Policy for avoiding deforestation, local economy and land market in Amazon: simulations using I-O matrices[1]

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Abstract

The current discussion on avoiding carbon emission associated to agricultural use of land needs a more systemic approach, whether in regard to the economic flows properly and their interactions, whether in terms of the institutional environment that ensures them. Given that avoiding deforestation schemes implicate resources input-output throughout local economies and broader economic context, it seems fundamental to discuss what are the final impacts of those flows. The basic questions are a) how such policies, starting from the rural sectors, will affect final demand, the value of the production and the variables of value added all over the economy and b) how variations in the economy affect the forms of use of natural resources and, therefore, deforestation itself. Related to institutions, the article puts special emphasis on defining the market for land, because it is the core of vital issues to what is discussed. The article uses an ascending model to generate input-output matrices for local economies based on primary products, where works a market for land, incorporates an algorithm of carbon balance, finds the multipliers of the economy of Southeastern Pará and simulates four situations of policies on avoiding deforestation. The main conclusion is that policies for avoiding deforestation will probably have a hard time if not part of macro development policy on local level.

Key-Words: Amazon, Amazon Region, Carbon Balance, Local Economy, Southeast Pará, Avoiding Deforestation

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1. Introduction

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The current discussion on carbon emission associated to agricultural use of the land to the detriment of forests needs a systemic perspective, through which the processes should be contextualized.

When the subject is forms of controlling and avoiding deforestation, for example, the focus has been put on microeconomic and generic foundation, where the predominant perspective has regarded “medium" and "homogeneous" agents, whose decisions would be guided by averages of variables that are neither structurally (of systems and forms of production) nor spatially (of clustering and poles of local economies) contextualized. Therefore, what was considered as a base for compensation was the net remuneration for separate product, obtained in that level of abstraction and formalism, after deducing all costs from the total revenue, including labor costs. Furthermore, estimations based on averages of averages have been offered as valid expressions for wide contexts. This was the procedure of Grieg-Gran (2006), main analytic source of Stern Review in what refers to the costs of a worldwide program for compensating reducing deforestation.

Stern (2007) himself recognizes part of the inadequacy of this approach - the one related to the disregard for macroeconomic effects of avoiding "production". Recognizing the lack, however, Stern reduces its consequences: "Research commissioned by the Review, suggests that the direct yields from land converted to farming, including proceeds from the sale of timber, are equivalent to less than $1 per tone of CO2 in many areas currently losing forest, and usually well below $5 per tone. *The opportunity costs to national GDP would be somewhat higher*, as these would include value added activities in country and export tariffs". (Stern, 2007:607; my italics, FAC).

Nevertheless, this “somewhat” should be large enough to embrace the macro effects of the impacts multipliers (Keynes, 1976) derived of that that Myrdal (1957), Hirshman (1958) and Perroux (1965) consecrated in the economic literature as phenomenon of "cumulative circular causality”, characteristic to the "forward and backward concatenations" that produce the “polarization effects” typical of development processes in the modern societies.

Such considerations bring us immediately to two questions: 1) How much, exactly, would be the "somewhat" added in the chains to be disassembled by an “avoiding deforestation program”? In addition, 2) once the compensation perspective excludes wages, what are the implications of that on the effective demand of economies where it will operate?

On the other hand, however, in addition to this perspective that approaches the problem of net emissions of CO2 by rural production through a “negative” way – “negative” because based on "non-production" – a more complex view of the agricultural systems is taking place with a “positive” perspective in relation to production. Instead treating it (almost) exclusively as environment pollutants and biodiversity degrading, a sub-group of systems based on perennial cultures and on agriculture-forest compositions is recognized by Stern Review as potentially consistent with the forest conservation in the context of strategies to reduce emissions (Stern, 2007: 603-621). It is also recognized that such activities can, by reducing the pressure on the forests and creating mechanisms of net sequestration of carbon, expand the offer and, in consequence, reduce the price of the environmental good – the stabilization or reversion of the climatic changes – itself, turning the mitigation strategies more cost effective.

These further considerations give us floor for a next question: 3) how consistent are these promising rural activities as sinks of carbon across the real dynamics of expansion of the (local) economies where they are inserted? 4) What is the institutional operating context, which systemicaly ensures the status quo and, so, has to be confronted by the new policy?

Those punctual questions take us to broader inquiries, organized by the current state of discussions about development and space configuration, which in last instance are the subjects that motivate our efforts in this article. Since the outlined compensation schemes – either by "non production" or by "clean production" proposals - imply entrance and exit of resources in wide and systemic economic contexts, what are the results of those flows on the general conditions of reproduction of referred economies? What are the effects on their fundamental variables of income and employment? What are the impacts on their natural bases? Finally, how strongly are their endogenous capacities to develop correlated to deforestation and CO2 emissions? How the land market as institutional key mechanism operates in such matters?

Ahead we seek answers to these questions starting from the analysis of the economy of a critical area in the recent dynamics of occupation of Amazon - the area assigned by IBGE as meso-region Southeastern Pará, in the state of Pará. With this purpose, we have generated an input-output matrix through a methodology of ascending calculation able to capture the foundations of the agrarian economy that underlay carbon emissions. The accounting is also able to place all the involved subjects we discussed above in a wide context of a local real economy of primary base, which includes both the primary mineral production and its unfolding in industry and commerce, at local, regional and national level. Of particular importance for the proper treatment of the raised issues is the consideration of the marked for land, which ultimately bases the way these economy evolves.

The article is organized in three sections, besides this introduction. In Section 2 we present a quick account of the studied region; in Section 3 we present the applied methodology; in Section 4, the results obtained above will be discussed in the light of the presented questioning. As conclusion, we will raise some considerations pointing to policy evaluation and future studies.

2. Southeastern Pará: a critical region in Amazon

Southeastern Pará is described by IBGE as a meso-region comprised of the municipal districts of *Marabá, Parauapebas, Curionópolis, Ourilândia do Norte, Tucumã, Eldorado dos Carajás, Canaã dos Carajás, São Felix do Xingu, São João do Araguaia, Brejo Grande do Araguaia, Bom Jesus do Tocantins, Palestina do Pará, São Domingos do Araguaia, Pau D'Arco, Redenção, Rio Maria, Xinguara, Conceição do Araguaia, Paragominas, Tucurui, Jacundá, Itupiranga, São Domingos do Capim, Rondom do Pará, Dom Eliseu, Ulianópolis, Goianésia do Pará, Novo Repartimento, Breu Branco* and *Nova Ipixuna*.

This has been an area of extraordinary dynamics. There were great cattle ranching projects financed by SUDAM allocated in the sixties, which confronted the old Para nuts extraction structures and the expansion of peasants agriculture along with great mineral projects and gold mining prospectors. As parts of the process, important structural transformations took place, reinforcing the role of the urban centers and the local rural bases in the logistics of new economic sectors conditioned by the presence of the Vale do Rio Doce Company (CVRD), which since 1985 operates in the region its north-system of ferrous metals based on Carajás (Monteiro, 2005).

Synthesis of the process undergone by the region in the last three decades, the rate of demographic growth decreased from about 8% a year until the nineties, to a 3.3% a year along that decade, at whose end the total population reached 1.2 million inhabitants. In year 2000, 759.575 of them lived in cities and 432.560 in the rural zone.

To that, associates an incorporation rate of new lands for agricultural use equally explosive in the first decades, dropping to 3.7% yearly between 1995 and 2004, period in which we estimate an area increase of 10.2 million hectares for agricultural proposal in the first year to 14 million hectares in the last.

3. The Alpha Social Accounting (CS^{α}): a bottom-up model of input-output matrices and its application to Southeastern Pará

The input-output model we will present is based on the schemes of Leontief (Guilhoto, Sesso Filho, 2005; Haddad, Ferreira, Boisier, 1989; Leontief, 1983), which allows doing social accounting of an economy of *k* products and *m* agents or sectors in a given political or territorial unit. The technique can be applied as much for observing relationships that are produced in supply buildup and in generation of the derived social income of a single product, as for constructing the complete social accounting of an economy as the aggregate of that calculation for each *k* product that comprises it.

Based on those principles, the model operates the interrelation among five types of matrices: the matrix of intermediary production or endogenous demand of the productive system (*Xij*), a vector-column of final or autonomous demand (*DFi*), a vector-column of Gross Value of the Production (*Xi*), a value-'added'(*VAj*) vector-line and another vector-line of Gross Income (*Yj*), for *i* = *j* representing the number of agents or sectors of the productive system.

The Input-Output model

Each *Xij* of the system is a result of the multiplication of the amount *q* transacted between the agents or sectors *i* with the agent or sector *j* by price *p* verified in that transaction. So that

$$X_{ij} = q_{ij} . p_{ij} \tag{1}$$

At the end, each line *i* registers the values of the sales of the agent or sector *i* for all the other agents or sectors and for the final consumers (*DFi*); each column *j* registers the purchases of the agent or sector *j*, its sum being the value of the input requested by him or it. At this point the other elements of the model can be calculated, because being

$$X_i = DF_i + \sum_{j=1}^{n} Xij \quad (2)$$

Then

$$VA_j = X_i - \sum_{i=1}^{n} X_{ij} \quad (3)$$

$$Y_j = \sum_{i=1}^{n} X_{ij} + VA_j \quad (4)$$

$$X = \sum_{i=1}^{n} \sum_{ji=1}^{n} X_{ij} + \sum_{i=1}^{n} DF_i \quad (5)$$

$$Y = \sum_{j=1}^{n} \sum_{i=1}^{n} Xij + \sum_{j=1}^{n} VA_j \quad (6)$$

where $X = Y$, X represents the Gross Value of the Total Production and Y the Total Gross Income.

Derivations of the basic Leontief model

The model for *n* agents in an economy can be equally applied to aggregates of those agents by attributes both geographical (areas) and structural (sectors, agglomerations, arrangements). There exists, for the same reasons, the disaggregating possibility as much of Final Demand (either between domestic and foreign or between local, regional and national, for example), as of value-‘added’ (wages, profits, income and taxes) (Leontief, 1983b, 1983c, 1983d; Isard, 1996; Isard, 1956; Guilhoto; Sonis; Hewings, 1996; Grocomo; Guilhoto, 1998; Haddad, 1989a, p. 338-340).

