBRP investment and distribution policies, the model is solved for the inflow of foreign resources that is consistent with halving extreme poverty by 2015. Flows of foreign aid of such importance may not be forthcoming, and in Section 7 the problem of the (low) efficiency of investment is focused on. The (formally similar) question is now how much the efficiency of investments should ceteris paribus increase in order to make possible the fulfilment of poverty reduction goals. Section 7 analyses the question of the required *overall* increase in investment efficiency; in Section 8 the question of the poverty reduction impact of equivalent percent changes in sectoral investment efficiency is examined. The ceteris paribus effect on poverty reduction is determined for a given percent change in each sectoral investment efficiency coefficient taken separately — a kind of sectoral-investment-efficiency-elasticity (or in our notation, α_i -elasticity) of poverty reduction. Section 9 concludes.

2. A characterization of Bolivian poverty

According to official statistics, 63 percent of the Bolivian population is poor, and 36 percent of them live in extreme poverty, barely covering their minimal subsistence needs. A majority of the poor (60 percent) live in the countryside. The incidence of poverty in rural areas is 82 percent.

Urban poverty is mainly due to lack of employment possibilities in the formal economy, the proliferation of informal jobs, and permanent downward pressure on wages (Vos *et al*. 1998).[1] The excess supply of urban labour is supplemented by immigration from the countryside, as the main way out of rural poverty is the so called "exit path." The exit path out of rural poverty thus becomes just an exit towards urban poverty (de Janvry and Sadoulet 2000). The stringent structural reform policies initiated in the mid-80s, with extensive privatisation, liberalisation and deregulation, eliminated many jobs in the public sector (mainly in mining and railways) and in protected industries, without succeeding in creating enough employment in new, internationally competitive activities. Employment in the public sector declined sharply — from 46 percent of the workforce in 1989 to 33 percent in 1995 — while formal employment in the private sector increased very slowly. Employment has increased mainly in low income, informal activities such as home service, and among the self-employed. Informal employment increased from 45 to 55 percent of the workforce between 1990 and 1997 (ILO 1999).

[1] Several studies make similar observations; see e.g. Morales Anaya (2000), Jiménez and Wodon (1999), Pereyra and Jiménez (1998).

The causes of rural poverty can be traced to the dualistic structure of Bolivian agriculture, which has deepened in the last decades. Bolivian agriculture is divided in a modern capital-intensive sector, and a labour-intensive, food-crop producing sector. This later traditional sector is mostly comprised of poor small peasants belonging to one of the several indigenous ethnic groups, and is concentrated in the high plateau of the *Altiplano*. Modern large farms are mainly in the tropical lowlands, and specialized in soybeans production for export. Export-crop agriculture has expanded at a fast rate (9 per cent in average in 1980-1998), while traditional food-crop agriculture has stagnated (1,8 percent growth, less than population growth, 2.3 percent). An extreme land concentration is another symptom of high dualism — 81 percent of farms share 3 percent of the land, while the largest 1 percent of farms cover 78 percent of the productive surface (Morales Anaya 2000, Cuadro 5).

Traditional, labour-intensive agriculture occupies most of the rural population. Stagnation and low productivity in traditional agriculture thus explains a large part of the widespread rural poverty.

Low productivity and stagnation in traditional agriculture have negative economy-wide effects. Food supply has lagged behind population growth. Calorie intake per capita has stagnated since the 1970s. Food imports and food aid have steadily increased. Limited supplies of food have also negative distributive effects. Given an almost fixed supply, increasing demand for food — average incomes have been growing by about 1,5 percent per annum since the mid-1980s — has driven food prices up. Higher food prices, in turn, negatively affected the real incomes of the poor. Real incomes of high-income groups are less affected. Between 1989 and 1997 the Gini index of inequality increased by 12 percent, from 0.467 to 0.521 (Hernany *et al.* 2001, Cuadro 17).

To conclude this section, let us include a succinct characterization of Bolivian poverty (Vos *et al*. 1998), which is capable of informing a minimum of meaningful distinctions among relevant socio-economic groups:

- The incidence of poverty is highest amongst *workers*; 76 percent of them have incomes below the poverty line.
- Poverty is also widespread in the urban *informal sector*; 63 per cent of the self-employed are poor.
- The level of *education* is another important determinant of poverty; the incidence of poverty is more than 80 per cent for those with less than 6 years of school. However, poverty is also high (64 per cent) among those with 6 to 10 years of education, which suggests that extending basic education is not sufficient for reducing poverty.
- The illiteracy rate is 10 percentage points higher for *women* than for men (illiteracy is correlated with high fertility rates and child malnutrition).
- A relatively large share of the population belongs to some of the *indigenous ethnic groups*; 34 per cent of the urban population speaks an indigenous language. The returns of education are much lower (40 per cent) for indigenous workers, which points to discrimination in the labour market.
- Rural *smallholders* — most of them living in the highlands of the Altiplano and belonging to indigenous ethnic groups — represent about 60 percent of the poor. They lack of irrigation, credit or technical assistance.

3. The Bolivian Poverty Reduction Strategy

The EBRP (*Estrategia Boliviana de Reducción de la Pobreza*) contains the official analysis of Bolivian poverty, formulates goals aiming at alleviating it, and the policies which would lead to that goals (see Bolivia 2001, or http://www.ebrp.gov.bo/). An approved strategy paper is a condition for external debt reduction within the framework of the international financial institutions' initiative for highly indebted poor countries (HIPC II). Poverty reduction strategy papers are endorsed by the World Bank and IMF Boards as the basis of concessional assistance from these institutions. The elaboration of the strategy papers is thought off as a participatory process in which civil society is consulted. Also, the papers are conceived as "living documents," as flexible strategies that evolve with the ongoing discussion and evaluation (see *Poverty Reduction Strategy Sourcebook,* www.worldbank.org).

The approach of the EBRP follows closely the general framework for poverty analysis of the World Bank's report *Attacking Poverty* (World Bank 2001). Poverty is there analysed under three headings: opportunity, empowerment, and security. Opportunity refers to the possibility for poor people to have access to markets and to benefit from them. The EBRP singles out the lack of employment opportunities and of an educated and trained workforce as the two principal causes of poverty. The second cause, the lack of empowerment, or the lack of responsiveness of state institutions to poor people, is attributed in the EBRP to the weakness and marginalization of the social organizations of the poor. The third aspect, security, refers to the vulnerability of the poor to different kinds of risks, and the difficulty of improving their capacity to manage risk. The kind of risk that the EBRP focuses on is the uncertainty concerning property rights in agriculture.

With the exception of the third point — property rights in agriculture — the EBRP focus on the relevant problems. As mentioned in the previous section, poverty in traditional agriculture seems to be associated to lack of basic social services and infrastructure, and to lack of productivity-enhancing rural programs (land redistribution, irrigation, credit, technical assistance, etc.). But formal land titling does not seem to be the most important ingredient of a rural strategy at very low levels of land ownership and incomes.[2]

This much about the etiology of poverty. When it comes to policy and strategy, the ERBP becomes inconsistent. The ERBP strategy maintains the focus of the past pattern of growth in capital intensive, primary sectors that contribute little to employment creation, such as gas, oil, minerals and soybeans.[3] The EBRP has not any clear indication either of the policy to be

[2] Cf. the following conclusions from recent studies of Latin American agriculture: "The standard liberalization package of right prices, right institutions and macro stability may not suffice to include the poor in agrarian growth. Indeed, a 'right institutions' policy of providing formal land titling may only serve to generalize and make marketable to outsiders what had been locally secure, smallholder tenure. Perhaps useful to get growth moving, such efforts are likely to work by moving smallholders out, as to include them in the boom." (Carter and Coles 1998, p. 173.) "When credit markets are imperfect titling programs can easily favour the better-off." (Deininger and Binswanger, 2001, p. 408.)

[3] The EBRP has recently been revised and some changes have been introduced (Bolivia 2003). The revised EBRP keeps however its targets and general strategic approach. Our comments should apply also to the revised EBRP.

followed towards traditional agriculture, the sector which concentrates 60 per cent of the poor.[4]

The absence in the EBRP of an analysis of the effects of different multisectoral output patterns on growth, income distribution and poverty is a serious drawback.

Several studies have shown that the pattern of output growth and trade specialization are critically important for income growth and poverty reduction. Sectoral specialization patterns as that of Bolivia, based on natural resource extraction and agricultural export crops have been shown not to be propitious to domestic income growth and progressive redistribution. Statistical cross-country studies have found that inequality is positively correlated with a pattern of primary export specialization (Bourguignon and Morrison 1990). Other, similar studies show that the ratio of natural resource exports to GDP is negatively correlated with growth (e.g. Sachs and Warner 1995). The share of primary exports in total exports seems to be one of the few variables systematically correlated with growth — with a negative sign (Sala-i-Martin 1997; see also Ros 2000, Ch. 9). In countries with fragile institutional structures and democratically undeveloped polities, natural resource based development may also have negative political economy effects such as corruption and capture of the state by parasitic cliques (Leite and Weidman 1999).

Empirical studies conducted within multisectoral frameworks have shown that the pattern of growth matters for the poor. Agricultural sector growth has the most significant effect in reducing poverty (see e.g. Mellor 1999, Ravaillon and Datt 1996, Timmer 1994, White and Anderson 2000).

The importance of agriculture, and in particular, food crops agriculture, for poverty alleviation and a more equal income distribution has been illuminated from several angles in recent years. According to Bourguignon and Morrison (1998), increased growth in the agricultural sector is the most effective way of attaining a more equal income distribution and reducing poverty. As reported in a survey of the subject by Bigsten and Levin (2000), dualism in the rural economy has been singled out as an important causal factor in explaining inequality. Another study based on wide survey of the literature (Lipton and Ravaillon 1995) emphasizes the critical role of agriculture in sustaining a pro-poor pattern of development: "The key sector identified for pro-poor growth in most LDCs is the rural farming sector. Agricultural growth, especially growth and stabilization of food staples production, is likely to benefit poor people." (p. 2608.)

As it has been shown by several authors (see Kalecki 1954, Basu 1984, Ch. 3), in the context of the less developed economy with limited supply of foreign resources, the pattern of output growth sets a limit on income redistribution or poverty reduction. With the growth of the incomes of the poor, the demand for food increases more than proportionally, as the income elasticity of the demand for food and other essential goods is relatively high for low-income groups. Given by assumption a limited capacity to import these goods, the possibility of augmenting the real incomes of the poor rests on the possibility for the agricultural sector of increasing the output of food at a sufficient rate, that is, above the rate of expansion of the

[4] More generally, there is in the EBRP a lack of analysis of the relationship between the policies and actions proposed by the strategy and their expected results. The EBRP lacks of a specification of the cost of the programs aimed to reduce poverty. It also lacks of an estimation of the impact of these programs on poverty indicators. The EBRP is therefore unable to tell if it is effective in attaining its aims and goals, and *a fortiori* unable to tell if it is the "best" strategy in some sense.

economy at large. The impossibility for agriculture to grow at a pace compatible with the rate of growth in food demand gives rise to price increases, and to reduced real wages and real incomes of the poor.

4. A model of poverty reduction strategy

The model in this study brings to a focus two critical aspects of the development and poverty reduction process, namely output structure and the structure of income distribution. In the model, the evolution over time of the multisectoral output structure is influenced by sectoral investment, which determines sectoral output growth (given the level of investment efficiency specific to the different sectors). The structure of the multisectoral distribution of incomes by size directly influences the incidence of poverty (lower income shares for low income groups imply greater poverty), and indirectly influences overall growth, trough its effect on the level of saving. In this section, we will succinctly describe the model, with somewhat more of attention given to the parts that are new for the present study. A complete mathematical description is given in Appendix A. Appendix B presents the estimated values of functions and parameters for Bolivia.

Thus, the central equation of the model, which determines the economy's evolution through time is the difference equation:

$$x_{t+1} = \alpha^{-1} d_t + x_t \qquad (1)$$

That is, the time-path of the *n*-vector of sectoral outputs x_t depends on the sectoral coefficients of investment efficiency α^{-1} (a diagonal *n*-matrix) and on the sectoral investments d_t (an *n*-vector). Investments are here defined in a very wide sense, as the cost, in terms of consumption sacrificed, of changing (hopefully of improving) economic arrangements. Changes in economic arrangements require investment, and by changing the world, create fresh investment opportunities (see Scott 1991, 1993). At a somewhat less abstract level, investment may be understood as the creation of productive capacities and capabilities, physical and human, material and immaterial. The relevant relationship is here the direct link between investment and output growth — not necessarily mediated by capital stocks.

