Simulating extended reproduction

Poverty reduction and class dynamics in Bolivia

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ABSTRACT: An extended reproduction model is used to simulate the effects of alternative poverty reduction strategies. Three policy variables are introduced: (de)indebtedness policy, investment policy and income distribution policy, contributing respectively to the objectives of policy sovereignty, structural change and social justice. The Millennium Development Goal of halving extreme poverty by 2015 seems to be a difficult, but attainable goal for Bolivia. The model shows also the effects of poverty reduction strategies on the different social classes.

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> It is generally taken for granted that Marxian economics and recent achievements in mathematical economics with large-scale digital computation are worlds apart. Certainly this need not be the case.
> András Bródy (1970: 163)

1. Introduction

In his Preface to Bródy's (1970) book, Wassily Leontief holds that economics does not progress in a straight line, as a typical natural science does. Economic thought advances in curves and loops, like a broad river slowly winding its way across a flat plain. It turns left and right and divides from time to time into separate branches, some of which end up in stagnant pools, while others unite again into a single stream.

About three decades ago, the mainstream of economics briskly turned right, to enter the intellectual topography characteristic of long-period depression. It entered the rather sterile landscape of commodity and money fetishism. "Egonomics" could this broad branch of the river more properly be called, based as it is on the constricted perspective of the *homunculus oeconomicus*. After traversing the dark valley of the long depressive phase, it seems to have

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ended up in a big, stagnant pool, incapable of giving meaningful answers to the many problems of senile, global capitalism. The several beaches on the sides of the pool — such as "Rational Expectations," or "Efficient Markets" — are rapidly becoming out of fashion and deserted.

The Marxian branches of the river almost disappeared under the ground that was opened as a result of the powerful seismic movements of the period. They were obliged to follow difficult and rocky underground ways that hopefully purified and clarified them. Similar fates corresponded to close standing branches, such as neo-Ricardian, neo-Keynesian and neo-structuralist economics. Will these branches be able to surface again? Along with the new branch of ecological economics, will they unite into a single lively stream, as in Leontief's metaphor? Will they exploit the achievements in mathematical economics and the huge advances in digital computation, as Bródy suggested?

The model constructed for the present study responds to real and urgent needs — how to reduce poverty in a poor country. It was not intended as a contribution to Marxian economics, but as an approximation to the analysis of a particular, highly relevant problem. What is interesting with Marxian economics is that the most meaningful and useful analytical instrument to approach the problem of fighting poverty that can be found, was already drafted by Marx. The choice of the theoretical structure of our study was not the consequence of an ideological *parti pris*, but the result of the strict application of the scientific method — the choice of the best available method of analysis applicable to a concrete set of observations in order to obtain testable deductions. As we see it, this is *scientific socialism*, in the sense of putting reason and science in the service of the free flourishing of human being and human society.

The source of the approach is Marx's reproduction schemes in *Capital* II. As we show below, Marx's approach was refined by several authors, before getting its most developed form from Leontief. Yet only Marxist authors such as Lange and Bródy dared to refer to the apparent Marxian roots of input-output analysis. Most others preferred not to be associated with such a heretic. Quesnay and Walras were more presentable forefathers — even if Walras cannot honestly be associated with the approach.

Our reproduction simulation model is, like the dynamic input-output model, a disaggregated "Harrod-Domar model." Growth depends on the magnitude of the social surplus (saving) and the effectiveness of investment (incremental capital output ratios). What principally distinguishes the model from the dynamic input-output model is the character of the solution. The standard solution of the dynamic input-output model determines the uniform, equiproportional rate of expansion for all sectors of the economy, and the output composition consistent with that rate of growth. This solution can be understood as the ideal, inherent expansion capabilities and equilibrium proportions belonging to the technological infrastructure (input and capital matrices) of the economy, for given distributional structures and saving/consumption behaviors.

The simulation approach is an applied, policy oriented approach. It departs from conditions existing at the start of the period of analysis, i.e. initial output levels and proportions. It studies different policies, which result in different output growth trajectories, given initial conditions, and given technologies and behaviors in the economy. A key policy variable is investment policy, which influences structural change in the economy. Another important policy variable, which affects the degree of policy sovereignty, is the level of foreign indebtedness, or accumulated foreign savings. The third key policy component is income distribution policy, particularly crucial in the context of highly unequal economies. The degree of distributive equity or social justice directly affects the poverty rate, whose reduction is the main focus of our study.

The frame of our strategy simulations is the UN Millennium Development Goal of halving extreme poverty by 2015. Different output trajectories result in different rates of poverty reduction. A status quo investment policy of maintaining the past emphasis in natural resource production and export is less effective in reducing poverty than a policy which tries to generate poverty minimizing output trajectories. Our study also shows that a policy which stimulates increasing employment is very similar in its effects to a poverty minimizing policy.

Given in Bolivia a very high poverty rate of 70 percent of the population and a very unequal income distribution, changes in the structure of output are not sufficient for achieving the Millennium Goal. The study shows what are the minimal income redistribution efforts, which in addition to pro-poor structural change are necessary in order to halve extreme poverty by 2015. A more advanced redistribution policy is also simulated, which totally eliminates extreme poverty.

The poorest country in South America, with an average income not much above the poverty line of 2 dollars a day, all social classes are more or less affected by poverty in Bolivia. But capitalists, workers and peasants benefit differently from different strategies. Status quo tends to benefit high income classes, and redistribution policies benefit low income classes. Dualism and heterogeneity in the economy — and possibly also statistical limitations — give rise to some counterintuitive results, such as for instance that the workers, in average, do not benefit of poverty reducing policies.

These are main themes of the following sections.

2. Reproduction schemes and input-output analysis

A permanent trait of the classical theory of economic growth, from Quesnay to Marx, is the idea that the expansion of societies' product depends on investment of the non consumed surplus product. There is growth when the product of society's work is more than what is necessary to satisfy consumption needs, and when this social surplus output takes the form of increased means of production put to work with increased labor force. Two central ideas are then, that total output must be larger than consumption — that is, positive surplus product or savings —, and that surplus product increases the existing means of production — that is, it is productively invested.

Quesnay's *Tableau Économique* was, in the words of Marx, "the first systematic conception of capitalistic production" — "an attempt to portray the whole production process of capital as a *process of reproduction*" — "the most brilliant idea of which political economy had hitherto been guilty" (1963: 344). The *Tableau* models the circular flow among of the three main social classes of the incipient capitalism of the time — peasants, manufacturers/merchants and landlords — and the interdependence between income and expenditure in consumption and production. At the same time, the classes represent different sectors of economic activity.

Marx's analysis of reproduction establishes the conditions for equilibrium in an economy with two sectors (producing means of production and consumption goods) and two social classes, capitalists and workers. The steady reproduction of the circular flow of the economy requires that the components of the social output — that is, used means of production and labor power, and surplus — keep definite proportions. In particular, the output of the sector producing means of production must equal the use (demand) of means of production by both sectors. In an expanding economy not all the surplus is consumed; part of the surplus is employed in increasing the amount of labor and means of production. These conditions can be interpreted as input-output equations, which result in particular conditions of equilibrium between the two departments.

For Marx, the importance of the reproduction schemes rests not only in the intersectoral consistency of equilibrium quantities, but also in the general framework required for a coherent determination of labor values and production prices. As shown by Kurz and Salvadori (2000), after Marx, the most important roots of input-output analysis are to be found in the works of authors investigating the determination of values and/or production prices within a comprehensive representation of the circular flow of the economy as an interrelated system. Among the most important we find Dmitriev, von Bortkiewicz and Charasoff. An interesting detail is that von Bortkiewicz was Leontief's dissertation adviser at Berlin University in the 1920s (Kurz and Salvadori 2000: 169).

Another important source, not often recalled today, is the attempt to construct a "national economic balance" in the Soviet Union of the 1920s. This intended tool of planning for growth and industrialization was an explicit empirical implementation of the ideas underlying the reproduction schemes of Marx.[1] Still a student at Leningrad University, Leontief wrote about this work in 1925:

> What is essentially new in this balance … is the attempt to embrace in figures not only the output but also the distribution of the national product, so as to obtain in this way a comprehensive picture of the whole process of reproduction in the form of a kind of "Tableau Économique".[2]

For authors cognizant of the Marxian tradition, such as Oskar Lange and András Bródy, it was easy too see the direct connection between Marx's reproduction schemes and Leontief's input-output models. For Lange (1969: 47),

> [t]he structure of production input equations … is the same as that of Marx's schemes… It can be seen that the production input equations are an extension of the division of the Marxian schemes into *n* branches.

Or also,

> Marx put forward the general idea that a balanced exchange of products among the various subdivisions of the national economy was essential if the processes of production and reproduction were to continue smoothly; in input-output analysis this idea is applied to the relationships arising among a large number of sectors of the national economy. (Lange 1964: 192)

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[1] According to Jasny (1962), the idea was fathered by V.G.Groman, who produced the first draft of a balance of the national economy in 1923 at the Gosplan. Stalin thought this kind of work was "a game with figures" (see references in Spulber and Dadkhah 1975). "The task which Groman had thought could have been accomplished in a matter of several weeks was ultimately done 38 years later. Early in 1961 Soviet statisticians completed "The Interbranch Balance of Production and Distribution of Output in the National Economy of the USSR for 1959" … The speed of accomplishment is certainly amazing." (Jasny 1962: 79)

[2] *Weltwirtschaftliches Archiv,* October 1925 (Jasny 1962: 79).

2. 1. *Simple reproduction*

With the powerful tools of the eigenvalue matrix algebra and Leontief's input-output representation, Bródy (1970) achieves a most compact and lucid formulation of the theory of reproduction.

Given the matrix *A* of input coefficients (denoting amounts of product *i* used to produce one unit of product *j*), and vectors v representing the inputs of labor force and c consumption needs, we can form (Bródy 1970: 23) the "complete" matrix **A**:

$$\mathbf{A} = \begin{bmatrix} A & c \\ v & 0 \end{bmatrix}. \qquad (1)$$

The economy is in simple reproduction when outputs **x** are just enough to cover (intermediate and final) consumption needs:

$$\mathbf{Ax = x.} \qquad \mathbf{(2)}$$

This is the same as saying that the maximal eigenvalue of matrix **A** is equal to one. That is, given the matrix **A**, and asked which are the scalars α (eigenvalues) and vectors **x** (eigenvectors) that satisfy the eigenequation **Ax =** α **x,** we find in simple reproduction that the maximal eigenvalue α = 1. (The eigenequation **Ax =** α **x** may also be written: α **x** -**Ax =** (α**I** – **A**) **x** = 0. The eigenvalues are those values, α, that make the determinant of the matrix (α**I** – **A**) singular. The determinant is an equation of degree *n* in α, with *n*, not necessarily distinct roots, associated with their respective eigenvectors — see e.g. Bródy 1970, Appendix I, or Wilkinson 1965).

The gross output vector **x**, as an eigenvector, gives only the proportions which satisfy the eigenequation **Ax =** α **x** — any scalar multiple of **x** is also an eigenvector. That is, only output proportions are determined by **A**, not the absolute scale of production.

2.2. *Extended reproduction*

In simple reproduction then, final and intermediate consumption **Ax** equal total output **x** — no surplus is left. Extended reproduction is possible when not all output is consumed, when **Ax** < **x**; that is, when there is a positive surplus product in every sector: **x – Ax = (I – A) x > 0.** Each sector of the economy produces a positive surplus.

Output growth depends on surplus being invested in expanding productive capacities. A matrix **B** is introduced, its coefficients indicating the quantity of output of sector *i* which must be invested in sector *j* in order to increase by one unit sector *j*'s output in the next period.

Balanced expanded reproduction requires that the surplus products of the different production sectors on the left hand of equation (3) match the investment needs generated by the uniform rate of growth λ on the right hand:

$$\mathbf{(I - A)\, x = \lambda\, Bx,} \qquad \mathbf{(3)}$$

that is, output should be so structured as to make possible a balanced growth in all sectors. Or also, if we write this as

$$\mathbf{x = Ax + \lambda\, Bx,} \qquad \mathbf{(4)}$$

output supplies **x** equal consumption plus investment demands associated with growth at the rate λ.

The solution of this equation for **x** gives output proportions that, after covering (intermediate and final) consumption **Ax** for simple reproduction, allow for growth in every sector at rate λ**.** (The corresponding eigenequation now is: $\mathbf{[I/\lambda - (I - A)^{-1} B] \, x = 0.}$ The viable growth rate λ is (the reciprocal of) the maximal eigenvalue of the matrix $\mathbf{(I - A)^{-1} B}$, to which corresponds a positive eigenvector **x**. Bródy (1970: 113) calls this solution "stationary state" — it is also called "turnpike" or "von Neumann path.")

Bródy (1970: 47) shows that the numerical examples of extended reproduction set out in the second volume of Capital are based on the same assumptions as those implicit in equation (4). The ideas underlying this model and those expressed in Marx's schemata are the same — they are an extension to *n* sectors of the extended reproduction scheme.

2.3. *Extended reproduction and the Harrod-Domar equation*

Several authors have seen Marx's expanded reproduction scheme as the original source of the Harrod-Domar type of growth model. Bródy (1970: 100) shows this in a very straightforward manner, by defining production prices within the expanding reproduction system of equation (4).

Prices of production are those prices **p** which cover input and labor costs **pA**, plus an average rate of profit λ on capital invested **pB**:

$$\mathbf{p = pA + \lambda pB} \quad . \qquad \mathbf{(5)}$$

(The eigenequation of this system is : $\mathbf{p \, [I - \lambda \, B \, (I - A)^{-1}] = 0.}$)

If we now express the expanded replication equation (3) using the price system and the output structure which correspond to the balanced solution eigenvectors, we will have:

$$\mathbf{p(I - A) \, x = \lambda \, pBx.} \qquad \mathbf{(6)}$$

The rate of growth (and profit) λ can thus be expressed as the net product of society divided by total capital employed:

$$\lambda = \mathbf{p(I - A) \, x \, / \, pBx.} \qquad \mathbf{(7)}$$

Multiplying numerator and denominator by the total value of production **px**, we get:

$$\lambda = [\mathbf{p(I - A) \, x \, / \, px}] \, \mathbf{.} \, [\mathbf{px \, / \, pBx}] \qquad \mathbf{(8)}$$

in which the first factor is the saving ratio, and the second factor is what Bródy calls "capital productivity," the reciprocal of the capital/output ratio. This is the Harrod-Domar growth equation.

In his illuminating article of 1957 Lange arrived, with a different mathematical approach, to the same conclusion: "… the rate of increase of gross national product is the product of the overall rate of investment and of the average output-outlay ratio" (Lange 1964: 217). Lange's "output-outlay ratios" indicate the effect of a unit increase in investment outlay in the various sectors of the economy on national gross output.

3. A simulation model for extended reproduction

Bródy (1970: 112) recognized the lack of realism of a solution giving a uniform expansion rate with fixed output proportions as one of the major limitations of the dynamic input-output model. However, a general solution of the eigenequation for a given economy, that is, a solution for the prices, output structure and rates of growth and profit that correspond to a long run, closed, balanced growth path may give many interesting insights — see e.g. Bródy (1970, Part 3) on USA and Hungary and Tsukui and Murakami (1979) on Japan.

In practical application, however, in particular when analyzing policies for growth and poverty reduction, a different solution approach seems necessary. Instead of defining optimal output structures for a closed economy, our approach is to start from existing outputs in an open economy, and to look at the effects of different output trajectories resulting from different investment patterns. That is, we adopt the simulation approach. Optimization enters the picture when we attempt to select the output trajectory that maximizes certain objective, e.g. poverty reduction.

Two other differences of our model refer to the inclusion of foreign saving and debt, and income distribution. The model reflects the possibility of enlarging the economy's saving and investment capacity by borrowing from abroad (i.e. by increasing foreign indebtedness) — or also the possibility of augmenting economic policy autonomy by reducing external indebtedness, along with the conditionalities imposed by foreign creditors.

The model includes also a detailed representation of income distribution and consumption/saving. Vector *v* representing inputs of labor force and vector *c* describing consumption in equation (1) are disaggregated by income level and social class, in order to trace the effects of alternative strategies on saving, consumption, investment and growth.

3.1. *The equation of extended reproduction*

As shown above, expanded input-output reproduction can be seen as a disaggregated Harrod-Domar model, in which growth depends on average capital output ratios and total saving. As shown in equation (8), the growth rate equals the output capital ratio times the saving ratio. Or, multiplying by output, the increment of output equals the output capital ratio times savings.

Accordingly, the equation of motion of the model is:

$$x_{t+1} - x_t = \hat{\alpha}^{-1} d_t . \qquad (9)$$

That is, the increment of sectoral outputs x_t (an *n*-vector) equal their respective sector's incremental capital output ratios $\hat{\alpha}$ (a diagonal *n*-matrix), times the sectoral investments d_t (an *n*-vector).

Writing this as:

$$x_{t+1} = \hat{\alpha}^{-1} d_t + x_t \qquad (10)$$

we see that the time-path of sectoral outputs depends on the (inverses of) sectoral incremental capital output ratios and sectoral investments. (The inverse elements $\hat{\alpha}^{-1}$ reflect sectoral output responses to investment; we will call them "investment efficiency coefficients.") In the words of Lange (1964: 269): "The investment done in one period adds to the amount of means of production in operation in the next period. In consequence, a larger output is obtained in the next period. The outputs of successive periods are linked up in a chain through the investments undertaken in each period. Thus, productive investment generates a process of growth of output."

The process follows the simple logic illustrated in Figure 1.

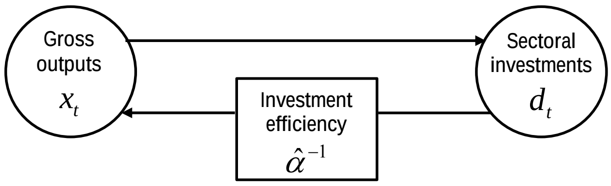


Fig. 1. Flow diagram of the dynamic law of the model

We can now introduce our first policy instrument, *investment policy*. Investment policy is the policy instrument which allows for influencing sectoral growth and output structure.

In order to specify an investment policy in the model of equation (9), let us distinguish between private investments $d^p{}_t$, and public investment $d^g{}_t$, of which sectoral investment d_t is the sum. Public investment is defined in a very wide sense, as the cost for the public sector of productivity-increasing changes. Public investment includes investments in infrastructure and public and mixed enterprises, and also the costs of explicit or implicit subsidisation of private investment (such as the different forms of "industrial policy"). Theoretically, it should also include investment in the social sectors ("human capital"), and in research, but this is difficult to implement statistically.