3.1 Formulation of the model as an ascending methodology for description and analysis of local economies - the Alpha Social Accounting (CS^{α})

The Alpha Social Accounting we use here is a methodology for ascending calculation of input-output matrices of computable balance (see Costa, 2002; Costa, 2006; Costa and Inhetvin, 2006). It is said an ascending methodology because based on parameters and indicators of each product that composes the original and fundamental sectors, whose statistic figures are obtained on the lowest and most elementary level as possible of a local economy. Such "original" sectors are designated as "alpha sectors": i.e. initial points, departure place of everything else. Any structural configuration able to be defined with the variables of the database (or with a combination of them) can be regarded as defining one "alpha sector". If, for example, one can establish in each information unit of the Agricultural Census what differentiates cases regarding “peasants” from those related to land-owners’(“*patronal*”) establishments, these two categories of establishments can constitute "alpha sectors" – obviously, if this is convenient to the analysis, as it is, for sure, in this article.

The method consists in identifying the production of each agent that belongs to an ‘alpha’-sector according to certain geographical boundary and then following the flows of that production until its final destination. In that itinerary, the transaction on the several derived sectors (transacted amounts in each point and the corresponding markup) are calculated and the results become parameters of "beta sectors", which are adjusted at three different levels: local (β_a), state (β_b) and national level (β_c). For each product, it is established a computable equilibrium on each sector, so that the amounts of supply and demand are necessarily equalized, establishing the respective medium prices (as we will see bellow).

Therefore, the CS^{α} constitutes a computation algorithm for obtaining the values *Xij* of the input-output model above presented. As already explained, in the system of Leontief it would be obtained all the social accounting of an economy of *k* products, whose flows are made by *n* agents contained in *m+1* positions in the productive and distributive system, in that the $m+1^{th}$ position is the one of the Final Demand, by the following equation:

$$X_{ij} = \sum_{i=1}^{m}\sum_{j=1}^{m+1}\sum_{v=1}^{k} q_{ijv}.p_{ijv} \tag{7}$$

where *v* is the product, *j* is the purchase and *i* the selling sector.

When established an amount “*g”* of geographical attributes “*s”*, and an amount “*e*” of structural attributes “*r*”, the equation (7) would be then a result of the aggregation of an amount *g.e* of sub-matrices, each of them composed by

$$X_{srij} = \sum_{s=1}^{g}\sum_{r=1}^{e}\sum_{i=1}^{m}\sum_{j=1}^{m+1}\sum_{v=1}^{k} q_{srijv}.p_{srijv} \tag{8}$$

The elements of the sum total matrices for the geographical attributes would be

$$X_{sij} = \sum_{s=1}^{g}\sum_{i=1}^{m}\sum_{j=1}^{m+1}\sum_{r=1}^{e} X_{rij} \tag{9}$$

For the structural attributes, the elements of the sum total matrices would be:

$$X_{rij} = \sum_{r=1}^{e}\sum_{i=1}^{m}\sum_{j=1}^{m+1}\sum_{s=1}^{g} X_{sij} \tag{10}$$

Culminating with a grand total matrix of the group comprised by the elements achieved by the equation:

$$X_{ij} = \sum_{i=1}^{m}\sum_{j=1}^{m+1}\sum_{r=1}^{g} X_{rij} = \sum_{i=1}^{m}\sum_{j=1}^{m+1}\sum_{s=1}^{e} X_{sij} \tag{11}$$

Finally, one should observe that the amounts resulting of the equations (9) to (11) should be calculated for each partial "sum total" by attributes and for the "grand total" of the attributes.

In matrix (10) the column and row j = 1 i = 1, which describe the input-output of the total output of the economy into consideration, can be "opened" by the values of columns j = 1 and the lines of i = 1 of matrices (8) or (9), of attributes, which will designate the sectors of the alpha model (Conf. Inhetvin and Costa, 2006: 79). This allows the generation of matrices of the type which is presented here.

3.2 Empirical operation of the model

The empirical operation of the system described above requires the following methodological steps:

a) To obtain the basic amount of *q*: how much of the product *v* was transacted by agents settled in *s* under the structural condition *r*?

b) To obtain the basic prices of *p*: at what price the amount of *q* was transacted by agents settled in *s* under the structural condition *r*?

c) To describe the distribution of *q* by the positions of *ij*: what proportion of *q* was transacted by the agents *ij*?

d) To describe the price formation in each position of *ij*: at what price was transacted each *qij*?

e) To obtain the values of the inputs coming from the *beta* sectors and the chains traveled by them.

f) To calculate the masses of both wage and profit.

g) To calculate the taxes values.

h) To calculate the employment amount.

For the matrix that we will discuss in this article, the procedures were the following:

Obtaining the basic of both amounts and prices of the products of the 'alpha'-sectors

This operation uses two data sets: the first one comprises the data of both production and price; the other comprises both kinds of attributes: geographical (municipal district, micro-region, etc.) and structural (production form, technological level, etc.). In the case of agriculture, both tables have their lines identified by the relationship "size class of the establishment" by "municipal district". This is the key-variable to do the interface between the two data sets. Regarding to other alpha-sectors, a convenient key-variable is established: in the case of the mining sector, for example, the lines were identified by enterprises. So that all the possible structural indications from data – either of secondary source (as those of Census) or of primary research – are able to relate to each line of the production data set. However, one should be aware that the opposite is not true: not all attributes obtained from the production data set are able to relate to the set with the structural data

The above mentioned data sets are the hard core of a database (in the case of this study, BDSudesteParaense), which was built from data of the CD-ROM of the IBGE-Agricultural Census of the State of Pará (a table of structural information has 465 cases - 31 municipal districts x 15 strata - with 210 variables, that collect the universe of the Census; a table of

21 variables with the production data of each case amounting 11.269 lines) and from data of the mineral production supplied by several pertinent sectors of CVRD. So the values of *q* were obtained through the sum of the variable "amount of production sold" in a query in BDSudesteParaense complying with the restrictions *r*, *s* and *v*; and the values of *p* are results of the division of the sum of the variable "value of amount of production sold" obtained for the same restrictions by the former mentioned sum of the variable "amount of production sold".

Distribution of amounts (q) and attribution of price (p) within all relationships between sectors

For describing the distribution of amounts and the prices formation amid the sectors, former researches in the area elaborated matrices of parameters corresponding to the relationships between 14 sectors and the final consumption of 25 of the main products of rural production in the mesoregion. These products represent altogether over 95% of the rural production value, and of all products of mineral exploitation (for methodology of construction of those matrices, see Costa *et alii*, 2002b, 2007). The method consists in describing forward chains, whose starting point is the primary production in the local economy, and the arrival point is the final consumer in any market level: local, state or national level.

For other products representing 5% of GVP of the rural sector in 1995, we used pattern-matrices, which result of a relatively arbitrary description of the flows of the products on the grounds of, in some few cases, the simple lack of information; in other cases, they result of reasonable or highly probable hypotheses in the description of the flow of the product.

In the first case, are the vegetables - we did not make primary research on these products. We presuppose that its chains are very simple, probably constituting direct flow between the own producers and the final consumers. In those cases, we structured a pattern-matrix where producers, in a local economy, directly transact 100% of the product with consumers.

With regard to certain products, it was considered reasonable supposing that the flow was directed to other producers, which with high probability were among the interviewed by the Census, irrespectively if the data base indicates "sales" or "self-consumption". This is the case, for example, of "chick of one day", of all work animals and of cow for reproduction. For those cases, it was built a producer-producer pattern-matrix.

The model operates descriptive matrices Q^v_{ij} of flows and P^v_{ij} of price formation for the 101 products of the rural production researched by the Census (whose list is on Table A-1) and for three mineral products of CVRD.

For all the cases, the values *q* and *p* were obtained so that

$$q_{srijv} = q_{srv} Q^v_{ij} \tag{12}$$

and

$$p_{srijv} = p_{srv} P^v_{ij} \tag{13}$$

Q^v_{ij} is the matrix of the transaction coefficients and P^v_{ij} is the matrix of price formation of *v* transacted between the sectors *j* and *i*. The elements of the first matrix are the proportions of the produced amount of *v* that goes through the position *ij*, i.e. which is the object of transaction between the agents on sector *ij*. The elements of the second matrix are the factors that in the position *ij* increase the medium price paid to the producers of *v*.

The matrices Q^v_{ij} have the following properties:

a) Each $Q^v_{ij} = V_{ij}/\sum V_{1j}$, where $\sum V_{1j}$ is the total production of product *v* distributed throughout the sectors *j* and Vij is the volume transacted in each relationship *ij*.

b) The first line Q^v_{1j} describes the direct allocation of 'alpha'- sector, so that $\sum Q^v_{1j} = 1$.

c) Since every values are proportions of a given total, whole $Q^v_{ij} < 0$ and

d) Considering that Q^v_j is the sum of the lines and Q^v_i the sum of the columns, every $Q^v_i = Q^v_j$ when *i=j*, *i* varying from 2 to *n.*

Such conditions guarantee that the bought product is totally sold in each sector and in the economy as whole, so that the total sales are precisely equal to total production. In that position, the medium prices for the sectors are established.

The CS^α calibrates the matrices Q^v_{ij}, for every year, based on changes verified in the local final demand and in the intermediary demand of the local industrial sectors in relation to the variations in the production of the alpha sectors. As it proceeds:

Calibration of Q^v_{ij} based on variations in the relative weight of Local Final Consumption.