The model of equation (1) can be compared to "*AK* models" within the wide strand of endogenous growth models (see e.g. Pack 1994). In effect, the structure of many recent growth models can be reduced to the form:

$$Y = A\ K \qquad (2)$$

or, in differential form

$$\Delta Y = A \Delta K \qquad (3)$$

in which *A* represents factors reflecting technology, and *K* includes both human and physical capital. In the *AK* model, the rate of growth (linearly) depends on the rate of investment. That is, an important common feature of these endogenous growth models is that an increase in the rate of investment could lead to sustained growth. However, while the

models of equations (2) and (3) show constant returns to scale, the multisectoral structure of the model of equation (1) gives rise to non-constant returns. Model (1), although showing constant returns at the sectoral level, gives rise to non-constant returns through changes in the sectoral composition of output — except of course in the case of equiproportional growth.

Since at least Rosenstein-Rodan (1943), one of the most prominent ideas of development economics is that investment is essential for growth, and that the coordination of investments across sectors is essential for industrialization. Recent models have extended to the open developing economy Rosenstein's ideas about coordination failures and "low-level-equilibrium traps." As surveyed by Bardhan (1995) and Rodrik (1995), in the new models, the role of development policy is to help to find a way out of the trap of low-productivity specialization, encouraging — either by trade policy or by subsidization — appropriate linkages and strategic complementation among sectors.[5] Coordination of investments may also be the key to high "animal spirits," and positive expectations about investment by other firms — the task of development policy is to coordinate expectations around high investment.

The experience of most successful developing countries in recent decades also confirms the importance of clear and consistent investment strategies. The cases of the east Asian economies are today well-known. These countries successfully implemented policies such as trade protection, selective credit subsidies, discriminatory export subsidies, physical export targets fixed at the level of individual firms, and price controls.[6] Even Chile, often shown as the prototype of the laissez faire, Washington consensus type of policy (Williamson 1990) has in fact been a successful investment planner. According to Moguillansky and Bielschowsky (2001, p. 38.) “the State played [in Chile] a much more important role in this process [of investment dynamism] than is normally acknowledged.”

What is less well known, however, is the fact that all developed countries of today have applied, at the initial stages of their industrial development, different types of investment policies. All now-developed countries — with the possible exceptions of Holland and Switzerland — have once applied the policies that they today discourage in the international financial and economic organizations in which they have a dominant role. This policy of discouraging the use by poorer countries of the tools that once made their prosperity has been graphically called “kicking away the ladder” (Chang 2002).[7]

At any rate, it seems to exist a growing consensus about a role for the government in encouraging a higher level of investment, and a higher efficiency for investment activity. A clear domestic investment strategy is indeed seen as the key to success or failure in the globalized economy of today (Rodrik 1999). Yet the best formulation of the role of investment policy seems still to be that given by Keynes (1936, p. 164), that is, that of organizing investment on long views and on the basis of the general social advantage, taking into account the efficiency of investments. Since Keynes, however, theoretical frameworks have evolved only slowly, and even today "the need to develop practical economically

[5] See in particular Murphy *et al.* (1989a, 1989b). For a survey of this strand of models of multiple equilibria and path dependence, see Rodríguez-Clare (1997).
[6] See e.g. Amsden *et al*. (1994), Chang and Rowthorn (1995), Lall and Teubal (1998), Wade (1990).
[7] According to Stern and Stiglitz (1997, p. 291), “in the United States the government paid for the first telegraph line and developed the Internet. It played a major role in the enormous increases in productivity in agriculture. It engaged in basic research that led to important surges in the biotechnology industry. In many countries the civilian aeronautics industry (including the jet engine) has been heavily influenced by military research. Government-sponsored research (or research in regulated industries) was responsible for the transistor, the laser, the computer and many of the other innovations that have transformed modern society.”

oriented guidance on inter-sectoral spending choices remains a priority item on the conceptual agenda." (Jimenez 1995, p. 2803.)

In order to specify an investment policy in the model of equation (1), let us distinguish between private investment d_t^p, and public investment d_t^g, of which sectoral investment d_t is the sum. Total investment equals total savings, and we assume for simplicity that the overall equality between savings and investment also applies for the private and public sector taken separately. Then, in the context of the model, given endogenously determined public saving s_t^g (a scalar), public investment is determined by investment policy:

$$d_t^g = z_t^g \, s_t^g \,, \qquad (4)$$

where z_t^g is a vector of public investment allocation shares.[8] An *investment policy* is a time sequence $\{ z_t^g \}$ of public investment allocation shares. A $\{ z_t^g \}$ sequence can be exogenously given, as for instance in a historical simulation, or when some particular policy is tested, or it can be also determined by optimization of some expression of social welfare. In the present study, in which the effects of the EBRP are explored, in all simulations the $\{ z_t^g \}$ sequence will be exogenously given.

Private investment, on the other hand, endogenously allocates private savings. A robust and — within the context of the model — quite natural theory for private investment allocation is the accelerator function.[9]

The second critical aspect brought to a focus by the model in this study is the structure of income distribution. In order to arrive to the representation of income distribution, let us briefly describe the determination of saving and consumption from incomes generated in production.

Total savings are the sum of domestic plus foreign savings (equal to the trade deficit). Exogenously given foreign savings φ_t are added (at an equal rate) to private and public saving, thus increasing the volume of funds available for domestic investment. Also, foreign savings add to the external debt of the period, and the effect of the rate of interest on debt growth is included (see equations (11) to (14) in Appendix A). In Section 6, the problem is posed of finding the (constant) stream of foreign resources φ_t required during 2000-2015 for halving extreme poverty by 2015.

[8] Let us recall that our definition of investment is rather wide. That is, public investment encompasses all activities aimed at improving economic arrangements. It represents the cost (in terms of consumption sacrificed) of the traditional investment in infrastructure or public/mixed enterprises, but also all other types of investments (or investment policies implying costs).

[9] Private sectoral investments are: $d_t^p = z_t^p \, s_t^p$, where: $z_t^p = \dfrac{\alpha(x_t - x_{t-1})}{\iota' \alpha(x_t - x_{t-1})}$, in which ι is a summing vector (1,1,…,1)'. (The estimated function is a distributed accelerator including three previous periods, see Appendix B eq.(15).)

Domestic savings in the model are simply non-consumed incomes:

$$s_t^* = y_t - c_t, \tag{5}$$

in which s_t^* is a *k*-vector of saving by income group (where the public sector is an income group), y_t is a *k*-vector of incomes by group, and c_t is a *k*-vector of consumption demands by income group.

Consumption by type of output is of the form:

$$c_t^* = \Gamma \; y_t, \tag{6}$$

where c_t^* is now an *n*-vector of consumption demands, and Γ is a $(n \times k)$ matrix of consumption propensities. (Consumption *by income group,* c_t, is obtained by trasposing and diagonalising the Γ matrix.)

Now, incomes by group y_t (a *k*-vector) depend linearly on sectoral gross outputs x_t:

$$y_t = V_t \; x_t, \tag{7}$$

in which V_t is a $k \times n$ matrix of shares of income (value added) by income-group, specific to each production sector. V_t may be assumed to be exogenously determined by historical or socio-political factors, or also to represent the effects of policy instruments.[10] A sequence $\{V_t\}$ of such matrices is called, in the context of the model, an *income distribution policy*. A given triplet $\{z_t^g\}$, $\{V_t\}$ and $\{\varphi_t\}$ of (investment, income distribution and external debt) policy sequences is a *development strategy*, or in the context of the present study, a *poverty reduction strategy*.

The V_t matrix of sectoral income distribution may assume different specifications. One type of specification analyses the sectoral distribution of income among *k* different *socio-economic groups*. This type of disaggregation is an important instrument for understanding the socio-economic dynamics of development.[11] But the analysis of poverty and poverty reduction policy requires also a representation of the *size distribution* of incomes. Unless defined very narrowly, socio-economic groups may include both poor and non-poor households. Thus, a $(10 \times n)$ matrix V_t^* is defined, describing the sectoral income shares by deciles. The *10*-dimensional vector:

$$y_t^* = V_t^* \; x_t \tag{8}$$

[10] Income distribution policy includes asset redistribution (e.g. land reform), tax policy, and public expenditure policy (education, health, infrastructure, etc.). Macroeconomic policies such as monetary (interest rate) and aggregate demand policies have also in general distributive effects.

[11] See Adelman and Robinson (1989, p. 965). For a survey of extended functional distribution in the context of input-output and SAM models see, respectively, Batey and Rose (1990) and Pyatt (1991).

gives now the overall size distribution of incomes by deciles, with its elements showing the income of the corresponding decile.

Given the poverty line income y^o (a scalar), the sum of deciles of y_t^* under the poverty line gives the number of deciles affected of poverty in period *t.* Now, it may not be satisfactory to have a poverty measure that changes by steps of 10 percentage points. Let us therefore assume that, within each decile, the distribution of income is unchanged during the period of analysis, and that the original distribution *within deciles* applies. In order to get a poverty measure that changes by steps of one percentage point, let us introduce the matrix $\beta = [\beta_{ij}]$. β shows, in each column *j*, the distribution by subdeciles *i* within decile *j*. β_{13}, for instance, denotes the income share of subdecile 3 within decile 1. By means of matrix β, incomes by subdecile can be calculated, as:

$$\tilde{y}_t = \hat{y}_t^* \, \beta, \qquad (9)$$

in which $\tilde{y}_t$ is a (10×10) *table* showing incomes by subdeciles. The ^ symbol over the y_t^* vector of incomes by decile means diagonalization, i.e., $\hat{y}_t^*$ is a diagonal (10×10) matrix.

Given the poverty line y^o, the incidence of poverty in period *t* can be calculated from table $\tilde{y}_t$. Poverty incidence is given by the element of table $\tilde{y}_t$ that is closest to y^o. That is if element $[\tilde{y}_{ij}]_t$ is closest to y^o, then the share of the poor is ij.[12]

Now, given the incidence of poverty in the period, the *number of the poor* can be calculated as an index number, with $t_0 = 100$, as:

$$\frac{inc_t}{inc_0} \; e^{gt} \times 100, \qquad (10)$$

where inc_t is the incidence of poverty in period t, and g is the (exponential) rate of population growth.

Matrix *V** for Bolivia in year 2000 is presented in Appendix B. It is maintained without changes in the EBRP simulations, as the strategy does not propound any particular redistributive policy. That is, the simulations will assume a constant $\{V_t\}$ sequence, a status quo distribution policy.

We have now the model elements required to generate development strategies and to determine their effects on poverty. Given: (a) initial outputs x_0, x_{-1}, (b) investment efficiency and consumption parameters α^{-1} and Γ, (c) the policy sequences $\{z_t^g\}$, $\{V_t\}$ and $\{\varphi_t\}$, the model can be recursively solved forward in time so as to determine sectoral output

[12] The calculus of the incidence of poverty in Appendix A (eqs. 24 to 28) is slightly different, due to occasional data unavailability at very detailed disaggregation levels (*k*=100; *n*=12). Average incomes are first calculated for every cell of the *V** matrix and compared to the poverty line. Members of cells with incomes less than the poverty line are then added.

trajectories.[13] Associated income levels are obtained from output trajectories — given sectoral distribution structures. Income levels (by income class) in turn determine poverty incidence — for a given poverty line. Appendix B shows the values of initial outputs, investment efficiency and consumption parameters of the EBRP simulations. The adopted poverty lines are one US dollar per day for extreme poverty and two dollars for poverty.

