Poverty reduction and SAM multipliers:

An evaluation of public policies in a regional framework[1]

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Abstract

The objective of this paper is to obtain several poverty reduction effects by using multipliers based on Social Accounting Matrices (SAMs). Expressions relating them to FGT poverty measures were derived, and two simulations were carried out for the Spanish region of Extremadura. In the first, we posited a per capita transfer equivalent to certain social policy instruments already existing in this region. Structural path analysis is also used to determine the paths by which poverty reduction effects are transmitted. In the second, we calculate the minimum government expenditure in transfers needed to reduce the regional poverty indices to the national values. The results confirmed that the main feature of poverty in Extremadura is incidence.

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1. INTRODUCTION

The distributional issues have a growing relevance in policy making. Policies as fiscal adjustments, monetary policy reforms or trade liberalizations and their impacts on poverty and income distribution have been often analysed, especially in developing countries. Therefore, the need of empirical tools for assessing the economic and social effects of such policies arises and very different micro- and/or macro-economic approaches have been proposed, as BOURGUIGNON, 2003 shows.

In the European and Spanish setting, the struggle against poverty and exclusion is one of the most important issues in social policy since the European Council in Niza (2000). Microsimulation models (for example, EUROMOD and ESPASIM) have been frequently used to evaluate the effects of public policies on poverty and inequality and monitor the evolution of National Plans for Social Inclusion. Nevertheless, these models have an important limitation because they do not consider all the interrelations and adjustments in the economy.

An alternative modelling framework lies on general equilibrium models. Together with Computable General Equilibrium models, widely used to analyse poverty issues[2], SAM multiplier models have been proposed by THORBECKE and JUNG, 1996 to analyze the poverty reductions caused by exogenous shocks.[3] These models capture all the economic interrelationships, that is, the direct and indirect effects, so they seem to be an appropriate tool for the analysis.

The present work is based on the aforementioned contribution, although with some differences. The main one is that, while THORBECKE and JUNG, 1996 analyzed the effects of exogenous injections on activity sectors, in our case we consider the effect

[2] Two interesting and recent reviews can be found in ESSAMA-NSSAH, 2005, and BOCCANFUSO et al., 2007.
[3] See also MUJERI and KHANDAKER, 1998.

of additional transfers on household groups. The linear nature of the model and the additive decomposability property of the poverty measures that we use allow us to estimate the reductions in each household group's poverty rates and in overall poverty, as well as the conjoint effects of multiple exogenous injections.

We present two particular applications for the case of Extremadura, an Objective-1 Region of the European Union located in SW Spain.[4] Firstly, we analyze different effects on poverty caused by a hypothetical per capita transfer whose amount is equivalent to the value of certain aids to social insertion that are in effect in this region. In this application, moreover, the structural path analysis is used to determine the paths of influence by which poverty reduction effects are transmitted. Secondly, we determine the minimum social expenditure needed to ensure that the regional poverty measures reach the respective national values. In both cases, the use of the FGT poverty measures, P_a , proposed by FOSTER, GREER and THORBECKE, 1984, allows the phenomena of the incidence, depth, and severity of poverty to be analyzed separately.

It should be emphasized that this method of analysis allows one to identify the household groups which most benefit from the implementation of the proposed transfer schemes (see in section 4 the multipliers called "poverty reduction absorption effects"), and to determine the groups that generate the greatest poverty reductions in receiving these transfers ("poverty reduction diffusion effects"). The results reflect not only qualitative aspects, i.e., the hierarchical ordering of the effects, but also the quantitative reductions in poverty.

The work is structured as follows. Section 2 briefly presents the generic formulation of multipliers based on social accounting matrix. Section 3 relates these linear SAM models to the FGT poverty measures, with the aim of analyzing and

[4] A detailed analysis of the regional per capita incomes in the European Union is performed by Ezcurra et al. (2006).

quantifying the different partial and overall effects on poverty. Sections 4 and 5 present the results of the two applications done for Extremadura. Finally, section 6 gives the main conclusions that can be drawn from our analysis.

2. SOCIAL ACCOUNTING MATRICES AND LINEAR SAM MODELS

In general terms, social accounting matrices are extensive databases that include the entirety of the transactions occurring in an economy during a certain period of time. SAMs are customarily presented as square matrices, with a row and a column for each agent or economic sector incorporated in the matrix. By convention, the row entries are interpreted as receipts, and the column entries as payments or expenditures. An important accounting constraint on a SAM is the necessary equality between the sum of each row and the sum of its corresponding column.

Their main application is to serve as the basis for the construction of different economic models. An important group of such models is that of the so-called linear SAM models or SAM multiplier models which allow one to determine the changes in the different agents' production or income levels caused by possible exogenous shocks.[5]

It is important to note that, since it completely captures the interrelationships between the different agents and sectors, this approach is well suited to evaluating multiplier effects. Also, the level of disaggregation that SAMs normally incorporate enables the resulting multipliers to be presented in great detail.

In order to take the step from a SAM to a multiplier model, it is necessary to distribute the accounts in the SAM into exogenous and endogenous. Exogenous accounts are usually considered to be those determined outside the economic system or

[5] Social accounting matrices are also employed to compute (calibrate) the parameters of the computable general equilibrium models. A recent example of a standard CGE model can be found in Lima and Cardenete (2007).

which constitute economic policy instruments, i.e., the accounts relating to government, savings/investment or capital accounts, and external sector accounts. The endogenous accounts are the remainder – generally primary factor accounts, other institutions and production sectors.

With respect to their formulation, one initially defines the matrix A_n of average expenditure propensities, which incorporates the endogenous transaction matrix coefficients standardized by columns. If x is the column vector representing the sum of exogenous injections received by each endogenous account, I the identity matrix, and y_n the column vector of endogenous incomes, the equation of the linear SAM model can be expressed as follows:

$$y_n = A_n\, y_n + x = (I - A_n)^{-1}\, x = M_a\, x \qquad (1)$$

The matrix M_a is usually known as the accounting multiplier matrix. Its generic element m_{ih} reflects the increase in the income of endogenous account i if account h receives a unit exogenous injection.[6]

Given the interdependency that characterizes the economic system, it may sometimes be important to decompose the multipliers into a series of values that represent the role of the different economic interrelationships. There are many contributions in this regard in the literature, outstanding being the initial work of PYATT and ROUND, 1979, and the structural path analysis procedure put forward by DEFOURNY and THORBECKE, 1984 (see subsection 4.4).