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 $s^{g*}{}_t$ (a scalar), public investment is determined by investment policy:

$$d^g{}_t = z^g{}_t \, s^{g*}{}_t , \qquad (10)$$

where $z^g{}_t$ is a distribution vector of public investment allocation shares. An *investment policy* is a time sequence $\{ z^g{}_t \}$ of public investment allocation shares. A $\{ z^g{}_t \}$ sequence can be exogenously given, as for instance in a historical simulation, or when some exogenously stipulated policy is tested. A $\{ z^g{}_t \}$ sequence can be also determined by optimization of some expression of social welfare — e.g. minimization of the share of the poor in year 2015.

We see then that we are postulating the possibility of any allocation of investment — we are not trying to find balanced output paths as in standard expanded reproduction (equation (3)), in which investment demands must be satisfied by domestic outputs. We assume an open economy, where excess demands and supplies can be internationally traded — e.g. excess supplies of oil can be exported, and excess demands of investment goods can be imported. (We are now describing sectoral supplies; sectoral demands will be described in short.)

Also, private investment behavior differs from Marx's schemes, where capitalists invest in their own sector. In the present model, capitalists allocate investments — that is, available saving/investment funds — according to the different sectors' past growth and their respective capital density. In the following equation, private investments, $d^p{}_t$, equal private savings $s^{p*}{}_t$, endogenously allocated according to the so called accelerator function $z^p{}_t$:

$$d^p{}_t = z^p{}_t \, s^{p*}{}_t \,, \qquad (11)$$

in which
$$z^p{}_t = \frac{\hat{\alpha}(x_t - x_{t-1})}{\iota' \hat{\alpha}(x_t - x_{t-1})}, \qquad (12)$$

where ι is a summing vector (1,1,…,1)'. That is, total private savings are allocated according to past growth and capital/output ratios in the sector. (We give here a compact representation of the model. Appendix A contains the detailed representation. In the detailed model, the estimated function is a distributed accelerator including three previous periods, see Appendix A, eq.(11).)

3.2. *Income distribution*

We have thus far described the investment of private and public savings and their effects on output growth, given investment efficiency parameters, as shown in the lower and left sides of Fig. 2. Let us now complete the loop, describing how savings are determined from incomes generated in production, for given income distribution and savings coefficients, as shown in the upper and right sides of the figure.

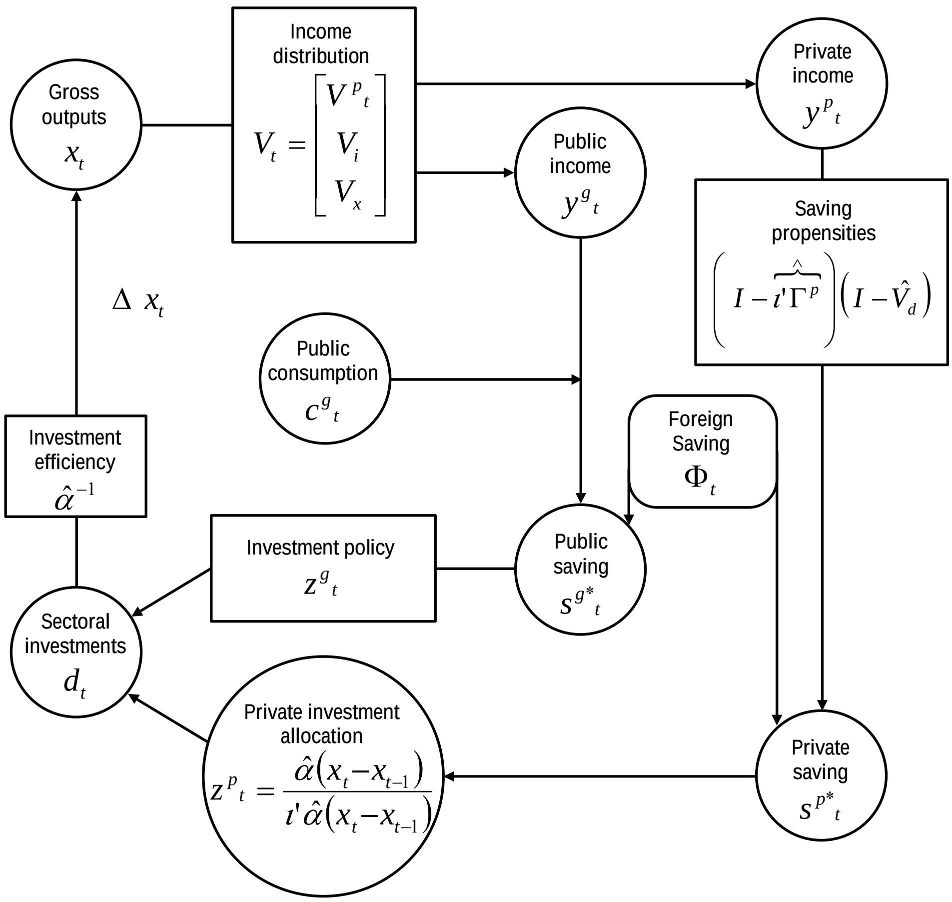


Fig. 2. Flow diagram of the dynamic core of the model

In the simplest form of reproduction analysis workers receive subsistence wages, and capitalists appropriate all surplus value or profits. In standard input-output, and even in the more elaborated analyses of Lange and Bródy the structure of income distribution is not specified. Within the input–output framework, however, a quite natural extension is to assume income distribution coefficients analogue to production input coefficients, thus generalizing to the distribution of value added the proportionality assumption made in relation to production inputs. Inspired by Kaldor (1956), Miyasawa and Masegi (1963) introduced this approach, and defined sectoral income distribution coefficients by income class (e.g. capitalists and workers), with particular consumption and saving behaviors.[3]

In line with this approach, the y_t vector of incomes of the k income classes, plus the government, plus external production factors depends linearly on sectoral gross outputs x_t :

$$y_t = V_t \; x_t , \qquad (13)$$

in which V_t is a $(k + 2)\times n$ matrix of shares of income (value added) by income class (plus the government and external factors), specific to each production sector. The V_t matrix is composed of a $(k \times n)$ $V^p{}_t$ matrix of private incomes, an $(1 \times n)$ V_i matrix of sectoral coefficients of indirect taxes and operating surplus of domestic enterprises, and an $(1\times n)$ V_x matrix of net flows of private external factors. (In addition to indirect taxes and operating surpluses, the public sector's income includes import duties, transaction taxes (and other indirect taxes), direct taxes, net unilateral transfers and net debt service — see equation (2) in Appendix A.)

The model thus directly distributes value added generated in production among households, the government and the rest of the world — a simplification of the usual social accounting matrix (SAM) framework, in which the distribution among "factors of production" and institutions (firms, government, etc.) is also included.[4] Appendix C shows the structure of the simplified SAM of the model, and the SAM generated by the model for the initial year 2000 (the model generates SAMs for every year of the simulation).

The $V^p{}_t$ matrix of sectoral income distribution may assume different specifications. The Kaldor-Miyasawa-Masegi specification analyses the sectoral distribution of income among *social classes*. Analysis of poverty and poverty reduction policy also requires a representation of the *size* distribution of incomes, since unless defined very narrowly, socioeconomic classes include both poor and non-poor households. Thus, a $(100 \times n)$ matrix $V^p{}_t$ is defined, describing sectoral income shares by percentiles. The $(100\times n)$ table:

$$V^c_w x_t \qquad (14)$$

depicts the distribution of incomes by percentiles in each sector, with its cells showing total incomes by sector and percentile. Given the expected (total and sectoral) population over time, per capita sectoral incomes by percentiles are obtained. For a given poverty line income y_{pline} (a scalar), the sum of persons belonging to cells with *per capita* incomes below of the poverty line gives the number of the poor in period *t.* (See eqs. 24-30, Appendix A, on the determination of population, sectoral employment, per capita incomes, and poverty measures.)

[3] Batey and Rose (1998) survey the literature on this class of "extended input-output" models.

[4] See Round (2003) for a survey of SAM literature, an approach closely related to extended input-output.

The second policy dimension of the model, in addition to investment policy, is *income distribution policy*. In the context of the present model, an income distribution policy is a sequence $\{V_t\}$ of income distribution matrices. In Section 4.3, for example, we solve for the income distribution policy which satisfies the Millennium Goal of halving extreme poverty by 2015.

3.3. *Saving and consumption*

Let us now close the loop of Figure 2, briefly describing the determination of saving and consumption from incomes generated in production.

Our representation of consumption and saving behavior is already present in Lange's (1964) pathbreaking analysis. Lange (1964: 207) introduces demand equations, based on behavioral data, which relate final consumption by produced item to value added. But while in Lange saving/investment is an exogenously determined share of total income, in the present model domestic savings are endogenously determined, non-consumed incomes. Economic policy can still influence the rate of investment by influencing income distribution policy $\{V_t\}$ — in particular, via changes in the share of public income in total income. This possibility is not tried in the present study.

Public savings (a scalar) is defined as the difference between public income and public consumption:

$$s^g{}_t = y^g{}_t - c^g{}_t \,. \qquad (15)$$

In order to determine private savings, let us first define private consumption by type of output:

$$c^p{}_t = \Gamma^p\left(I - \hat{V}_d\right)y^p{}_t \,, \qquad (16)$$

where $c^p{}_t$ is an *n*-vector of consumption demands, Γ^p is an $(n \times k)$ matrix of consumption propensities, V_d is a $(1 \times n)$ matrix of coefficients of direct taxes and *I* is the identity matrix.

Private consumption demands *by income class* (a *k*-vector) are:

$$c^{p*}{}_t = \widehat{\iota'\Gamma^p}\left(I - \hat{V}_d\right)y^p{}_t \,,$$

in which ι is a $(n \times 1)$ summing vector (1, 1, …, 1)' and $\widehat{\iota'\Gamma^p}$ a $(k \times k)$ diagonal matrix of total consumption propensities by income class.

Hence, private savings by income class (a *k*-vector) are:

$$s^p{}_t = \left(I - \widehat{\iota'\Gamma^p}\right)\left(I - \hat{V}_d\right)y^p{}_t \,. \qquad (17)$$

Our third policy dimension, along with investment and distribution policies, is foreign saving and indebtedness. The rate of net inflow of foreign capital, which adds to external indebtedness, is an exogenous variable in the context of the model. It may be understood as a policy variable, which works through policies related to international capital flows and currency exchange. The level of external indebtedness reflects the economy's degree of policy autonomy, as highly indebted countries are constrained in their policy choices by external creditors' policy preferences.[5]

Exogenously determined net foreign savings Φ_t add to private and public saving (for simplicity, at an equal rate), thus increasing the volume of resources available for domestic investment. In the context of the model, a foreign saving time sequence $\{\Phi_t\}$ constitutes an *indebtedness policy*.

Figure 2 shows total private savings ${s^{p}}^{*}_{t}$ and public savings s_t^{g*} — i. e. they include the effects of adding foreign savings to private and public domestic savings $s^p{}_t$ and $s^g{}_t$ (see eqs. 8 to 10 in Appendix A). (Foreign savings add also to the external debt of the period; see equation (7) in Appendix A.)

To recapitulate. The model simulates the reproduction of the economic system trough time under different policy assumptions. Starting from a given initial situation, it describes the evolution of the economy under different policy sequences. Given: (a) initial output values, (b) values of model parameters and exogenous variables, and (c) policy parameter sequences for investment policy $\{z^g{}_t\}$, income distribution policy $\{V_t\}$, and indebtedness policy $\{\Phi_t\}$, the model can be recursively solved forward in time, so as to numerically determine the trajectories of sectoral outputs and other endogenous variables. Endogenous income levels (by percentiles) determine in turn poverty incidence (for a given poverty line) and other welfare indicators such as the Gini coefficient of inequality. Policy sequences $\{z^g{}_t\}$, $\{V_t\}$ and $\{\Phi_t\}$ can be exogenously given, or they can also be determined by optimization of some expression of social welfare. Policy sequences are exogenously given, for instance, when past development is simulated, or when a particular strategy is tested, as in the case of the official poverty reduction strategy in the next section. In Section 4.2, the model is solved for the investment policy $\{z^g{}_t\}$ that minimizes poverty by 2015, for given income distribution $\{V_t\}$ and indebtedness $\{\Phi_t\}$ policy sequences.

3.4. *Excess demands*

We have thus far described the evolution of outputs/supplies over time under different policy assumptions. Let us finally introduce sectoral demands, in order to enquire into the "horizontal" balance between sectoral supplies and demands. (The flow diagram in Figure 2 describes the dynamic core of the model; the comprehensive flow diagram in Appendix A.9 describes the whole model, including supply/demand balances.)

Total sectoral demands are composed of: (i) intermediate demands, (ii) consumption demands, and (iii) investment demands.

[5] In Buzaglo and Calzadilla (2009) we discuss the policy background more detail, along with the instruments available for implementing the assumed changes in the policy areas of international financial flows/indebtedness, investment activity and income distribution.

Intermediate demands result immediately as the product Ax_t, given the $(n \times n)$ A matrix of technical coefficients. Consumption demands by type of good or service where described in equation (16) above. Investment demands are related to investment by destination d_t through the capital coefficients $(n \times n)$ matrix H of sectoral composition by sector of origin of investments by destination.

Then, the *n*-vector of sectoral excess demands q_t is the difference between sectoral supplies and demands:

$$q_t = x_t + o_t - Ax_t - c_t^p - c_t^g - Hd_t \,. \qquad (18)$$

Total supply is composed of sectoral gross outputs x_t, and includes also sectoral import duties, transaction taxes and other indirect taxes — the *n*-vector o_t. Total sectoral demands are composed of intermediate demands Ax_t, private consumption demands c_t^p, public consumption demands c_t^g, and investment demands (by sector of origin) Hd_t.

When all output is internationally tradable and world prices prevail in the economy, q_t represents sectoral trade balances — positive elements are net exports and negative elements are net imports. That is, the model is aimed at depicting a small open economy, in which exogenous — and for the purposes of the analysis, fixed — relative prices are assumed to prevail. The q_t vector thus reflects the effect of the strategy on international trade specialization. In the framework of this model, a "balanced growth path" such as the turnpike solution of Bródy's equation (3) for extended reproduction — in practice, an investment policy that minimizes sectoral excess demands (in absolute value) — is one of many different possible strategies. It would be the case of a particular pattern of structural change, from certain initial specialization profile toward a more self-sufficient economy.

4. Simulating extended reproduction strategies

The above reproduction model was first conceived for simulating alternative development strategies in Mexico (Buzaglo, 1984). The by that time current official strategy of "petrolisation," that is, of dramatically expanding production capacities in the oil sector, was compared to an alternative basic needs oriented strategy, in which agriculture and other wage goods producing sectors were developed. The basic needs strategy included also an income distribution policy which stipulated improvements in the incomes of low-income classes (agricultural day laborers, poor peasants and the urban working classes, formal and informal).

Simulation with the model showed how "petrolization" would result in increasing imports of foodstuffs. It showed also the crucial importance of increasing investment efficiency in agriculture, especially in the case of a basic needs-based strategy.

In the Mexican study investment policies are exogenously stipulated; the planned "petrolization" investment policy of the government is simulated, and compared with a public investment sequence in which the weight of oil-related sectors is reduced, and that of essential goods producing sectors is increased (also, the weight of investment goods producing sectors is increased in the medium term).

In Buzaglo (1991a), applied to Argentina, some investment policies are obtained by optimization, instead of being exogenously stipulated.[6] "Living off our means," a policy slogan at a time of high indebtedness and widespread capital flight, is simulated as a strategy combining (a) an investment policy rendering trade balances (sectoral excess demands) as close to zero as possible (i.e. maximizing import- and export substitution), (b) a status-quo, high inequality income distribution policy, and (c) an external debt moratorium reducing the stream of future foreign dissaving. In an alternative type of optimization, an "Ideal opening" is explored, in which investment policy searches the output pattern that maximizes growth. Growth maximization is supplemented by an advanced redistribution policy, and a status-quo, non moratorium indebtedness policy.

The present study explores the viability for Bolivia of achieving the Millennium Development Goal of halving extreme poverty by 2015, and the effects that this would imply for the socio-economy, in particular for the different social classes. Optimization is used in the selection of both investment and income distribution policies. Investment policies are determined such as to induce poverty minimizing (and for comparison, employment maximizing) structural change and growth. A complementary income distribution policy is explored, which would be needed in order to achieve the goal of halving extreme poverty by 2015 — for comparison, a policy totally eliminating extreme poverty is also obtained. A further difference with the previous studies, in addition to the greater detail in the public sector's accounts, is the production of annual SAMs as a part of the model simulation output (see Appendix C).

All strategies share the same foreign indebtedness policy. In all cases applies the foreign debt agreement attained with international creditors in the framework of the Debt Initiative for Highly Indebted Poor Countries, which reduces the expected outflow of savings in concept of debt repayments. Poverty reduction strategies only differ in their investment and income distribution policies. In what follows we succinctly describe five different strategies, (a) Base scenario, (b) Millennium investment strategy, (c) two different Millennium investment plus redistribution strategies, and (d) Millennium Employment strategy.

4.1. *Reproducing status quo*

The Base scenario is the now superseded, official *Estrategia Boliviana de Reducción de la Pobreza* (EBRP). The policies proposed in the formerly official strategy paper (Bolivia, 2001) were a mere continuation of previous policies, in spite of a detailed and accurate study of the nature and causes of widespread poverty. This strategy maintained the natural resource intensity of the past pattern of growth, with its concentration on oil, gas and export crops. So our simulated EBRP investment policy continues the investment policy of the past. It maintains the focus of the past pattern of growth in capital intensive, primary sectors such as gas, oil, minerals and soybeans, and in general, it maintains the pattern of sectoral priorities of the past.

The EBRP had no statements of policies addressing the highly unequal distribution of resources and incomes. Tax policy, a key instrument of redistribution policy and an indicator of distributional preferences, was not to be activated as an instrument for poverty reduction.

[6] Buzaglo (1991b) presents a verbal description of the model and a synthesis of the results. A formal (and compact) presentation is Buzaglo (1999).

In our simulated EBRP strategy income distribution policy is then a constant income distribution matrix sequence during the 2000-2015.[7]

Let us briefly comment on the results of this Base, EBRP reproduction scenario. Figure 3 shows the results of the different simulations on the share of the extremely poor in total population in 2000-2015. The EBRP initial value for extreme poverty (50 percent) corresponds to the absolute poverty line of 1 US dollar a day, the threshold commonly used in international comparisons. The figure shows that under the assumptions of our model the EBRP does not succeed in halving the incidence of extreme poverty by 2015. The reduction in the share of the extremely poor is 5 percentage points, that is, 20 points below the goal.