Let us include finally the functions that allow to complete the picture of the economy's Social Accounting Matrix. In other to enquire into the sectoral balances between supplies and demands, we will distinguish among: (i) consumption demands, (ii) intermediate demands, and (iii) investment demands. Consumption demands by type of product where described in equation (6). Intermediate demands result immediately as the product Ax_t, given the $(n \times n)$ A matrix of technical coefficients. Investment demands f_t are related to investment by destination d_t through a capital coefficients $(n \times n)$ matrix B, of sectoral composition by sector of origin of investments by destination — i.e. $f_t = Bd_t$.[14]

Let us define b_t, the n-vector of sectoral excess demands, as the difference between sectoral supplies and demands:

$$b_t = x_t - c_t - Ax_t - f_t. \qquad (12)$$

When all output is internationally tradable and world prices prevail in the economy, b_t represents sectoral trade balances, i.e. positive elements are net exports and negative elements are net imports. The b_t vector thus reflects the effect of the strategy on the pattern of international specialization.

Finally, in order to evaluate the effectiveness of the strategy in generating employment, a $(k \times n)$ matrix of employment coefficients by type of labour Λ is defined, and a k-vector of employment ℓ_t is so determined:

$$\ell_t = \Lambda x_t \qquad (13)$$

The technical, capital and employment coefficients matrices (respectively A, B and Λ) of the present study are shown in Appendix B.

5. Simulating the EBRP

The EBRP is not explicit about its desired pattern of growth. It does not seem to be aware of the importance of the multisectoral structure of output documented in sections 2 and 3. However, decisions about sectoral priorities and investment policies are rarely taken in a political vacuum, by the government maximizing a social preference function under the restrictions of the best informed model of the economy. Decisions affecting the evolution of trade specialization and sectoral output patterns seem most often to be the result of the

[13] The Bolivian model is formulated and solved within the general algebraic modelling system GAMS (see e.g. Brooke *et al.* 1992).

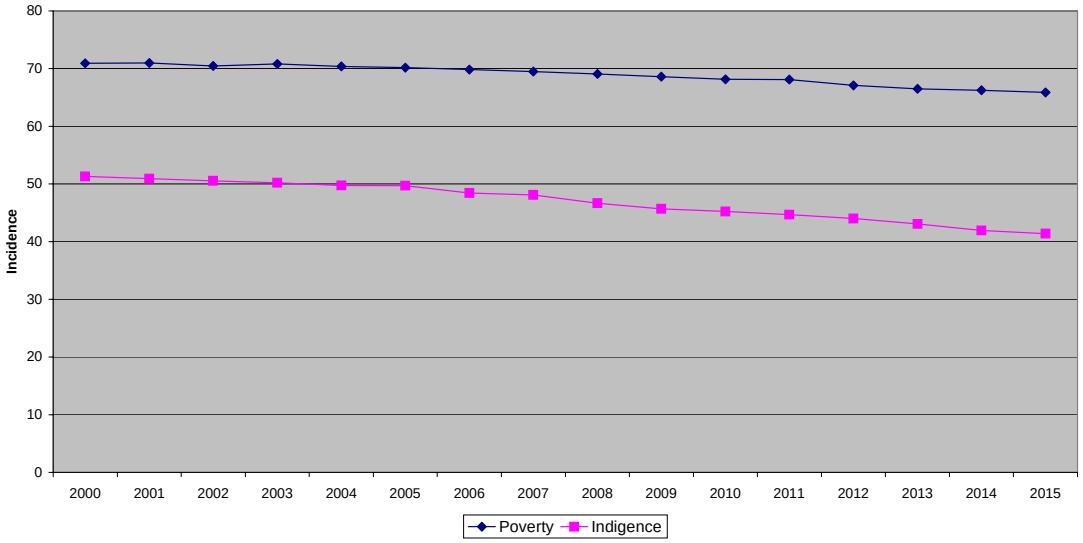
[14] On the capital coefficients matrix, see e.g. Taylor (1990). Keuning (1996) estimates a capital table for Indonesia within the framework of a SAM.

complex interplay of a whole constellation of economic, social and political forces — often unconscious of the decisions' ultimate effects. In the Bolivian case, it would seem that the social and economic forces with most influence in the evolution of the economy are those that — beyond any systematic strategic thinking — are interested in the continued expansion of natural resource output and export. The "stylized fact" about the EBRP investment policy is that the EBRP evidences a preference for maintaining the present specialization and output pattern, that is, of continuing with the investment policy of the recent past.

It is also difficult to dispel the income distribution policy of the EBRP. Initial versions of the EBRP postulated poverty reduction through overall economic growth, along with specific programs for targeted groups. This formulation does not appear in later versions, but the approach of the EBRP still seems to be to continue with the present development model and its associated distributional pattern, adding now a set of assistance programs targeted towards the poor. Tax policy, a crucial instrument of redistribution policy and an indicator of distributional preferences, does not show any change. The tax system, which has a low and regressive profile, does not seem to be a candidate for reform. Our stylized interpretation of the EBRP distribution policy is that it will be unchanged.

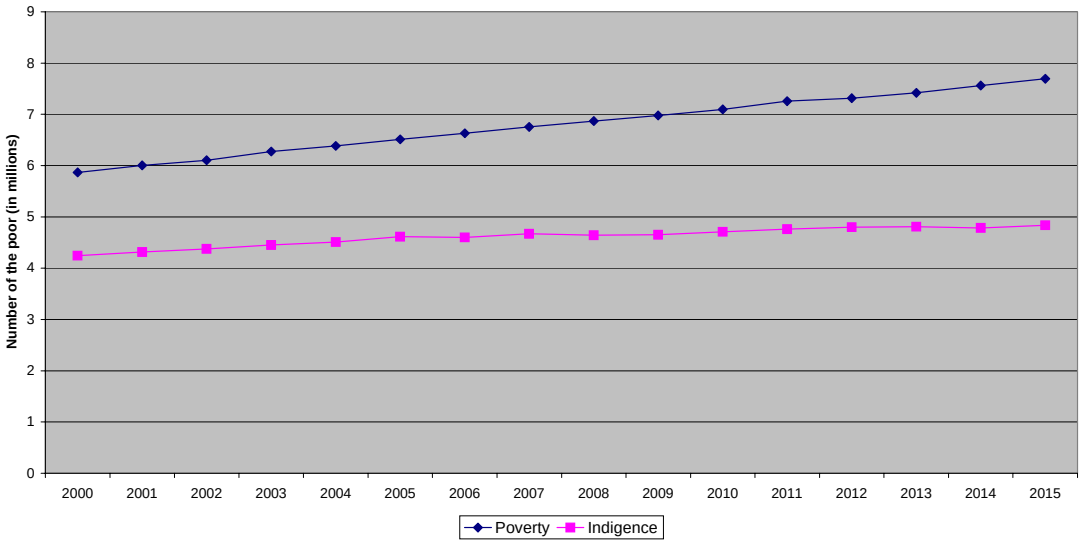
Along with investment policy and distribution policy, the model of the previous section assumes a third policy variable that — within certain limits — is available for poverty reduction policy, namely foreign saving. The net inflow of foreign resources — equivalent to the trade deficit — adds to the investment and growth potential of the economy. The HIPC Initiative of the international financial organizations has reduced the external debt of Bolivia. Debt relief diminishes future outflows and increases the growth capacity of the economy.

The above interpretation of the EBRP as rather stationary makes our EBRP simulation similar to a basic or status quo scenario. Development strategy is unchanged, with the only exception of foreign savings φ_t, now increased by the HIPC debt relief. The assumed values of investment policy $\{z_t^g\}$ and distribution policy $\{V_t^*\}$ appear in Appendix B. They are constant for 2000-2015.



The above figure shows the evolution of poverty and extreme poverty incidence in 2000-2015 for the EBRP simulation. The initial values of poverty and indigence (71 and 50 percent) are higher than the official figures (63 and 36 percent) due to different poverty lines, defined in this study as 1 and 2 US dollars a day respectively. It is clear that under our assumptions the EBRP does not succeed in halving extreme poverty by 2015. Indigence decreases by 18 percent. The effect on overall poverty is even less.

The following figure shows the effects of the strategy on the number of the poor.



The rate of poverty reduction is less than the rate of population growth (2.3 percent), and the number of people under the poverty lines increases. It increases only slightly for the extremely poor (14 percent), and more markedly for those under the 2 dollar line (31 percent).

In fact, the revised version of the EBRP (Bolivia 2003) implicitly admits that the poverty reduction objectives will not be attained under present conditions. It admits that a growth rate twice as high as that of the last two decades, or alternatively, a reduction in the Gini index of inequality of one percentage point a year until 2015 would be necessary. But the policies required to produce such results do not seem to be available.

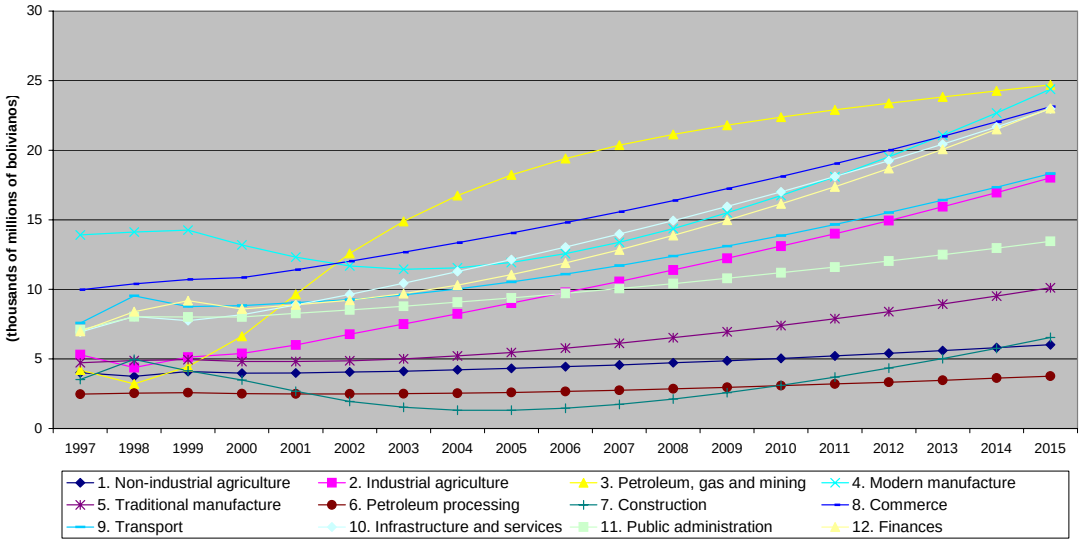
The overall growth performance of the EBRP simulation is indeed not that bad; the average rate of growth in 2000-2015 is 5.7 percent (3.4 in per capita terms). From the perspective of the serious recession which affects Bolivia since 1999 — output in per capita terms has stagnated since then — the EBRP simulation may be said to be too optimistic. The growth potential of the Bolivian model is mainly determined by data from before the recession and is not affected by the pessimism prevailing since then.[15] But what is needed for halving extreme poverty in the context of the EBRP pattern of growth is twice faster growth, *in per capita terms*. As shown by the *EBRP+aid* scenario of the next section, the per capita average output

[15] Growth in the model is decisively influenced by the coefficients of investment efficiency α^{-1} (see eq. (1) in Section 4). They were calculated for the present study by (least squares) optimization, so as to track past sectoral output growth in 1990-1997 as accurately as possible (see Appendix B). That is, α s in the model do not include the drag effect of the post-1998 "growth collapse" (Auty and Evia 2001). This effect is still (May 2004) impossible to include, as the required figures are not yet available.

growth rate required for halving indigence in the framework of the simulated EBRP is 7 percent.

We now include a figure summarizing the simulated EBRP effects on the output pattern of growth. The investment policy of the EBRP accelerates the growth of the oil, gas and mining sector, and this sector becomes rapidly the most important sector, although its relative importance diminishes with time. Modern, export crop agriculture also follows a path of rapid expansion. Food crop, traditional agriculture, on the other hand, continues its past stagnating trend, and its share in total output is further reduced. This multisectoral pattern of growth is particularly detrimental to poverty reduction, as a major part of the poor work within the traditional agricultural sector. Also, the natural resource and primary export sectors have few links with the rest of the economy and low labour/output ratios. Both sectors have additionally relatively unequal own income distribution structures.

From the multisectoral perspective of the present study the EBRP fails in significantly reducing poverty due to both the low overall growth capacity of the economy and the unhelpful pattern of growth adopted. A more helpful growth pattern should imply a reduction in the growth effort required for achieving the same poverty reduction goals.