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[6] Alternative SAM multipliers have been proposed. Examples are the fixed price multipliers of PYATT and ROUND (1979), and the mixed multipliers of LEWIS and THORBECKE (1992).

3. LINEAR SAM MODELS AND POVERTY SENSITIVITY EFFECTS

The linear SAM multipliers methodology has been applied in very different issues, particularly noteworthy being the analysis of income distribution[7]. The objective of the present work, as was noted above, is the analysis of questions linked to poverty alleviation using the analytical framework provided by these models and the households disaggregation customarily included in SAMs. More particularly, our aim is to show to what extent possible income transfers directed at the different household groups would permit a significant reduction of poverty.

Assuming the traditional distribution into endogenous and exogenous accounts described in section 2, the accounting multipliers matrix M_a has a partitioned structure in which diverse types of effects can be differentiated. Given the applications to be made in the present study, once the matrix M_a is computed, we focus our analysis on its submatrix that represents the effects on the household groups of income injections that they receive.

It is evident that to approach this analysis one must start by choosing a poverty measure with the appropriate properties. Following THORBECKE and JUNG, 1996, we use the FGT P_a poverty measures proposed by FOSTER, GREER and THORBECKE, 1984, given their property of additive decomposability. This property is very important for our work, since the SAM's households disaggregation will permit both partial analyses of poverty by specific household groups and overall analyses.

This family of poverty measures represents a generalization of the most common indices in the literature. Their generic expression is:

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[7] As examples, RUBIO and VICENTE (2003) and DE MIGUEL-VÉLEZ and PÉREZ-MAYO (2006) present both applications to España and Extremadura, respectively.

$$P_a = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right)^a, a \geq 0 \quad (2)$$

with z being the poverty line, q the number of poor people, n the size of the population and y_i the per capita income o expenditure of individual i. The parameter a represents the individuals' different sensitivities to the poverty gap in terms of poverty threshold (i.e., distance from the poverty line). The greater the value of this parameter, the more importance will be given to people with a greater poverty gap. It can thus be interpreted as the degree of aversion to poverty.

More specially, for a equal to 0 the FGT measure is the head-count ratio, i.e., it simply represents the proportion of households below the poverty line. While this index measures the incidence, it provides no information on how poor the poor are. In this sense, if a is equal to 1, the FGT measure captures the changes in the poverty level of poor households, i.e., it reflects the depth of poverty. Nevertheless, this poverty gap index does not consider the inequality among the poor households, and therefore provides no information on the severity of poverty. This last aspect is captured by the third FGT poverty measure in which the parameter a is taken equal to 2.

On the other hand, KAKWANI, 1993, shows how a change in a poverty measure can be decomposed into the sum of two components: the variation in the mean income, and the change in the income distribution:

$$dP_{a\,i} = \frac{\partial P_{a\,i}}{\partial \overline{y}_i} d\overline{y}_i + \sum_{k=1}^{l} \frac{\partial P_{a\,i}}{dq_{i\,k}} dq_{i\,k} \quad (3)$$

with $P_{a\,i}$ being the FGT P_a poverty measure corresponding to household group i, $\bar{y}_i$ its mean income, and q_{ik} the income distribution parameters.[8]

We can define $h_{a\,i}$ as the elasticity of the $P_{a\,i}$ poverty measure with respect to the mean income of household group i.[9] Assuming that the additional income transfers that constitute the exogenous shocks are distributionally neutral, equation (3) can be expressed in the following way:

$$\frac{dP_{\alpha i}}{P_{\alpha i}} = \eta_{\alpha i} \frac{d\bar{y}_i}{\bar{y}_i} \tag{4}$$

To link the SAM multiplier with the variations in the poverty measure, it is necessary to consider the definition of the generic multiplier m_{ih} and to make a simple transformation in its expression ($dy_i = m_{ih}\, dx_h$):

$$d\bar{y}_i = m_{ih}\, d\bar{x}_h^i \tag{5}$$

where $d\bar{x}_h^i$ is the exogenous change in the income of household group h defined on a per capita basis for group i. Substituting this expression into equation (4), one obtains

$$\frac{dP_{\alpha i}(h)}{P_{\alpha i}} = \eta_{\alpha i}\, m_{ih} \frac{d\bar{x}_h^i}{\bar{y}_i} \tag{6}$$

[8] In the expression (3) it is implicitly assumed that there is no relationship between income and inequality changes. Therefore, the results should be analysed upon this assumption.
[9] These elasticities were calculated using the program DAD (Duclos et al., 2001) according to the following expressions: $h_{ai} = -\frac{a\,[P_{a-1} - P_a]}{P_a}$ for α different from 0; and $h_{ai} = -\frac{zf(z)}{P_0}$ for α equal to 0, with $f(z)$ being the non-parametrically estimated income density function.

This equation is important because it allows one to determine the relative reduction in the poverty of household group i due to an exogenous injection to group h. These effects will be explicitly considered in the first application to be presented in the following section[10].

Given the characteristics of the FGT poverty measures, it is possible to define an aggregate or overall poverty measure P_α as a weighted sum of the individual poverty measures of the different household groups:

$$P_a = \sum_{i=1}^{m} P_{a\,i} \frac{n_i}{n} \tag{7}$$

with n_i being the population of household group i, and n the total population ($n = \sum_{i=1}^{m} n_i$). Differentiating this expression and carrying out simple transformations, one obtains

$$\frac{dP_a}{P_a} = \sum_{i=1}^{m} \left(\frac{dP_{a\,i}}{P_{a\,i}} \right) \left(\frac{P_{a\,i}\, n_i}{P_a\ \, n} \right) \tag{8}$$

Considering the definition of the P_a class of poverty measures, and with $s_{a\,i}$ being the poverty share of household group i of the total poverty, one can express equation (8) in the form

[10] The letter "h" in the term on the left-hand side of this equation is simply a notation to differentiate the group of households receiving the exogenous injection. For this same reason, it is also included in equations (10), (12), and (13).
Besides, this equation actually expresses poverty reductions because positive income transfers are considered and all the elasticities included in the analysis are negative.

$$\frac{dP_a}{P_a} = \sum_{i=1}^{m} \left(\frac{dP_{a\,i}}{P_{a\,i}} \right) s_{a\,i} \tag{9}$$

Substituting expression (6) into this expression, one has

$$\frac{dP_\alpha(h)}{P_\alpha} = \sum_{i=1}^{m} s_{\alpha i}\, \eta_{\alpha i}\, m_{ih}\, \frac{d\bar{x}_h^i}{\bar{y}_i} \tag{10}$$

This equation will also be important in the subsequent application. In particular, it allows one to determine the relative reduction in overall poverty caused by an exogenous injection to household group *h*. One observes that this overall effect is no more than the weighted sum of the changes that this injection causes in the poverty of the different groups –see equation (6)– using the parameters $s_{\alpha i}$ as weights.