For every year the column $Q^v_{iDemandaFinalLocal}$ is increased so that

$$\Psi_{DemandaFinalLocal}.Q^v_{iDemandaFinalLocal} \tag{14}$$

where

$$\Psi_{DemandaFinalLocal} = (1+\varphi +\epsilon.y)/(1+z) \tag{15}$$

For φ being the rate of growth of the local population (used proxy: annual variation of the total population of Southeastern Pará), ϵ and z, respectively, the income elasticity of the demand and the out-put increment rate of the product in question, and *y* the increasing rate of the income *per capita* of local population (proxy: variation in the real average wage of the local economy obtained from the statistics of RAIS published by the Ministry of Labor and Employment). Therefore, if local demand of *v* varies differently of the respective local production, then $\Psi \neq 1$. In this case, the operation of (14) produces unbalances in the sectors so that $Q^v_i \neq Q^v_j$. For *i*, $j \neq 1$ the differences (between the new ones) Q^v_i- Q^v_j are redistributed by the column *j* in accordance with the principle of fixed coefficients of Leontief for the production functions of all sectors, therefore, proportionally Q^v_{ij}/ Q^v_j. Normalized the results in relation to the total of the line i=1, all the properties above described will be reestablished for the (new) matrix Q^v_{ij}.

Calibration of $\boldsymbol{Q^v_{ij}}$ *in accordance with variations in relative weights of local industrial sectors.* For the two industrial sectors of the local economy considered by the CS^α,

$\Psi_{IndDeBenefLocal}.Q^{v}_{iIndDeBenefLocal}$ (16)

and

$\Psi_{IndDeTransfLocal}.Q^{v}_{iIndDeTransfLocal}$ (17)

For $\Psi_{IndDeBenefLocal}$ and $\Psi_{IndDeTransfLocal}$ being, respectively, the difference index between the variation of the employment in local primary industry and in local manufacturing industry that uses the product in question and the variation of local production of that same product. Unbalances are produced and balances reestablished as in the previous item.

The structure of the $\boldsymbol{CS^{\alpha}}$*: alpha-sectors and beta-sectors*

In the present research, considering a fundamental social labor division, Southeastern Pará's Alpha Economy, besides being sectioned in 'alpha'-setors, was also divided into five 'beta'-sectors describing the local economy, four describing the state one and four describing the national economy in their relationships with the 'alpha'-setors. Therefore, the sectors $i = j$ are the following:

1. Production ('alpha'-sectors)
2. Primary Intermediation
3. Primary (first level) industry
4. Manufacturing Industry
5. Local wholesale
6. Retail and other services of the local economy
7. Primary production and first level industry - state economy
8. Manufacturing Industry - state economy
9. Wholesale - state economy
10. Retail and other services - state economy
11. Primary production and first level industry - national economy
12. Manufacturing Industry - national economy
13. Wholesale - national economy
14. Retail and other services - national

In addition, for the final consumption, we have:

15. Final Consumption of Families - Local Economy
16. Capital formation with local mediation
17. Final Consumption - State Economy
18. Final Consumption - National Economy

The access to data of the production requirements of the 'alpha'-sectors and their investments

Data related to both production inputs (material and services) and capital investments of 'alpha'-sectors compose the table containing the structural attributes in the database above mentioned. For rural production, data came from the Agricultural Census (1995/96) and were revised up to the year 2004 by considering the hypothesis that the technical relationships stayed unchanged; for mineral production, we considered the values of logistics of CVRD 2005 for its enterprises in the area.

Values were accessed for the following types of inputs and services:

Inputs for Ranching (rural production)
Inputs for Aviculture (rural production)
Chemical inputs (rural and mineral production)
Mineral inputs (rural and mineral production)
Mechanical inputs (rural and mineral production)
Organic inputs (rural and mineral production)
Imported inputs from other Brazilian states (mineral production)
Fuel (rural and mineral production)

General services (mineral production)
Services of the Civil Construction (rural and mineral production)
Services of Transport (rural and mineral production)
Technical services and Consulting (rural and mineral production)

Investment data were obtained for the following items:

Machines and Equipments (rural and mineral)
Vehicles (rural and mineral production)
Animals (rural production)
Civil Construction (rural and mineral production)
Plantations (plantations)
Land for crops
Land for pasture

For each item of both input and investment, the backward itinerary of quantity and price was modeled, the latter decreasing at the rate of the corresponding markups (wages plus gross margin of profit) from the 'alpha'-sectors down to the "first vendor" 'beta'-sector. Foreign imports were deduced from the total value, as much those of input as for investments.

Those kind of backward chains were calculated for all the items that compose each of the following variables, endogenous flows of the local economy:

Consumption of 'alpha'-sector’s Households
Consumption of the urban households of Local Economy
Consumption of Industrial and commercial energy

The consumption of urban and rural households was modeled by considering data of the Research on Family Budget (POF), done by IBGE in 2003, whose results indicate the composition of expenditures according to the situation of the household, if rural or urban, and for the great regions of the Country: for the research in question, the data considered were those of the Northern Region. So that, for each expenditure item, it was generated a matrix that considered, as in the case of the productive input, the structural characteristics of the local economy, either in what refers to the logistics of raw food or in what refers industrial production.

Mass of profits, mass of wages and employment

CS^{α} calculates the value-added for each sector by aggregating the value added of each product that goes through it, as much for 'alpha'-sectors, as for 'beta'-sectors. It proceeds doing a functional partition of value added between wages and profits using the following algorithm:

For each X_i, (in agreement with the relations (2) the total revenue of sector i), being λ_i the applied worker's monetary productivity and ω_i the average wage of the sector *i*, then:

$$E_i = \frac{X_i}{\lambda_i}; \tag{18}$$

$$S_i = E_i.\omega_i \tag{19}$$

and

$$L_i = VA_{j=i} - S_i \tag{20}$$

For E_i being the employment volume, S_i the total of wages, L_i the gross profit sum and VA_i, as defined in (3), the total value added of sector *i*.

Empirically, those figures are calculated in CS^{α} by processing the following data: in the case of the 'alpha'-sectors, the data related to salary and employment are supplied by the Agricultural Census for the rural production, and by CVRD for the mineral production; in the case of the 'beta'-sectors, parameters of medium wages were obtained from the statistics of the Ministry of Labor and Employment (databases of the Annual Report on Social Information - RAIS), available for every year of the research and all the involved geographical attributes; the earned income parameters for workers are obtained from the statistics of the Annual Research of Commerce (*Pesquisa Anual de Comércio* - PAC: data available at IBGE for the years from 1996 to 2004), Annual Research of Services (*Pesquisa Anual de Serviços* - PAS: IBGE, available data from 2000 to 2004), Annual Industrial Research (*Pesquisa Industrial Anual* - *PIA*: IBGE, data available for years1996 to 2004) and Researches of the Industry of the Civil Construction (*Pesquisa da Indústria da Construção Civil* - PICC: IBGE, data available for years 2001 to 2004).

Taxes

For the 'alpha'-sectors, CS^{α} uses information on taxes provided by the Agricultural Census, in the case of rural production, and by CVRD, in the case of the mineral production. For the 'beta'-sectors, it calculates the total value of taxes (G_j) from the calculation in separate of direct and indirect taxes. The direct taxes result of fiscal imputations on S_i and L_i obtained by the equations (19) and (20). So that $G^D_{j=i}$ (total of indirect taxes for each sector) is estimated by $G^D_j = g_L.L_i + g_S S_i$ (21).

For gL and gS, expressing the tax burden respectively on the revenues of capital and of labor[3]. The indirect taxes are imputed on the final demand, defined above like DF_i, so that:

$$G^I_j = g^I_i.DF_i \tag{22}$$

For g^I_i representing the parameter of incidence of direct tax in the final demand of the sector i=j[4].

3.3 Indexes of the model

The methodology of CS$^{\propto}$ updates the data for any year. In the present study, the 'alpha'-sectors that requested update were the rural ones, from the Census year 1995 up to 2004, the base year for the whole estimation. For the mineral sector, data were supplied for that year by CVRD.

Update of production by product

For updating data of the rural sectors, both production (quantity) indexes and price indexes were used, which were based on the annual statistic series surveyed by IBGE at municipal level: the *Municipal Agricultural Production* (PAM-IBGE), the *Vegetable Extractive Production* (PEV-IBGE) and *Municipal Ranching Research* (PPM-IBGE). The series of the ranching products prices came from IPEADATA, in complement.

The indexes are dynamically estimated for each total amount of product *v* for the group of the municipal districts *s*, whose base years are, in the case of the agriculture, 1995, and in the case of the mining, 2004. Thus, the quantity and prices indexes are, respectively:

$$I^Q_{sva} = \frac{q_{sva}}{q_{svAnoBase}} \tag{23}$$

and

$$I^P_{sva} = \frac{\bar{p}_{sva}}{\bar{p}_{svAnoBase}} \tag{24}$$

The update for 2004 is produced by the equation

$$X_{asrij} = \sum_{a=1995}^{2004}\sum_{s=1}^{g}\sum_{r=1}^{e}\sum_{i=1}^{m}\sum_{j=1}^{m+1}\sum_{v=1}^{k}\left(I^Q_{avs}.q_{asrijv}\right)\left(I^P_{avs}.p_{asrijv}\right) \tag{25}$$

To get the grand total it proceeds as prescribed in equations (9), (10) and (11).

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[3] Here we used the parameter published by Giambiagi (2004).

[4] We used here the parameters arisen from Siqueira et alii (2001).

3.4 – The internalization of the accounting of CO_2 in CS^{α}

As detailed above, CS^{α} associates each production information unit to a set of structural information. With those data the model applies, for 'alpha'-sectors linked to the rural production, the same algorithm used for the calculation of carbon balance by Costa (2007 and 2008). The operation needs three steps. First, the volume of lands directly necessary for that production is verified. Second, the lands indirectly associated to that, be it in form of 'capital-*capoeira*', ' reserve-*capoeira*' or ' scrap-*capoeira*', are calculated. Third, the emission and sequestration of carbon parameters are applied according to the several forms of both use and non use of the land.

For this study, we neither consider the CO_2 balance values of non-rural 'alpha'-sector (the mineral production) nor of 'beta'-sectors. This happens because our purpose is rather cutting out the critical sectors related to CO_2 emissions associated to the deforestation and use of land.