To close this section, we would like to inform the interested reader that a summary social accounting matrix for 2005, showing the main aggregated variables and consistency relations inherent to the model, may be found in Appendix C.

6. External aid and the EBRP

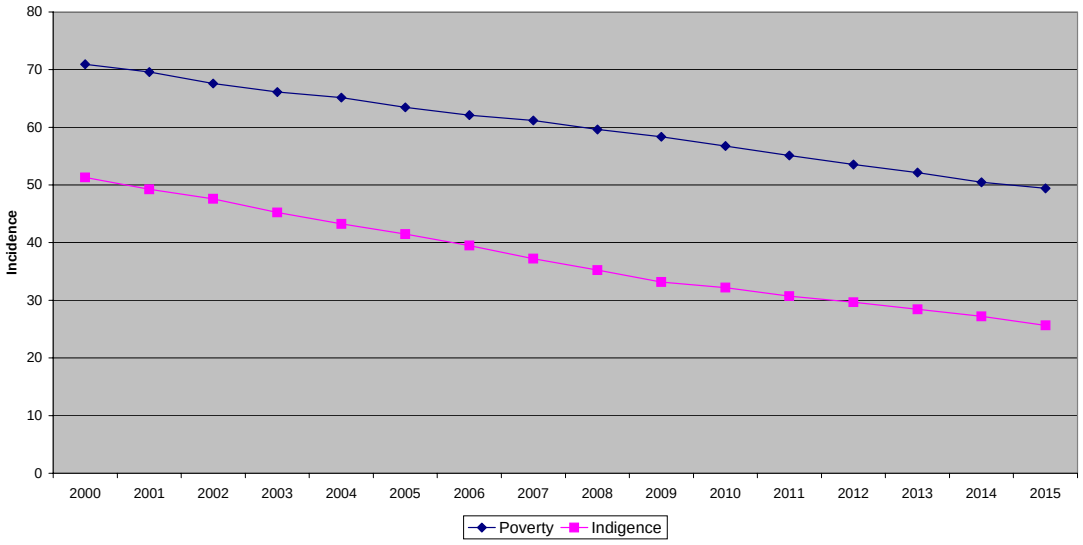
The results of the previous section are pessimistic about the possibility for Bolivia of halving the incidence of extreme poverty by 2015, as aimed by the EBRP. The same view is expressed in the revised version of the strategy (Bolivia 2003) and by the World Bank (2003).[16] What could be done for making the EBRP able to fulfil its poverty targets? An idea that comes naturally to the mind is external aid. External aid has been helpful in reducing the

[16] See also Baird and Shetty (2003).

external debt burden within the framework of the HIPC Initiative, but Bolivian growth is still much lower than required for significant poverty reduction. Also, international aid is very low in relation to the developed countries BNP, and much less than ambitioned by the international community (0.7 percent).

A natural experiment with the model within the context of the EBRP strategy is then to ask how much development assistance is required for Bolivia to attain the poverty reduction targets by 2015.[17] To answer this question, the model is solved for the value of φ (constant over the period) that ensures that poverty by 2015 is one half of poverty in 2000, for the EBRP investment and income distribution policies $\{z_t^g\}$ and $\{V_t *\}$.[18] A ceteris paribus change in the inflow of external resources within the EBRP strategy context is simulated, a kind of *EBRP+aid* scenario.

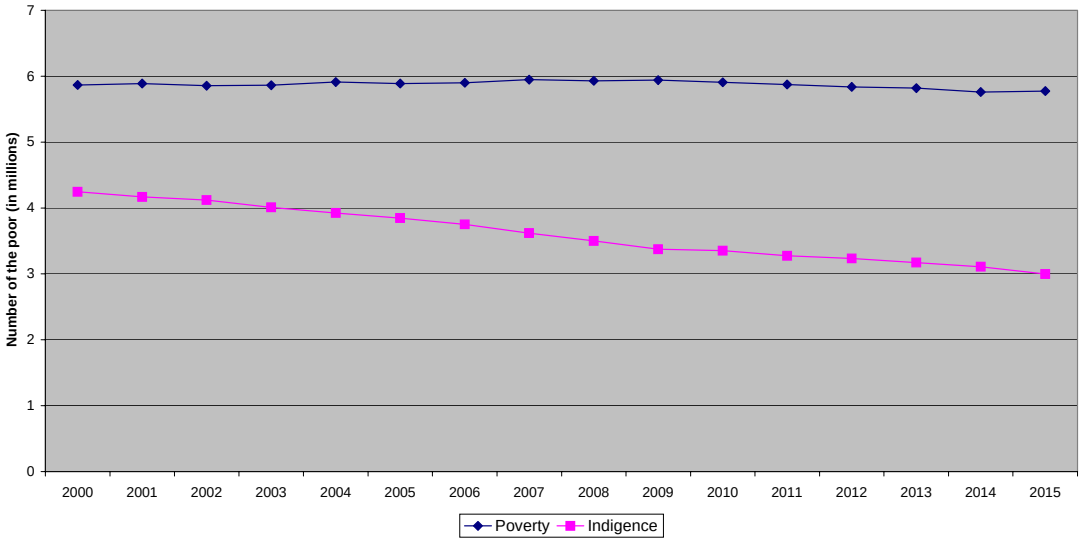
As shown by the figure below, given an unlimited supply of foreign aid, it is theoretically possible for the EBRP to halve extreme poverty. Poverty and indigence gradually diminish, and extreme poverty attains the target value by 2015.



The number of people in extreme poverty (shown in the figure below) is more resilient than the incidence of extreme poverty. Due to population growth, in 2015 there are still 3 million indigents. The number of people under 2 dollars a day has barely changed.

[17] The World Bank (2003) study also estimates required amounts of external aid for attaining the Millennium Development Goals in a sample of countries. The model used is the aggregated *AK* model of equation (2) in Section 4 (Devarajan *et al.* 2002).

[18] Closer to the technical formulation of the problem, one should say that the solution is the minimum value of the multiple of φ that satisfies the constraints of the model, included that poverty in 2015 is ½ of poverty in 2000. The optimization algorithm used is based on Wolfe's reduced gradient method (see Abadie and Carpentier 1965; Drud 1985, 1992).



The required increase in the inflow of foreign resources in order to attain the EBRP indigence target with unchanged investment and distribution policies is however huge. The required net inflow of foreign savings is 6.5 times the current value of 400 million dollars assumed in the EBRP simulation of the previous section.

The growth effort implied by the scenario is also big; the average growth rate for 2000-2015 is 9.3 percent (7 percent in per capita terms). The investment policy of the strategy is identical with that of the EBRP simulation in the previous section, and the *EBRP+aid* multisectoral pattern of growth closely follows the EBRP pattern shown above. The only difference is the scale, which implies higher levels of output. The petroleum, gas and mining sector, which as before is the leading sector, more than triplicates its output in the period.[19]

7. Structural reform: increasing investment efficiency

In the last decades, several international meetings have been devoted to the problems faced by low income countries. Frequently, the consensus conclusions of these meetings emphasise the importance of increasing international development assistance — and of reducing agricultural (and other) protectionism affecting less developed economies. In these two fronts the progress has been very slow, but even if it accelerates in the future, it is unrealistic to assume that foreign aid could reach the levels required for Bolivia according to the scenario of the previous section.

In this section, we will assume that greater amounts of international aid will not be forthcoming, and we will turn our focus toward the dynamic efficiency of the domestic economy. In the model of Section 4, dynamic efficiency is manifested in the level of investment efficiency, our α^{-1}s.[20] Ceteris paribus, the lower the α s, the higher the rate of growth.

[19] The *EBRP+aid* sectoral output series is included in Appendix C.

[20] See equation (1). We define sectoral investment efficiency as the inverse of α_i , the sectoral marginal capital/output ratio.

In this section, we will assume an overall increase in the efficiency of investment, benefiting all sectors indifferently. Our stylized structural reform in the context of the EBRP will be oriented to improve the overall "investment climate," and will not be concerned with the type of investment policies discussed in Section 4. Policy and institutional reforms often mentioned as improving investment climate include ensuring property rights and the rule of law, and enhancing the quality of governance and capacity in the public sector.[21]

The problem in this section is then to find the multiple of the α vector which is consistent with a halving of absolute poverty by 2015, when all other parameters of the EBRP simulation are kept unchanged. That is, the model is solved for the value of the multiple of α that ensures that poverty by 2015 is one half of poverty in 2000, for the EBRP investment and income distribution policies $\{z_t^g\}$ and $\{V_t^*\}$.[22]

As it could be expected given the results of the simulation in the last section, a huge increase in investment efficiency is needed for attaining the EBRP poverty reduction goals with unchanged investment and distribution policies. The level of investment efficiency compatible with halving extreme poverty in 2015 is 57.6 percent higher than the current level of efficiency.[23]

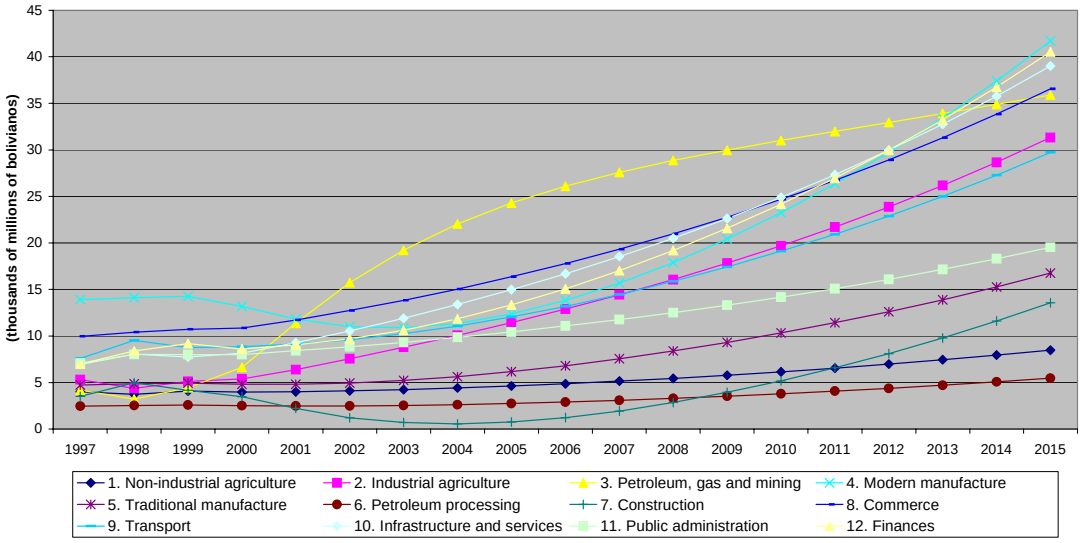
As in the *EBRP+aid* simulation, radically increased investment efficiency succeeds in gradually reducing the incidence of poverty and extreme poverty until 2015. The trajectories are practically the same as those of the *EBRP+aid* simulation shown in the previous section. The same applies to the absolute numbers of poor and indigent people, which follow the same pattern as the preceding simulation; the number of the poor is more or less unchanged, while the number of the extremely poor diminishes by 31 percent.

The assumed overall increase in the efficiency of investments slightly changes the EBRP sectoral pattern of growth. In comparison with the two preceding simulations, the petroleum, gas and mining sector has slightly lost in importance (see the figure below). The "petroleum intensity" of the EBRP becomes less pronounced, and four sectors, modern manufacture (04), finances (12), infrastructure and services (10), and commerce (08) surpass the oil sector towards the end of the period.

[21] See e.g. Baird and Shetty (2003). However, they admit that in order to attain the Millennium Development Goals in some cases "it will be necessary to implement sectoral policies and reorient public expenditure to make the pattern of growth more pro-poor." (p. 16)

[22] The solution is the maximum value of the multiple of α that satisfies the constraints of the model, included that poverty in 2015 is ½ of poverty in 2000. The computational solver is the same as in the previous problem (see Note 18).

[23] That is, 57.6 percent higher than the average level of investment efficiency in 1990-1997 (see Appendix B). In the solution, the EBRP α s are multiplied by 0.6346.