Finally, the applications carried out show the effects of exogenous injections received, not by a single household group, but by several groups simultaneously. Because of the linear character of the model, the equations corresponding to multiple exogenous injections involve minimal changes from the foregoing equations, consisting basically in the inclusion of summations. One thus obtains the following equations, the respective analogues of expressions (5), (6), and (10):

$$d\bar{y}_i = \sum_{h=1}^{m} m_{ih}\, d\bar{x}_h^i \tag{11}$$

$$\frac{dP_{\alpha i}}{P_{\alpha i}} = \eta_{\alpha i}\, \frac{d\bar{y}_i}{\bar{y}_i} = \eta_{\alpha i} \left(\sum_{h=1}^{m} m_{ih}\, d\bar{x}_h^i \right) \frac{1}{\bar{y}_i} = \sum_{h=1}^{m} \eta_{\alpha i}\, m_{ih}\, \frac{d\bar{x}_h^i}{\bar{y}_i} = \sum_{h=1}^{m} \frac{dP_{\alpha i}(h)}{P_{\alpha i}} \tag{12}$$

$$\frac{dP_\alpha}{P_\alpha} = \sum_{i=1}^{m} \left(\frac{dP_{\alpha i}}{P_{\alpha i}} \right) s_{\alpha i} =$$

$$= \sum_{i=1}^{m} \left(\sum_{h=1}^{m} \eta_{\alpha i} \, m_{ih} \, \frac{d\bar{x}_h^i}{\bar{y}_i} \right) s_{\alpha i} = \sum_{h=1}^{m} \sum_{i=1}^{m} s_{\alpha i} \eta_{\alpha i} \, m_{ih} \, \frac{d\bar{x}_h^i}{\bar{y}_i} = \sum_{h=1}^{m} \frac{dP_\alpha(h)}{P_\alpha} \tag{13}$$

Equations (12) and (13) merit especial mention. Equation (12) shows the conjoint effect of the different exogenous injections on the poverty of household group *i*, and can be calculated as the sum of the individual effects of each injection on this group's poverty – see equation (6). Analogously, equation (13) shows the total reduction in the aggregate poverty measure due to the different exogenous shocks. As in the previous case, this overall effect is calculated as a sum, in this case of the effects obtained from equation (10).

4. PER CAPITA TRANSFERS AND POVERTY REDUCTION

In the two next sections, we show the main results obtained in the applications that have been carried out. In the first, we analyzed the reduction that would occur in poverty if there were a universal per capita injection in every household group whose amount would be equivalent to the social insertion aids granted by the Extremadura Regional Government. In the second, we determined the minimum expenditure in transfers that the government would have to make in order to reduce the poverty levels in Extremadura to the national levels. Both applications are based in the equations defined in the former section, so the SAM multiplier model is used to perform the poverty analysis. Their main virtues are the simplicity, the transparency, and providing an adequate structure for examining the effects of exogenous policy shocks. Moreover, the decomposition multiplier analysis can surely assist further.

To implement the model we used as database a SAM for the Extremadura´s economy corresponding to the year 2000. This is an update of a previous matrix for the year 1990[11]. The main statistical sources that we used in its construction were the National and Regional Accounts and diverse taxation statistics. Besides, the European Community Household Panel and the Household Budget Continuous Survey have been used as reference sources in the disaggregation of households sector.

The SAM-Extremadura-2000 includes 32 accounts: two accounts for labour and capital factors, five for household groups, fifteen for production sectors, an aggregate capital account or savings/investment account, seven accounts for different taxes and transfers, an account for the government, and an account for the foreign sector.[12]

Respect to the 5 household groups considered in the matrix, and therefore in our applications, the first three groups correspond to households whose principal income receiving member is active, additionally disaggregated according to the main source of income. In particular, the first group consists of households with a breadwinner who is an employee, the second one is composed of households whose head is self-employed, and the third one includes the rest of households with active heads, who are mainly unemployed. On the other hand, the fourth and fifth groups correspond to non-active households, classified according to their income level. A key variable to explain the differences between both groups is the level of education. Although the most frequent level in both categories is "primary school", only the high-income group contains households with heads who have got a university degree.

Table 1 lists for each of these household groups the initial values of the different FGT poverty measures considered, as well as their respective elasticities, their poverty

[11] This update has been developed by means of the cross-entropy method (ROBINSON et al., 2001).

[12] As was mentioned above, the 22 accounts related to primary factors, households, and production sectors are considered endogenous to compute the accounting multipliers.

shares, and their mean incomes[13]. The table also presents the population data and the household-household accounting multiplier submatrix. In general, the information in this table is basic for interpreting the results of the two applications that were carried out.

[INSERT TABLE 1]

In this section, we analyze the effects obtained in the first application. More specifically, we simulate a per capita universal injection in every group of households, similar to a Basic Income scheme. In order to determine the amount of these transfers, we choose an injection equivalent to the amount of the social insertion aid granted by the government in Extremadura, which is on average equivalent to approximately 30% of the inter-professional minimum wage.

Three tables of results with an identical format will next be presented, corresponding to the head-count ratio (table 2), the poverty gap (table 3), and the distributionally-sensitive index (table 4). Hence, the results to be presented capture the effects of the proposed transfers in terms of the incidence ($\alpha = 0$, see subsection 4.1), depth ($\alpha = 1$, see subsection 4.2), and severity of poverty ($\alpha = 2$, see subsection 4.3). Moreover, the structural path analysis is used to determine the paths by which the influence is transmitted (subsection 4.4), which reveals much more explicitly and clearly the endogenous interaction process than the usual multiplier decomposition procedures.