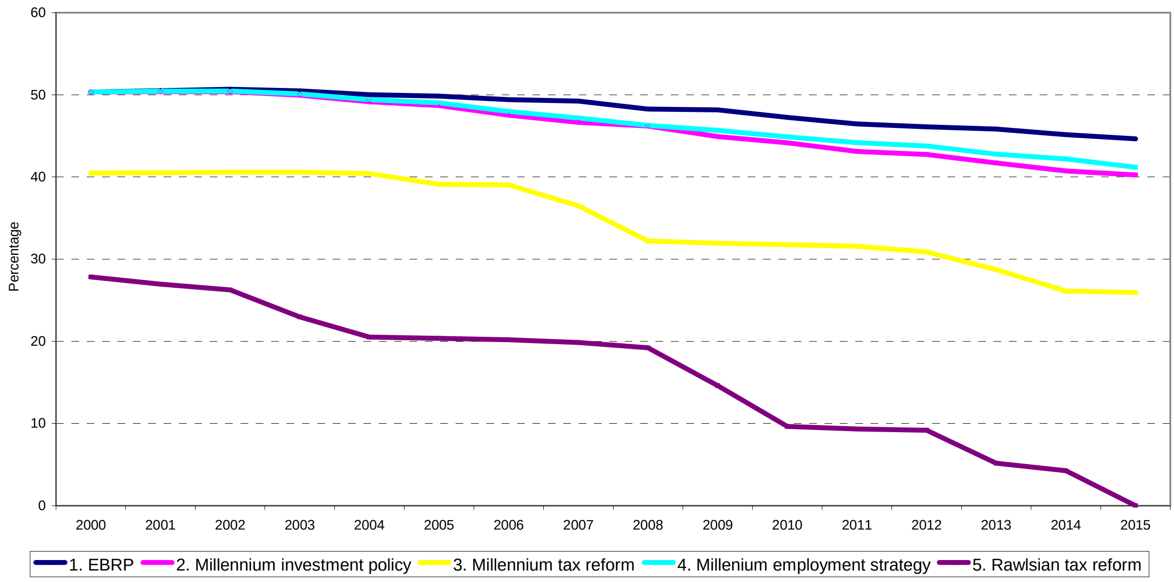


Fig. 3. Share of the population in extreme poverty

The simulated effects of the EBRP strategy on sectoral outputs are shown in Figure 4. The status-quo investment policy of the EBRP induces continued expansion of a natural resource and capital intensive sector such as Petroleum, gas and mining. This sector rapidly increases its weight in total output, although its growth rate diminishes with time. It becomes the largest sector for the most part of the period. Modern, Export crops agriculture also follows a path of rapid expansion. Food crop, traditional agriculture, on the other hand, prolongs its past stagnating trend, and its share in total output is further reduced.

[7] For the assumed values of investment policy $\{z^g{}_t\}$, distribution policy $\{V_t\}$, indebtedness policy $\{\Phi_t\}$, and other model data, see Appendix B. In the EBRP they are constant for 2000-2015. The model is formulated and solved within the general algebraic modelling system GAMS (see e.g. Brooke *et al.* 1992).

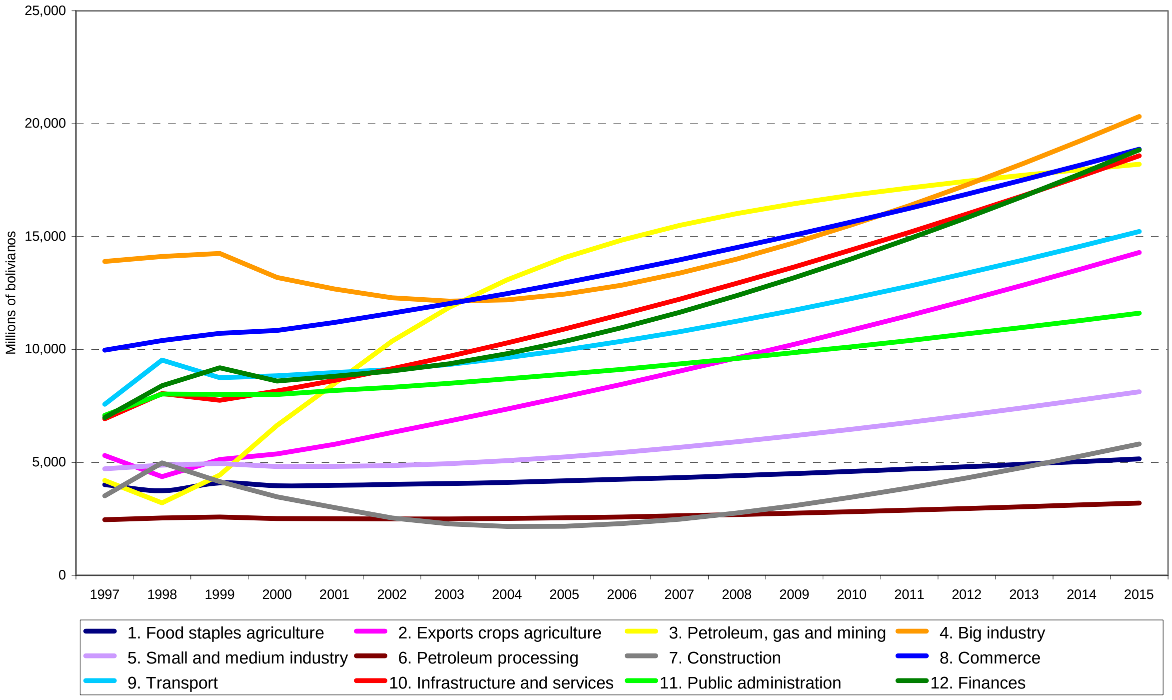


Fig. 4. Output pattern of the EBRP

In synthesis, the EBRP fails to significantly reduce poverty, due to a concentrated income distribution structure, and an unhelpful sectoral growth pattern — in addition to a low overall growth capacity. A more helpful sectoral pattern of growth and a less concentrated income distribution structure should imply higher poverty reduction outcomes for equivalent rates of overall growth. These are the subjects of discussion of the following sections.

4.2. *Poverty minimizing structural change*

We investigate now the possibility for investment policy alone to induce such changes in the level and structure of output as to reduce extreme poverty by a half by 2015. That is, we solve for the $\left\{z^{g}{}_{t}\right\}$ allocation vector sequence of available public investment funds — i.e. public savings available for financing the use of investment policy instruments — such that the sectoral growth pattern of the economy is most effective in reducing extreme poverty. In order to separately analyze the effects of investment and income distribution policies, we assume in this section a status quo distribution policy. That is, income distribution (corresponding to the latest income survey of year 2000) remains unchanged throughout the strategy horizon.[8] The effect of this poverty minimizing "Millennium investment policy" on the evolution of extreme poverty can be seen in Figure 3. The "Millennium investment policy" does not succeed in halving poverty by 2015. Pro-poor structural change achieves only two fifths of the reduction in poverty needed to attain the Millennium Goal. The Millennium investment policy is twice as effective as the EBRP in reducing poverty, but it is still a bit more than halfway from the target.

[8] For simplicity, we solve for a constant $\{ z_t^g \}$ sequence for the whole 2000-2015 period. A restriction is imposed on the excess demands of non-tradables' sectors (7th to 12th), so as to maintain the initial equilibria. One third of the public investment budget is allocated equally to all sectors. The resulting z^g vector is: (0.029 0.029 0.029 0.029 0.238 0.029 0.078 0.029 0.374 0.054 0.043 0.037)'.

The changes in output structure obtained by the Millennium investment policy are rather large (see Figure 5). In order to minimize poverty, investment policy favors sectors with more equal income distributions and/or higher dynamic (investment) efficiency. Activity sectors in which the poor account for a relatively large income share, and/or where the output response to investment is relatively high, tend to get higher weights in the investment policy vector.

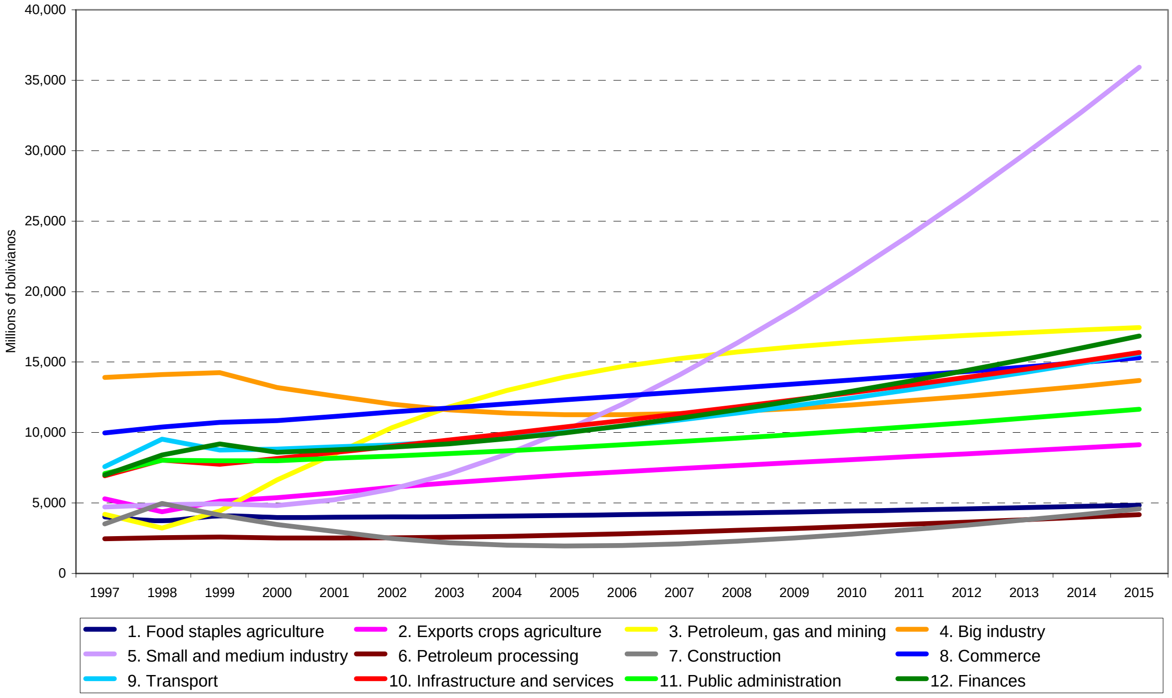


Fig. 5. Output pattern minimizing extreme poverty by 2015

Thus, sectors such as Petroleum, gas and mining, favored by past investment policy and enjoying high growth rates, tend to gradually lose its privileged position, due to their relatively unequal distributional structure and low dynamic efficiency. Big industry, with the largest initial output share is to some extent a similar case — partially similar, as the efficiency of investment in the sector is not particularly low. Big industry loses its position of a relatively important contributor to total output, to become a more ordinary sector. Similarly, the output share of Export crops agriculture gradually declines along the period.

The Millennium investment policy favors the expansion of Small and medium industries, due to their particular income distribution structure. While this sector's investment efficiency is about the same as Big industry, its more "pro-poor" income distribution structure makes it superior from the poverty reduction efficiency perspective, and increases its weight in investment policy. This, in turn, accelerates growth in the sector, and increases its share in total output and employment.

The case of Food staples agriculture deserves a special comment. Sustained growth of output and incomes in this sector has been singled out as the key for distributionally progressive growth. Kalecki's (1954) theoretical insights have been largely confirmed by empirical studies (see e.g. Lipton and Ravaillon, 1995). The poverty minimizing Millennium investment policy results in a disappointingly low growth for Food staples agriculture. Income distribution structure in the sector should qualify it for a high weight in investment policy — i.e., most peasants producing Food staples are poor. The problem is the sector's very low dynamic efficiency. A peso invested in Food staples agriculture gives rise to a very low increase in the sector's output — the second lowest after Transport, a very capital-intensive sector.[9] Food staples agriculture mostly occupies very poor peasants in the highlands (Altiplano), producing in very difficult soil and climactic conditions, and until recently without significant infrastructure, or technical and credit support.

At any rate, present knowledge seems to suggest a careful approach to policy reform in the Food staples agricultural sector. Detailed study and experimentation should be required to arrive to effective policy reforms. Also, land tenure reform should be considered among the efficiency increasing reforms (de Janvry *et al*. 2001). Yet the most widely shared implication of the analyses is that agricultural policy and land reform need to be embedded in comprehensive policy and institutional reforms (de Janvry *et al.* 2001: 23).[10]

The present study of optimal poverty reducing investment policies suggests also the possibility and convenience of combining agricultural reform and development with promotion of small and medium industry (and services) in rural areas. The existence of traditional, communal forms of property and production in the Altiplano highlands and other agricultural regions might resemble the conditions in the Chinese countryside two or three decades ago. The Chinese experience in recent decades shows the vast potential capacities existent in rural areas for expanding non-agricultural production. For instance, the output of China's rural industry sector increased in 1978-2000 at the astonishing rate of 22 percent per year in average (Kwong and Lee, 2005).

4.3. *Expanded reproduction with structural change and income redistribution*

> Providing for the poor is a duty, which falls on the State as a whole, and has regard only to the general advantage.
> Baruch de Spinoza (*The Ethics* IV, Appendix 17)

> Let us tax the rich to subsidize the poor.
> Jean Paul Marat (Thompson 1989: 170)

We have seen in the previous section that the poverty minimizing Millennium investment policy did not succeed in attaining the Millennium Goal of halving extreme poverty by 2015. The output structure induced by this policy implies a reduction in the poverty rate of about a half of what is needed to reach the Goal, while the Base scenario attained one tenth of the needed reduction.

Given this poverty minimizing investment policy, we ask now if there are, given the consumption and saving behaviors of the different income classes in the model, viable changes in the structure of income distribution that would accomplish the remaining reduction needed. We ask if there is any $\{V_t\}$ income distribution policy sequence which along with the poverty minimizing investment policy of the previous section halves extreme poverty by 2015. We design the simplest conceivable redistributive policy, consisting of a tax applied at a constant rate on all incomes above twice the poverty line (of 2 dollars a day). The fund thus collected is equally distributed to all people below the line of extreme poverty (1 dollar a day). This is of course not intended as a realistic description of what an effective income redistribution policy might be, but a first feasibility check of income redistribution as a means

[9] Incremental capital output ratios α in our study were determined by historical simulation with the model, so as to track past outputs (1990-1997) as accurately as possible (see Appendix B).
[10] Among other reforms, the government elected in 2006 launched a land redistribution program, based primarily on the distribution among poor peasants of state, idle, and illegally occupied land.

of achieving the Millennium Goal.[11] It is also intended to roughly quantify the magnitude of the redistribution effort required.

The optimization exercise of this section consists thus in solving the model for the income tax rate which would make the share of the extremely poor in 2015 to approach 25 percent as much as it is possible — i.e. a half of what it was in 2000. The Millennium investment policy of the previous section is now supplemented by a straightforward redistribution scheme. All other things — initial conditions, behavioral coefficients and in particular, investment policy parameters — are equal to those of the previous section. The "Millennium tax [and expenditure] reform" transforms the $\{V_t\}$ status quo income distribution into a new, post-tax and subsidies sequence $\{V_t^*\}$ which achieves the Millennium poverty goal.

Figure 3 above shows the evolution of poverty in what results to be an industrializing growth-cum-redistribution poverty reduction strategy — a poverty minimizing policy focusing particularly on industrial growth based on small and medium enterprises, combined with redistributive reforms. Figure 3 shows how redistributive reforms, immediately from its inception reduce extreme poverty by 10 percentage points, and continue to progressively cut it until the Millennium Goal is attained in 2015.

The Millennium tax rate that obtains this result is 8.1 percent. A not unrealistically high rate, if it is kept in mind that, as for most Latin American countries, Bolivia's tax revenues are relatively low. Bolivia's tax revenues/GDP ratio is low in comparison to what is "normal" given the country's level of development, that is, below the regression line relating this ratio to GDP per capita. As calculated by Perry *et al.* (2006, Table 5.7) Bolivia is "undercollecting" — i.e., collecting under what would be expected given its GDP per capita level — at 3.6 percent of GDP. As a share of GDP, the Millennium tax represents 4.6 percent — the required redistribution would thus involve an additional effort of one percent of GDP above the average.

Figure 3 shows also the effects of a more ambitious, fully "Rawlsian" strategy. A fully Rawlsian strategy would probably adopt the more ambitious goal of totally eliminating extreme poverty by 2015, giving absolute priority to the needs of the extremely poor. The "Rawlsian tax" obtained by solving the model in exactly the same way as in the Millennium tax above — except that the objective is zero extremely poor in 2015 — is 16.7 percent.

4.4. *Poverty reducing vs. employment increasing reproduction*

The sectoral output elasticity of poverty, that is, the effect of sectoral growth on poverty reduction, has recently been investigated in a wide empirical study (Perry *et al*. 2006). According to this cross country study, relative labor intensity determines a sector's influence on poverty alleviation. Both the size of growth and the degree of labor intensity in that growth are relevant for explaining poverty reduction. "[A]griculture, the most labor-intensive sector, presents the largest growth elasticity of poverty, while mining [including oil] and utilities carry the lowest elasticities for poverty reduction" (Perry *et al*. 2006: 91).

It is interesting to check these ideas in the context of our simulation model, not only to test the empirical plausibility of the model, but also because of the potential interest of its policy inferences. The object of this section is to *ceteris paribus* compare the previous Millennium

[11] A realistic description of redistribution policies would also include reform policies such as asset redistributions (e.g. the already initiated land and natural resource reforms) which are not easy to quantify.

investment policy which minimizes poverty, with an investment policy which induces employment maximizing structural change.

In terms of our analytical model, such an employment focus is represented by the search of the investment policy that obtains the highest employment growth. In order to evaluate employment creation under different strategies, a matrix of sectoral employment coefficients by type of labor is defined, and a vector of employment by type of labor is so determined (see equation (23), Appendix A). To every output trajectory is thus associated an employment trajectory.

Hence, given the expected flows of foreign saving assumed in all strategies, and the (unchanged) initial income distribution, we solve for the investment policy $\{ z_t^g \}$ that maximizes employment in the final year 2015. [12]

The path of extreme poverty for the Millennium employment strategy is shown in Figure 3. This strategy is slightly less effective in reducing poverty than the Millennium investment policy. It is, on the other hand, slightly more effective in expanding employment — there are about thirty thousand more occupied persons in 2015. That is, there are in general only slight differences between both strategies, and this is reflected in rather similar GDP growth rates, 4.4 percent versus 4.5 percent annually in average for the employment and poverty minimizing strategies respectively.