8. The α_i-elasticity of poverty within the EBRP

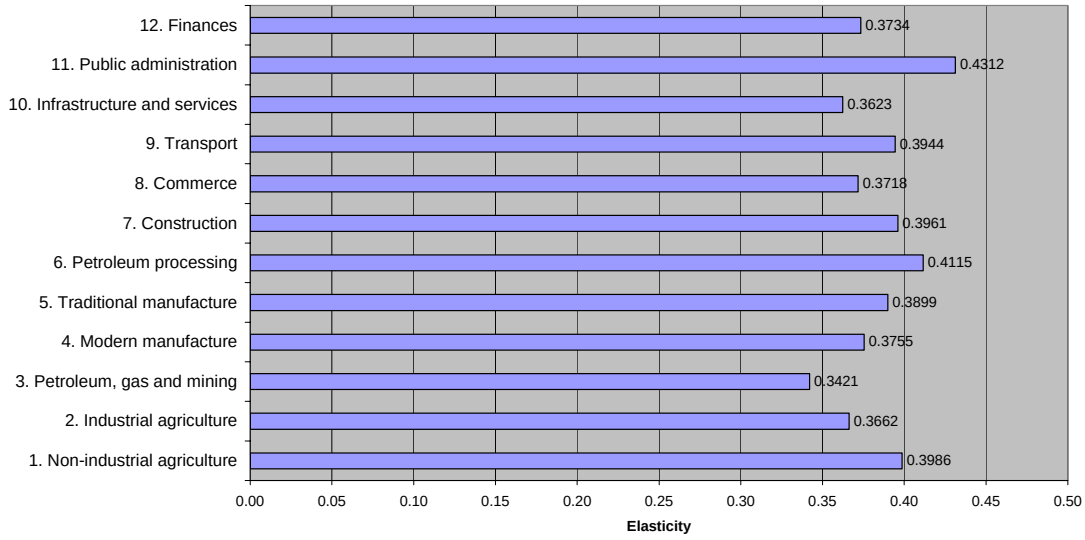
In this section, we examine the response of poverty to changes in the efficiency of investment in the different activity sectors, taken separately. Within the context of the EBRP, we investigate the impact on poverty reduction — as indicated by our model of the Bolivian economy — of a given increase in the sectors' own investment efficiency, all other things being equal — including investment efficiency in other sectors.

We will inquire then, for every sector, which is the poverty level that results (by 2015) when we assume a given percentage change in the efficiency of investment in one sector, all other things equal. That indicates the elasticity of poverty incidence to a ceteris paribus change in particular investment efficiency coefficients, within the context of the EBRP. For simplicity we call it α_i-elasticity of poverty.

The EBRP simulation of Section 5 is thus repeated as many times as there are sectors, with only one parameter changed in each simulation. The only difference in each successive simulation is that the investment efficiency coefficient pertaining to one sector is increased by a constant factor.

When interpreting the results of the computations, it is important to keep in mind that the figure indicates the impact of a particular α_i on overall poverty *within the context of the EBRP*, i.e. in particular, for a given investment policy and its associated multisectoral output pattern. The figure below shows the effect on the incidence of extreme poverty of doubling the efficiency of investment of the sector, all other things unchanged.[24]

[24] The marginal capital/output ratio α_i corresponding to sector *i* is halved, and all other values of the EBRP simulation are left unchanged.



The first observation about the results shown in the figure is that there are not great intersectoral differences in the impacts on poverty. Extreme poverty is in all cases in the range 34-43 percent at the end of the period. That is, the contributions of partial changes in sectoral investment efficiency to poverty reduction are similar and small. A second observation results of comparing this figure with the EBRP multisectoral growth pattern shown in Section 5. Sectors with relatively bigger impacts on poverty reduction — sectors 3 (petroleum), 10 (infrastructure), 4 (modern manufacture), 8 (commerce), and 12 (finances) — are also sectors with the greatest output shares and growth rates in the EBRP strategy. Advances in technology, skills or regulation in those sectors benefit a larger share of output and incomes — including incomes accruing to the poor. Sectors with low shares of output and incomes, as for instance traditional agriculture, have low impacts. It must be emphasised therefore that this analysis is only relevant within the context of the EBRP.

9. Final comments and further research

Our multisectoral distributional study of poverty reduction within the Bolivian Poverty Reduction Strategy (EBRP) is pessimistic about the possibility of fulfilling the Millennium Development Goal of halving extreme poverty by 2015. This pessimism is shared by other studies that used different analytical frameworks. Also according to the study, the amount of development assistance that would be required for attaining the goals of the EBRP seems unrealistically high — unrealistic at least from the present perspective (in the last decade international aid in real terms has in fact decreased). The improvements in the overall dynamic efficiency of the economy that would be necessary seem also out of the reach of familiar structural reform programs focusing on investment climate. When investment efficiency is analysed separately by sector and the sectors' partial influence on poverty reduction is determined, they do not show large effects, and the effects are quite similar, when consideration is taken of their weight in total output.

The study emphasised the importance for poverty reduction of the multisectoral pattern of growth and of the multisectoral (and multi-class) structure of income distribution. The study suggests that the failure of the EBRP in attaining its goals may reside in a non-pro-poor pattern of growth. Natural questions for further research are then: Is there any multisectoral

pattern of growth which is consistent with the EBRP goals? Or also: Is there any multisectoral *and* distributional pattern of growth that consistent with them?

An affirmative (non-unique) answer to these questions would lead to the search for optimality. Optimality may refer to poverty reduction — e.g. to attain the largest possible decrease in poverty — or to other functions that reflect additional social and economic goals, such as for instance distributive justice, employment, and industrialization.

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APPENDIX A: List of equations and diagram of the model

Each equation appears first in mathematical notation, and then in GAMS notation, the notation system of the modelling and optimization language used for the study (see e.g. A. Broke, D. Kendrick and A. Meeraus, *GAMS: a user's guide*, Scientific Press, San Francisco, 1992). A flow diagram of the model's dynamic core is included at the end of the appendix.

Private incomes

$$y_t^p = V_t^p x_t \tag{1}$$

```
yp(t,k) =E= sum(n, Vp(k,n)*x(t,n));
```

Public external net income (interests on external debt)

$$f_t^g = iE_t \tag{2}$$

```
fg(t) =E= i*E(t);
```

Government incomes

$$y_t^g = V_t^g x_t + T_t - f_t^g \tag{3}$$

```
yg(t) =E= sum(n, Vg(n)*x(t,n))+Tx(t)-fg(t);
```

Indirec taxes: DsM, IVA no deducible, IT, and OII

$$V_t^{oi} = \hat{V}_t^o x_t \tag{4}$$

```
Voi(t,n) =E= Vo(n)*x(t,n);
```

Sectoral private consumption

$$c_t^p = \Gamma^p y_t^p \tag{5}$$

```
cp(t,n) =E= sum(k, gammap(n,k)*yp(t,k));
```

Sectoral public consumption

$$c_t^g = x_{11,t} - c_{11,t}^p \tag{6}$$

```
cg(t,n) =E= 0$(ord(n)<>11) + [x(t,"sector11")-cp(t,"sector11")]$(ord(n)=11);
```

Private saving by income class

$$s_t^p = \left(I - \iota' \wedge \Gamma^p\right) y_t^p \tag{7}$$

```
sp(t,k) =E= (1-sum(n, gammap(n,k)))*yp(t,k);
```

Public saving

$$s_t^g = y_t^g - c_t^g \tag{8}$$

```
sg(t) =E= yg(t)-cg(t,"sector11");
```

Net trade by sector of origin

$$q_t = x_t + V_t^{oi} - \left(C_t^i + c_t^p + c_t^g + f_t\right) \tag{9}$$

qn(t,n) =E= x(t,n)+Voi(t,n)-(CI(t,n)+cp(t,n)+cg(t,n)+f(t,n));

Private external net factor incomes

$$f_t^p = \iota' V_t^x x_t \tag{10}$$

fp(t) =E= sum(n, Vx(n)*x(t,n));

Rate of foreign saving

$$u_t = \frac{\varphi_t}{\iota' s_t^p + s_t^g} \tag{11}$$

u(t)*(sum(k, sp(t,k))+sg(t)) =E= fi(t);

External debt growth

$$E_{t+1} = E_t + \varphi_t \tag{12}$$

E(t+1) =E= E(t)+fi(t);

Total (domestic plus foreign) private savings

$$s_t^{p*} = \iota' s_t^p \left(1 + u_t\right) \tag{13}$$

spe(t) =E= sum(k, sp(t,k))*(1+u(t));

Total (domestic plus foreign) public savings

$$s_t^{g*} = s_t^g \left(1 + u_t\right) \tag{14}$$

sge(t) =E= sg(t)*(1+u(t));

Private investment allocation vector

$$z_t^p = \frac{\hat{\alpha}\left(x_t - 0.5x_{t-1} - 0.3x_{t-2} - 0.2x_{t-3}\right)}{\iota' \hat{\alpha}\left(x_t - 0.5x_{t-1} - 0.3x_{t-2} - 0.2x_{t-3}\right)} \tag{15}$$

zp(t,n) =E= alfa(n)*(x(t,n)-0.5*x(t-1,n)-0.3*x(t-2,n)-0.2*x(t-3,n)) /
sum(n, alfa(n)*(x(t,n)-0.5*x(t-1,n)-0.3*x(t-2,n)-0.2*x(t-3,n)));

Private investments by sector of destination

$$d_t^p = z_t^p s_t^{p*} \tag{16}$$

dp(t,n) =E= zp(t,n)*spe(t);

Public investments by sector of destination

$$d_t^g = z_t^g s_t^{g*} \tag{17}$$

dg(t,n) =E= zg(n)*sge(t);

Total investments by sector of destination

$$d_t = d_t^p + d_t^g \tag{18}$$

d(t,n) =E= dp(t,n)+dg(t,n);

Output growth

$$x_{t+1} = \hat{\alpha}^{-1} d_t + x_t \tag{19}$$

x(t,n) =E= d(t-1,n)/alfa(n)+x(t-1,n);

Total investments by sector of origin

$$f_t = B d_t \tag{20}$$

f(t,n) =E= sum(j, (BE(n,j)*d(t,j)));

Intermediate consumption

$$C_t^i = A x_t \tag{21}$$

CI(t,n) =E= sum(j, A(n,j)*x(t,j));

Employment by income class

$$l_t = \Lambda_0 e^{-\hat{r}t} x_t \tag{22}$$

l(t,k) =E= sum(n, lambda(k,n)*exp(-r(n)*(ORD(t)-1))*x(t,n));

Sectoral employment

$$\lambda_t = \Lambda_0 ' \wedge \iota e^{-\hat{r}t} x_t \tag{23}$$

lambdam(t,n) =E= sum(k, lambda(k,n)*exp(-r(n)*(ORD(t)-1))*x(t,n));

Sectoral population

$$\zeta_t = \frac{\Xi_t \lambda_t}{\iota \lambda_t} \tag{24}$$

xi(t,n) =E= xi(t)*lambdam(t,n) / sum(n, lambdam(t,n));

Average income (per person)

$$\left[\overline{y}^*_{k,n}\right]_t = \left[V^{*p}_{k,n} \hat{x}_{n,n} \big/ \zeta^*_{k,n}\right]_t \tag{25}$$

Yper(t,cn,n) =E= ((vp0(cn,n)*vp2(n))*x(t,n))/(xi(t,n)*pp0(cn,n));

Number of indigents

$$\Xi_t^I = \left[\sum_{k=1,n=1}^{k=100,n=12} \zeta^*_{k,n}\right]_t \qquad \text{for } \left[\overline{y}^*_{k,n}\right]_t \le \textit{line of extreme poverty} \tag{26}$$

xiI(t) =E= sum(n, sum(cn, (xi(t,n)*pp0(cn,n))*(-max((min((Yper(t,cn,n)-tc*360),0)),-1))));

Number of the poor

$$\Xi_t^P = \left[\sum_{k=1,n=1}^{k=100,n=12} \zeta_{k,n}^* \right]_t \qquad \text{for } \left[\bar{y}_{k,n}^* \right]_t \leq \textit{poverty line} \tag{27}$$

xiP(t) =E= sum(n, sum(cn, (xi(t,n)*pp0(cn,n))*(-max((min((Yper(t,cn,n)-tc*360*2),0)),-1))));