[13] To obtain these data, we used as the variable of interest the household per capita income. Although our analysis is focused on a particular regional economy, the European Union considers the national level to be the framework of reference in terms of poverty. We hence defined the poverty line as the value representing 50% of Spain's annual per capita income, precisely 459108 pesetas.
Otherwise, one can observe that all the values of α, related to incidence, depth and severity, respectively, are taken into account in the applications.

4.1. POVERTY EFFECTS. INCIDENCE

Each of the three next tables incorporates four types of effects on poverty. A first set captures the reductions in poverty of each household group caused by each exogenous shock, i.e., it shows the effects $dP_{\alpha i}(h)/P_{\alpha i}$ obtained using equation (6). These effects could be termed as poverty reduction individual effects. For example, in terms of incidence (see table 2), the per capita transfer targeted on the first household group (h_1) would lead to a 4.54% poverty reduction of the second group (i_2).

The results allow one to affirm firstly that transfer targeted at a certain household group leads to the greatest reduction in poverty of that same group – see the diagonal elements shown in the upper part of the table. This result is unsurprising, and holds in practically all the cases and independently of the value of α. Also, one can state that the active–self-employed households (group 2) act more as a "receptor" than as an "inductor" of poverty reduction, since its reduction in poverty due to transfer received by other groups is clearly greater than the effects in the opposite sense (cf. the symmetrical elements)[14]. For the active–other income households (group 3) the exact opposite is the case.

A second set of effects on poverty is presented in the final column of table 2. In particular, the effects $dP_{\alpha i}/P_{\alpha i}$ indicate the poverty reductions of each household group caused jointly by the total of transfers. Using a certain analogy with the nomenclature of the accounting multipliers, we can denominate them poverty reduction absorption effects; i.e., they capture to what extent all the injections considered are translated into a

[14] This result not only holds in terms of the incidence of poverty, but also in terms of depth (table 3) and severity (table 4).

reduction of each household group's poverty level.[15] As was noted above, these reductions can be calculated as the sum of the effects in the corresponding row – see equation (12).

To comment on these results, we would first observe that the set of transfers would cause a significant poverty reduction of over 20% in the non-active–low income group (i_4). This group's high elasticity (η_{0i4}) and low per capita income ($\bar{y}_{i4}$) contribute decisively to this effect– see table 1. For the active–self-employed group (i_2) also, the reduction would be 15.63%, basically as a consequence of the its high multipliers $m_{i2,h}$. This result highlights the important role that the multipliers play in the calculation of the poverty reductions[16]. In the contrary sense, the poverty reduction corresponding to the non-active–high income group (i_5) is very small – only approximately 4%.

Thirdly, table 2 also shows the effect of each exogenous injection on the aggregate poverty measure, i.e., it presents the effects $dP_\alpha(h)/P_\alpha$ obtained using equation (10). Recall that these effects, which we can call poverty reduction diffusion effects, are calculated as a weighted sum of the elements in the upper column, using the respective poverty shares of each household group as weights.

The results again show the important role that the non-active–low income group (h_4) plays in terms of poverty reduction, since it presents the greatest diffusion effect: the per capita transfer granted to this group would allow the overall poverty to be reduced by 4.3%. This group is followed by the active–wage-earning group (h_1) with a reduction of 3.75%, a result largely conditioned by the high proportion of poor existing

[15] In a SAM model framework, this nomenclature and the later used, “diffusion effects”, are employed in, for example, DE MIGUEL and MANRESA, 2004.

[16] In table 1, one observes that the multipliers in the rows of the active–wage-earner (group 1) and active–self-employed (group 2) groups are clearly greater than the rest. The low values corresponding to the three last groups are because a very important part of their income comes from transfers received from the government, which lack the interdependency effects of the factorial income distribution.

in this group (close to 35% – see table 1)[17]. The effect shown by the non-active–high income group (h_5) is again of minimal relevance.

Finally, the bottom row of table 2 shows the joint effect on the aggregate poverty of all the transfers – the effect dP_α / P_α calculated using equation (13). In this case, the overall poverty reduction would be 11.98%, a figure that is of course the sum of the different diffusion effects.

[INSERT TABLE 2]

4.2. POVERTY EFFECTS. DEPTH

In this subsection, we analyze the effects on the depth of poverty ($\alpha = 1$), which are shown in table 3. Firstly, it is evident that the poverty reductions obtained in this case are substantially greater than those given in table 2, because the corresponding elasticities η_{1i} are greater than in the previous case, η_{0i}. The final effect on the aggregate poverty of all the transfers is sufficiently illustrative, reaching a reduction of 23.2% practically double that obtained in the previous case.

In this sense, one observes the influence of the income distribution. The proposed transfers would reduce the distance to the poverty line and hence the depth of poverty, although not necessarily its incidence since there would be poor households that would not surpass the poverty line. Hence, with the transfer considered here, the depth of poverty is considerably more sensitive than the incidence.

Nonetheless, in qualitative terms the results have a certain similarity with those presented previously. For example, in the poverty reduction absorption effects, the non-

[17] Although this household group presents relatively small elasticities, its influence is important since it involves about 40% of the population.

active–low income (i_4) and the active–self-employed (i_2) household groups which would have poverty reductions of around 41.5% and 31.5%, respectively, stand out again.

The poverty reduction diffusion effects present greater deviations from the foregoing effects, since in this case the transfers targeted at the active–other income group (h_3) would cause the greatest reduction in aggregate poverty (7.89%). This group is followed by the active–wage-earning (h_1) and non-active low-income (h_4) groups, with overall poverty reductions of 6.43% and 6.29%, respectively. This change in order is due to the variation of the poverty shares between incidence and depth, with s_{1i} presenting very high values for groups h_3 and h_1 – see table 1. Recall that incidence and depth capture different phenomena, so that these changes in the poverty shares are again determined by the income distribution itself; i.e., the active–other income group's greater depth index combined with its high percentage of the population mean that this group has a large contribution to the overall poverty (s_{1i3}).

[INSERT TABLE 3]

4.3. POVERTY EFFECTS. SEVERITY

The effects on poverty severity ($a = 2$) are shown in table 4. In this case, the reduction in overall poverty caused by all the simulated transfers would be greater than that observed in the two previous cases, reaching 27.11%. Again, there is a major contribution to this from the high diffusion effect presented by the active–other income group (h_3), which in turn is due to its high elasticity (h_{2i3}) and its high share of the total poverty (s_{2i3}).