The small differences existing between the strategies are due to rather similar output growth patterns — the Millennium employment strategy growth pattern is shown in Figure 6. Compared to the poverty minimizing strategy, the Millennium employment strategy increases the weight of Food staples agriculture, and decreases that of Small and medium industry.[13]

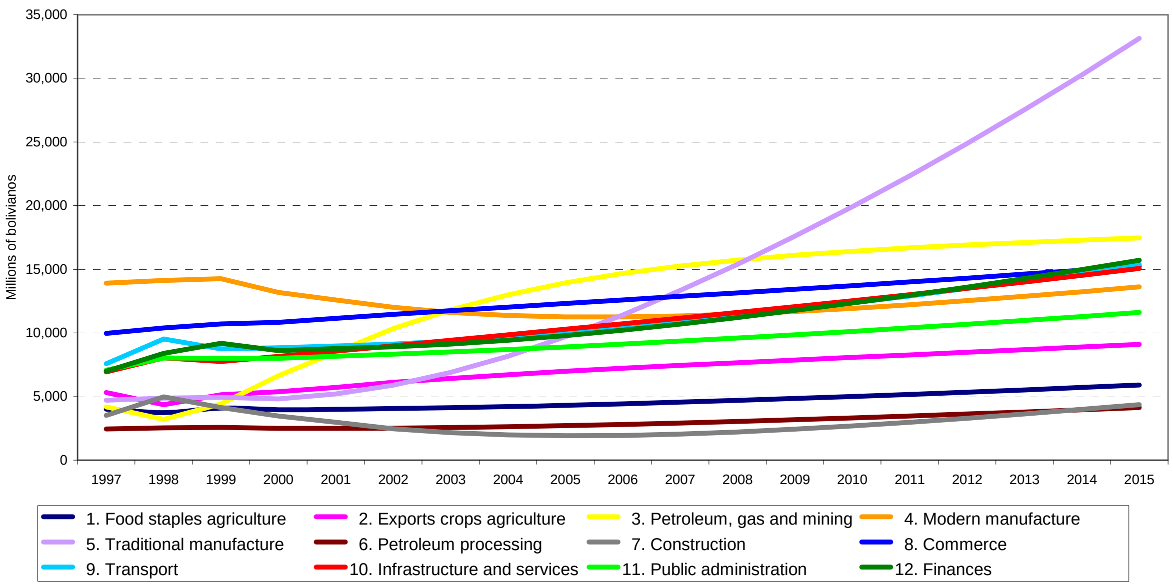


Fig. 6. Output pattern maximizing employment by 2015

[12] The restrictions on the $\{ z_t^g \}$ investment policy vector in note 22 above apply also in this simulation. The z^g solution vector is: (0.065 0.029 0.029 0.029 0.221 0.029 0.075 0.029 0.368 0.049 0.044 0.033)'.

[13] Cf. the first and fifth elements of the corresponding investment policy z^g vectors of notes 8 and 12.

Increasing the weight of Food staples agriculture in investment policy has effects on the sector's output and employment. Food staples agriculture is able to keep its share in total employment — i.e. about one fifth of the working population. Food output growth accelerates but it is still slower than population growth. Permanent excess demands of food staples make redistribution policies particularly critical, and the previous comments on agricultural reform are also pertinent here.

Small and medium industry is the leading sector also in the Millennium employment strategy. But a slightly diminished weight in investment policy makes growth in this sector slightly lower, as compared to the poverty minimizing strategy.

5. Poverty reduction strategies and social classes

As stated above, our reproduction model attempts to describe income distribution in detail, both in respect to the distribution of incomes according to their size, and in respect to the distribution of income among social classes. Income distribution matrix *V* can be seen, as the *A* and *B* input-output and capital matrices often are, as reflecting the inherent coherence structure of the socio-economy (consistent with a unique set of prices). But while input-output matrices reflect largely technical conditions, the structure of income distribution reflects mostly socio-political and historical conditions. If technological coefficients are difficult to forecast, the future configuration of social forces shaping socio-political development is even harder to guess. In our study, technical and capital coefficients were assumed to remain unchanged over time. In most simulations, income distribution coefficients were also assumed to be constant, but in two cases we tried to determine what changes in income distribution would be needed to achieve the Millennium Development Goal.

Detailed knowledge of the largely beneficial effects that halving (or eliminating) extreme poverty in the medium/long term would have for the different actors of the socio-political process should increase the probability, if any, of the necessary changes. This knowledge might also increase the selectivity of redistribution policies. It might also help to inform the basis of larger social redistributive coalitions, and to anticipate potential sources of social tension.

5.1. *An approximation to poverty and class in Bolivia*

Our approach to modeling class and poverty starts from the $(100 \times n)$ matrix of percentile income distribution by sector, which permits to identify persons/households below the poverty line. In the income redistribution simulations, the initial income distribution matrix (which corresponds to the survey year 2000) is changed into a matrix sequence that corresponds to the new (after tax and subsidies) distribution of incomes (i.e., after the simulated introduction of tax and subsidies satisfying halved (or eliminated) poverty). In order to transform the new post-redistribution $(100 \times n)$ matrix sequence of percentile income distribution by sector into a $(k \times n)$ matrix of class distribution by sector, a matrix *T*, formed of *n* matrices—a diagonal matrix of matrices—, is introduced. Each of the *n* matrices in the diagonal of *T* describes income distribution by percentiles and class in the sector. (See details in Appendix A.8.)

The source of income distribution and saving/consumption data is the extensive household survey under the Program for the Improvement of Surveys and the Measurement of Living Conditions in Latin America and the Caribbean (MECOVI). The closest the MECOVI's classification of households comes to the concept of class, is the "occupational category" —

viz. (blue-collar) workers, (white-collar) employees, self-employed, employers, domestic workers. These categories, along with the (rural/urban) place of residence and the number of years of education (less/not less than 12 years) allow for identifying within the MECOVI household sample the following social classes: (1) urban owners, (2) rural owners, (3) skilled workers, (4) peasants, (5) non-skilled workers, and (6) self-employed.

The limitations of this empirical approximation to the notion of social class are compounded by the well known problems of income data based on household surveys, among other problems the well known tendency to under-/overestimate incomes at the high/low ends of the income distribution.

Table 1. Class structure, average income, poverty and absolute poverty in Bolivia (2000)

Class	Percent of households	Average income [a]	Percent of poor [b]	Percent in absolute poverty [c]
Urban owners	3.7	2 045	28.1	12.5
Rural owners	0.4	2 335	21.1	20.5
Skilled workers	10.8	2 220	20.3	5.2
Peasants	33.2	309	93.6	82.1
Non-skilled workers	27.5	927	66.1	39.8
Self-employed	24.4	724	73.3	45.1
Total	**100.0**	**858**	**70.5**	**50.3**

(a) Annual average income (dollars), (*b*) income under two dollars a day, (*c*) income under one dollar a day. *Source*: Household survey MECOVI 2000.

The Bolivian class structure, the level of average incomes by class, and poverty levels according to the MECOVI 2000 sample are shown in Table 1. The Bolivian class structure shows the weight of the peasant class, more important than in most other Latin American societies. This class is also one the most apparent actors of the process of social change and democratization. Most of the peasants belong to some of the different indigenous ethnic groups, work under very primitive conditions, and obtain incomes which are, in average, below the extreme poverty line of one dollar a day — by far the worst living conditions of all classes. Over three-fourths of them live in absolute poverty; very few earn incomes above the poverty line of two dollars.

The traditional working class is the second largest social class. Poverty is widespread among the non-skilled workers, but the poverty rates are much less than among peasants, and their average incomes are somewhat above the national average. The closure of the tin mines and other nationalized enterprises since the mid-1980s has reduced the weight of the class. In the de-industrializing, low-growth environment of the period, this provoked a regression towards peasant agriculture (mainly coca leaf), and urban low income self-employment.

The self-employed, sometimes called the “informal proletariat” (Portes and Hoffman 2003), have a numerical weight similar to the working class. This is a highly heterogeneous group, which includes a wide diversity of strategies of urban survival, such as street commerce, occasional employment, and other. During the neoliberal ”structural adjustment” period many former workers of the mining, industrial and public sectors — and also many peasants escaping the miserable conditions in the countryside — became self-employed. The average incomes of the group are about the same as the 2 dollar’s poverty line, but almost half of them live in absolute poverty.

The middle class of relatively highly educated workers includes managers and administrators, and salaried professionals working in large enterprises and the public sector. The average incomes of this class are comparable to those of the propertied classes of owners, and the poverty rates are lower. The class is numerically less important than what it is in developed countries — in the US, for instance, the share of these groups is more than three times greater (see Wolff and Zacharias 2007). But judging from their income level, their relative social and political weight is higher.

The already mentioned weaknesses of household survey data and of our own class definitions are more apparent when it comes to the numerically small capitalist class of rural and urban owners.[14] Although the problem could have been reduced by depuration of the sample, the estimations presented here are based on rough data, and make for rather heterogeneous owner classes. The owners earn, in average, incomes that are more than twice the national average, yet there is a unexpectedly large number of poor owners. Besides the already mentioned technical problems, this is possibly due to the very low national average, which is not far from the 2 dollar's poverty line, and that given the very diverse regional circumstances of a large poor country, ownership of a certain quantity of land or capital is not always enough for escaping poverty.

5.2. *Structural change and social classes*

We have in previous sections described the effects, simulated with the help of our extended reproduction model, of five different poverty reduction strategies: Base scenario, Millennium investment strategy, two different Millennium investment plus redistribution strategies, and a Millennium employment strategy.

Our notion of strategy refers to the combination of (a) an indebtedness policy, (b) an investment policy, and (c) an income distribution policy. Indebtedness policy, which can be seen as contributing to the aim of economic policy sovereignty (as high indebtedness implies low control of own policies), is the same for all our simulated strategies — the result of the Debt Initiative for Highly Indebted Poor Countries. Investment policy, the instrument for influencing structural change, was determined, in the Base scenario, as a stipulated sequence which merely prolongs past policies. In the Millennium investment strategy and the Millennium employment strategy, investment policy was determined, respectively, so as to minimize poverty, and to maximize employment. Income distribution policy, which directly affects measures of social justice — such as the Gini or other inequality indicators — is activated in two cases, in combination with poverty minimizing investment policy. Instead of status quo distribution, one redistribution policy halving extreme poverty, and another eliminating it (by 2015), are obtained trough optimization.

Table 2 shows the effects on Bolivian class structures towards 2015 for the three simulations that include different investment policies, resulting in different in different output structures in the terminal year. Given different sectoral employment- and class structures, different output structures result in different class structures.

Table 2. Class structure under different strategies, Bolivia 2015

Class	Base scenario	Millennium investment strategy	Millennium employment strategy

[14] Table 1 shows a much larger class of urban than rural owners, but this is probably due to the fact that rural owners often reside in the cities.

Urban owners	3.6	3.7	3.6
Rural owners	0.4	0.3	0.3
Skilled workers	9.3	8.3	8.1
Peasants	35.2	28.2	30.7
Non-skilled workers	26.4	32.2	30.8
Self-employed	25.2	27.3	26.5
Total	**100.0**	**100.0**	**100.0**

As we have seen in Section 4.4, the poverty minimizing strategy and the employment maximizing strategy result in similar output structures, and have similar effects on both poverty reduction and employment creation. As compared with the Base simulation, the Millennium strategies reduce the weight of capital intensive sectors such as natural resource and export crops sectors, which have relatively unequal income distribution structures, and comparatively low employment intensities. Millennium strategies increase, on the other hand, the weight of more equalitarian and employment intensive sectors such as Small and medium industries and services. Millennium strategies tend to increase the weight of the workers and self-employed, as compared with the Base strategy which relies more on concentrated, capital intensive sectors. Differently than in the Base strategy, the relative industrialization induced by the Millennium strategies makes the share of workers surpass that of peasants in 2015.

The anti-poverty and pro-employment strategies, by reducing the output shares of capital intensive sectors with more unequal income structures, tend to diminish the weight of the middle classes of skilled workers and professionals. The Millennium strategies result in a lower weight in the social structure for the class of skilled workers.

Finally, the employment strategy, as compared with the poverty minimizing one, tend as we saw before to favor the agricultural sector relatively more, and relatively less the sector of Small and medium industries. The employment strategy is more pro-agrarian, with more weight for the peasant class — while in the poverty minimizing strategy the weight of workers and self-employed is greater.

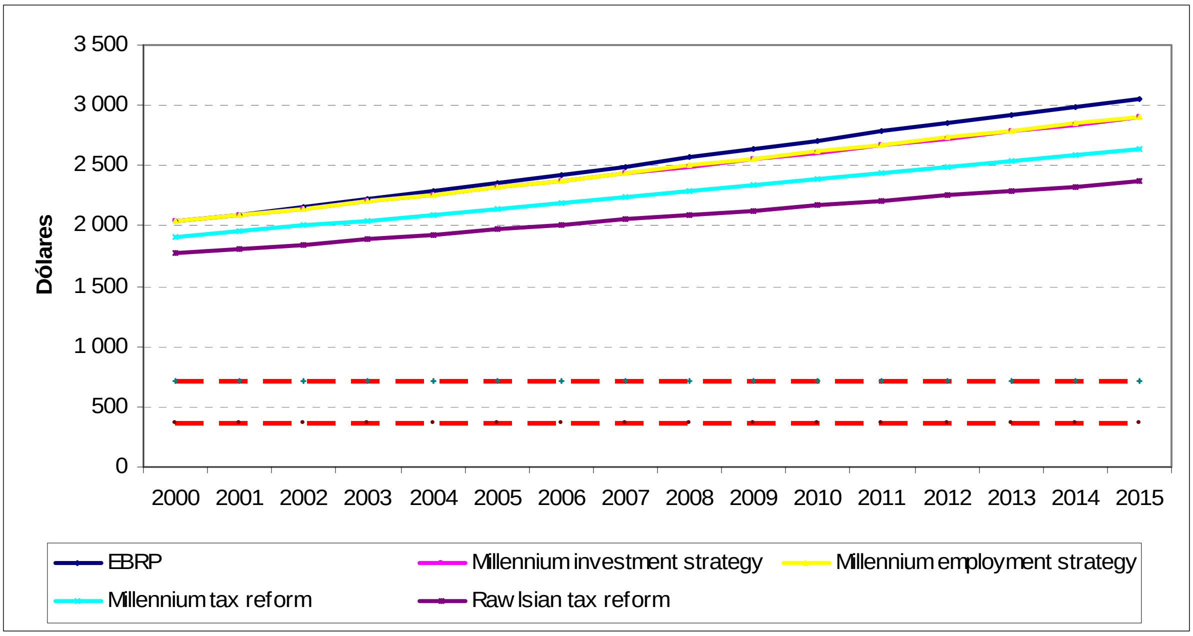
5.3. *Poverty reduction and social classes*

The focus is now on how different poverty reduction strategies may affect the different social classes. Different patterns of structural change produce different class structures, with their particular income structures. Also, income redistribution schemes as the one simulated in our study, which changes the income distribution structure by uniformly redistributing incomes towards the extremely poor, affect the classes differently. Besides its inherent interest, this kind of analysis may serve to evaluate the socio-political plausibility of different strategies, in the sense of the amplitude and weight of their potential bases of social support and resistance. It might also serve to orient specific social or sectoral policies aimed at increasing their efficacy.

Let us show the simulated effects on the incomes of the various social classes.

Urban owners. Figure 7 shows the simulated effects of the different strategies on the average income of the urban owner class. The Millennium investment and employment strategies result in similar output structures, associated in turn with similar and less unequal income distributions. These strategies rely more on "small owner" sectors rather than on "big owner" sectors — e.g., more of small industry and less of big industry. The resulting average incomes of the class are somewhat lower, as compared with the Base (EBRP) scenario, in which relatively more capital intensive sectors, with more concentrated ownership structures, have a greater role.

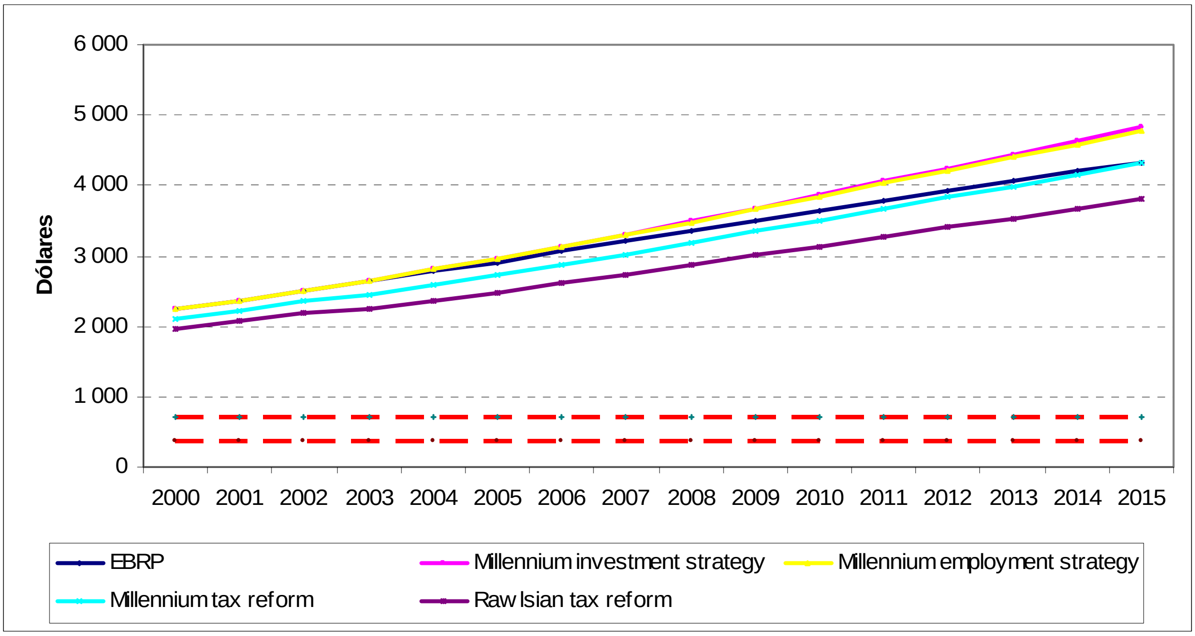
Figure 7. Urban owners. Average annual income under different strategies



The Millennium tax [and expenditure] reform strategy simulated the effects of redistribution policies needed to halve extreme poverty. These policies imply a tax of 8.1 percent on incomes above twice the poverty line of 2 dollars a day (2 and 1 dollar lines are shown in the Figure). The "Rawlsian" strategy, which eliminates extreme poverty in 2015, implies a tax of 16.7 percent. When introduced, redistribution policies reduce the income of the urban owners. However, income growth makes owners' average income surpass the initial, non-tax levels after a few years (two and six) in both cases.