Incidence of extreme poverty

$$\Xi_t^I / \Xi_t \tag{28}$$

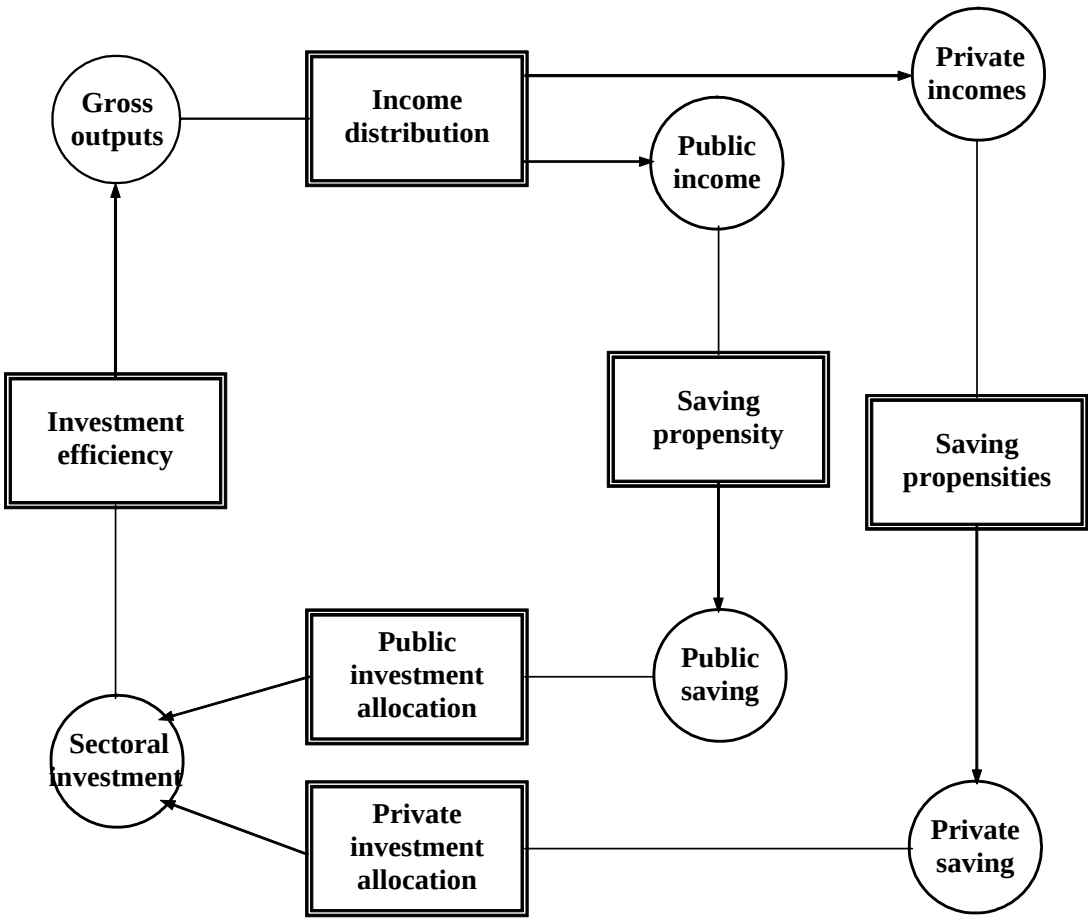
Iind(t) =E= xiI(t)/xi(t);

Incidence of poverty

$$\Xi_t^P / \Xi_t \tag{29}$$

Ipob(t) =E= xiP(t)/xi(t);

Flow diagram of the model's dynamic core



APPENDIX B: Model data

Sectoral aggregation key

From the description of the main traits of the Bolivian poverty problematic in Section 2, it seems essential to have a sectoral disaggregation that singles out those sectors in wich poverty is specially concentrated, and might need specific policies orientated towards them. In the countryside, poverty is concentrated within small-scale, labour-intensive agriculture. Export-crop, capital-intensive agriculture, should constitute a separate sector, with particular intermediate input, socio-economic, and income distribution structures. Investment allocated to one or other of these two sectors would normally have very different effects on output, employment, exports, etc. Bolivian 36-sector national accounts distinguish between industrial agriculture, livestock, non-industrial agriculture, and coca. The two first are agreggated for the purposes of our study in an industrial agriculture sector, and the two other in non-industrial agriculture. As far as possible, a similar differentiation should be done within the urban economy. Small-scale, labour-intensive, "informal" activities that concentrate a major share of the urban poor should be described separately. The manufacturing sectors of the 36-sector Bolivian classification are agreggated into two sectors, Modern and Traditional manufacture, according to capital/labour intensity, and to the relative number of self-employed active in them. The retained classification contains the following sectors: 1) Non-industrial agriculture, 2) Industrial agriculture, 3) Petroleum, gas, and mining, 4) Modern manufacture, 5) Traditional manufacture, 6) Petroleum processing, 7) Construction, 8) Commerce, 9) Transport, 10) Infrastructure and services, 11) Public administration, and 12) Finances.

Bolivian national accounts classification
1. Productos Agrícolas No Industriales
2. Productos Agrícolas Industriales
3. Coca
4. Productos Pecuarios
5. Silvicultura, Caza y Pesca
6. Petróleo Crudo y Gas Natural
7. Minerales Metálicos y No Metálicos
8. Carnes Frescas y Elaboradas
9. Productos Lácteos
10. Productos de Molinería y Panadería
11. Azucar y Confitería
12. Productos Alimenticios Diversos
13. Bebidas
14. Tabaco Elaborado
15. Textiles y Productos de Cuero
16. Madera y Productos de Madera
17. Papel y Productos de Papel
18. Substancias y Productos Químicos
19. Productos de Refinación del Petróleo
20. Productos de Minerales No Metálicos
21. Productos Básicos de Metales
22. Productos Metálicos, Maquinaria y Equipo
23. Productos Manufacturados Diversos
24. Electricidad, Gas y Agua
25. Construcción y Obras Públicas
26. Comercio
27. Transportes y Almacenamiento
28. Comunicaciones
29. Servicios Financieros
30. Servicios a las Empresas
31. Propiedad de Vivienda
32. Servicios Comunales, Sociales y Personales
33. Restaurantes y Hoteles
34. Servicios Domésticos
35. Servicios de la Administración Pública
36. Compras Directas de Otros Bienes

Model EBRP classification	Aggregated activities
1. Non-industrial agriculture	1. 3.
2. Industrial agriculture	2. 4. 5.
3. Petroleum, gas and mining	6. 7.
4. Modern manufacture	8 -- 14 17. 18. 21. 22.
5. Traditional manufacture	15. 16. 20. 23.
6. Petroleum processing	19.
7. Construction	25.
8. Commerce	26. 33. 34.
9. Transport	27.
10. Infrastructure and services	32. 24. 28.
11. Public administration	35.
12. Finances	29 -- 31

Source : Instituto Nacional de Estadística, Bolivia. www.ine.gov.bo

{ z_t^g } of the EBRP - zg(n) Public investment allocation vector

Sector	Value
1. Non-industrial agriculture	0.0398
2. Industrial agriculture	0.1017
3. Petroleum, gas and mining	0.0414
4. Modern manufacture	0.0783
5. Traditional manufacture	0.0279
6. Petroleum processing	0.0137
7. Construction	0.1040
8. Commerce	0.0612
9. Transport	0.3598
10. Infrastructure and services	0.0813
11. Public administration	0.0438
12. Finances	0.0471

Source : Instituto Nacional de Estadística, Bolivia. www.ine.gov.bo

tc = 6.18	exchange rate 2000
tcp = 0.023	population growth rate
Nbol0 = 8,272,860	Bolivia's population year 2000
fi0 = 400	foreign saving (million dollars)
E.fx("2000") = 26,589,066.78	foreing Debt (tousands of bolivianos)
Tx(t) = 2,391,700.44	net transfers (tousands of bolivianos)

Source : Instituto Nacional de Estadística, Bolivia. www.ine.gov.bo

V* **- Vp0(cn,n) Distribution of private sectoral value added (sum=1)**

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
centil001	0.00214	0.00446	0.00000	0.00000	0.00016	0.00000	0.00000	0.00033	0.00000	0.00000	0.00000	0.00000
centil002	0.00394	0.00330	0.00000	0.00000	0.00000	0.00000	0.00000	0.00035	0.00000	0.00004	0.00000	0.00000
centil003	0.00545	0.00210	0.00000	0.00000	0.00032	0.00000	0.00121	0.00017	0.00000	0.00004	0.00000	0.00000
centil004	0.00382	0.00420	0.00000	0.00000	0.00014	0.00000	0.00000	0.00047	0.00000	0.00000	0.00000	0.00000
centil005	0.00292	0.00487	0.00000	0.00000	0.00033	0.00000	0.00000	0.00058	0.00000	0.00039	0.00000	0.00000
centil006	0.00750	0.00261	0.00000	0.00000	0.00000	0.00000	0.00018	0.00008	0.00000	0.00000	0.00000	0.00000
centil007	0.00694	0.00199	0.00000	0.00000	0.00081	0.00000	0.00084	0.00083	0.00000	0.00000	0.00000	0.00000
centil008	0.00633	0.00305	0.00000	0.00000	0.00099	0.00000	0.00000	0.00087	0.00000	0.00013	0.00000	0.00000
centil009	0.00325	0.00532	0.00000	0.00000	0.00000	0.00000	0.00011	0.00193	0.00000	0.00019	0.00000	0.00000
centil010	0.00853	0.00227	0.00000	0.00000	0.00080	0.00000	0.00213	0.00070	0.00000	0.00000	0.00000	0.00000
centil011	0.00568	0.00089	0.00000	0.00000	0.00000	0.00000	0.00264	0.00372	0.00000	0.00000	0.00000	0.00000
centil012	0.00333	0.00920	0.00000	0.00000	0.00006	0.00000	0.00042	0.00089	0.00000	0.00000	0.00000	0.00000
centil013	0.00319	0.00591	0.00000	0.00000	0.00170	0.00000	0.00159	0.00220	0.00000	0.00018	0.00000	0.00000
centil014	0.00334	0.00706	0.00000	0.00000	0.00154	0.00000	0.00198	0.00187	0.00000	0.00025	0.00000	0.00000
centil015	0.00814	0.00469	0.00000	0.00000	0.00189	0.00000	0.00207	0.00111	0.00000	0.00000	0.00000	0.00000
centil016	0.00187	0.00578	0.00000	0.00000	0.00185	0.00000	0.00207	0.00414	0.00000	0.00017	0.00000	0.00000
centil017	0.00409	0.00695	0.00000	0.00000	0.00108	0.00000	0.00657	0.00138	0.00000	0.00053	0.00000	0.00000
centil018	0.00586	0.00428	0.00000	0.00014	0.00327	0.00000	0.00388	0.00215	0.00000	0.00064	0.00000	0.00000
centil019	0.00523	0.00548	0.00000	0.00000	0.00000	0.00000	0.01021	0.00248	0.00000	0.00000	0.00004	0.00000