The differences between the results for this measure and for the two previous measures are once more given by the income distribution. The severity measure takes into account the income inequality between poor households, and therefore depends on the income distribution between those households. Nonetheless, one observes that the results for poverty severity and depth are relatively similar to each other, the differences with respect to incidence being greater.

More specifically, comparison of tables 3 and 4 shows again that household groups h_3, h_1 and h_4 determine the greatest reductions in overall poverty. The poverty reduction absorption effects also follow to a certain extent the same patterns, since the non-active–low income group (i_4) is again that which has the greatest poverty reduction, 32.33%. The second place in terms of severity is now occupied by the active–other income group (i_3), with its absorption effect undergoing a notable increase over its previous values.

[INSERT TABLE 4]

Finally, based on the results shown in the three former tables (incidence, depth, and severity), we would also stress that the non-active–high income household group experiences poverty reductions of little relevance (absorption effects i_5), and it has a very limited capacity to induce reductions in overall poverty (diffusion effects h_5). This result is not surprising since this group is the one with the lowest initial poverty rates, rates that are indeed very low – see table 1.

4.4. STRUCTURAL PATH ANALYSIS APPLIED TO POVERTY REDUCTION

The equations in section 3 show that the accounting multipliers m_{ih} are among the determinants of the obtained poverty effects. To conclude this first application, the structural path analysis is used in order to decompose the multipliers and show the paths by which the influence is transmitted from a particular account (origin) to another (destination).[18]

More specifically, this analysis decomposes the global influence linking any two poles of a structure –the previous accounting multipliers- as the sum of total influences transmitted along each paths spanning both poles. These latters, in turn, can be computed multiplying the direct influences by a quantity called the path multiplier.

Following DEFOURNY and THORBECKE (1984),

$$IG_{(k\to i)} = m_{ih} = \sum_{p=1}^{k} IT_{(h\to i)p} = \sum_{p=1}^{k} ID_{(h\to i)p} M_p \quad (14)$$

where $IG_{(h\to i)}$ represents the global influence from h_{th} column in the SAM to the i_{th} row, $IT_{(h\to i)p}$ the total influence from h to i transmitted along path p, $ID_{(h\to i)p}$ the direct influence from h to i transmitted along path p; M_p the path multiplier corresponding to this path, and k the number of paths. Besides, the direct influence transmitted by a specific path is computed as the product of the average expenditure propensities defining this path. In this sense, matrix A_n represents the matrix of direct influences. On the other hand, the path multiplier shows the amplification of direct influence through adjacent feedback circuits.

[18] It should be reminded that the accounting multipliers previously used reflect the effects of the income injections received by households on their respective income levels, that is, the multipliers placed in the submatrix households-households. See table 1.

Combining this expression with the equation (6),

$$\frac{dP_{ai}(h)}{P_{ai}} = \sum_{p=1}^{k} h_{ai} IT_{(h\to i)p} \frac{d\overline{x}_h^i}{\overline{y}_i} = \sum_{p=1}^{k} h_{ai} ID_{(h\to i)p} M_p \frac{d\overline{x}_h^i}{\overline{y}_i} \tag{15}$$

Equation (15) links the structural path analysis with the poverty alleviation, that is, allows one to reveal the paths of influence through which the poverty reduction effects are transmitted. In our case, this equation is used to decompose the poverty reduction individual effects ($dP_{\alpha i}(h)/P_{\alpha i}$), by estimating what share of the poverty effects is transmitted by every path.[19]

The results we obtained are shown in table 5. Before commenting them, it should be clarify three important questions. Firstly, the presented percentages are valid for incidence, depth and severity, because the same accounting multipliers have been used to compute the figures in tables 2-4. Secondly, only those paths transporting at least 3.5% of the corresponding poverty reduction effect are explicitly shown.[20] Finally, the presented paths always travel following the circular flow of the income. In this sense, one can observes that all the paths follow the scheme Household Group (*h*) + Production Sector (PS) + Production Factor (L or K) + Household Group (*i*).

For a better interpretation of table 5, we can mention, for instance, that the 30.87% of the poverty reduction individual effect (i_2, h_1) (-0.0454 in terms of incidence, -0.0915 for depth and -0.0792 for severity, see tables 2-4 respectively) is transmitted by the path defined by the household group 1 (h_1), the production sector 14 (PS14, Other sales oriented services), the capital factor (K) and the second household group (i_2). The

[19] Given the linear nature of equation (15), the figures in table 5 represent not only the percentage of the poverty reduction individual effect transmitted by a specific path, but also the percentage that the total influence transmitted by this path represents in the global influence.
[20] The presented paths allow one to explain, in average terms, the 57.77% of the poverty effects.

paths "h_1 + PS11 (Recovery and repair, trade and hostelry) + K + i_2" and "h_1 + PS1 (Agriculture) + K + i_2" represent respectively 29.12 and 6.28% of this poverty reduction effect.

In general terms, the results are conjointly determined by three parameter sets: 1) the consumption structure of the household groups, namely, the elements of the submatrix production sectors – households of the average expenditure propensities matrix A_n ; 2) the cost structure of production sectors, especially, the costs of labour and capital factors located in the submatrix production factors-production sectors of matrix A_n; and 3) the distribution of primary incomes between the household groups, that is, the elements of submatrix households-production factors of matrix A_n.

The product of the three previous average expenditure propensities allows one to get the direct influence *ID* related to each path, which, in our case, is the main determinant of the computed percentages because the path multiplier M_p shows relatively similar values in any path (see equation 15).

In the light of the obtained percentages, it is obvious that a significant part of the influence is transmitted by paths that flow by the production sectors 11, Recovery and repair, trade and hostelry, and 14, Other sales oriented services. Therefore, these production sectors play a key role in the poverty alleviations presented in tables 2-4. This result is due to the fact that both sectors show by far the higher consumption in the expenditure structures of each and every household group.

Regarding the poverty reductions experienced by the household group "Active–wage-earners" (row i_1), it is possible to observe that the paths that go through the labour factor transmit much more influence than those travel through the capital factor. This fact takes place because this group takes a large share of labour incomes (over 70%), with a much smaller share of capital incomes. An analogous reasoning can be used to explain the large percentage transmitted by the paths that travel through the capital factor for groups "Active–self-employed" (row i_2) and "Non-active–low income" (row i_4).