Rural owners. This class has the highest average incomes. It has also a high number of absolute poor (see Table 1), but this most probably reflects the statistical problem of poor rural smallholders being counted as rural employers. In comparison with the case of the urban owners for whom the Base EBRP strategy gives somewhat higher incomes, for rural owners Millennium investment and employment strategies are superior strategies (Figure 8). This is due to the fact that these strategies favor investment and growth in traditional agriculture, in comparison with the Base scenario. On the basis of merely unenlightened self-interest, rural owners should also be able to favor the Millennium tax reform strategy, which combines the Millennium poverty minimizing investment strategy with redistribution policies — terminal

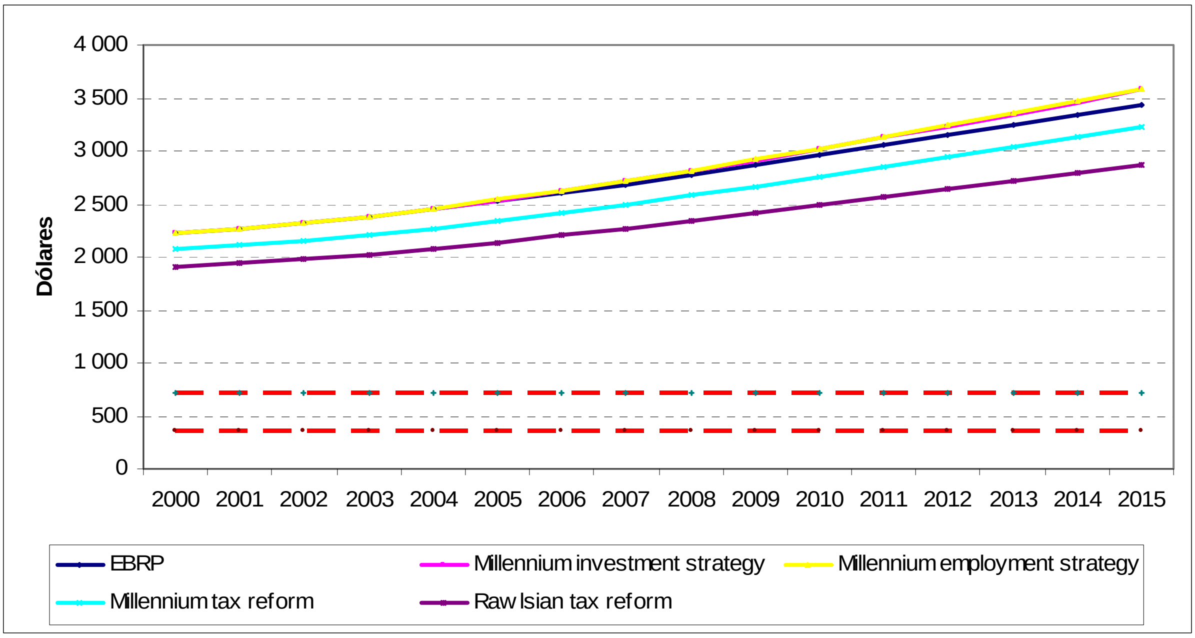
Figure 8. Rural owners. Average annual income under different strategies



average incomes are in this case about the same as in the status quo EBRP strategy. An enlightened rural owner class should even be able to support the more ambitious reform and redistribution policies of the Rawlsian strategy — the Rawlsian scenario achieves the same income levels for the class a couple of years later.

Skilled workers.

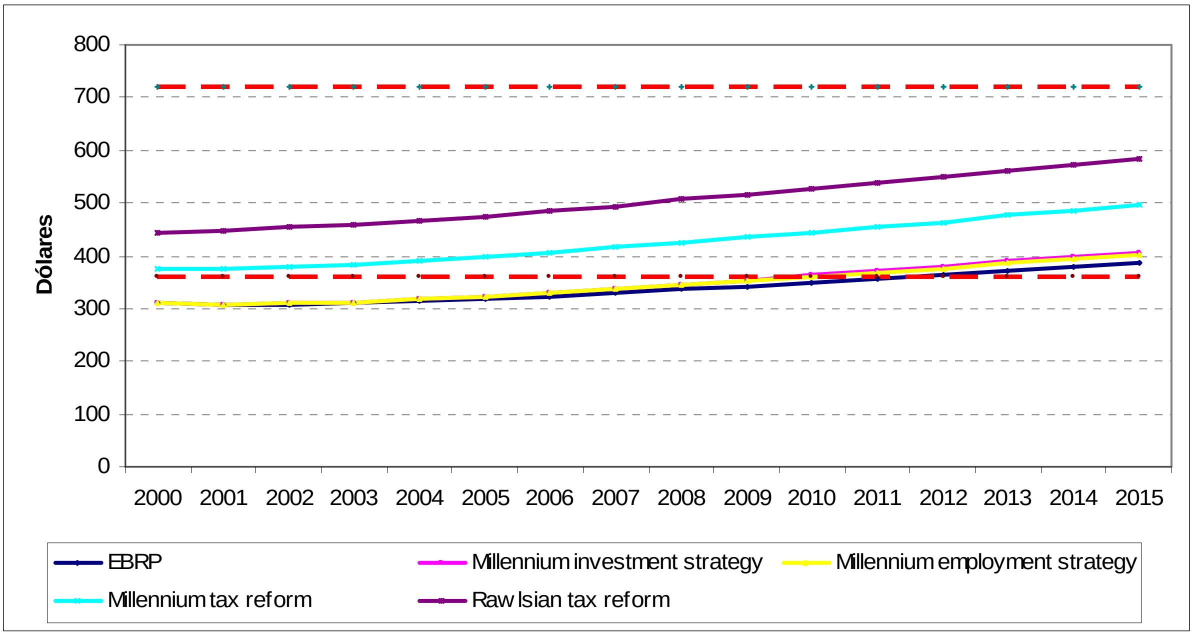
Figure 9. Skilled workers. Average annual income under different strategies



The middle classes of skilled workers, managers and salaried professionals earn incomes which are in average similar to the capitalist classes. The lower incidence of absolute poverty (Table 1) indicates probably also greater homogeneity of the class and less statistical errors. As the rural owners, skilled workers would benefit of structural change of the type induced by poverty reducing and/or employment augmenting investment policies (see Figure 9). The difference with the EBRP status quo strategy is less important, and this might make the middle classes less clear potential supporters of investment-cum-redistribution strategies.

Peasants. For its large weight in the social structure, for the widespread poverty within the class, and for the appallingly low level of their average incomes, the peasant class is the key social class in the struggle against poverty and inequality.

Figure 10. Peasants. Average annual income under different strategies

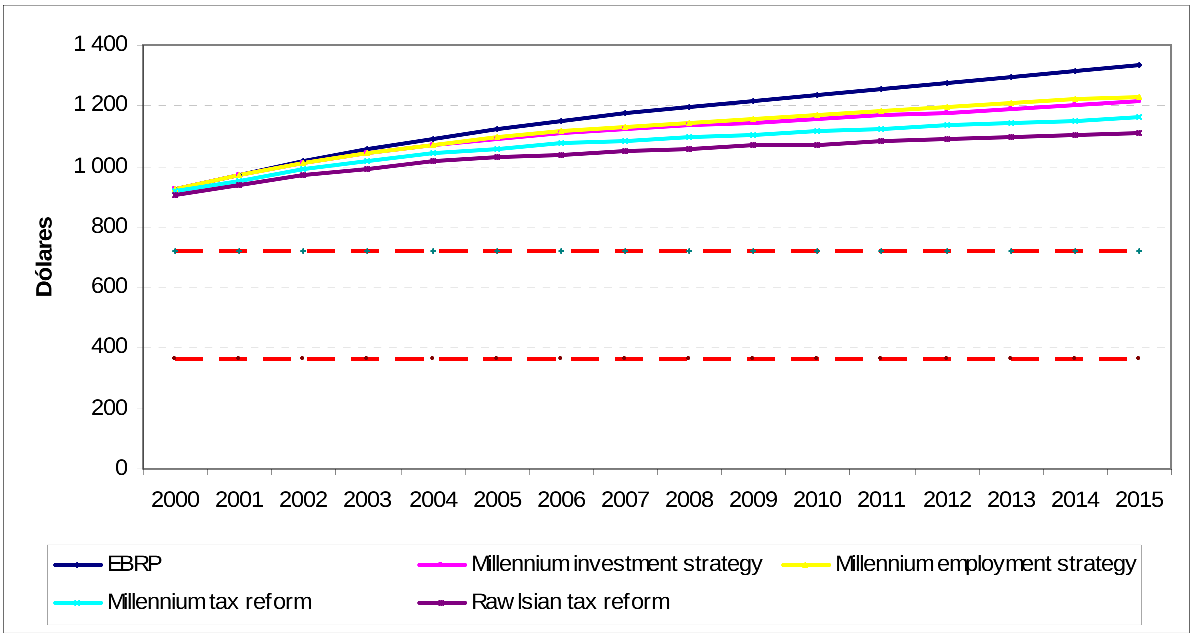


The results of poverty reducing (or employment increasing) investment policies alone on the incomes of the peasants are rather discouraging (Figure 10). Strategies which not include redistribution policies do not succeed in lifting peasants' average incomes more than a few percentage points above the extreme poverty line by 2015 — yet the investment and employment strategies cross the absolute poverty line two years before the EBRP. The already mentioned (Section 4.2) very low response to investment of output in the traditional (peasant) agricultural sector makes outputs and incomes in the sector relatively unresponsive to standard, quantitative investment policies. The simulations suggest that ambitious, well designed and carefully implemented reforms are necessary in peasant agriculture. As quoted before, "agricultural policy and land reform need to be embedded in comprehensive policy and institutional reforms" (de Janvry *et al*. 2001: 23). At a minimum, land reform should be accompanied by infrastructural investments, agricultural research and extension, and targeted credit policies. As said before, the government elected in 2006 launched, along with other reforms, a land redistribution program, based primarily on the distribution among poor peasants of state, idle, and illegally occupied land. Our simulations suggested also the convenience of combining these agricultural reform policies with the inducement of small and medium scale rural industrialization, in imitation of the astonishing successful Chinese case.

Those simulated strategies which include redistribution could be understood as pessimistic interpretations of the effects of such comprehensive reform programs on the peasant class. In the very pessimistic assumption of such reforms having no effect on sectoral growth, the Millennium tax [and expenditure] reform strategy would represent the effects of an agricultural reform program of roughly 2.8 percent of GNP (as this poverty halving strategy implies a redistribution of 4.6 percent of GNP, and about 60 percent of the extremely poor are rural poor). Similarly, the "Rawlsian" strategy which eliminates extreme poverty by 2015 would represent the effects on the peasants' average incomes of a program for 5.7 percent of GNP.

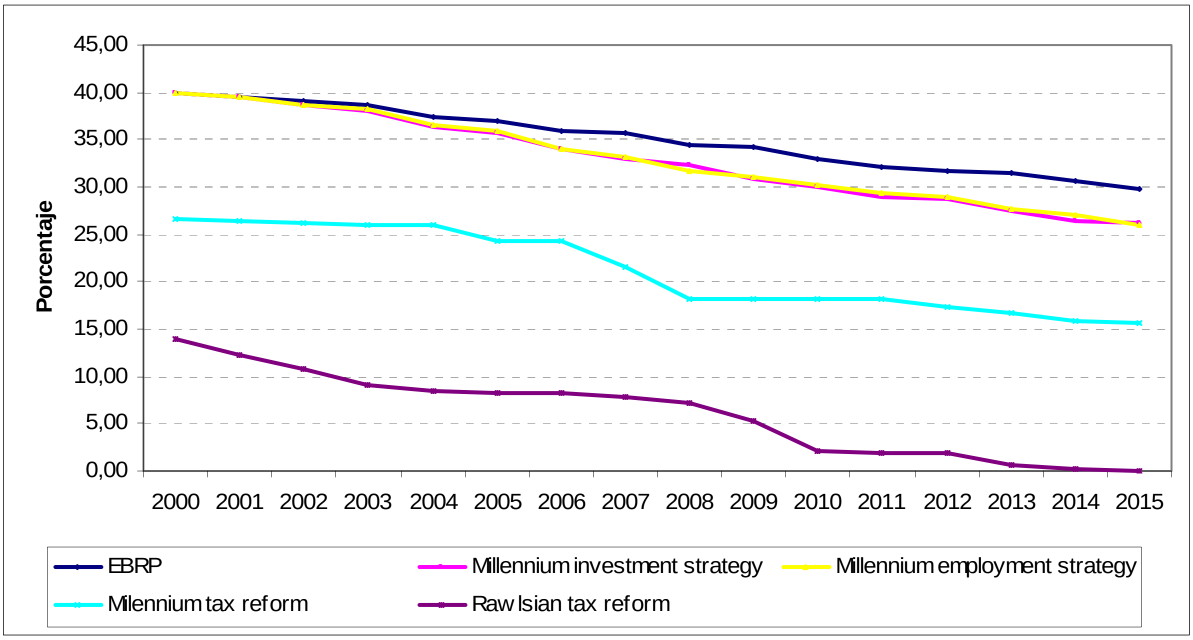
Workers. The simulation results for the working class incomes under different strategies are somewhat paradoxical. On the one hand, structural change strategies increase the weight of the workers in the social structure (Table1). On the other hand, these strategies, increasing the weight of relatively small scale sectors that pay lower wages in average, reduces the workers' average incomes in comparison with the EBRP, which puts more weight on capital intensive high-wage sectors (Figure 11). However, the differences between the strategies are not large — EBRP average worker incomes are about 10 percent higher than the investment and employment strategies in 2015.

Figure 11. Non-skilled workers. Average annual income under different strategies



The workers receive wages that are in average 27 percent above the 2 dollars' poverty line, but a large proportion of them are in absolute poverty (40 percent in 2000, see Table 1). This reflects dualism and heterogeneity within the economy, although possibly also the already mentioned statistical problems. In the redistribution strategies, while workers with incomes above incomes of 4 dollars a day pay the simulated taxes, 40 percent of them are in the receiving side of the redistribution. Initially, taxes and subsidies compensate each other, but with time changes in output structure increase the differences between redistributive and non-redistributive strategies. In 2015, the Millennium tax and the Rawlsian strategy result in average incomes about 5 and 10 percent less respectively than in the investment and employment strategies. But perhaps this should not be too high a price for the working class as a whole to pay for policy changes that, from their inception, radically reduce extreme poverty within the class — by 13 percentage points for the Millennium tax, and 26 for the Rawlsian strategy (see Figure 12) — while by 2015 it has been more than halved in one case, or totally eliminated in the other.

Figure 12. Non-skilled workers. Share of extremely poor under different strategies.



Self-employed. The self-employed "informal proletariat" is the third class in numerical import after peasants and workers (together, the three make 85 percent of the total). After the peasant class, the self-employed is the class in which poverty is most prevalent (Table 1). Their average incomes are the lowest among the urban classes — roughly equal to the 2 dollars' poverty line.

Average incomes of the self-employed are more or less unchanged by different poverty reduction strategies (Figure 13). The self-employed mostly work in sectors such as commerce and construction, which grow similarly under different investment policies. The Base EBRP scenario, and the pro-poor and pro-employment investment policies affect the self-employed in similar ways.

Secondly, average incomes of the self-employed class are more or less also unchanged under different income redistribution policies under the whole period. Income dispersion and heterogeneity within the class make that taxes paid by self-employed earning taxable incomes more or less compensate subsidies received by the large group of extremely poor.

Figure 13. Self-employed. Average annual income under different strategies.

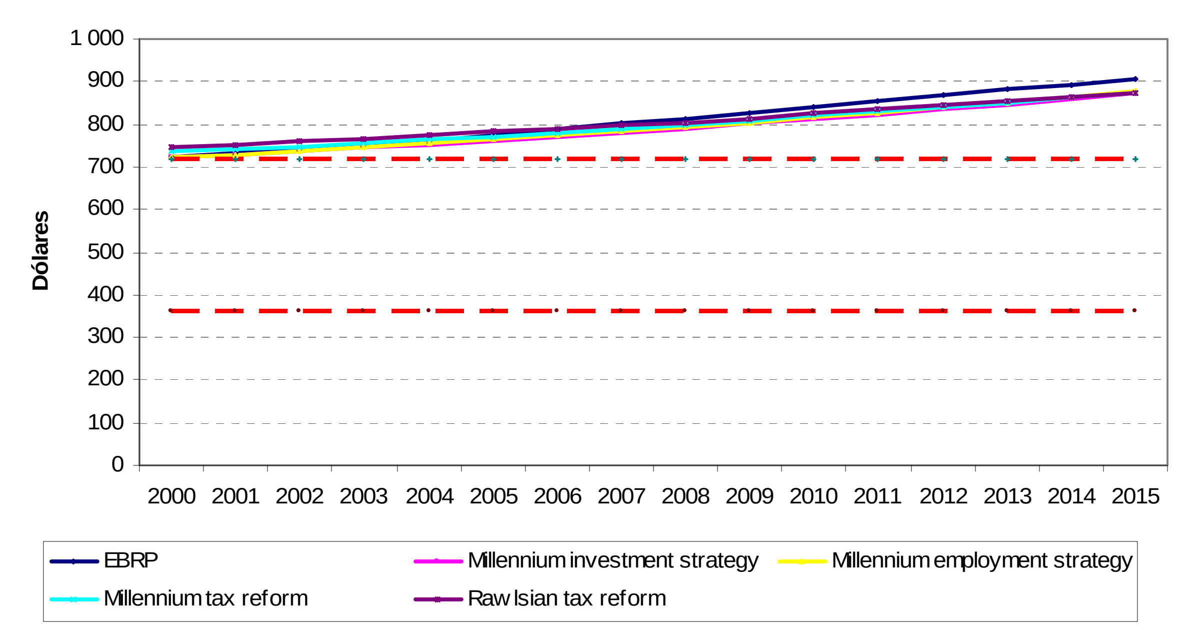
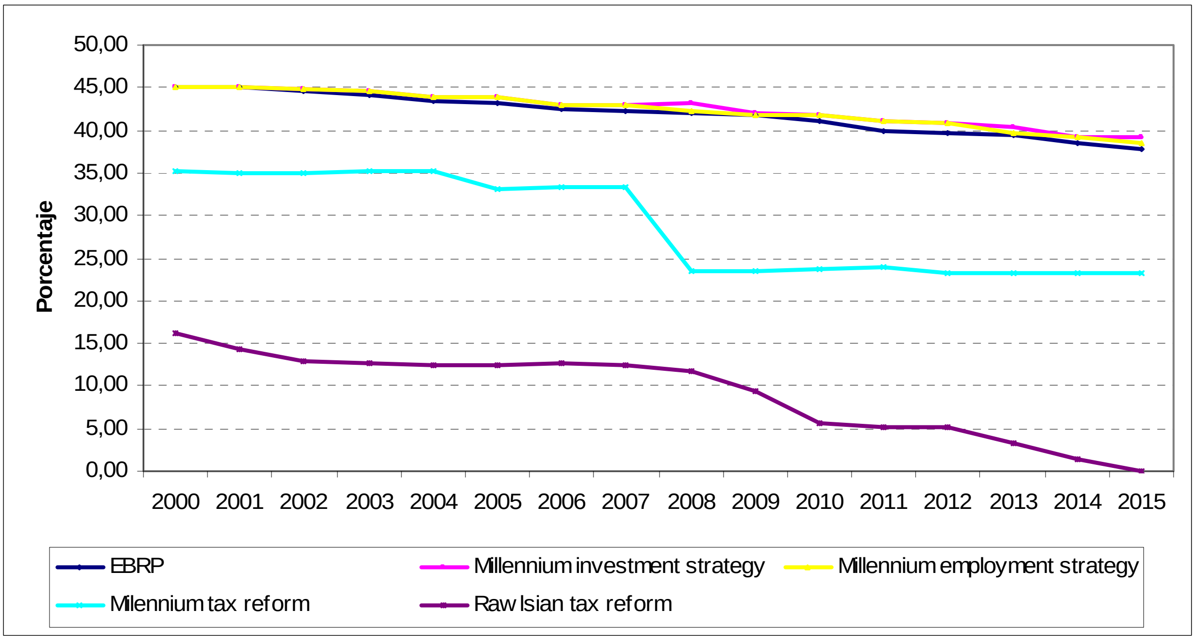


Figure 14 illustrates the neutrality of poverty among the self-employed to the simulated structural changes. EBRP and the investment strategies affect similarly the rate of extreme poverty. Only redistribution policies are successful in reducing poverty among the class of self-employed.