centil020	0.01250	0.00266	0.00000	0.00000	0.00085	0.00000	0.00807	0.00069	0.00000	0.00016	0.00000	0.00000
centil021	0.00245	0.01007	0.00000	0.00000	0.00222	0.00000	0.00831	0.00155	0.00019	0.00011	0.00000	0.00000
centil022	0.00436	0.00642	0.00000	0.00000	0.00232	0.00000	0.00276	0.00475	0.00000	0.00000	0.00000	0.00005
centil023	0.00547	0.00634	0.00000	0.00000	0.00638	0.00000	0.00189	0.00342	0.00000	0.00020	0.00000	0.00000
centil024	0.00357	0.00978	0.00000	0.00000	0.00313	0.00000	0.00931	0.00229	0.00000	0.00021	0.00000	0.00000
centil025	0.00853	0.00504	0.00000	0.00000	0.00269	0.00000	0.00030	0.00503	0.00055	0.00000	0.00000	0.00000
centil026	0.00183	0.00783	0.00000	0.00000	0.00213	0.00000	0.00198	0.00788	0.00000	0.00005	0.00000	0.00000
centil027	0.01014	0.00240	0.00000	0.00000	0.00268	0.00000	0.01339	0.00390	0.00000	0.00000	0.00000	0.00041
centil028	0.01018	0.00480	0.00000	0.00008	0.00392	0.00000	0.00487	0.00479	0.00000	0.00000	0.00000	0.00004
centil029	0.01016	0.00390	0.00000	0.00022	0.00470	0.00000	0.00533	0.00556	0.00000	0.00000	0.00000	0.00000
centil030	0.00443	0.00858	0.00000	0.00092	0.00550	0.00000	0.01450	0.00285	0.00000	0.00082	0.00000	0.00000
centil031	0.00993	0.00753	0.00000	0.00000	0.00462	0.00000	0.00175	0.00522	0.00000	0.00014	0.00000	0.00000
centil032	0.00079	0.00757	0.00000	0.00000	0.00456	0.00000	0.00848	0.00457	0.00000	0.00576	0.00000	0.00048
centil033	0.00289	0.01243	0.00000	0.00000	0.00985	0.00000	0.00441	0.00467	0.00000	0.00085	0.00000	0.00000
centil034	0.01403	0.01015	0.00000	0.00106	0.00000	0.00000	0.00663	0.00157	0.00017	0.00156	0.00000	0.00000
centil035	0.01254	0.00459	0.00000	0.00000	0.00460	0.00000	0.00501	0.00601	0.00000	0.00176	0.00000	0.00000
centil036	0.00910	0.00504	0.00000	0.00000	0.00452	0.00000	0.02732	0.00313	0.00000	0.00152	0.00000	0.00018
centil037	0.01166	0.00407	0.00000	0.00028	0.00270	0.00000	0.01955	0.00375	0.00000	0.00225	0.00000	0.00141
centil038	0.00747	0.00976	0.00085	0.00000	0.00000	0.00085	0.01582	0.00753	0.00000	0.00000	0.00000	0.00046
centil039	0.00170	0.00741	0.00000	0.00119	0.00611	0.00000	0.00643	0.01175	0.00000	0.00144	0.00000	0.00000
centil040	0.00824	0.00543	0.00000	0.00000	0.00219	0.00000	0.01666	0.01002	0.00000	0.00045	0.00030	0.00000
centil041	0.00546	0.00632	0.00000	0.00167	0.00114	0.00000	0.03666	0.00234	0.00164	0.00381	0.00012	0.00000
centil042	0.01307	0.00602	0.00000	0.00000	0.00182	0.00000	0.02572	0.00681	0.00000	0.00042	0.00000	0.00000
centil043	0.00900	0.01045	0.00000	0.00155	0.00979	0.00000	0.01770	0.00526	0.00000	0.00049	0.00000	0.00000
centil044	0.00489	0.01135	0.00000	0.00000	0.00044	0.00000	0.00586	0.00628	0.00000	0.01019	0.00000	0.00000
centil045	0.00346	0.01091	0.00000	0.00000	0.00233	0.00000	0.02667	0.00950	0.00147	0.00047	0.00029	0.00000
centil046	0.00578	0.00552	0.00000	0.00047	0.01509	0.00000	0.01469	0.00781	0.00000	0.00287	0.00095	0.00211
centil047	0.00000	0.02433	0.00000	0.00000	0.00046	0.00000	0.00351	0.00883	0.00000	0.00441	0.00000	0.00000
centil048	0.00746	0.00356	0.00000	0.00000	0.01660	0.00000	0.01313	0.00478	0.00027	0.00262	0.00064	0.00980
centil049	0.01517	0.00402	0.00026	0.00000	0.01285	0.00026	0.03082	0.00610	0.00000	0.00164	0.00029	0.00000
centil050	0.01860	0.00687	0.00000	0.00000	0.00087	0.00000	0.01330	0.00978	0.00000	0.00236	0.00127	0.00000
centil051	0.00722	0.00866	0.00000	0.00070	0.00280	0.00000	0.00278	0.01503	0.00157	0.00437	0.00102	0.00000
centil052	0.00943	0.01803	0.00000	0.00367	0.00116	0.00000	0.02490	0.00773	0.00000	0.00000	0.00127	0.00000
centil053	0.00095	0.00999	0.00030	0.00000	0.00781	0.00030	0.04504	0.01317	0.00000	0.00239	0.00000	0.00000
centil054	0.00636	0.00684	0.00000	0.00084	0.01771	0.00000	0.00633	0.01321	0.00425	0.00108	0.00109	0.00232
centil055	0.00167	0.00342	0.00000	0.00000	0.05314	0.00000	0.00112	0.01309	0.00000	0.00000	0.00311	0.00000
centil056	0.00952	0.00803	0.00000	0.00000	0.02542	0.00000	0.03338	0.00475	0.00184	0.00550	0.00038	0.00000
centil057	0.01551	0.00353	0.00000	0.00000	0.01294	0.00000	0.00900	0.01483	0.00000	0.00212	0.00184	0.00389
centil058	0.01049	0.00258	0.00000	0.00000	0.00529	0.00000	0.01435	0.01879	0.00000	0.00841	0.00008	0.00191
centil059	0.00699	0.01072	0.00000	0.00000	0.00676	0.00000	0.00823	0.01611	0.00114	0.00531	0.00056	0.00601
centil060	0.01398	0.01149	0.00000	0.00116	0.00622	0.00000	0.01905	0.01385	0.00000	0.00529	0.00176	0.00000
centil061	0.00639	0.00270	0.00000	0.00000	0.02449	0.00000	0.00478	0.02189	0.00020	0.00707	0.00130	0.00000
centil062	0.00765	0.01297	0.00000	0.00000	0.03237	0.00000	0.00596	0.01234	0.00127	0.00530	0.00293	0.00000
centil063	0.01660	0.00573	0.00000	0.00000	0.00976	0.00000	0.00129	0.02644	0.00000	0.00185	0.00242	0.00000
centil064	0.01706	0.01178	0.00059	0.00307	0.00770	0.00059	0.00798	0.01936	0.00050	0.00503	0.00000	0.00192
centil065	0.02240	0.01439	0.00000	0.00373	0.01491	0.00000	0.01256	0.01027	0.00233	0.00447	0.00250	0.00000
centil066	0.01069	0.01158	0.00000	0.00247	0.02171	0.00000	0.01634	0.01697	0.00000	0.00000	0.00472	0.00663
centil067	0.01934	0.00814	0.00000	0.00000	0.02240	0.00000	0.00195	0.01785	0.00210	0.00067	0.01003	0.00000
centil068	0.00837	0.00802	0.00000	0.00166	0.00417	0.00000	0.01051	0.01855	0.00249	0.02079	0.00353	0.00000
centil069	0.01119	0.01111	0.00000	0.00526	0.01305	0.00000	0.01495	0.01795	0.00119	0.00377	0.01174	0.00000
centil070	0.01237	0.01766	0.00033	0.00150	0.01773	0.00033	0.00135	0.01889	0.00325	0.00636	0.00045	0.01183
centil071	0.00920	0.01191	0.00000	0.00000	0.02437	0.00000	0.01165	0.02077	0.00393	0.00963	0.00677	0.00101
centil072	0.00627	0.01117	0.00658	0.00868	0.01347	0.00658	0.00764	0.01637	0.00805	0.01151	0.00374	0.00694
centil073	0.00803	0.00374	0.00312	0.00096	0.01221	0.00312	0.00207	0.01721	0.01046	0.02550	0.00563	0.00531

centil074	0.03037	0.00489	0.00508	0.00662	0.00575	0.00508	0.00676	0.01618	0.00688	0.00933	0.01179	0.00255
centil075	0.01565	0.00283	0.00000	0.00685	0.05660	0.00000	0.00592	0.01694	0.00867	0.00774	0.00601	0.00776
centil076	0.01471	0.00590	0.00000	0.02443	0.02523	0.00000	0.00997	0.01324	0.00989	0.00713	0.00782	0.01003
centil077	0.01697	0.00573	0.00000	0.03406	0.00000	0.00000	0.00000	0.01765	0.00366	0.00925	0.01945	0.00000
centil078	0.00100	0.01408	0.00059	0.01029	0.03172	0.00059	0.02698	0.01627	0.01668	0.01306	0.01068	0.00502
centil079	0.00463	0.00445	0.00490	0.00325	0.07006	0.00490	0.04864	0.01643	0.00000	0.00708	0.01806	0.01120
centil080	0.00315	0.05066	0.00364	0.01937	0.00157	0.00364	0.00358	0.00554	0.00710	0.01066	0.02262	0.00413
centil081	0.01551	0.00287	0.00000	0.01143	0.05077	0.00000	0.00996	0.02054	0.00334	0.02921	0.01137	0.00393
centil082	0.02258	0.00134	0.00080	0.01391	0.00000	0.00080	0.02580	0.02777	0.02187	0.01148	0.01903	0.00357
centil083	0.00621	0.00737	0.00832	0.01687	0.03329	0.00832	0.00580	0.02087	0.02095	0.01110	0.02559	0.00656
centil084	0.02073	0.02591	0.00523	0.02711	0.00000	0.00523	0.02274	0.02688	0.01456	0.01043	0.01893	0.00000
centil085	0.01144	0.02252	0.00670	0.01371	0.02557	0.00670	0.00764	0.01283	0.01508	0.02679	0.02815	0.01083
centil086	0.00064	0.00808	0.00239	0.03897	0.00152	0.00239	0.01347	0.02497	0.02400	0.02140	0.02967	0.01097
centil087	0.00000	0.00245	0.01058	0.00817	0.01055	0.01058	0.00949	0.01911	0.02977	0.04414	0.02533	0.02582
centil088	0.00287	0.00146	0.01413	0.01864	0.01469	0.01413	0.00000	0.03516	0.02147	0.04845	0.02748	0.00299
centil089	0.00433	0.00752	0.02345	0.02070	0.00342	0.02345	0.01937	0.01525	0.04663	0.01417	0.03775	0.02886
centil090	0.01371	0.02099	0.00447	0.03145	0.00327	0.00447	0.02660	0.03507	0.02193	0.03874	0.02051	0.01985
centil091	0.00822	0.02760	0.00712	0.05353	0.00000	0.00712	0.03745	0.01111	0.01963	0.01906	0.03766	0.04494
centil092	0.00713	0.00389	0.01190	0.06310	0.00000	0.01190	0.01155	0.04124	0.01969	0.01511	0.05412	0.02065
centil093	0.02615	0.01591	0.05962	0.02687	0.04893	0.05962	0.01450	0.00416	0.03320	0.03806	0.06310	0.00000
centil094	0.00000	0.00000	0.02244	0.04539	0.08928	0.02244	0.00705	0.01761	0.04234	0.03303	0.04843	0.05921
centil095	0.04207	0.01448	0.06757	0.06177	0.00560	0.06757	0.01142	0.00936	0.05368	0.03471	0.05377	0.03135
centil096	0.00261	0.12419	0.07214	0.02120	0.01256	0.07214	0.00536	0.00000	0.04920	0.06102	0.01792	0.08002
centil097	0.04250	0.01878	0.07503	0.07068	0.00000	0.07503	0.00000	0.01574	0.08089	0.03365	0.02543	0.11987
centil098	0.00000	0.00000	0.05439	0.16060	0.00000	0.05439	0.00000	0.00000	0.06197	0.12091	0.06091	0.08313
centil099	0.01306	0.07636	0.10575	0.05889	0.00000	0.10575	0.00000	0.00000	0.13483	0.05321	0.12605	0.13341
centil100	0.10974	0.00000	0.42174	0.09084	0.00000	0.42174	0.00000	0.00000	0.18324	0.08557	0.10163	0.21066
sum	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Source : Mecovi 2000. Encuesta de hogares. Instituto Nacional de Estadística, Bolivia. www.ine.gov.bo

x_0, x_{-1}, x_{-2}, x_{-3} - xa(ta,n) Initial outputs

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
1997	4,008,900	5,307,819	4,196,216	12,426,964	4,719,905	2,458,918	3,121,654	9,969,792	7,573,816	6,929,086	7,082,619	6,987,301
1998	3,739,516	4,368,919	3,208,408	12,675,620	4,875,253	2,539,850	3,235,130	10,395,279	9,527,808	8,049,438	8,032,750	8,399,329
1999	4,088,615	5,130,629	4,436,759	12,929,250	4,951,506	2,579,575	3,352,731	10,713,720	8,756,902	7,752,498	8,008,895	9,187,399
2000	3,968,496	5,379,375	6,637,814	13,187,956	4,814,921	2,508,419	3,474,607	10,842,237	8,829,269	8,161,622	8,007,226	8,597,576

Source : Instituto Nacional de Estadística, Bolivia. www.ine.gov.bol

α - alfa(n) Marginal capital/output ratios

Sector	Value
1. Non-industrial agriculture	3.8209
2. Industrial agriculture	1.9792
3. Petroleum, gas and mining	2.2506
4. Modern manufacture	0.9324
5. Traditional manufacture	0.9618
6. Petroleum processing	1.8252
7. Construction	2.6911
8. Commerce	1.1611
9. Transport	7.5743
10. Infrastructure and services	1.2995
11. Public administration	1.8406
12. Finances	0.6423

Note: Obtained by historical optimization. Investment efficiency parameters are determined so as to track past sectoral output trajectories (1990-1997) as accurately as possible The problem posed is then to find α such that

$$\sum_{1990}^{1997}(x_t - \bar{x}_t)'(x_t - \bar{x}_t) = \min,$$

in which x_t and $\bar{x}_t$ are simulated and historical output vectors respectively.