Finally, we can also point the production sector 1, Agriculture. This sector lets the transmission of a not inconsiderable part of the influence, due to a cost structure with a high weight of the capital incomes and representing an important share in the consumption structures of the household groups.

[INSERT TABLE 5]

5. EXPENDITURE MINIMIZATION AND POVERTY REDUCTION

The previous application (see subsections 4.1 to 4.3) has shown the capacity to reduce overall poverty of the active–wage-earning (group 1), active–other income (group 3), and non-active–low income (group 4) groups when they receive per capita transfers. These last two groups, together with the active–self-employed group (group 2), are those that also undergo the greatest poverty level reductions. For the three versions of the FGT poverty measure considered, one also observes that the greater the value of a, the greater the importance of the active–other income household group (group 3), which presents clearly greater diffusion and absorption effects.

In this second exercise, we considered an application that was clearly different from the foregoing. In particular, our objective was to determine the minimum expenditure in transfers that the government must make in order to reduce overall poverty in Extremadura to the national value[21]. Evidently, this expenditure is just the

[21] These values are 0.1768 in terms of poverty incidence, 0.0416 for the depth, and 0.0150 for the severity. Hence, the reductions needed in the overall poverty figures for Extremadura are 52.80%,

sum of the transfers allocated to each of the 5 household groups. We included two additional constraints. Firstly, all the transfers must at least be null to guarantee that no household group has a reduction in the transfers that it is currently receiving. And secondly, no poverty measure, whether overall or specific to some household group, may be negative.

Since we are dealing with three different aspects of poverty, we considered three different optimization problems. Because of the characteristics of the objective function and of the constraints, these problems were solvable by linear programming techniques.

Table 6 presents a synthesis of the results for these three cases. Firstly, one observes that the minimum expenditure necessary to reduce the aggregate poverty in Extremadura to the national level is clearly smaller in terms of depth and, above all, severity in comparison with the expenditure necessary in terms of incidence.

This fact allows us to emphasize a result briefly outlined in the previous application: if one wants to define a distinguishing characteristic of poverty in Extremadura, this is without doubt its incidence[22]. In this sense, in order to reach the national values, the expenditure needed for FGT P_0 is 2.6 times the necessary expenditure in terms of depth, and 4.3 times the expenditure in terms of severity. I.e., although the figures for severity and depth are still above the national measures, and the percentage reductions required are very similar to those corresponding to incidence, they both involve fewer households and can be corrected with a smaller expenditure.

On the other hand, comparing the minimum expenditure of 17191 millions pesetas corresponding to severity with the amount of the per capita injection considered

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51.96%, and 51.61%, respectively. As can be observed in the subsequent table 6, these are exactly the reductions obtained with the set of proposed transfers.

[22] This same conclusion is reached in previous studies of poverty for the Extremadura region. See, for example, JURADO and PÉREZ-MAYO (2005). Also, from the foregoing tables 2 to 4 one observes that, for the same exogenous injections, the greatest reductions in overall poverty are in terms of severity and depth.

in the first application –which was approximately 23260 millions pesetas– one again clearly observes that the effects on poverty will be very different according to which household groups the income transfers are targeted at. In this second application, by allocating all the transfers to the third group, not only would the quantity be less than in the previous application, but the reductions obtained in overall poverty would be spectacularly greater (51.61% as against 27.11%).

Analyzing in more detail the results given in table 6, one observes that in all the cases this third household group (active–other income) appears as a major receiver of transfers, with reductions in its poverty measure ranging between 75.86% and 95.28%. For the first two measures considered (incidence and depth) the non-active–low income households (group 4) would also receive an important volume of transfers that would allow their poverty rates to be reduced to zero. In general, the fact that these two groups should be the targets of transfers is a logical result in view of their defining parameters, especially their high poverty elasticities, high poverty shares, and low mean incomes.

For the other household groups, there would be reductions ranging between 0.09% and 38.49%, particularly noteworthy being the reductions for the active–self-employed households (group 2), given the high absorption effects that this group presents.

[INSERT TABLE 6]

6. CONCLUSIONS

In this work, we have used accounting multipliers based on social accounting matrices to analyze different public policies directed at the poverty alleviation. Starting from the expression for the FGT poverty measures, we determined the relationships between variations in the poverty indices and exogenous increases in income. The expressions thus obtained showed that the resulting poverty reductions depend on these multipliers, as well as on the elasticities of the poverty measure with respect to the mean income, the poverty shares with respect to the total poverty, and the mean incomes.

One attractive feature of SAM multipliers is that they allow one to consider not only the direct effects of the transfers received by a given household group on its own poverty rates, but also the effects of such transfers on the poverty rates of other groups. Thus, this methodological approach allows the identification of those household groups that undergo the greatest poverty reductions (absorption effects), and of those groups that, on receiving income injections, lead to the greatest reductions in overall poverty (diffusion effect).

This methodology was applied to the region of Extremadura in two different exercises. The first simulated a per capita transfer for the amount of certain already existing social policy instruments in this region, by including, besides, a structural path analysis to decompose the multipliers and show the most important paths of influence. As a complement to this first simulation, in the second exercise the minimum expenditure was determined that would allow the region to achieve the national values of the respective FGT poverty measures.

In general, it was found that poverty in Extremadura is a phenomenon fundamentally related to incidence, i.e., although there is a great number of poor, it is possible to state that, on average, their situation is not excessively serious. On the other hand, it was found that, for any value of the parameter ? , the active–other income and non-active–low income household groups presented the highest poverty indices, whereas the poverty situation of the non-active–high income group was very light.

In relation to the first simulation, it was observed that, for all three measures considered, the active–other income, non-active–low income, and active–wage-earning groups presented the largest diffusion effects, i.e., they showed the greatest capacity to reduce overall poverty. With respect to the poverty reduction undergone by each group in response to the set of transfers considered, the non-active–low income group benefited most. In general, these results were determined by the aforementioned set of model parameters. In addition, the performed structural path analysis allowed us to show how a basic share of the poverty reduction effects is transmitted by paths which travel through the production sectors Recovery and repair, trade and hostelry and Other sales oriented services.