Figure 14. Self-employed. Share of extremely poor under different strategies.



Appendix A: Detailed model structure

(A flow diagram of the model is included in 9.)

1. General Notations

j	socioeconomic groups (percentiles)
k	socioeconomic groups (deciles)
n	production sectors
t	year
^	on a vector transforms it in a diagonal matrix
'	means transpose
ι	vector sum (1,1,...,1)'
I	identity matrix

2. Model Parameters

Policy parameters

z_t^g	$(n \times 1)$	vector of sectoral distribution of public sector investment (sum=1)
$V^p{}_t$	$(k \times n)$	matrix of sectoral value added distribution by deciles, private sector
V_d	$(1 \times k)$	vector of coefficients of direct taxes
V_o	$(1 \times n)$	vector of sectoral coefficients of import duties, transaction tax and other indirect taxes
V_w	$(1 \times n)$	vector of sectoral coefficients of value added: wages and salaries & operating surplus of private enterprises
V_i	$(1 \times n)$	vector of sectoral coefficients of value added: indirect taxes and operating surplus of public enterprises
V_x	$(1 \times n)$	vector of sectoral coefficients of value added: net flow of private external factors
V_w^d	$(k \times n)$	matrix of distribution of private sector value added by deciles (sum=1)
V^g	$(1\times n)$	vector of sectoral value added distribution, public sector
Φ_t	(scalar)	foreign savings

Behavioral parameters

$\hat{\alpha}$	$(n \times n)$	diagonal matrix of marginal capital / output ratios
A	$(n \times n)$	matrix of sectoral coefficients of intermediate inputs
V_w^c	$(j \times n)$	matrix of distribution of private sector value added by percentiles (sum=1)
V_w^{np}	$(j \times n)$	matrix of distribution of the number of persons who depend on each production sector by percentiles (sum=1)
Γ^p	$(n \times k)$	matrix of marginal propensities to consume, private sector
H	$(n \times n)$	matrix of distribution by origin of investments by destination (sum=1)
Λ	$(k \times n)$	matrix of labor / output ratios

3. Exogenous Variables

y_{pline}	(scalar)	poverty line
y_{eline}	(scalar)	extreme poverty line
$\hat{\tau}$	$(n \times n)$	matrix of exponential change rates in labor productivity
ε	(scalar)	exchange rate
r	(scalar)	population growth rate
i	(scalar)	interest rate (external debt)
R_t	(scalar)	HIPC relief
T_t	(scalar)	net unilateral transfers

P_t	(scalar)	Bolivia's population

4. Endogenous Variables

x_t	$(n \times 1)$	vector of gross outputs
$y^p{}_t$	$(k \times 1)$	vector of available incomes, private sector
$y^g{}_t$	(scalar)	public sector income
$c^p{}_t$	$(n \times 1)$	vector of consumption expenditures, private sector
$c^g{}_t$	(scalar)	public sector consumption expenditure
$s^p{}_t$	$(k \times 1)$	vector of savings by socioeconomic group, private sector
$s^g{}_t$	(scalar)	public sector savings
E_t	(scalar)	external debt
u_t	(scalar)	rate of foreign saving
$s^{p^*}{}_t$	(scalar)	total (domestic plus foreign) private sector savings
$s^{g^*}{}_t$	(scalar)	total (domestic plus foreign) public sector savings
$z^p{}_t$	$(n \times 1)$	vector of sectoral distribution of private sector investment (sum=1)
$d^p{}_t$	$(n \times 1)$	vector of private sector investment by destination
$d^g{}_t$	$(n \times 1)$	vector of public sector investment by destination
d_t	$(n \times 1)$	vector of total (private plus public) investment by destination
b_t	$(n \times 1)$	vector of total (private plus public) investment demand by sector of origin
$f^p{}_t$	(scalar)	net flow of private external factors (wages and salaries and operating surplus)
$f^g{}_t$	(scalar)	net flow of public external factors (foreign debt service)
a_t	$(n \times 1)$	vector of intermediate consumption by sector of origin (intermediate sales)
m_t	$(k \times 1)$	vector of direct taxes by socioeconomic group
o_t	$(n \times 1)$	vector of import duties, value added tax, non-deductible and transaction tax and other indirect taxes
q_t	$(n \times 1)$	vector of exports net of imports by sector of origin
κ_t	$(k \times 1)$	vector of labor requirements by socioeconomic group
η_t	$(n \times 1)$	vector of labor requirements by production sector
ρ_t	$(n \times 1)$	vector of Bolivia's total population by production sector
ω_t	$(j \times n)$	matrix of average per-capita income by percentile
$\pi^p{}_t$	(scalar)	number of poor people
$\pi^i{}_t$	(scalar)	number of people in absolute poverty
$\sigma^p{}_t$	(scalar)	incidence of poverty
$\sigma^i{}_t$	(scalar)	incidence of extreme poverty

5. Dynamic Core Equations

Private sector income

$$y^p{}_t = V^p x_t \tag{1}$$

Public sector income

$$y^g{}_t = V^g x_t + V_d y^p{}_t + \varepsilon T_t - \varepsilon i E_t \tag{2}$$

Private sector consumption

$$c^p{}_t = \Gamma^p \left(I - \hat{V}_d \right) y^p{}_t \tag{3}$$

Public sector consumption

$$c^g{}_t = x_{11,t} - c^p{}_{11,t} \tag{4}$$

Private sector savings

$$s^p{}_t = \left(I - \overbrace{\iota' \Gamma^p}^{\wedge} \right)\left(I - \hat{V}_d \right) y^p{}_t \tag{5}$$

Public sector savings

$$s^g{}_t = y^g{}_t - c^g{}_t \tag{6}$$

Foreign debt growth

$$E_{t+1} = E_t + \Phi_t - R_t \tag{7}$$

Rate of foreign saving

$$u_t = \frac{\varepsilon \Phi_t}{\iota' s^p{}_t + s^g{}_t} \tag{8}$$

Private sector total (domestic plus foreign) savings

$$s^{p*}{}_t = \iota' s^p{}_t \left(1 + u_t \right) \tag{9}$$

Public sector total (domestic plus foreign) savings

$$s^{g*}{}_t = s^g{}_t \left(1 + u_t \right) \tag{10}$$

Vector of sectoral distribution of private sector investment

$$z^p{}_t = \frac{\hat{\alpha}\left(x_t - 0.5x_{t-1} - 0.3x_{t-2} - 0.2x_{t-3} \right)}{\iota' \hat{\alpha}\left(x_t - 0.5x_{t-1} - 0.3x_{t-2} - 0.2x_{t-3} \right)} \tag{11}$$

Private sector investment by sectoral destination

$$d^p{}_t = z^p{}_t \, s^{p*}{}_t \tag{12}$$

Public sector investment by destination

$$d^g{}_t = z_t^g s^{g*}{}_t \tag{13}$$

Total (private plus public) investment by destination

$$d_t = d^p{}_t + d^g{}_t \quad (14)$$

Output growth

$$x_{t+1} = \hat{\alpha}^{-1} d_t + x_t \quad (15)$$

6. Peripheral Equations

Total (private plus public) investment by sector of origin

$$b_t = H\, d_t \quad (16)$$

Net flow of private external factors

$$f^p{}_t = V_x x_t \quad (17)$$

Net flow of public external factors

$$f^g{}_t = \varepsilon\, iE_t \quad (18)$$

Intermediate consumption by sector of origin

$$a_t = A\, x_t \quad (19)$$

Direct taxes

$$m_t = \hat{V}_d\, y^p{}_t \quad (20)$$

Other taxes (import duties, value added tax, non deductible and transaction tax and other indirect taxes)

$$o_t = \hat{V}_o x_t \quad (21)$$

Exports net of imports by sector of origin

$$q_t = x_t + o_t - \left(a_t + c^p{}_t + c^g{}_t + b_t\right) \quad (22)$$

Employment by socio economic group

$$\kappa_t = \Lambda\, e^{-\hat{\tau}\, t} x_t \quad (23)$$

Employment by production sector

$$\eta_t = \Lambda' \hat{\imath}\, e^{-\hat{\tau}\, t} x_t \quad (24)$$

Bolivia's total population by production sector

$$\rho_t = \frac{\eta_t P_t}{\iota' \eta_t} \tag{25}$$

Average per-capita income by percentile

$$\omega_t = \frac{V_w^c x_t V_w}{V_w^{np} \hat{\rho}_t} \tag{26}$$

Number of poor people

$$\pi^p{}_t = \sum_{(j,n) \in L^p} V_w^{np} \hat{\rho}_t(j,n) \qquad L^p = \left\{ (j,n) : \omega_t(j,n) \le y_{pline\ (poverty\ line)} \right\} \tag{27}$$

Number of people in absolute poverty

$$\pi^i{}_t = \sum_{(j,n) \in L^i} V_w^{np} \hat{\rho}_t(j,n) \qquad L^i = \left\{ (j,n) : \omega_t(j,n) \le y_{eline\ (extreme\ poverty\ line)} \right\} \tag{28}$$

Incidence of poverty

$$\sigma^p{}_t = \frac{\pi^p{}_t}{P_t} \tag{29}$$

Incidence of extreme poverty

$$\sigma^i{}_t = \frac{\pi^i{}_t}{P_t} \tag{30}$$

7. Accounting Identities and Auxiliary Equations

Technical coefficients plus value added coefficients add to unity

$$\iota' = \iota' A + V_w + V_i + V_x \tag{31}$$

Vector of sectoral value added distribution, government sector

$$V^g = V_i + V_o \tag{32}$$

Matrix of sectoral value added distribution by deciles, private sector (sum=1)

$$V_w^d(k,n) = \sum_{j=1+10(k-1)}^{10k} V_w^c(j,n) \tag{33}$$

Matrix of sectoral value added distribution by deciles, private sector

$$V^p = V_w^d \hat{V}_w \tag{34}$$

Bolivia's population

$$P_t = P_{(0)}\, e^{rt} \qquad (35)$$

8. From income distribution by size to income distribution by class

In order to transform the $(100 \times n)$ matrix sequence of percentile income distribution by sector reflecting progressive redistribution into a $(k \times n)$ matrix of class distribution by sector, a matrix *T*, composed of *n* matrices—a diagonal matrix of matrices—, is introduced. Each of the *n* matrices in the diagonal of *T* describes income distribution by percentiles and class in the respective sector.

Matrix T then, is formed of a diagonal of *n* matrices. Each of these submatrices T_i (*i* = 1, 2, … , *n*) of *T* describes percentile income distribution for each of the *k* classes in the respective sector — i.e., their dimension is $k \times 100$.

Or, in matrix notation: $T = \begin{bmatrix} T_1 & & & \\ & T_2 & & \\ & & \ddots & \\ & & & T_n \end{bmatrix}$.

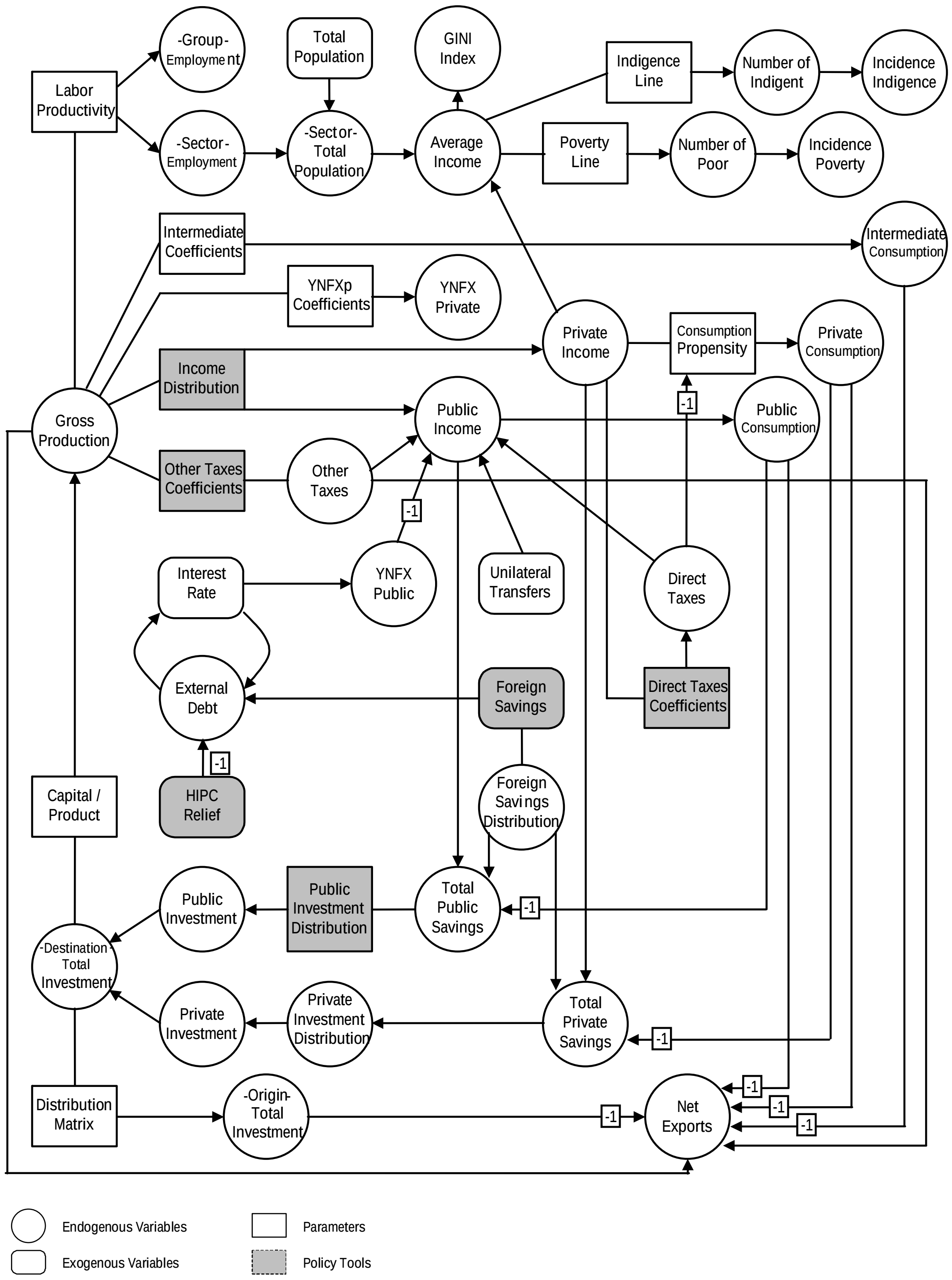
Introducing also summing vectors $\iota \equiv \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}$ of appropriate dimensions, along with their

transforms $\iota' \equiv [1, 1, ..., 1]$, and: $\hat{\iota} \equiv \begin{bmatrix} 1 & & & \\ & 1 & & \\ & & \ddots & \\ & & & 1 \end{bmatrix}$, we can define the operation:

$$\begin{bmatrix} \iota' & & & \\ & \iota' & & \\ & & \ddots & \\ & & & \iota' \end{bmatrix} \cdot \begin{bmatrix} T_1 & & & \\ & T_2 & & \\ & & \ddots & \\ & & & T_n \end{bmatrix} \cdot \begin{bmatrix} \hat{\iota} & & & \\ & \hat{\iota} & & \\ & & \ddots & \\ & & & \hat{\iota} \end{bmatrix} . V = V^{class} .$$

V^{class} is the $(k \times n)$ matrix of sectoral income distribution by social class, used for obtaining average incomes by social class.

9. Flow diagram of the detailed model



Appendix B: Model data

Sectoral aggregation key

The structural traits of the poverty problematic suggest a sectoral disaggregation that singles out those sectors in which poverty is particularly concentrated, and in which income distribution is particularly skewed. In the countryside, poverty is concentrated within small-scale, labor-intensive (peasant) agriculture. Export-crop, capital-intensive agriculture, should constitute a separate sector, with particular intermediate input, socioeconomic, 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 aggregated for the purposes of our study in an Export crops agricultural sector, and the two other in Food staples agriculture. A similar distinction is made within the urban economy. Small-scale, labor-intensive, "informal" activities that concentrate a major share of the urban poor are described separately. The manufacturing sectors of the 36-sector Bolivian classification are aggregated into two sectors, Small and medium industry, and Big industry. The retained classification contains the following sectors: 1) Food staples agriculture, 2) Export crops agriculture, 3) Petroleum, gas, and mining, 4) Big industry, 5) Small and medium industry, 6) Petroleum processing, 7) Construction, 8) Commerce, 9) Transport, 10) Infrastructure and services, 11) Public administration, and 12) Finances.