4. The input-output matrix and multipliers of the economy of Southeast Pará

The algorithms above are operated by the computer program Netz (Costa, 2002; Costa, 2006; Costa, 2006b) developed by the research group Agriculture and Sustainable Development at the Center for Amazonian High Studies of the Federal University of Pará (Núcleo de Altos Estudos Amazônicos da Universidade Federal do Pará). In the present exercise, the economy of Southeast Pará was configured starting from the production of three 'alpha'-sectors: two of rural and one of mineral productions.

The agrarian bases of Southeastern Pará result of a process led by agents with different sociological characteristics, to which we also have associated differentiated economic rationalities (conf. Costa, 2007. Costa, 2005; Costa 2000; Costa, 1995). In the region, such actors established their own structures derived from both their peculiar forms of privatization of the land and other natural resources and their different social and technical relationships engendered in the exploitation of the land and other natural resources.

Two are the basic structures around which the production and the rural life in the region have been organized: peasant's unit of production and the land-owners ("*patronal*") establishment. The peasant's unit of production is characterized for having in the family the decisive parameters: either defining the reproductive needs, that establish the extension and the intensity of use of their work capacity, or deciding the process of appropriation of lands in the frontier advances. This approach based in fact the distinction between establishments in the database here used: those establishments whose family work force overcome 50% of the total applied work force, were considered as "peasant". The others were treated as land-owners ("*patronal*") (Veiga, 1991a and 1991b): i.e. rural companies and farms for which the mediation of the labor market is essential condition, which strongly determines their technical characteristics.

Regarding mineral production, the database contains all necessary information to the plants of the CVRD operating in the area in the year of 2004 (information provided by CVRD to the author).

3.2 The economy of Southeastern Para and the Carbon net emissions

The economy of Southeastern Pará described in Table 2 for year 2004[5] includes the 'alpha'-sectors and its unfolding in local (β_a sectors), state (β_b sectors) and national (β_c sectors) levels. In its absolute dimensions, that economy generated in 2004 a total value added (VA) of R$ 11.2 billion corresponding to a total gross value of production (GVP) of R$ 26.22 billion. It accounted for a volume of work places (E) of 372.3 thousand, associated to a global mass of wages (S) of R$ 1.83 billion, for a gross profit of capital (L) of R$ 8,06 billion and for taxes (I) amounting R$ 1.3 billion.

The local economy participated with 61% of total AV: 73% of that in the production sectors (α sectors) – 16.8% corresponding to the agricultural and 56.5% to the mineral

[5] The differences between the values of economic variables presented here and in other published articles where we used matrix CSα for the same economy in the year 2004, are due to the inclusion in this work, of the market for land. We will discuss this further below.

production. Trade sectors, industry and local services of the local component of Southeastern Pará's economy (β_a sectors) access 27% of local VA and represent 16% of the total.

Table 2 – Economic structure of Southeast Para in 2004 and the CO_2 balance of rural sectors. Input-Output matrix CS^{α} in R$ 1,000,000 corrents

	Intermediary Production																	Final Demand					GVP
	Local Economy								State Economy				National Economy				Total	Local		State	National7	Total	
	'Alpha'-Sectors			Primary intermediation	Industry		Commerce and Services		Industry		Commerce and Services		Industry		Commerce and Services								
	Patronal	Peasants	Mining		Primary processin	Manufacturing[4]	Wholesale	Re-tail and serv.[2]	Primary process[3]	Manufacturing[4]	Wholesale	Retail and serv.	Primary process[3]	Manufacturing[4]	Wholesale	Retail and serv.		Families	Capital Formation[5]				
1a *Patronal*	5,1	-	-	9,0	184,6	17,6	39,9	70,3	0,2	-	0,6	-	-	-	1,6	0,0	328,8	263,2	277,2	-	-	540,4	869,2
1b.Peasant	-	24,9	-	10,4	77,7	43,9	32,1	41,2	0,2	-	2,2	-	-	-	8,9	0,0	241,6	263,2	145,9	-	-	409,1	650,7
1c. Mining	-	-	-	-	410,5	-	-	-	-	-	-	-	334,7	-	-	-	745,1	-	-	-	4.098,	4.098,8	4.843,9
2.PrimInterme	-	-	-	0,0	42,9	-	10,4	84,3	0,0	-	0,8	0,0	-	-	0,0	-	138,5	0,3	-	0,0	-	0,4	138,9
3. IndFirstProc	-	-	-	-	19,5	56,5	4,4	159,1	0,0	6,9	40,5	183,	0,0	45,2	31,4	86,1	633,3	2,6	-	-	485,9	488,5	1.121,9
4. IndTransf.	-	-	-	0,3	-	-	-	897,7	-	-	-	9,5	-	75,9	-	56,6	1.039,9	-	-	-	-	-	1.039,9
5. Whokesale	2,3	2,5	32,4	0,0	1,6	207,8	22,7	584,7	23,5	6,8	50,6	0,0	4,5	-	28,6	0,0	967,9	5,0	-	-	-	5,0	972,9
6. Retail&Srv	218,	117,	367,6	0,0	9,4	-	0,9	0,0	-	0,0	0,2	0,0	0,0	-	-	0,0	713,8	3.186,	650,5	0,0	-	3.836,6	4.550,5
7.IndFirstProc	-	-	-	-	-	-	-	0,8	-	136,9	258,8	-	-	-	0,0	0,0	396,5	-	-	0,0	0,0	0,0	396,5
8. Ind.	-	-	-	-	-	-	38,8	-	-	-	170,1	73,6	-	-	69,9	-	352,4	-	-	0,0	0,4	0,4	352,8
9. Whokesale	1,7	1,4	5,6	0,5	38,0	128,6	341,	763,6	13,4	8,3	5,1	118,	0,9	-	-	-	1.426,9	-	-	41,5	68,0	109,4	1.536,3
10.	-	-	54,2	-	-	-	-	-	-	-	-	-	-	-	-	-	54,2	277,2	-	387,	-	664,9	719,1
11.	-	-	-	-	-	-	-	-	-	71,9	-	-	-	2.703,	0,0	0,2	2.775,9	-	-	-	0,1	0,1	2.776,0
12.	-	-	-	-	-	108,6	69,5	403,8	-	-	658,3	137,	-	-	1.667,	179,	3.224,7	-	-	-	477,4	477,4	3.702,1
13. Whokesale	-	-	526,6	-	-	-	299,	765,9	-	-	157,9	2,2	91,7	125,5	6,8	7,9	1.984,0	40,9	-	-	78,5	119,4	2.103,4
14. Retail&Srv	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,0	-	-	443,3	443,4	443,4
r.Total Input	227,	146,	986,4	20,2	784,2	562,8	859,	3.771,	37,4	230,7	1.345,	525,	431,7	2.950,	1.814,	330,	15.023,	4.038,	1.073,	429,	5.652,	11.193,	26.217,
x *Patronal*	642,	-	-	82,6	179,9	69,3	15,8	169,1	25,2	36,7	59,1	82,4	143,3	111,9	36,8	69,3	1.723,5						
v.Peasant	-	504,	-	36,0	101,9	49,1	48,0	140,3	15,0	14,6	30,8	28,8	70,3	68,3	28,6	43,7	1.179,8						
z. Mining	-	-	3.857,	0,2	55,9	358,7	49,6	469,6	318,	70,7	101,3	82,8	2.130,	571,4	223,1	-	8.290,4						
VA[6]	642,	504,	3.857,	118,7	337,7	477,1	113,	779,0	359,	122,1	191,2	194,	2.344,	751,7	288,5	112,	11.193,						
s.Wages[6]	172,	74,1	272,0	6,0	71,2	73,3	41,8	382,3	17,0	24,9	66,0	60,4	93,9	288,0	137,4	54,1	1.835,2						
L=.Profit [6b]	456,	429,	2.942,	100,9	220,9	391,0	62,5	282,0	338,	92,8	67,9	96,4	2.152,	315,4	92,0	20,8	8.060,8						
I.=Taxes	12,9	0,9	643,2	11,9	45,6	12,8	9,1	114,7	4,1	4,4	57,3	37,2	98,1	148,3	59,1	38,0	1.297,7						
G.Income	869,	650,	4.843,	138,9	1.121,	1.039,	972,	4.550,	396,	352,8	1.536,	719,	2.776,	3.702,	2.103,	443,	26.217,						
Employment(1	51,6	138,	13,9	1,1	12,0	10,5	7,5	53,9	2,2	3,2	11,0	7,3	12,5	24,5	17,6	5,0	372,3						
CO2 Emission	291,	104,	-																				
CO2 Sequestration	73,7	29,1	-																				
CO2 Balance	217,	75,4	-																				

Source: IBGE, Censo Agropecuário, Produção Agrícola Municipal, Produção Extrativa Municipal, Produção Pecuária Municipal. RAIS/MTE CVRD, several autors. Primary research. Sistema Netz of Contas Sociais Alfa - CS^{α}. * The municipal districts listed in Section 1. 1 'Alpha'-Sector of the CS^{α}.

Based on their products and their basic flow. 2 All kind of services are included. 3 Primary processing industry. 4 Manufacturing industry, includes eletricity production. 5 Gross Capital Formation of the 'alpha'-sectors that was intermediated by the 'beta'-setors of the local economy. 6a Includes social obligations minus taxes. 6b Includes imports minus taxes. 7 Includes foreign exports.