The second application allowed us to emphasize the problem of the poverty incidence. The minimum expenditure needed to reach the national head-count ratio was distinctly greater than the corresponding expenditure for the national poverty gap index or the distributionally-sensitive index. Furthermore, given the large diffusion effects shown by the active–other income and non-active–low income groups, the transfers should go entirely to these two groups.

To conclude, we would point out the potential of the present analysis. Using the SAM multiplier methodology allowed us to obtain important results related to the processes of income distribution and poverty reduction, by involving all the interrelationships that define the circular flow of income. Thus, it becomes a useful tool in policy making because it improves alternative partial approaches as microsimulation models. On the other hand, the recent and interesting efforts presented in the CGE literature let think about using these models as an alternative modelling framework.

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Table 1. Data for the model implementation (1)

		Poverty measures – initial values			Elasticities			Poverty shares		
		(P_{0i})	(P_{1i})	(P_{2i})	(η_{0i})	(η_{1i})	(η_{2i})	(s_{0i})	(s_{1i})	(s_{2i})
Group 1	Active–wage-earners	0.3303	0.0709	0.0212	-1.7383	-2.9974	-3.2014	0.3481	0.3230	0.2697
Group 2	Active–self-employed	0.3489	0.0643	0.0201	-1.6325	-3.2885	-2.8462	0.1537	0.1225	0.1069
Group 3	Active–other income	0.4967	0.1698	0.0769	-1.3314	-3.7759	-5.9910	0.2696	0.3987	0.5040
Group 4	Non-active–low income	0.7194	0.1160	0.0320	-3.4407	-6.9708	-5.4123	0.2218	0.1547	0.1193
Group 5	Non-active–high income	0.0209	0.0008	0.0000	-0.9563	-0.2316	-0.0505	0.0068	0.0011	0.0001
	Total (P_α)	0.3746	0.0866	0.0310						

Table 1. Data for the model implementation (2)

		Mean income (pesetas)	Percentage of the population		Household-household accounting multipliers submatrix (m_{ih})					
		($\bar{y}_i$)	(n_i/n)			**h_1**	**h_2**	**h_3**	**h_4**	**h_5**
Group 1	Active–wage-earners	640 842	0.3947		**i_1**	1.2508	0.1077	0.2617	0.2465	0.1551
Group 2	Active–self-employed	619 870	0.1650		**i_2**	0.3402	1.1461	0.3588	0.3422	0.2132
Group 3	Active–other income	519 209	0.2033		**i_3**	0.0680	0.0292	1.0712	0.0674	0.0423
Group 4	Non-active–low income	427 514	0.1155		**i_4**	0.0271	0.0116	0.0285	1.0271	0.0169
Group 5	Non-active–high income	854 650	0.1214		**i_5**	0.0988	0.0424	0.1038	0.0985	1.0616

Table 2. Poverty reduction due to per capita transfers.

FGT P_0 (incidence)

$dP_{\alpha i}(h)/P_{\alpha i}$	h_1	h_2	h_3	h_4	h_5	$dP_{\alpha i}/P_{\alpha i}$
i_1	-0.0719	-0.0026	-0.0078	-0.0041	-0.0027	**-0.0892**
i_2	-0.0454	-0.0640	-0.0247	-0.0134	-0.0088	**-0.1563**
i_3	-0.0072	-0.0013	-0.0582	-0.0021	-0.0014	**-0.0702**
i_4	-0.0158	-0.0028	-0.0086	-0.1753	-0.0030	**-0.2055**
i_5	-0.0076	-0.0014	-0.0041	-0.0022	-0.0252	**-0.0405**
$dP_{\alpha}(h)/P_{\alpha}$	**-0.0375**	**-0.0117**	**-0.0241**	**-0.0430**	**-0.0035**	
dP_{α}/P_{α}	**-0.1198**					

Table 3. Poverty reduction due to per capita transfers.

FGT P_1 (depth)

$dP_{\alpha i}(h)/P_{\alpha i}$	h_1	h_2	h_3	h_4	h_5	$dP_{\alpha i}/P_{\alpha i}$
i_1	-0.1240	-0.0045	-0.0134	-0.0072	-0.0047	**-0.1538**
i_2	-0.0915	-0.1289	-0.0497	-0.0269	-0.0176	**-0.3148**
i_3	-0.0204	-0.0037	-0.1652	-0.0059	-0.0039	**-0.1990**
i_4	-0.0320	-0.0057	-0.0173	-0.3551	-0.0062	**-0.4163**
i_5	-0.0018	-0.0003	-0.0010	-0.0005	-0.0061	**-0.0098**
$dP_{\alpha}(h)/P_{\alpha}$	**-0.0643**	**-0.0196**	**-0.0789**	**-0.0629**	**-0.0062**	
dP_{α}/P_{α}	**-0.2320**					

Table 4. Poverty reduction due to per capita transfers.

FGT P_2 (severity)

$dP_{\alpha i}(h)/P_{\alpha i}$	h_1	h_2	h_3	h_4	h_5	$dP_{\alpha i}/P_{\alpha i}$
i_1	-0.1325	-0.0048	-0.0143	-0.0076	-0.0051	**-0.1642**
i_2	-0.0792	-0.1116	-0.0430	-0.0233	-0.0153	**-0.2724**
i_3	-0.0323	-0.0058	-0.2621	-0.0094	-0.0062	**-0.3157**
i_4	-0.0248	-0.0045	-0.0135	-0.2757	-0.0048	**-0.3233**
i_5	-0.0004	-0.0001	-0.0002	-0.0001	-0.0013	**-0.0021**
$dP_{\alpha}(h)/P_{\alpha}$	**-0.0634**	**-0.0167**	**-0.1421**	**-0.0422**	**-0.0067**	
dP_{α}/P_{α}	**-0.2711**					

Table 5. Structural path analysis. Poverty reduction individual effects and percentages transmitted along each path*