Bolivian national accounts classification	Model EBRP classification	Aggregated activities
1. Non-industrialized crop production	1. Food staples agriculture	1. 3.
2. Industrialized crop production	2. Exports crops agriculture	2. 4. 5.
3. Coca	3. Petroleum, gas and mining	6. 7.
4. Livestock production	4. Big industry	8 -- 14 17. 18. 21. 22.
5. Timber production, hunting and fisheries	5. Small and medium industry	15. 16. 20. 23.
6. Crude oil and natural gas	6. Petroleum processing	19.
7. Mining	7. Construction	25.
8. Meat and processed meat	8. Commerce	26. 33. 34.
9. Dairy products	9. Transport	27.
10. Baking and grain mill products	10. Infrastructure and services	32. 24. 28.
11. Sugar and confectionary products	11. Public administration	35.
12. Other food products	12. Finances	29 -- 31
13. Beverages		
14. Processed tabacco		
15. Textile, clothing and leather products		
16. Wood and wood products		
17. Paper and paper products		
18. Chemical products		
19. Processed oil products		
20. Non-metallic mineral products		
21. Base metals		
22. Metallic products, machinery and equipment		
23. Other manufacturing		
24. Electricity, gas and water		
25. Construction and public building activities		
26. Trade		
27. Transport and storage		
28. Communication		
29. Financial Services		
30. Company Services		
31. Property		
32. Local, social and personal services		
33. Restaurants and hotels		
34. Domestic Services		
35. Public sector		
36. Direct purchases of other goods		

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

x_0, x_{-1}, x_{-2}, x_{-3} **Initial outputs (thousand of Bolivianos of 2000)**

	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

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

Scalar parameters, exogenous variables and initial values

i = 0.05	interest rate
ε = 6.18	exchange rate year 2000
r = 0.023	population growth rate
Φ_t = 400	foreign saving (million USD)
R_t = 105.1	HIPC relief (million USD)
T_t = 338.5	net transfers (million USD)
P_{2000} = 8,272,860	Bolivia's population year 2000
E_{2000} = 4,302.4	foreign debt (million USD)

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

A, V_w, V_i, V_x Technical coefficients and distribution matrices

Matrix of intermediate inputs

A	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

Wages and salaries and operating surplus (domestic private factors)

Vw	0.82176	0.67026	0.63904	0.28478	0.38784	0.34760	0.37424	0.52330	0.51828	0.59828	0.73390	0.45729

Indirect taxes, wages and salaries and operating surplus (domestic public factors)

Vi	0.00000	0.00022	0.00170	0.00097	0.00104	0.00089	0.00099	0.00364	0.00074	0.00139	0.00000	0.01474

Wages and salaries and operating surplus (foreign factors)

Vx	0.01066	0.00887	0.00755	0.00275	0.00306	0.00495	0.00313	0.00504	0.00381	0.00513	0.00000	0.00321

Source: SAM Matrix 2000, CIESS-ECONOMETRICA. Instituto Nacional de Estadística.

V_d Direct Taxes

	decile01	decile02	decile03	decile04	decile05	decile06	decile07	decile08	decile09	decile10
Vd	0.02880	0.02880	0.02880	0.02880	0.02880	0.02880	0.02880	0.02880	0.02880	0.02880

Source: SAM Matrix 2000, CIESS-ECONOMETRICA. Instituto Nacional de Estadística.

V_o Import duties, transaction tax and others indirect taxes

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
Vo	0.00796	0.00296	0.33565	0.15082	0.07729	0.27771	0.10103	0.02267	0.01930	0.05985	0.00000	0.02740

Source: SAM Matrix 2000, CIESS-ECONOMETRICA. Instituto Nacional de Estadística.

$\{z^g{}_t\}$ Public investment allocation vector of the EBRP

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
Zg	0.03979	0.10172	0.04140	0.07826	0.02787	0.01373	0.10402	0.06124	0.35979	0.08132	0.04382	0.04705

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

Γ^p Private marginal consumption propensities

	decile01	decile02	decile03	decile04	decile05	decile06	decile07	decile08	decile09	decile10
sector01	0.15960	0.13917	0.13780	0.12439	0.11249	0.10776	0.10685	0.09535	0.07890	0.05869
sector02	0.03040	0.02651	0.02625	0.02369	0.02143	0.02053	0.02035	0.01816	0.01503	0.01118
sector03	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector04	0.46526	0.42866	0.42025	0.39723	0.37148	0.36223	0.35939	0.33934	0.30370	0.25329
sector05	0.09031	0.07441	0.06388	0.06842	0.07337	0.06800	0.07060	0.06242	0.06990	0.06717
sector06	0.00448	0.00508	0.00560	0.00600	0.00599	0.00654	0.00690	0.00647	0.00670	0.00760
sector07	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
sector08	0.03497	0.05907	0.06224	0.09020	0.09321	0.10372	0.09657	0.12871	0.10786	0.11060
sector09	0.06801	0.09628	0.10587	0.11001	0.11461	0.12150	0.11395	0.11240	0.11192	0.11500
sector10	0.08928	0.10494	0.10285	0.10715	0.11339	0.12438	0.12130	0.12124	0.13513	0.13891
sector11	0.01079	0.01185	0.01133	0.01020	0.01218	0.01349	0.01194	0.01171	0.01250	0.01151
sector12	0.04673	0.05394	0.05750	0.06187	0.06160	0.06802	0.07047	0.06758	0.07028	0.07836

Source: Instituto Nacional de Estadística. Household survey MECOVI 2000 - Method SUR (seemingly unrelated regression)

B Distribution of investment demands

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
sector01	0.03914	0	0	0	0	0	0	0	0	0	0	0
sector02	0	0.14560	0	0	0	0	0	0	0	0	0	0
sector03	0	0	0.13494	0	0	0	0	0	0	0	0	0
sector04	0.75519	0.60873	0.51024	0.76389	0.69474	0.57787	0.96694	0.48256	0.52156	0.55456	0.49420	0.49428
sector05	0	0	0	0	0.13742	0	0	0	0	0	0	0
sector06	0	0	0	0	0	0	0	0	0	0	0	0
sector07	0.20567	0.24567	0.35482	0.23611	0.16784	0.42213	0.03306	0.51744	0.47844	0.44544	0.50580	0.50572
sector08	0	0	0	0	0	0	0	0	0	0	0	0
sector09	0	0	0	0	0	0	0	0	0	0	0	0
sector10	0	0	0	0	0	0	0	0	0	0	0	0
sector11	0	0	0	0	0	0	0	0	0	0	0	0
sector12	0	0	0	0	0	0	0	0	0	0	0	0

Source: There are no detailed Bolivian data on capital stocks and/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 Buzaglo (1984).

α Marginal capital/output ratios

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
alfa	4.9998	2.1212	3.3307	1.0962	1.1622	2.4453	2.8766	1.3555	8.4877	1.392	2.0895	0.6805

Source: Obtained by historical optimization with the model of the present study. Investment efficiency parameters are determined so as to make sectoral outputs generated by the model track past sectoral output trajectories (1990-1997) as accurately as possible. The problem posed is thus to find α such that:

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

in which x_t and $\overline{x}_t$ are simulated and historical output vectors respectively. That is, find α such that the sum of the squares of the differences between the historical and the model's sectoral outputs is minimised.

τ Exponential change in labor productivity

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector010	sector011	sector012
tau	0.00032	0.02695	0.06472	0.00817	0.01134	0.01728	0.03154	0.00105	0.03122	0.03883	0.02371	0.04162

Source: Instituto Nacional de Estadística. Household survey MECOVI 1999 and 2000.

Λ Labor/output ratios

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
decile01	0.02842	0.03320	0.00000	0.00000	0.00049	0.00000	0.00108	0.00279	0.00000	0.00040	0.00000	0.00000
decile02	0.03584	0.02079	0.00000	0.00000	0.00205	0.00000	0.00325	0.00518	0.00000	0.00032	0.00000	0.00000
decile03	0.02104	0.01908	0.00000	0.00002	0.00437	0.00000	0.01065	0.00769	0.00017	0.00064	0.00002	0.00001
decile04	0.02368	0.01343	0.00000	0.00023	0.00560	0.00000	0.01250	0.00691	0.00003	0.00267	0.00000	0.00017
decile05	0.01198	0.01376	0.00009	0.00033	0.00409	0.00001	0.01656	0.00904	0.00038	0.00332	0.00027	0.00045
decile06	0.01335	0.00778	0.00004	0.00026	0.00914	0.00001	0.01288	0.00908	0.00070	0.00301	0.00136	0.00149
decile07	0.01295	0.00726	0.00003	0.00052	0.00709	0.00000	0.00425	0.01134	0.00062	0.00402	0.00284	0.00086
decile08	0.00833	0.00445	0.00063	0.00206	0.00741	0.00009	0.00388	0.00683	0.00300	0.00531	0.00554	0.00226
decile09	0.00366	0.00455	0.00129	0.00268	0.00274	0.00018	0.00245	0.00514	0.00498	0.00665	0.00881	0.00230
decile10	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: Instituto Nacional de Estadística. Household survey MECOVI 2000.

$\left\{V_w^c\right\}$ 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

Source: Instituto Nacional de Estadística. Household survey MECOVI 2000.

V_w^{np} Distribution of private sectoral value added (sum=1)

	sector01	sector02	sector03	sector04	sector05	sector06	sector07	sector08	sector09	sector10	sector11	sector12
centil001	0.01517	0.03360	0.00000	0.00000	0.00179	0.00000	0.00000	0.00326	0.00000	0.00000	0.00000	0.00000
centil002	0.02576	0.02356	0.00000	0.00000	0.00000	0.00000	0.00000	0.00331	0.00000	0.00086	0.00000	0.00000
centil003	0.03377	0.01392	0.00000	0.00000	0.00315	0.00000	0.00801	0.00149	0.00000	0.00093	0.00000	0.00000
centil004	0.02219	0.02616	0.00000	0.00000	0.00129	0.00000	0.00000	0.00393	0.00000	0.00000	0.00000	0.00000
centil005	0.01578	0.02813	0.00000	0.00000	0.00288	0.00000	0.00000	0.00445	0.00000	0.00747	0.00000	0.00000
centil006	0.03876	0.01412	0.00000	0.00000	0.00000	0.00000	0.00100	0.00063	0.00000	0.00000	0.00000	0.00000
centil007	0.03305	0.01028	0.00000	0.00000	0.00632	0.00000	0.00426	0.00568	0.00000	0.00000	0.00000	0.00000
centil008	0.02894	0.01471	0.00000	0.00000	0.00726	0.00000	0.00000	0.00553	0.00000	0.00219	0.00000	0.00000
centil009	0.01400	0.02394	0.00000	0.00000	0.00000	0.00000	0.00053	0.01181	0.00000	0.00284	0.00000	0.00000
centil010	0.03400	0.00973	0.00000	0.00000	0.00515	0.00000	0.00932	0.00403	0.00000	0.00000	0.00000	0.00000
centil011	0.02170	0.00364	0.00000	0.00000	0.00000	0.00000	0.01093	0.02046	0.00000	0.00000	0.00000	0.00000
centil012	0.01201	0.03505	0.00000	0.00000	0.00036	0.00000	0.00165	0.00457	0.00000	0.00000	0.00000	0.00000
centil013	0.01129	0.02222	0.00000	0.00000	0.00954	0.00000	0.00603	0.01102	0.00000	0.00226	0.00000	0.00000
centil014	0.01100	0.02518	0.00000	0.00000	0.00808	0.00000	0.00701	0.00883	0.00000	0.00292	0.00000	0.00000
centil015	0.02568	0.01591	0.00000	0.00000	0.00963	0.00000	0.00711	0.00511	0.00000	0.00000	0.00000	0.00000
centil016	0.00572	0.01912	0.00000	0.00000	0.00909	0.00000	0.00683	0.01832	0.00000	0.00187	0.00000	0.00000
centil017	0.01224	0.02205	0.00000	0.00000	0.00518	0.00000	0.02142	0.00588	0.00000	0.00559	0.00000	0.00000
centil018	0.01693	0.01314	0.00000	0.00235	0.01484	0.00000	0.01193	0.00888	0.00000	0.00657	0.00000	0.00000
centil019	0.01445	0.01586	0.00000	0.00000	0.00000	0.00000	0.03047	0.00981	0.00000	0.00000	0.00061	0.00000
centil020	0.03295	0.00757	0.00000	0.00000	0.00358	0.00000	0.02286	0.00262	0.00000	0.00149	0.00000	0.00000
centil021	0.00619	0.02743	0.00000	0.00000	0.00893	0.00000	0.02323	0.00566	0.00324	0.00097	0.00000	0.00000
centil022	0.01074	0.01688	0.00000	0.00000	0.00908	0.00000	0.00720	0.01655	0.00000	0.00000	0.00000	0.00077
centil023	0.01290	0.01590	0.00000	0.00000	0.02391	0.00000	0.00483	0.01144	0.00000	0.00168	0.00000	0.00000
centil024	0.00796	0.02363	0.00000	0.00000	0.01104	0.00000	0.02264	0.00733	0.00000	0.00170	0.00000	0.00000
centil025	0.01828	0.01150	0.00000	0.00000	0.00925	0.00000	0.00068	0.01553	0.00761	0.00000	0.00000	0.00000
centil026	0.00378	0.01718	0.00000	0.00000	0.00701	0.00000	0.00440	0.02337	0.00000	0.00041	0.00000	0.00000
centil027	0.02037	0.00511	0.00000	0.00000	0.00860	0.00000	0.02900	0.01130	0.00000	0.00000	0.00000	0.00551
centil028	0.01965	0.00988	0.00000	0.00080	0.01222	0.00000	0.01003	0.01319	0.00000	0.00000	0.00000	0.00046
centil029	0.01882	0.00780	0.00000	0.00226	0.01375	0.00000	0.01068	0.01482	0.00000	0.00000	0.00000	0.00000
centil030	0.00797	0.01634	0.00000	0.00936	0.01578	0.00000	0.02843	0.00734	0.00000	0.00534	0.00000	0.00000
centil031	0.01741	0.01424	0.00000	0.00000	0.01297	0.00000	0.00327	0.01320	0.00000	0.00085	0.00000	0.00000
centil032	0.00135	0.01362	0.00000	0.00000	0.01215	0.00000	0.01528	0.01091	0.00000	0.03468	0.00000	0.00535
centil033	0.00472	0.02137	0.00000	0.00000	0.02564	0.00000	0.00776	0.01089	0.00000	0.00496	0.00000	0.00000
centil034	0.02210	0.01726	0.00000	0.00934	0.00000	0.00000	0.01124	0.00354	0.00169	0.00876	0.00000	0.00000
centil035	0.01923	0.00750	0.00000	0.00000	0.01122	0.00000	0.00834	0.01330	0.00000	0.00966	0.00000	0.00000
centil036	0.01380	0.00807	0.00000	0.00000	0.01058	0.00000	0.04412	0.00671	0.00000	0.00810	0.00000	0.00180
centil037	0.01693	0.00625	0.00000	0.00228	0.00621	0.00000	0.03061	0.00775	0.00000	0.01179	0.00000	0.01360
centil038	0.01044	0.01446	0.01336	0.00000	0.00000	0.01336	0.02384	0.01503	0.00000	0.00000	0.00000	0.00429
centil039	0.00230	0.01083	0.00000	0.00894	0.01326	0.00000	0.00941	0.02274	0.00000	0.00706	0.00000	0.00000
centil040	0.01085	0.00765	0.00000	0.00000	0.00463	0.00000	0.02383	0.01920	0.00000	0.00216	0.00206	0.00000
centil041	0.00695	0.00867	0.00000	0.01192	0.00233	0.00000	0.05179	0.00427	0.01381	0.01749	0.00080	0.00000
centil042	0.01630	0.00793	0.00000	0.00000	0.00366	0.00000	0.03480	0.01215	0.00000	0.00185	0.00000	0.00000
centil043	0.01090	0.01338	0.00000	0.01033	0.01887	0.00000	0.02312	0.00908	0.00000	0.00217	0.00000	0.00000
centil044	0.00578	0.01422	0.00000	0.00000	0.00082	0.00000	0.00740	0.01062	0.00000	0.04266	0.00000	0.00000
centil045	0.00394	0.01339	0.00000	0.00000	0.00418	0.00000	0.03276	0.01564	0.01074	0.00191	0.00169	0.00000
centil046	0.00639	0.00649	0.00000	0.00288	0.02641	0.00000	0.01738	0.01235	0.00000	0.01141	0.00555	0.01581
centil047	0.00000	0.02791	0.00000	0.00000	0.00077	0.00000	0.00409	0.01367	0.00000	0.01703	0.00000	0.00000
centil048	0.00785	0.00395	0.00000	0.00000	0.02782	0.00000	0.01481	0.00711	0.00181	0.00982	0.00343	0.06855
centil049	0.01535	0.00441	0.00295	0.00000	0.02081	0.00295	0.03377	0.00899	0.00000	0.00601	0.00152	0.00000