Table 3 – Matrix of Multipliers (Inverse Matrix of Leontief) based on the Input-Output Matrix of the economy of Southeast Para, CS^{α} in 2004

	Local Economy								State Economy				National Economy			
	'Alpha'-Sectors[1]			Primary interme-diation	Industry		Commerce		Industry		Commerce		Industry		Commerce	
	Patronal	Peasant	Mining		Primary proc-essing	Manufact uring	Whole-sale	Retail and services	Primary proc-essing	Manufact uring	Whole-sale	Retail and services	Primary proc-essing	Trans-forma-tion	Whole-sale	Retail and services
1ª Land Owner	1,135330	0,1268	0,123763	0,185401	0,294865	0,157982	0,1701231	0,159757	0,122805	0,125309	0,129528	0,167601	0,119872	0,122824	0,126366	0,159804
1b.Peasant	0,102731	1,1403	0,098095	0,172877	0,174469	0,152630	0,1372206	0,128171	0,097469	0,098104	0,102406	0,117760	0,094831	0,097084	0,102853	0,118517
1c. Mining	0,070073	0,0657	1,069281	0,055006	0,438163	0,106418	0,1173839	0,120877	0,058747	0,090975	0,122516	0,186753	0,178127	0,153048	0,140485	0,176640
2.PrimIntermed Prim.	0,022541	0,0210	0,018695	1,017242	0,057902	0,022158	0,0298094	0,040307	0,017385	0,018042	0,019474	0,028011	0,016831	0,017415	0,018114	0,025660
3. IndFirstProc	0,075888	0,0715	0,070351	0,060957	1,086617	0,128693	0,0913071	0,126539	0,061941	0,082108	0,100395	0,334925	0,061045	0,075377	0,088613	0,274524
4. IndTransf.	0,195736	0,1821	0,160888	0,150893	0,163617	1,153637	0,1593488	0,353855	0,143795	0,144526	0,156280	0,168161	0,145190	0,166064	0,162032	0,285549
5. Whokesale	0,187072	0,1757	0,159425	0,141517	0,160919	0,358388	1,1938245	0,331800	0,199173	0,182806	0,193227	0,160725	0,139885	0,144132	0,158828	0,172518
6. Retail&Srv	0,940453	0,8745	0,761565	0,713480	0,778960	0,707624	0,7092027	1,704711	0,684484	0,687829	0,692329	0,711385	0,692264	0,691634	0,692737	0,708283
7.IndFirstProc	0,064558	0,0605	0,056172	0,050437	0,062993	0,097697	0,1509513	0,112481	1,061148	0,448543	0,270354	0,130626	0,049314	0,050626	0,065065	0,058485
8. IndTransf	0,051022	0,0480	0,048445	0,040428	0,049804	0,075021	0,1372165	0,086550	0,048410	1,047811	0,161561	0,166398	0,041049	0,042522	0,076904	0,047641
9. Whokesale	0,264766	0,2479	0,221104	0,205573	0,258456	0,406503	0,5794498	0,466638	0,250816	0,249225	1,232337	0,391566	0,197495	0,201893	0,208435	0,236747
10. Retail&Serv	0,046365	0,0463	0,057548	0,046197	0,050485	0,046772	0,0468952	0,046934	0,046239	0,046599	0,046952	1,047671	0,047575	0,047294	0,047153	0,047558
11. IndFirstProc	0,350923	0,3283	0,361158	0,271260	0,336752	0,492138	0,6965543	0,618609	0,299307	0,505421	0,711544	0,532624	1,292232	1,040720	0,896348	0,632038
12. IndTransf.	0,466240	0,4361	0,480973	0,360123	0,447176	0,652892	0,9154140	0,822837	0,396296	0,399483	0,929142	0,682813	0,388663	1,413084	1,205811	0,851569
13. Whokesale	0,285901	0,2672	0,352496	0,219508	0,288939	0,329106	0,6221431	0,507011	0,239653	0,245450	0,379085	0,281368	0,262813	0,288244	1,283666	0,291287
14. Retail&Srv	0,000000	0,0000	0,000000	0,000000	0,000000	0,000000	0,0000005	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	0,000000	1,000000
																Multipliers
A. Sectorial of	1,840601	1,8406	1,840601	1,840601	1,840601	1,840601	1,8406010	1,840601	1,840601	1,840601	1,840601	1,840601	1,840601	1,840601	1,840601	1,840601
B. Setorial of Product	4,259606	4,0926	4,039965	3,690906	4,650124	4,887668	5,756845	5,627084	3,727674	4,372236	5,247138	5,108395	3,727192	4,551969	5,273420	5,086825
B11. Sectorial Impact	1,135330	1,1403	1,069281	1,017242	1,086617	1,153638	1,193825	1,704712	1,061148	1,047811	1,232338	1,047672	1,292232	1,413085	1,283666	1,000001
B12. Total pulling	3,124276	2,9522	2,970684	2,673664	3,563507	3,734030	4,563020	3,922372	2,666526	3,324425	4,014800	4,060724	2,434960	3,138884	3,989754	4,086824

Source: Table 1.

The two 'alpha'-sectors of rural production present very different carbon balances: the *patronal*-farms, with net (emission minus sequestration) balance of 217.8 Gt CO2 equivalent, impact three times more than the 75.4 Gt CO2 equivalent generated by the peasants production units. This brings to very different social opportunity costs, measured by the relation Added Value/CO2 Net Emission, between *patronal*-farms, of R$ 2.95/t CO2, and the equivalent peasants, of R$ 6.69/t CO2. The same is verified in relation to the private opportunity costs - regarding to the agents - measured by the relation Profit (minus taxes)/CO2 Net Emission: respectively R$ 2.10/t CO2 equivalent and R$ 5.69/t CO2 equivalent.

3.2 The multipliers of the economy of Southeast Pará

We know now the place of the rural economy in the local economy of Southeastern Pará and the unfolding into the state and national economy. Thus, we know its position in a macro-system, to which belong the carbon balances and the structures underlying them. If variations are observed in the value of the production or of the final demand of that economy, how would behave the variables of income, employment, CO2 emission and CO2 sequestration?

To answer to that demand we will take two steps. First, doing the calculation of the matrix that allows to arrive to the value of the production - the vector-column X_i of the equation (2) - starting from variations of the final (effective) demand. Second, proceeding the calculation of the variables of added value, employment and of CO2 balance starting from variations in the value of the production.

The multipliers and the variations on the effective final demand

The vector-column *Xi* of the equation (2) (the gross value of the production) can be the result of the multiplication of matrix *DFi* by the inverse of a matrix *A*, once the elements of *A* are

$$a_{ij} = \frac{Xij}{X_i} \tag{28}$$

Because $$\begin{bmatrix} \mathbf{X_1} \\ \mathbf{X_2} \\ \mathbf{...} \\ \mathbf{X_n} \end{bmatrix} = \begin{bmatrix} \mathbf{a_{11}} & \mathbf{a_{12}} & \mathbf{...} & \mathbf{a_{1n}} \\ \mathbf{a_{21}} & \mathbf{a_{22}} & \mathbf{...} & \mathbf{a_{2n}} \\ \mathbf{...} & \mathbf{...} & \mathbf{...} & \mathbf{...} \\ \mathbf{a_{n1}} & \mathbf{a_{n2}} & \mathbf{...} & \mathbf{a_{nn}} \end{bmatrix} \begin{bmatrix} \mathbf{X_1} \\ \mathbf{X_2} \\ \mathbf{...} \\ \mathbf{X_n} \end{bmatrix} + \begin{bmatrix} \mathbf{DF_1} \\ \mathbf{DF_2} \\ \mathbf{...} \\ \mathbf{DF_n} \end{bmatrix} \tag{29}$$

and, therefore, $$\begin{bmatrix} \mathbf{X_1} \\ \mathbf{X_2} \\ \mathbf{...} \\ \mathbf{X_n} \end{bmatrix} = \begin{bmatrix} \mathbf{1-a_{11}} & \mathbf{-a_{12}} & \mathbf{...} & \mathbf{-a_{1n}} \\ \mathbf{-a_{21}} & \mathbf{1-a_{22}} & \mathbf{...} & \mathbf{-a_{2n}} \\ \mathbf{...} & \mathbf{...} & \mathbf{...} & \mathbf{...} \\ \mathbf{-a_{n1}} & \mathbf{-a_{n2}} & \mathbf{...} & \mathbf{1-a_{nn}} \end{bmatrix}^{-1} \begin{bmatrix} \mathbf{DF_1} \\ \mathbf{DF_2} \\ \mathbf{...} \\ \mathbf{DF_n} \end{bmatrix} \tag{30}$$

or $$\begin{bmatrix} \mathbf{X_1} \\ \mathbf{X_2} \\ \mathbf{...} \\ \mathbf{X_n} \end{bmatrix} = \begin{bmatrix} \mathbf{b_{11}} & \mathbf{b_{12}} & \mathbf{...} & \mathbf{b_{1n}} \\ \mathbf{b_{21}} & \mathbf{b_{22}} & \mathbf{...} & \mathbf{b_{2n}} \\ \mathbf{...} & \mathbf{...} & \mathbf{...} & \mathbf{...} \\ \mathbf{b_{n1}} & \mathbf{b_{n2}} & \mathbf{...} & \mathbf{b_{nn}} \end{bmatrix} \begin{bmatrix} \mathbf{DF_1} \\ \mathbf{DF_2} \\ \mathbf{...} \\ \mathbf{DF_n} \end{bmatrix} \quad (31)$$

The inverse matrix of Leontief $(I-A)^{-1}$, that of the elements b_{ij} in the equation (31), supplies the structure of the relationships between the agents (contained in sectors) in the production of *1* or of *k* products. According to the degree of internality of components of the final demand, its elements can be either multipliers that capture the direct and indirect effects of a variation in the final demand or global impact multipliers that also capture the induced effects of a variation (Chiang, 1982).

The elements b_{ij} have characteristics that need explanation (Haddad, 1989:110):

1. $b_{ij} \geq a_{ij}$ - each element of the inverse matrix b_{ij} is larger or equal to the respective element of the matrix of technical coefficients a_{ij}, once the first indicates the direct and indirect effects on the sales of the agent *i* to assist the R$ 1.00 of the agent's final demand *j*, while the second just indicates the direct effects. The equality between the two coefficients happens only in the case where indirect effects are null.

2. $b_{ij} \geq 0$ - an expansion in the final demand of the agent *i* will produce a positive or null effect on the sales of agent *j*, never a negative effect; the null effect will appear if there is neither direct nor indirect interdependence between the agents *i* and *j*.

3. $b_{ij} \geq 0$ - if $i=j$, that is, the elements of the main diagonal of the inverse matrix will always be equal or larger than 1.