Γ - gammap(n,k) Private marginal consumption propensities

Sector	decil01	decil02	decil03	decil04	decil05	decil06	decil07	decil08	decil09	decil10
1. Non-industrial agriculture	0.1335	0.1135	0.1025	0.0866	0.0827	0.0664	0.0700	0.0609	0.0517	0.0379
2. Industrial agriculture	0.0421	0.0358	0.0323	0.0273	0.0261	0.0210	0.0221	0.0192	0.0163	0.0120
3. Petroleum, gas and mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4. Modern manufacture	0.3418	0.2974	0.2802	0.2359	0.2300	0.1974	0.2075	0.1878	0.1712	0.1461
5. Traditional manufacture	0.0787	0.0710	0.0732	0.0540	0.0572	0.0596	0.0571	0.0582	0.0584	0.0588
6. Petroleum processing	0.0045	0.0056	0.0060	0.0060	0.0059	0.0062	0.0066	0.0068	0.0065	0.0074
7. Construction	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8. Commerce	0.1186	0.1382	0.1635	0.1610	0.1993	0.2174	0.2116	0.3043	0.2205	0.2715
9. Transport	0.1024	0.0911	0.1096	0.1110	0.0993	0.1205	0.1258	0.1223	0.1078	0.1192
10. Infrastructure and services	0.1115	0.1145	0.1337	0.1117	0.1130	0.1225	0.1294	0.1199	0.1335	0.1467
11. Public administration	0.0145	0.0130	0.0150	0.0111	0.0112	0.0130	0.0131	0.0099	0.0118	0.0120
12. Finances	0.0483	0.0585	0.0632	0.0618	0.0602	0.0634	0.0687	0.0692	0.0678	0.0765

Source : Mecovi 2000. Encuesta de hogares. Instituto Nacional de Estadística, Bolivia. www.ine.gov.bo
Method: seemingly unrelated regression (STATA).

A - A(n,j) Technical coefficients

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
sector01	0.09670	0.06614	0.00000	0.09835	0.00005	0.00000	0.00000	0.01285	0.00000	0.00920	0.01095	0.00000
sector02	0.00395	0.03782	0.00414	0.21793	0.07989	0.00000	0.02061	0.00131	0.00000	0.00000	0.00476	0.00000
sector03	0.00000	0.00036	0.01362	0.04452	0.07741	0.52060	0.06244	0.00000	0.00000	0.01185	0.00000	0.00000
sector04	0.03708	0.11345	0.06814	0.21352	0.09575	0.01840	0.16575	0.19256	0.10863	0.11256	0.06859	0.04090
sector05	0.00139	0.00092	0.01099	0.02483	0.27812	0.00120	0.31598	0.00615	0.00834	0.02727	0.03693	0.00708
sector06	0.00266	0.01191	0.10371	0.01922	0.02206	0.02067	0.00648	0.01026	0.27458	0.03234	0.01976	0.00929
sector07	0.00000	0.00000	0.00019	0.00008	0.00011	0.00033	0.00000	0.00056	0.00011	0.00167	0.00037	0.01861
sector08	0.00000	0.00000	0.00317	0.00385	0.00248	0.00220	0.00203	0.00580	0.00428	0.01194	0.01696	0.00612
sector09	0.02276	0.04488	0.08698	0.04514	0.01608	0.04166	0.01479	0.15837	0.01579	0.01843	0.01502	0.00972
sector10	0.00000	0.00347	0.02496	0.02486	0.02474	0.02721	0.00619	0.04151	0.05562	0.06751	0.02787	0.05740
sector11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector12	0.00305	0.04168	0.03579	0.01921	0.01137	0.01429	0.02737	0.03867	0.00982	0.10243	0.06488	0.37563

Source : Instituto Nacional de Estadística, Bolivia. www.ine.gov.bo

B - BE(n,j) Distribution of investment demands

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
sector01	0.03914	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector02	0.00000	0.14560	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector03	0.00000	0.00000	0.13494	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector04	0.75629	0.64983	0.54370	0.80499	0.69600	0.57909	0.96786	0.48366	0.52266	0.61566	0.49538	0.49538
sector05	0.00000	0.00000	0.00000	0.00000	0.13705	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector06	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector07	0.20457	0.20457	0.32136	0.19501	0.16695	0.42091	0.03214	0.51634	0.47734	0.38434	0.50462	0.50462
sector08	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector09	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Source: There are no detailed Bolivian data on capital stocks or origin and destination of investments. At a similar level of development, an aggregated Mexican *B* matrix of the mid-1970s is adopted. See Table C.IX in: J. Buzaglo, *Planning the Mexican economy: Alternative development strategies* (Croom Helm, London; St. Martins Press, New York, 1984).

Λ - lambda(k,n) Labour/output ratios

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
decil01	0.02842	0.03320	0.00000	0.00000	0.00049	0.00000	0.00108	0.00279	0.00000	0.00040	0.00000	0.00000
decil02	0.03584	0.02079	0.00000	0.00000	0.00205	0.00000	0.00325	0.00518	0.00000	0.00032	0.00000	0.00000
decil03	0.02104	0.01908	0.00000	0.00002	0.00437	0.00000	0.01065	0.00769	0.00017	0.00064	0.00002	0.00001
decil04	0.02368	0.01343	0.00000	0.00023	0.00560	0.00000	0.01250	0.00691	0.00003	0.00267	0.00000	0.00017
decil05	0.01198	0.01376	0.00009	0.00033	0.00409	0.00001	0.01656	0.00904	0.00038	0.00332	0.00027	0.00045
decil06	0.01335	0.00778	0.00004	0.00026	0.00914	0.00001	0.01288	0.00908	0.00070	0.00301	0.00136	0.00149
decil07	0.01295	0.00726	0.00003	0.00052	0.00709	0.00000	0.00425	0.01134	0.00062	0.00402	0.00284	0.00086
decil08	0.00833	0.00445	0.00063	0.00206	0.00741	0.00009	0.00388	0.00683	0.00300	0.00531	0.00554	0.00226
decil09	0.00366	0.00455	0.00129	0.00268	0.00274	0.00018	0.00245	0.00514	0.00498	0.00665	0.00881	0.00230
decil10	0.00345	0.00345	0.00556	0.00365	0.00143	0.00077	0.00106	0.00141	0.00577	0.00555	0.00822	0.00567

Source : MECOVI 2000 - Instituto Nacional de Estadística, Bolivia. www.ine.gov.bo

APPPENDIX C: Some selected results

EBRP Simulation: A SAM for 2005

MATRIZ DE CONTABILIDAD SOCIAL - 2005 - VERSION PRELIMILAR (En miles de bolivianos)

	Act Prod	BB y SS	Gobierno	Hogares	R del M	Inversión	Total
Actividades Productivas		109,984,569					**109,984,569**
Bienes y Servicios	49,011,719		8,687,171	52,122,208	26,484,018	13,498,404	**149,803,520**
Gobierno	1,969,464	10,802,866			598,747		**13,371,077**
Hogares y Empresas	58,464,706						**58,464,706**
Resto del Mundo	538,680	29,016,086					**29,554,765**
Ahorro			4,683,907	6,342,498	2,472,000		**13,498,404**
Total	**109,984,569**	**149,803,520**	**13,371,077**	**58,464,706**	**29,554,765**	**13,498,404**	**374,677,043**

PIB = C + I + G + X - M **71,775,716**
PIB = VAB + Ds/M + IVAnd + IT y OII **71,775,716**

EBRP+aid scenario: Sectoral outputs

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
1997	4,008,900	5,307,819	4,196,216	13,898,093	4,719,905	2,458,918	3,516,122	9,969,792	7,573,816	6,929,086	7,082,619	6,987,301
1998	3,739,516	4,368,919	3,208,408	14,121,114	4,875,253	2,539,850	4,973,640	10,395,279	9,527,808	8,049,438	8,032,750	8,399,329
1999	4,088,615	5,130,629	4,436,759	14,254,359	4,951,506	2,579,575	4,146,702	10,713,720	8,756,902	7,752,498	8,008,895	9,187,399
2000	3,968,496	5,379,375	6,637,814	13,187,956	4,814,921	2,508,419	3,474,607	10,842,237	8,829,269	8,161,622	8,007,226	8,597,576
2001	4,036,501	6,965,054	14,207,417	11,004,071	4,807,929	2,456,449	1,460,561	12,240,101	9,353,532	9,940,799	8,661,377	9,311,468
2002	4,177,174	8,656,731	20,377,459	9,900,236	5,012,921	2,466,468	91,169	13,716,132	10,029,991	11,769,027	9,300,542	10,320,978
2003	4,347,266	10,298,608	25,216,504	9,647,641	5,376,451	2,527,032	-653,099	15,221,785	10,925,012	13,640,010	9,967,889	11,602,070
2004	4,558,447	11,952,885	29,136,339	10,052,149	5,868,532	2,628,939	-964,008	16,779,287	11,959,096	15,546,073	10,662,575	13,143,528
2005	4,800,911	13,621,647	32,289,869	11,011,007	6,470,155	2,765,099	-905,254	18,382,081	13,118,566	17,492,889	11,378,318	14,888,932
2006	5,068,811	15,308,964	34,866,164	12,404,382	7,160,098	2,928,745	-558,046	20,029,728	14,384,450	19,483,287	12,116,470	16,806,426
2007	5,358,728	17,023,272	37,013,755	14,144,465	7,923,304	3,114,851	14,019	21,723,621	15,740,123	21,520,415	12,876,732	18,870,941
2008	5,667,596	18,769,702	38,839,829	16,166,973	8,748,760	3,319,707	765,929	23,464,606	17,175,129	23,607,566	13,659,169	21,063,310
2009	5,993,358	20,552,888	40,426,784	18,423,779	9,628,404	3,540,599	1,663,470	25,254,084	18,681,790	25,747,787	14,464,238	23,370,473
2010	6,334,620	22,376,953	41,835,802	20,880,338	10,556,624	3,775,604	2,681,768	27,093,703	20,254,929	27,944,072	15,292,492	25,783,486
2011	6,690,449	24,245,514	43,112,465	23,511,979	11,529,594	4,023,382	3,802,859	28,985,297	21,891,309	30,199,398	16,144,633	28,296,559
2012	7,060,288	26,161,931	44,291,111	26,301,303	12,544,815	4,283,024	5,013,774	30,930,904	23,589,094	32,516,768	17,021,488	30,906,298
2013	7,443,851	28,129,399	45,397,774	29,236,335	13,600,787	4,553,949	6,305,280	32,932,743	25,347,523	34,899,256	17,923,985	33,611,104
2014	7,841,063	30,151,032	46,452,420	32,309,138	14,696,766	4,835,815	7,670,904	34,993,204	27,166,662	37,350,037	18,853,149	36,410,757
2015	8,252,011	32,229,925	47,470,564	35,514,818	15,832,587	5,128,467	9,106,240	37,114,851	29,047,224	39,872,407	19,810,098	39,306,109