centil050	0.01837	0.00726	0.00000	0.00000	0.00134	0.00000	0.01431	0.01393	0.00000	0.00838	0.00645	0.00000
centil051	0.00685	0.00887	0.00000	0.00378	0.00420	0.00000	0.00286	0.02044	0.00955	0.01468	0.00503	0.00000
centil052	0.00859	0.01736	0.00000	0.01873	0.00165	0.00000	0.02428	0.01001	0.00000	0.00000	0.00602	0.00000
centil053	0.00083	0.00949	0.00295	0.00000	0.01097	0.00295	0.04307	0.01669	0.00000	0.00759	0.00000	0.00000
centil054	0.00552	0.00622	0.00000	0.00404	0.02424	0.00000	0.00582	0.01625	0.02347	0.00330	0.00492	0.01348
centil055	0.00139	0.00306	0.00000	0.00000	0.07000	0.00000	0.00101	0.01572	0.00000	0.00000	0.01359	0.00000
centil056	0.00780	0.00704	0.00000	0.00000	0.03312	0.00000	0.02948	0.00560	0.00971	0.01620	0.00164	0.00000
centil057	0.01235	0.00301	0.00000	0.00000	0.01659	0.00000	0.00784	0.01713	0.00000	0.00607	0.00762	0.02082
centil058	0.00810	0.00215	0.00000	0.00000	0.00662	0.00000	0.01210	0.02085	0.00000	0.02322	0.00032	0.00991
centil059	0.00525	0.00861	0.00000	0.00000	0.00815	0.00000	0.00671	0.01742	0.00551	0.01438	0.00220	0.03017
centil060	0.01019	0.00897	0.00000	0.00475	0.00720	0.00000	0.01494	0.01448	0.00000	0.01385	0.00662	0.00000
centil061	0.00449	0.00205	0.00000	0.00000	0.02754	0.00000	0.00364	0.02204	0.00092	0.01790	0.00478	0.00000
centil062	0.00515	0.00946	0.00000	0.00000	0.03515	0.00000	0.00440	0.01206	0.00550	0.01297	0.01029	0.00000
centil063	0.01091	0.00396	0.00000	0.00000	0.01015	0.00000	0.00092	0.02510	0.00000	0.00436	0.00826	0.00000
centil064	0.01078	0.00793	0.00421	0.01069	0.00764	0.00421	0.00548	0.01753	0.00206	0.01137	0.00000	0.00815
centil065	0.01371	0.00929	0.00000	0.01263	0.01464	0.00000	0.00822	0.00909	0.00918	0.00986	0.00787	0.00000
centil066	0.00637	0.00730	0.00000	0.00803	0.02043	0.00000	0.01034	0.01443	0.00000	0.00000	0.01450	0.02669
centil067	0.01106	0.00490	0.00000	0.00000	0.02046	0.00000	0.00120	0.01442	0.00767	0.00136	0.03019	0.00000
centil068	0.00460	0.00466	0.00000	0.00493	0.00360	0.00000	0.00615	0.01465	0.00879	0.04030	0.01001	0.00000
centil069	0.00588	0.00620	0.00000	0.01553	0.01101	0.00000	0.00847	0.01364	0.00400	0.00716	0.03230	0.00000
centil070	0.00633	0.00955	0.00187	0.00423	0.01440	0.00187	0.00074	0.01369	0.01054	0.01161	0.00116	0.04061
centil071	0.00452	0.00625	0.00000	0.00000	0.01886	0.00000	0.00614	0.01452	0.01239	0.01692	0.01718	0.00334
centil072	0.00285	0.00549	0.03400	0.02243	0.01016	0.03400	0.00388	0.01087	0.02379	0.01905	0.00913	0.02159
centil073	0.00350	0.00177	0.01566	0.00231	0.00854	0.01566	0.00098	0.01087	0.02950	0.04022	0.01287	0.01528
centil074	0.01249	0.00221	0.02374	0.01554	0.00383	0.02374	0.00309	0.00972	0.01869	0.01399	0.02560	0.00728
centil075	0.00630	0.00120	0.00000	0.01532	0.03591	0.00000	0.00258	0.00974	0.02217	0.01118	0.01255	0.02080
centil076	0.00562	0.00239	0.00000	0.05221	0.01536	0.00000	0.00402	0.00726	0.02426	0.00988	0.01528	0.02549
centil077	0.00620	0.00222	0.00000	0.06990	0.00000	0.00000	0.00000	0.00925	0.00878	0.01209	0.03731	0.00000
centil078	0.00035	0.00519	0.00236	0.02007	0.01768	0.00236	0.00987	0.00818	0.03763	0.01646	0.01956	0.01176
centil079	0.00155	0.00155	0.01850	0.00604	0.03683	0.01850	0.01769	0.00784	0.00000	0.00839	0.03153	0.02526
centil080	0.00102	0.01762	0.01305	0.03427	0.00079	0.01305	0.00124	0.00254	0.01492	0.01221	0.03798	0.00882
centil081	0.00473	0.00093	0.00000	0.01980	0.02512	0.00000	0.00333	0.00911	0.00669	0.03245	0.01839	0.00803
centil082	0.00642	0.00040	0.00265	0.02230	0.00000	0.00265	0.00811	0.01171	0.04059	0.01195	0.02916	0.00703
centil083	0.00168	0.00213	0.02529	0.02571	0.01481	0.02529	0.00171	0.00806	0.03673	0.01102	0.03603	0.01199
centil084	0.00537	0.00707	0.01528	0.03830	0.00000	0.01528	0.00639	0.00986	0.02405	0.00966	0.02540	0.00000
centil085	0.00278	0.00591	0.01814	0.01860	0.00964	0.01814	0.00201	0.00445	0.02362	0.02325	0.03552	0.01816
centil086	0.00014	0.00197	0.00601	0.04929	0.00054	0.00601	0.00324	0.00810	0.03509	0.01734	0.03471	0.01683
centil087	0.00000	0.00057	0.02543	0.00978	0.00367	0.02543	0.00224	0.00598	0.04153	0.03435	0.02844	0.03784
centil088	0.00057	0.00033	0.03243	0.02149	0.00487	0.03243	0.00000	0.01025	0.02808	0.03588	0.02961	0.00404
centil089	0.00085	0.00156	0.05083	0.02244	0.00107	0.05083	0.00401	0.00421	0.05676	0.00975	0.03802	0.03726
centil090	0.00243	0.00400	0.00923	0.03112	0.00095	0.00923	0.00524	0.00912	0.02539	0.02503	0.01927	0.02440
centil091	0.00139	0.00511	0.01388	0.04997	0.00000	0.01388	0.00699	0.00268	0.02129	0.01145	0.03337	0.05134
centil092	0.00108	0.00066	0.02013	0.05518	0.00000	0.02013	0.00193	0.00946	0.01968	0.00852	0.04459	0.02161
centil093	0.00367	0.00241	0.09517	0.02142	0.01078	0.09517	0.00224	0.00081	0.03059	0.01950	0.04672	0.00000
centil094	0.00000	0.00000	0.03255	0.03163	0.01828	0.03255	0.00096	0.00328	0.03517	0.01505	0.03177	0.05129
centil095	0.00472	0.00181	0.08709	0.04047	0.00107	0.08709	0.00142	0.00157	0.03992	0.01374	0.03246	0.02436
centil096	0.00026	0.01393	0.08363	0.01169	0.00210	0.08363	0.00060	0.00000	0.03286	0.02259	0.00970	0.05696
centil097	0.00404	0.00179	0.07886	0.03701	0.00000	0.07886	0.00000	0.00208	0.04729	0.01070	0.01232	0.07402
centil098	0.00000	0.00000	0.04777	0.06548	0.00000	0.04777	0.00000	0.00000	0.03207	0.03310	0.02460	0.04259
centil099	0.00081	0.00503	0.06999	0.01949	0.00000	0.06999	0.00000	0.00000	0.05142	0.01057	0.04019	0.05266
centil100	0.00551	0.00000	0.15296	0.02293	0.00000	0.15296	0.00000	0.00000	0.04324	0.01568	0.02130	0.05400

Source: Instituto Nacional de Estadística. Household survey MECOVI 2000.

Appendix C: Social Accounting Matrix of the Model

1. Schematic Social Accounting Matrix of the Model

		1	2	3	4	5	6	7
		Production Activities	**Goods and Services**	**Public Sector**	**Private Sector**	**Rest of the World**	**Investment**	**Total**
1	**Production Activities**		GP by Product x					**Gross Production x**
2	**Goods and Services**	Intermediate Comsumption A·x		Consumption Public Sector cg	Consumption Private Sector cp	Exports (qx)	GFFC+Change in Stocks b	**Aggregate Demand A·x+cg+cp+(qx)+b**
3	**Public Sector**	Indirect Taxes Vi·x	DsM+IVAnd+ITyOII Other Taxes Vo·x		Direct Taxes m	Net Unilateral Transfers ε·T		**Total Income Public Sector Vg·x+m+ε·T**
4	**Private Sector**	ww+OS (Domestic) Vp·x						**Total Income Private Sector Vp·x**
5	**Rest of the World**	ww+OS (External) YNFXpriv (net) Vx·x	Imports (qm)	Servicing External Debt (net) ε·i·E				**Total Income Rest of the World Vx·x+qm+ε·i·E**
6	**Savings**			Public Sector Savings sg	Private Sector Savings sp	Foreign Savings ε·Φ		**Aggregate Savings sg+sp+ε·Φ**
7	**Total**	**Gross Production x**	**Aggregate Supply x+Vo·x+(qm)**	**Total Use Public Sector cg+ε·i·E+sg**	**Total Use Private Sector cp+m+sp**	**Total Use Rest of the World (qx)+ε·T+ε·Φ**	**Aggregate Investment b**	

2. Social Accounting Matrix for Bolivia, year 2000

(thousand of bolivianos)

			1 Production Activity													2 Goods and Services					
			Sector01	Sector02	Sector03	Sector04	Sector05	Sector06	Sector07	Sector08	Sector09	Sector10	Sector11	Sector12	Total	Sector01	Sector02	Sector03	Sector04	Sector05	Sector06
1	Production Activities	1. Traditional agriculture														3,968,496	0	0	0	0	0
		2. Modern agriculture														0	5,379,375	0	0	0	0
		3. Oil, Gas and Mining														0	0	6,637,814	0	0	0
		4. Modern Industry														0	0	0	13,187,956	0	0
		5. Traditional Industry														0	0	0	0	4,814,921	0
		6. Processed oil products														0	0	0	0	0	2,508,419
		7. Construction														0	0	0	0	0	0
		8. Trade and domestic services														0	0	0	0	0	0
		9. Transport														0	0	0	0	0	0
		10. Infrastructure and local services														0	0	0	0	0	0
		11. Public sector														0	0	0	0	0	0
		12. Financial and company services														0	0	0	0	0	0
		Total														**3,968,496**	**5,379,375**	**6,637,814**	**13,187,956**	**4,814,921**	**2,508,419**
2	Goods and Services	1. Traditional agriculture	383,740	355,795	0	1,296,987	246	0	0	139,275	0	75,125	87,718	0	**2,338,885**						
		2. Modern agriculture	15,676	203,474	27,510	2,874,011	384,645	0	71,622	14,192	0	0	38,111	0	**3,629,241**						
		3. Oil, Gas and Mining	0	1,961	90,438	587,159	372,740	1,305,882	216,962	0	0	96,737	0	0	**2,671,881**						
		4. Modern Industry	147,145	610,280	452,294	2,815,840	461,016	46,161	575,899	2,087,756	959,099	918,690	549,201	351,661	**9,975,042**						
		5. Traditional Industry	5,511	4,955	72,982	327,502	1,339,145	3,012	1,097,895	66,679	73,679	222,564	295,731	60,869	**3,570,524**						
		6. Processed oil products	10,540	64,067	688,416	253,486	106,204	51,861	22,527	111,189	2,424,380	263,942	158,191	79,914	**4,234,717**						
		7. Construction	0	0	1,284	1,117	516	824	0	6,043	937	13,618	2,980	159,976	**187,297**						
		8. Trade and domestic services	0	0	21,030	50,739	11,963	5,522	7,067	62,853	37,746	97,440	135,835	52,589	**482,783**						
		9. Transport	90,333	241,449	577,345	595,263	77,402	104,500	51,395	1,717,043	139,437	150,403	120,295	83,601	**3,948,465**						
		10. Infrastructure and local services	0	18,685	165,648	327,792	119,118	68,245	21,491	450,108	491,106	551,003	223,126	493,540	**2,929,864**						
		11. Public sector	0	0	0	0	0	0	0	0	0	0	0	0	**0**						
		12. Financial and company services	12,087	224,187	237,579	253,381	54,750	35,835	95,109	419,248	86,665	836,001	519,507	3,229,504	**6,003,854**						
		Total	**665,032**	**1,724,853**	**2,334,528**	**9,383,277**	**2,927,745**	**1,621,844**	**2,159,968**	**5,074,386**	**4,213,049**	**3,225,524**	**2,130,696**	**4,511,653**	**39,972,554**						
3	Public Sector		**0**	**1,191**	**11,309**	**12,793**	**5,030**	**2,233**	**3,433**	**39,429**	**6,538**	**11,316**	**0**	**126,738**	**220,010**	**31,570**	**15,950**	**2,228,008**	**1,988,959**	**372,143**	**696,602**
4	Private Sector	decile01	165,717	123,227	0	0	6,624	0	5,813	35,783	0	3,831	0	0	**340,994**						
		decile02	173,587	190,810	0	544	22,874	0	51,361	116,999	0	9,408	250	0	**565,833**						
		decile03	199,300	234,948	0	4,567	66,631	0	81,447	238,384	3,420	6,771	0	1,932	**837,399**						
		decile04	255,504	266,721	3,587	9,510	73,102	737	145,713	330,368	769	76,795	1,751	9,926	**1,174,483**						
		decile05	270,247	322,124	1,091	13,854	114,657	224	244,536	382,973	15,506	142,987	20,839	46,799	**1,575,838**						
		decile06	267,774	300,336	1,273	23,904	260,043	262	213,491	740,692	40,279	168,229	65,314	55,534	**2,137,132**						
		decile07	430,661	375,234	3,872	66,428	314,294	796	100,996	1,024,210	60,979	270,061	232,811	80,152	**2,960,495**						
		decile08	358,679	415,910	101,431	430,075	450,007	20,850	160,225	888,497	344,645	541,424	661,573	212,089	**4,585,404**						
		decile09	319,582	362,361	322,727	754,794	267,201	66,338	183,178	1,352,906	1,004,825	1,249,572	1,432,696	445,753	**7,761,933**						
		decile10	820,119	1,013,930	3,807,864	2,451,990	291,999	782,722	113,573	562,926	3,105,590	2,413,817	3,461,295	3,079,381	**21,905,207**						
		Total	**3,261,170**	**3,605,600**	**4,241,845**	**3,755,666**	**1,867,432**	**871,929**	**1,300,333**	**5,673,738**	**4,576,013**	**4,882,896**	**5,876,530**	**3,931,566**	**43,844,718**						
5	Rest of the World		**42,294**	**47,731**	**50,132**	**36,221**	**14,713**	**12,413**	**10,873**	**54,684**	**33,669**	**41,886**	**0**	**27,618**	**372,235**	**1,696,803**	**0**	**0**	**11,037,583**	**1,275,792**	**1,328,952**
6	Savings																				
7	TOTAL		**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**	**84,409,517**	**5,696,869**	**5,395,325**	**8,865,822**	**26,214,498**	**6,462,856**	**4,533,973**

			Goods and Services							3 Public	4 Private Sector											5 Rest of	6	7
			Sector07	Sector08	Sector09	Sector10	Sector11	Sector12	Total	Sector	decile01	decile02	decile03	decile04	decile05	decile06	decile07	decile08	decile09	decile10	Total	World	nvestmen	TOTAL
1	Production Activities	1. Traditional agriculture	0	0	0	0	0	0	**3,968,496**															**3,968,496**
		2. Modern agriculture	0	0	0	0	0	0	**5,379,375**															**5,379,375**
		3. Oil, Gas and Mining	0	0	0	0	0	0	**6,637,814**															**6,637,814**
		4. Modern Industry	0	0	0	0	0	0	**13,187,956**															**13,187,956**
		5. Traditional Industry	0	0	0	0	0	0	**4,814,921**															**4,814,921**
		6. Processed oil products	0	0	0	0	0	0	**2,508,419**															**2,508,419**
		7. Construction	3,474,607	0	0	0	0	0	**3,474,607**															**3,474,607**
		8. Trade and domestic services	0	10,842,237	0	0	0	0	**10,842,237**															**10,842,237**
		9. Transport	0	0	8,829,269	0	0	0	**8,829,269**															**8,829,269**
		10. Infrastructure and local services	0	0	0	8,161,622	0	0	**8,161,622**															**8,161,622**
		11. Public sector	0	0	0	0	8,007,226	0	**8,007,226**															**8,007,226**
		12. Financial and company services	0	0	0	0	0	8,597,576	**8,597,576**															**8,597,576**
		Total	**3,474,607**	**10,842,237**	**8,829,269**	**8,161,622**	**8,007,226**	**8,597,576**	**84,409,517**															**84,409,517**
2	Goods and Services	1. Traditional agriculture								**0**	52,855	76,477	112,068	141,882	172,165	223,661	307,219	424,609	594,789	1,248,675	**3,354,402**	**0**	**3,581**	**5,696,869**
		2. Modern agriculture								**0**	10,068	14,567	21,346	27,025	32,793	42,602	58,518	80,878	113,293	237,843	**638,934**	**998,913**	**128,237**	**5,395,325**
		3. Oil, Gas and Mining								**0**	0	0	0	0	0	0	0	0	0	0	**0**	**5,363,200**	**830,741**	**8,865,822**
		4. Modern Industry								**0**	154,083	235,566	341,778	453,102	568,528	751,836	1,033,336	1,511,184	2,289,442	5,388,539	**12,727,394**	**0**	**3,512,062**	**26,214,498**
		5. Traditional Industry								**0**	29,908	40,891	51,951	78,044	112,292	141,139	202,982	277,984	526,968	1,429,034	**2,891,193**	**0**	**1,138**	**6,462,856**
		6. Processed oil products								**0**	1,482	2,794	4,558	6,846	9,164	13,575	19,846	28,803	50,537	161,650	**299,256**	**0**	**0**	**4,533,973**
		7. Construction								**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**3,638,366**	**3,825,663**
		8. Trade and domestic services								**0**	11,583	32,461	50,620	102,886	142,654	215,278	277,654	573,174	813,059	2,352,940	**4,572,310**	**6,032,950**	**0**	**11,088,043**
		9. Transport								**0**	22,522	52,911	86,104	125,482	175,411	252,186	327,623	500,535	843,693	2,446,507	**4,832,975**	**218,228**	**0**	**8,999,668**
		10. Infrastructure and local services								**0**	29,567	57,666	83,650	122,218	173,542	258,155	348,779	539,929	1,018,692	2,955,244	**5,587,441**	**132,797**	**0**	**8,650,102**
		11. Public sector								**7,504,025**	3,572	6,510	9,216	11,633	18,644	27,999	34,343	52,168	94,258	244,858	**503,201**	**0**	**0**	**8,007,226**
		12. Financial and company services								**0**	15,477	29,641	46,766	70,572	94,275	141,184	202,616	300,943	529,781	1,666,972	**3,098,227**	**0**	**0**	**9,102,080**
		Total								**7,504,025**	**331,118**	**549,485**	**808,056**	**1,139,690**	**1,499,468**	**2,067,617**	**2,812,916**	**4,290,208**	**6,874,513**	**18,132,262**	**38,505,332**	**12,746,087**	**8,114,126**	**106,842,125**
3	Public Sector		**351,056**	**245,806**	**170,399**	**488,480**	**0**	**235,535**	**6,824,508**		**9,821**	**16,296**	**24,117**	**33,825**	**45,384**	**61,549**	**85,262**	**132,060**	**223,544**	**630,870**	**1,262,728**	**2,091,700**		**10,398,947**
4	Private Sector	decile01																						**340,994**
		decile02																						**565,833**
		decile03																						**837,399**
		decile04																						**1,174,483**
		decile05																						**1,575,838**
		decile06																						**2,137,132**
		decile07																						**2,960,495**
		decile08																						**4,585,404**
		decile09																						**7,761,933**
		decile10																						**21,905,207**
		Total																						**43,844,718**
5	Rest of the World		**0**	**0**	**0**	**0**	**0**	**268,970**	**15,608,100**	**1,329,453**														**17,309,788**
6	Savings									**1,565,468**	**56**	**52**	**5,226**	**968**	**30,986**	**7,966**	**62,316**	**163,136**	**663,876**	**3,142,075**	**4,076,658**	**2,472,000**		**8,114,126**
7	TOTAL		**3,825,663**	**11,088,043**	**8,999,668**	**8,650,102**	**8,007,226**	**9,102,080**	**106,842,125**	**10,398,947**	**340,994**	**565,833**	**837,399**	**1,174,483**	**1,575,838**	**2,137,132**	**2,960,495**	**4,585,404**	**7,761,933**	**21,905,207**	**43,844,718**	**17,309,788**	**8,114,126**	

Source: SAM Matrix 2000, CIESS-ECONOMETRICA. Instituto Nacional de Estadística. Model calibration year 2000.

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