The multipliers - impacts and effects

The inverse matrix of Leontief supplies the multipliers of income and of product of an economy. Those can be of two types, depending on the way they are calculated: if considering the variables income and local consumption (the sector "families") either exogenous or endogenous. We can call the first of Type I, described above as b_{ij}, and the second t_j Type II, which we will treat bellow as b^*_{ij} (Haddad, 1989: 317-318; Tosta et alii, 2004:252).

In this study, we have only worked with Type II multipliers. Thus, they were calculated considering the value added (income of the families) as a line and the local final consumption as a column in the matrix of technical coefficients. Thus, multipliers will be obtained with the following characteristics.

1. The elements b^*_{ij} will always be larger than the values b_{ij} in the same positions because, as we saw above, while the formers capture just the direct and indirect effects of a variation in the final exogenous demand of the sector, the latter capture those direct and indirect effects and further the induced effects resulting of the derived variation on the income and in the local (endogenous) final demand.

2. The elements b^*_{ij} of the main diagonal (as i=j) capture the direct, indirect and induced effects that an elevation of the final demand of a sector does produce in it. To this, we will call *multiplier of sectorial impact*.

3. The multiplier of sectorial impact, described in 2, is different from the *sectorial multiplier of product*. This incorporates the derived effects on the other sectors resultant of the impact on a given sector. Thus, it results of the direct, indirect and induced effects produced in the very sector by an increase in its final demand, represented by b^*_{ij} when i=j, plus the effects also direct, indirect and induced that such an increment produces in the suppliers sectors. Hence the sum of the columns of the matrix $[b^*_{nj}]$ supplies the sectorial multipliers so that, $O_j = \sum_{i=1}^{n-1} b^*_{ij}$ in that *Oj* represents the *sectorial multiplier of product* for the sector j and b^*_{ij} the element of the line *i* and of the column *j* of the inverse matrix of Leontief (Tosta et alii, 2004:253).

4. The difference between the sectorial multiplier of product and sectorial impact gives a sort of pulling effects - the composition of the indirect and induced effects that a sector produces on the others.

5. The elements b^*_{nj}, that is, values for the last line *n* that represents the expansion of the income generated by the increment of the exogenous final demand for the different sectors that appear in the columns. Therefore, they are Keynesian multipliers of income disaggregated by sector and consequently will be treated as sectorial multipliers of income.

6. According to what was explained in 5, an aggregated multiplier of income - which gives out the effect on the total economy of an increment of R$ 1.00 in its exogenous final demand - will be a weighted average of the sectorial multipliers of income effects (Haddad, 1989:321).

7. If it is considered, that the total value added is transformed into income of the families - that is to say, that there is not income leaks in any sector - the sectorial multipliers of income will be the same to each other and equal to the global or aggregated multiplier of income (Haddad, 1989:320).

The global or aggregated multiplier of income of Southeastern Pará’s economy was R$ 1.84 in year 2004: injecting R$ 1 in the exogenous part of its effective demand, the value added of the system as a whole will grow R$ 1.84.

The other multipliers indicate how each sector will intermediate the flows of resources in affecting the value of the total production and, thus, the variables of income and employment. Regarding to the ‘alpha’-sector of “peasant” production, each unit more or less in its final demand will be multiplied by its *sectorial multipliers of product* equal to 4.1 (1.1 of sectorial impact and 3 of pulling effects); the ‘alpha’-sector *patronal*’s multiplier of product amounts 4.3 (1.1 of sectorial impact and 3.2 of indirect effects).

Variation of value added, of employment and of CO_2 balance variables as a result of corresponding changing on the Gross Value of the Production

Given the structure of the focused economy in 2004 and its multipliers, it is possible to calculate, for variations in the exogenous final demand, the impacts on the variables of the value added, the employment and others associated to the system. Assumed the hypothesis of proportionality between any of those variables and the gross value of the production in all sectors of the economy, it can be estimated the respective, direct, indirect and induced variations caused by the expansion in the final demand of a certain sector based on the equation:

$$U = (u_j)_{1xn}.(I - A)^{-1}.DF \qquad (32)$$

where U is the variable in question (the total employment, or the CO2 emission or sequestration, for example) and (u_j) is the vector line (1xn) with the respective coefficients of each sector *" j "*, obtained by the division of the real value of the variable in the sector by sector's gross value of the production; *DF* is the vector column of the variation in the effective demand. The term $(I\text{-}A)^{-1}$ is, as explained above, de inverse matrix of Leontief,

4.1 Restraining policy and local economy: a forecasting exercise

Using formula (32), we can discuss the main question placed in the introduction of the article. Recollecting: Since the outlined schemes of compensation for avoiding deforestation imply entrance and exit of resources in wide and systemic economic contexts, what are the results of such flows on the fundamental variables of income and employment and the impacts to deforestation and to CO2 emissions?

Four simple exercises, whose basic terms are in Table 3, will help us to reasoning on that matter. The first portrays a situation where the policy of compensation is designed in context where the contracts are met and there is no market pressures, the second discusses the effect of the land market as a mechanism of exogenous pressure, the third questions about endogenous pressure derived from demand for products, the fourth points to other policy perspectives in order to interfere in the carbon balance.

Table 3 – The terms of meaningful conditions of compensation for reduction of CO2 emission regarding structure of the current economy of Southeast Pará: absolute variations on the final demand, 2004 (R$ million)

Sector	Exercise 1	Exercise 2	Exercise 3	Exercise 4
1ª *Patronal*	-434,59[1]	0,00	-869,18[4]	-434,59[1]
1b.Peasant	-325,36[1]	0,00	869,18[4]	-325,36[1]
1c. Mining	0,00	0,00	0,00	6.563,05[3]
6. Com. Retail &	442,88[2]	442,88[2]	442,88[2]	442,88[2]

Source: Table 1. Notes: [1] 50% of Gross Production Value of respective lines in Table 1. [2] 50% of the value of the line "Profit" on the 'alpha'-sector "Peasant" and "*Patronal*". [3] Data from CVRD (conf. Ceplan, 2006). [4] 100% of the production of the 'alpha'-sector "Patronal", the most polluntant of all, turned to made by 'alpha'-sector "Peasant", which grows exactly in the same proportion.

Table 4 – Estimated variation on the key-variables of the economy of Southeast Pará as a results of compensations schemes targeting reduction of CO_2 emission

Level	Variables of the economy *(in R$ million of 20005)*					CO_2 Balance (10^6)		
	Value Added	Wages	Profit	Employment	Taxes	Emission	Sequestration	Net Balance
Exercise 1 (Absolute Variation)								
Local	-601,33	-126,54	-469,53	-102,96	-5,26	-213,22	-55,37	-157,84
State	-0,5	-0,62	0,43	-0,05	-0,31	0	0	0
National	18,22	2,91	13,62	0,31	1,69	0	0	0
Exercise 2 (Absolute Variation)								
Local	389,29	108,65	246,27	28,83	34,38	32,84	8,54	24,31
State	89,72	15,47	64,48	2,32	9,77	0	0	0
National	336,15	52,29	253,27	5,52	30,59	0	0	0
Exercise 3 (Absolute Variation)								
Local	419,25	30,62	368,44	167,65	20,2	-116,15	-25,41	-90,74
State	83,85	14,5	60,19	2,17	9,16	0	0	0
National	312,06	48,53	235,13	5,13	28,4	0	0	0
Exercise 4 (Absolute Variation)								
Local	7.792,24	1.076,23	5.598,43	186,26	1.117,58	162,57	42,27	120,3
State	725,98	131,71	513,17	19,11	81,11	0	0	0
National	2.978,13	479,8	2.221,38	51,22	276,95	0	0	0
Values in 2004								
Local	6.829,83	1.093,46	4.885,26	288,96	851,12	395,99	102,78	293,21
State	866,47	168,32	595,16	23,69	102,99	-	-	-
National	3.497,40	573,42	2.580,40	59,60	343,57	-	-	-

Fonte: Table 2 and Table 3. Processing by the Author.

Idealized context

What would happen with the economy and with the CO2 balance if a compensation program for emission reduction would achieve to reduce in 5 years 50% of the production responsible for the balance of carbon verified in 2004, for just compensation to the landowners of the rural establishments in the verified level of their profit? That is, the compensation scheme remunerates the agents, managers of the rural production, in 50% of the annual profits. In the hypothesis that those agents will continue residing in the same local, this would imply an entrance of R$ 442.88 million a year in the local economy for purchases of goods and services. By contrast, the production would reduce at 50% corresponding, respectively, to reductions of R$ 434.59 and of R$ 325.36 million on the peasant and patronal 'alpha'-sectors' final demand. The results of that operation can be seen in the first section of Table 4 and in the first part of the Graph 1. It would achieve to reduce the emissions in -53.8% - almost four percentage points more than it was projected. This, however, at the cost of a considerable reduction of the local economy, in spite of the maintenance of the mineral 'alpha'-sector production. So the value added would reduce in absolute terms R$ 601.33 million (a reduction of -8.8%, in relation to 2004); the mass of wages would fall -11.6%; the profits -9.6%; the taxes -0.6% and the employment nothing less than -35.6%. Furthermore, there would be a resetting in the composition of the income in favor of state and national economies, once all variables rise on this level although at low rates.

The reality of the market for land as a mechanism of exogenous pressure

The previous exercise corresponds to a perspective in the ongoing debate over compensation to avoid deforestation and CO2 emissions in Amazônia. The argument is: given the “failure of state” in ruling the agent’s “environmental liabilities” because of technical incapacity to enforce the formal constraints (Young, 2008), all depend on private decisions and, so, on compensation for the "good entrepreneurs" (Nepstedt, 2008) who not overthrow their forests according to their opportunity cost. Given, now, the "market failure in assign value to the “environmental services of the forest ", as a sink of carbon, for example, the state would be summoned to carry the obligation of the compensation. In that it would consist a "redeeming pact” (Veiga, 2007).

It is important to notice that the reasoning refers to an object of contract that, however environmental service produced by original forest, exists only associated to ownership or possession of the land. In this sense, the ground of the contracts is not the “original forest” and what it objectively is (biome, ecosystem), a specific asset because of its attributes, but “land”, a “generic asset” as ownership.