Household Groups	h_1	h_2	h_3	h_4	h_5
i_1	h_1 +PS11+L+i_1 (18.78%) h_1 +PS14+L+i_1 (15.78%) h_1 +PS14+K+i_1 (7.60%) h_1 +PS11+K+i_1 (7.17%) h_1 +PS12+L+i_1 (3.86%) h_1 +PS15+L+i_1 (3.61%)	h_2 +PS11+L+i_1 (20.23%) h_2 +PS14+L+i_1 (16.28%) h_2 +PS14+K+i_1 (7.37%) h_2 +PS11+K+i_1 (7.31%) h_2 +PS15+L+i_1 (4.66%)	h_3 +PS11+L+i_1 (18.96%) h_3 +PS14+L+i_1 (15.91%) h_3 +PS14+K+i_1 (7.66%) h_3 +PS11+K+i_1 (7.23%) h_3 +PS6+L+i_1 (3.52%)	h_4 +PS11+L+i_1 (18.10%) h_4 +PS14+L+i_1 (17.33%) h_4 +PS14+K+i_1 (8.27%) h_4 +PS11+K+i_1 (6.85%) h_4 +PS15+L+i_1 (3.74%) h_4 +PS6+L+i_1 (3.70%)	h_5 +PS11+L+i_1 (18.38%) h_5 +PS14+L+i_1 (16.48%) h_5 +PS14+K+i_1 (7.86%) h_5 +PS11+K+i_1 (6.95%) h_5 +PS15+L+i_1 (3.91%) h_5 +PS6+L+i_1 (3.54%)
i_2	h_1 +PS14+K+i_2 (30.87%) h_1 +PS11+K+i_2 (29.12%) h_1 +PS1+K+i_2 (6.28%)	h_2 +PS11+K+i_2 (27.26%) h_2 +PS14+K+i_2 (27.08%) h_2 +PS1+K+i_2 (6.31%)	h_3 +PS14+K+i_2 (27.95%) h_3 +PS11+K+i_2 (26.78%) h_3 +PS1+K+i_2 (6.75%)	h_4 +PS14+K+i_2 (29.77%) h_4 +PS11+K+i_2 (25.04%) h_4 +PS1+K+i_2 (7.78%)	h_5 +PS14+K+i_2 (28.58%) h_5 +PS11+K+i_2 (25.64%) h_5 +PS1+K+i_2 (7.28%)
i_3	h_1 +PS14+K+i_3 (16.77%) h_1 +PS11+K+i_3 (15.78%) h_1 +PS11+L+i_3 (12.07%) h_1 +PS14+L+i_3 (10.15%)	h_2 +PS11+K+i_3 (14.82%) h_2 +PS14+K+i_3 (14.77%) h_2 +PS11+L+i_3 (12.68%) h_2 +PS14+L+i_3 (10.19%)	h_3 +PS14+K+i_3 (15.03%) h_3 +PS11+K+i_3 (14.40%) h_3 +PS11+L+i_3 (11.64%) h_3 +PS14+L+i_3 (9.75%) h_3 +PS1+K+i_3 (3.63%)	h_4 +PS14+K+i_3 (16.42%) h_4 +PS11+K+i_3 (13.78%) h_4 +PS11+L+i_3 (11.24%) h_4 +PS14+L+i_3 (10.75%) h_4 +PS1+K+i_3 (4.31%)	h_5 +PS14+K+i_3 (15.67%) h_5 +PS11+K+i_3 (14.02%) h_5 +PS11+L+i_3 (11.45%) h_5 +PS14+L+i_3 (10.27%) h_5 +PS1+K+i_3 (4.01%)
i_4	h_1 +PS14+K+i_4 (27.80%) h_1 +PS11+K+i_4 (26.22%) h_1 +PS1+K+i_4 (5.65%)	h_2 +PS11+K+i_4 (24.59%) h_2 +PS14+K+i_4 (24.43%) h_2 +PS1+K+i_4 (5.70%)	h_3 +PS14+K+i_4 (25.19%) h_3 +PS11+K+i_4 (24.14%) h_3 +PS1+K+i_4 (6.08%)	h_4 +PS14+K+i_4 (26.83%) h_4 +PS11+K+i_4 (22.58%) h_4 +PS1+K+i_4 (7.01%)	h_5 +PS14+K+i_4 (25.77%) h_5 +PS11+K+i_4 (23.12%) h_5 +PS1+K+i_4 (6.56%)
i_5	h_1 +PS14+K+i_5 (22.08%) h_1 +PS11+K+i_5 (20.81%) h_1 +PS11+L+i_5 (7.84%) h_1 +PS14+L+i_5 (6.59%) h_1 +PS1+K+i_5 (4.50%)	h_2 +PS11+K+i_5 (19.53%) h_2 +PS14+K+i_5 (19.43%) h_2 +PS11+L+i_5 (8.24%) h_2 +PS14+L+i_5 (6.62%) h_2 +PS1+K+i_5 (4.54%)	h_3 +PS14+K+i_5 (20.08%) h_3 +PS11+K+i_5 (19.22%) h_3 +PS11+L+i_5 (7.67%) h_3 +PS14+L+i_5 (6.43%) h_3 +PS1+K+i_5 (4.86%)	h_4 +PS14+K+i_5 (21.49%) h_4 +PS11+K+i_5 (18.06%) h_4 +PS11+L+i_5 (7.27%) h_4 +PS14+L+i_5 (6.95%) h_4 +PS1+K+i_5 (5.63%)	h_5 +PS14+K+i_5 (20.35%) h_5 +PS11+K+i_5 (18.27%) h_5 +PS11+L+i_5 (7.28%) h_5 +PS14+L+i_5 (6.52%) h_5 +PS1+K+i_5 (5.18%)

*h_j are the path origins and i_j the path destinations.

Table 6. Minimum expenditure and poverty reduction

FGT P_0 (incidence)	Group 1	Group 2	Group 3	Group 4	Group 5	Minimum expenditure
dx_h (millions pesetas)	0	0	60.734.8	13.639.4	0	**74 374.2**
$dP_{\alpha i}/P_{\alpha i}$	-0.1206	-0.3849	-0.7586	-1	-0.0642	
dP_{α}/P_{α}	**-0.5280**					
FGT P_1 (depth)	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Minimum expenditure**
dx_h (millions pesetas)	0	0	21.369.2	6.971.1	0	**28 340.3**
$dP_{\alpha i}/P_{\alpha i}$	-0.0790	-0.2946	-0.7618	-1	-0.0059	
dP_{α}/P_{α}	**-0.5196**					
FGT P_2 (severity)	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Minimum expenditure**
dx_h (millions pesetas)	0	0	17.191.0	0	0	**17 191.0**
$dP_{\alpha i}/P_{\alpha i}$	-0.0519	-0.1565	-0.9528	-0.0490	-0.0009	
dP_{α}/P_{α}	**-0.5161**					