As all generic asset, "land" is product of wide circulation, since results from production process coupled to a market: the market for land. Like any production process in a market economy, the production of land take place ever since there is renewed buying power demanding its results and exist the assumptions of the production - human hability suitable for the required processing and raw material to be processed.

This market for land is specifically expressed in the prices and in the "nature" of what it moves. Annual research of iFNP Institute, covering the period 2001 to 2007 in 241 municipalities of the Amazon (in the states of Acre, Amapá, Amazonas and Pará), explains, after some processing, the three major empirical categories of “land” as a ware: "land with forest ","land for pasture" and" land for farming". Figure 2 shows in part (A), their price trends during the period in figures corrected to $ 2007, in part (B), relations between them. The following points stand out:

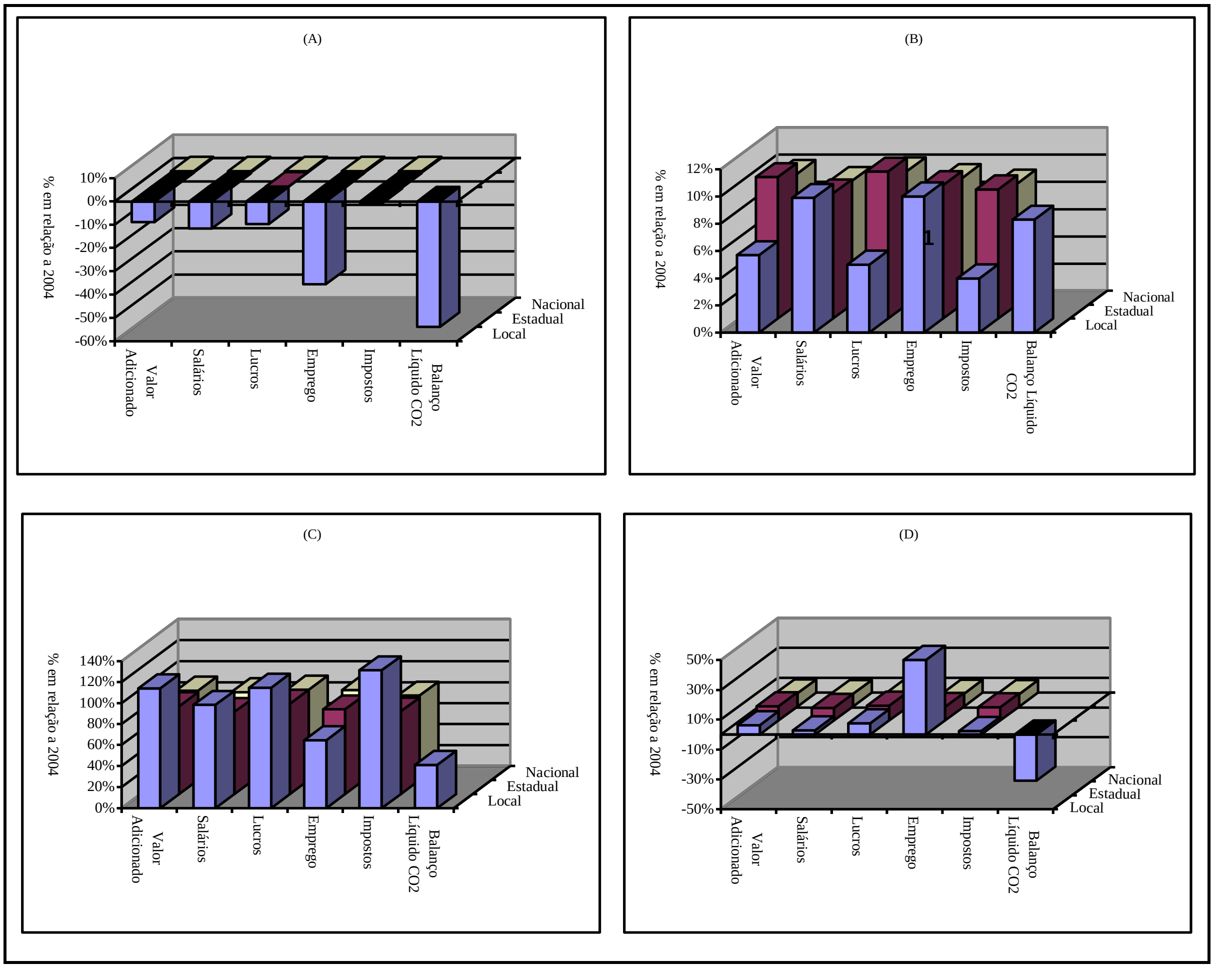
The prices of “land with forest” are in average 43% of the price of "land for pasture” and 23% of those of "land for crops". So the market for land recognizes the price of "land with forest" only as a parcel of the price formation of "land for pasture" and of "land for farming". This requires a regulation that will ultimately transform “forests" (actually not merchandise) into "land with forest" (a merchandise), the price systemically controlled so as not to compromise in the next step, the feasibility of transforming these into "land for pasture" or "land for farming". From another perspective, the market for land presupposes a production process of "land with forest" out of "original forest" - this ist the raw materials of the first - which establishes a "price of production" of the first compatible with the profitability of the production structures that have inputs such as "land for pasture" or "land for farming." The purchasing power associated to these structures, on the other hand, guarantees the demand and sets the whole chain.

The already published few data of the last of Agricultural Census allow us to determine the substantive elements of the market: its real flows expressed in the quantities involved. Taking the inventory of land in total establishments of North-Region, between the censuses of 1995 and 2006, there was a variation of 14.2 million hectares (Table 5). Observing the distribution of the difference by type of application, it is possible to establish that in 11 years, the operators of the establishments acquired 5.4 million hectares of “land for farming”, 8.2 million of "land for pasture” and besides added 0.5 million hectares to the stock of “land with forest”.

These "products" (the first two types constituting gross fixed capital formation in the sector, the latter, a contingency reserve) have not existed in the region in year 1995. They were produced thus in the period inter-censuses first by mechanisms for processing raw material "original forest" in "land with forest". Whereas all "original forests" stay on public lands in the Amazon, this is a strictly institutional process of private appropriation of public affairs, in the region known as "grilagem" (distorting forms of property rights, based on documents supposedly very old - conf. Benatti, 2008). Apart from the costs of this operation, very difficult to stimate, the monetary valuation of the market for land begins with the primary sales of "land with forest". A second movement starts with the deforestation of “land with forest” and will be complete with the sale of the resulting "land for pasture" and "land for farming".

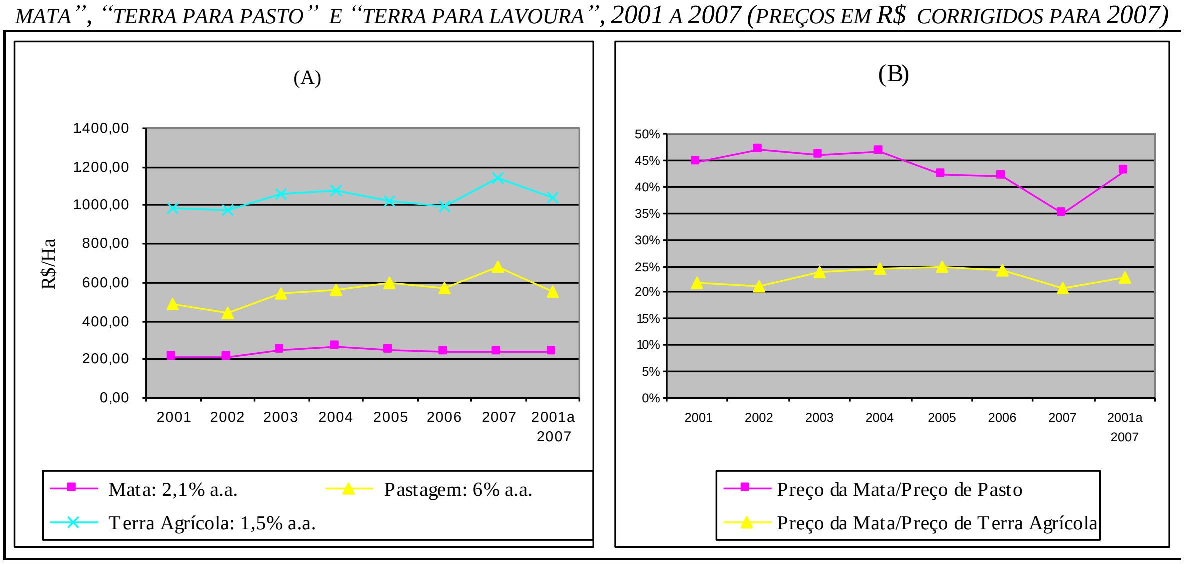
Considering the average price (adjusted to 2007) by type of "land" valid for the entire period, in the first movement was spent R$ 3.4 billion and in the second, R$ 11.6 billion. The total direct sales amount somewhere around R$ 15 billion in 11 years - about a GVP of R$1.4 billion, enabling Value Added of R$ 1.0 billion per year.

GRÁFICO 1 – QUATRO EXERCÍCIOS DE IMPACTO DE ESQUEMAS DE COMPENSAÇÃO PARA REDUÇÃO DA EMISSÃO LÍQUIDA DE CO2 NA ECONOMIA DO SUDESTE PARAENSE



Fonte: Tabela 4.

GRÁFICO 2 – MERCADO DE TERRAS NA REGIÃO NORTE: EVOLUÇÃO(A) E RELAÇÃO DOS PREÇOS (B) DE "TERRA COM MATA", "TERRA PARA PASTO" E "TERRA PARA LAVOURA", 2001 A 2007 (PREÇOS EM R$ CORRIGIDOS PARA 2007)



FFonte: iFNP, Anualpec 2003, 2004, 2005, 2006, 2007 e 2008. Processamento do autor. **Notas Metodológicas: 1** – O Instituto iFNP publica desde 2003 preços de terras do tipificando-as “com mata”, “pastagens” e “terras agrícolas” a partir de pesquisa de campo que cobrem 22 municípios do Acre, 16 municípios do Amapá, 64 do Amazonas e 139 do Pará. **2 –** Médias aritméticas simples dos preços corrigidos pelo IGP-DI para 2007 de acordo com tipo de terras. **3 –** Taxas calculadas por regressão das transformações logarítmicas em relação ao tempo.

TABELA 5 – MERCADO DE TERRAS NA REGIÃO NORTE ENTRE OS 1995 E EM 2006

		Estoque de terras nos estabelecimentos:		Passagem das “terras com Mata” para a condição de capital físico: ”terra de pastagem”, ”terras para lavoura” e “reserva de mata”	
		1995 (A)	2006 (B)	Fluxo Real (Há) (B)-(A)=(C)	Fluxo Monetário (R$) (C)*Preço Médio
Terras para Lavoura		1.972.056	7.406.786	5.434.730	3.020.839.633
Terras de Pastagens		24.386.621	32.630.532	8.243.911	8.546.530.707
Reserva de Terras com Matas		25.756.634	26.283.121	526.487	
Total de Terras Apropriadas		52.115.311	66 320 439	14.205.128	11.567.370.340
Transformação necessária de “floresta originária” em “Terra com Mata”	Fluxo Real (há)			14.205.128 (1.291.375/ano)	
	Fluxo Monetário (R$)				3.384.818.012 (307.710.728/Ano)
Valor total movimentado no mercado de terras (R$)					14.952.188.352 (1.359.289.850/Ano)

Fonte: IBGE, Censo de 1995 e Censo de 2006.

Known the figures of the market for land in the region, suppose that in 1995 there had been a policy of avoiding deforestation for the whole Northern Region based on remuneration of the owners with reserves of "lando with forest " at a fair price, as proposed in the previous section. Indeed, these owners were the only present actors holding the object of contracts that could considered in this policy perspective. Consider further, that a maximum effort had been made as contracts were cut covering total reserves of “land with forest”, 25.7 million hectares (because the purpose was, say, the "zero deforestation"), at a price determined by the activity of lower income, the extensive livestock - say, R$ 40.00 p/ha. The policy would cost around R$ 1.0 billion a year (about the average availability of FNO, the constitutional developmente found for the Norther Region, during this period). In 2006 we would have had nothing different from the balance sheet presented in Table 5. Though the policy should be viewed in a way effective, since the reserves of “land with forest” were intact, even enhanced, and the policy makers should celebrate the fact that "good entrepreneurs” would have fulfilled their contracts. But alongside this, we would have the same 11.6 million hectares of original forest additionally processed that presents the reality of the Census. With one difference, however: the society would have spent R$ 11.0 billion for literally nothing - or rather, to increase the wealth of the owners of "land with forest".

TABELA 6 – ESTIMATIVA DO MERCADO DE TERRAS NO SUDESTE PARAENSE ENTRE OS 1995 E EM 2004

		Estoque de terras nos estabelecimentos:		Passagem das "terras com Mata" para a condição de capital físico: "terra de pastagem", "terras para lavoura" e "reserva de mata"	
		1995 (A)	2004 (B)	Fluxo Real (Há) (B)-(A)=(C)	Fluxo Monetário (R$) (C)*Preço Médio
Terras para Lavoura		347.082	446.260	99.178	151.206.899,7
Terras de Pastagens		4.829.473	6.490.670	1.661.198	1.522.398.472,2
Reserva de Terras com Matas		4.992.744	4.992.744	0	
Total de Terras Apropriadas		10.169.298	11.929.674	1.760.376	1.673.605.372,0
Transformação necessária de "floresta originária" em "Terra com Mata"	Fluxo Real (Ha)		1.760.376 (195.597,30 /ano)		
	Fluxo Monetário (R$)			638.133.132,0 (70.903.681,3 /Ano)	3.384.818.012,0 (307.710.728/Ano)
Valor total movimentado no mercado de terras (R$)					2.311.738.504,0 (256.859.833,8 /Ano)

Fonte: IBGE, Censo de 1995 e 2004 Estimativas das CS$^{\alpha}$.

For Southeastern Pará's economy, the market for land has been modeled by CSα considering the prices of the three types of land in 2004. It was assumed also that the needs of land to explain the expansion of the activities were determined by parameters of existing technology in 1995 and attended by the market. These assumptions ensured the preservation of the reserves of land with forest in 1995. The results were internalized in the economy of Southeastern Pará presented in Table 1 and allowed to build for the mesoregion aggregates figures flows similar to that of Table 5, which however covers a shorter period from 1995 to 2004 (see Table 6). Alongside the same 5 million hectares of preserved "land with forest", the market for land in the mesoregion would have produced 1.7 million new "land for pasture" between 1995 and 2004 (the Census tells about 1.6 million by 2006) plus 99.2 thousand hectares of new "land for farming" out from the conversion of a 1.8 million hectares "original forest".

This is the story. Knowing it seems prudent to prospect the future considering a situation in which the program of compensation for emission reduction under scrutiny has managed to reduce 50% of production underlying the carbon balance in 2004, compensating producers established in the level found in their earnings, but at the same time, new producers will be established, mediated by the market of land, for which purchasing power exogenous career, replacing the production of alpha rural sectors in the level of 2004. Specifically, the schedule of compensation paid to staff managers of rural production in 50% of annual profits, which would imply a contribution of U.S. $ 442.88 million a year into the local economy by purchasing goods and services and no reduction in production. The result is the second part of Table 4 and in section (B) of Figure 2: the variables all grow the local economy, expand the value added in absolute terms, U.S. $ 419.2 million (5.7 %) compared to 2004, wages and employment grow, respectively, 9.9% and 10.0%, 5% and profits taxes 4%, generating an expansion as a result of net carbon emissions of 8.3% . The state economy expand the value added to R $ 89.72 million (10.4% compared to 2004) and in national R $ 341.56 million (9.6%). The failure of the policy of containment would in that case, a remarkable economic success.

This is the story. Knowing it, it seems prudent to prospect the future considering simultaneous movements. First, a compensation program for emission reduction would reduce in 5 years 50% of the production responsible for the balance of carbon verified in 2004 for compensation only to the landowners of the rural establishments in the verified level of their profit. Second, new producers, mediated by the market of land, would settle down, restoring the production level of the rural 'alpha'-sectors to the level of 2004. What would happen, in this case, with the economy and its CO2 balance? That is: as in the first exercise the compensation scheme remunerates the manager agents of the rural production in 50% of the annual profits, what implies an entrance of R$ 442.88 million a year in the local economy for purchases of goods and services; but, conversely to that situation, there is no reduction in the production. The results of that situation can be found in the second section of Table 4. All variables of the local economy would grow: the added value would expand, in absolute terms, R$ 419.2 (5.7%) in relation to 2004; wages and employment would grow, respectively, 9.9% and 10%; profits, 5%; and taxes 4%, generating, as a consequence, a raise in the net CO_2 emissions of about 8.3%. However, the state economy would expand the value added in R$ 89.72 million (10.4% in relation to 2004) and the national in R$ 341.56 million (9.6% more than in 2004). The failure of the restraining policy would correspond, in that case, to a notable economic success.

The local market for consum goods as endogenous mechanisms of pressure

As already pointed out, the Southeastern Para’s economy is a complex one, where there are non-rural sectors with high expansion prospect. We should then figure out two simultaneous movements for it. First, a compensation program for emission reduction would reduce in 5 years 50% of the production responsible for the balance of carbon verified in 2004 for compensation only to the landowners of the rural establishments in the verified level of their profit. Second, the mineral production expands strongly. What would happen, in this case, with the economy and its CO_2 balance? That is, as in the first exercise, the compensation scheme remunerates the manager agents of the rural production in 50% of the annual profits, what implies an entrance of R$ 435.14 million a year in the local economy for purchases of goods and services. However, at the same time the mining 'alpha'-sector more than double its annual production, increasing approximately R$ 6.6 billion on the gross value of the production, as CVRD will do in the next five years. The result of that operation can be found in the last section of Table 4: all variables of the local economy would rise, the added value and the mass of profits leading them, the most part belonging expectedly to the mineral 'alpha'-sector. Nevertheless, compared to 2004, employment would grow 155,3% and the mass of wages 112,3%, producing an independent pulling in the rural and urban 'alpha'-sectors of local economy that makes carbon net emissions grow 30,4%, in spite of the observed reduction. Important expansion would be verified, also, in the state and national economies. The dynamics of the autonomous local economy would turn the restraining policy, in that case, innocuous.

Technological change and institutional capacity - other possibilities for policy

An additional exercise shall be considered Finally, treating the following question: What would happen with the economy and its CO_2 balance if a compensation program for emission reduction achieves to induce for converting the productive base, from the rural systems that showed the worst balance in 2004, into the rural systems that showed the best ones. In this way, in 5 years all production would be based on agricultural systems that 2004 proved to be the least net emission sources.

Resources of R$ 442.88 million a year would flow in the economy, partly applied in knowledge (S&T), bonus and credit subsidy, and as form of payment for environmental services generated by human labor produced systems in operation, including especially those based on untransformed "original forest". In part, these resources should flow into the local economy as results of actions of the state to rebuilt the institutional environment mainly by constraing the "grilagem", the main mechanism of production of land.The result of that operation can be seen on the third section of Table 4. All variables of the local economy would rise: compared to 2004, the added value would increase 6.1%, whereby the mass of wages 2.8% and the mass of profits 7.5%. Notwithstanding, the net emission of carbon would decrease in about 31%. In this case, a win-win situation would be on stage: a policy of technological conversion would achieve both, to reduce the emissions and to enable economic dynamics.

1. Conclusion

By treating a real local economy, its macro configuration and relationships with the broader systems of the state and national economies, some questions about the application of compensation schemes for contention of CO_2 emission in the future can be more precisely discussed. The arguments and exercises above allow indicating the following:

1. In what refers to the emissions, there are important differences between the costs of social opportunity of the *patronal* 'alpha'-sector, of R$ 2.89/t CO2 equivalent, and of peasants 'alpha'-sector, of R$ 6.57/t CO2 equivalent.
2. Also different, are the private opportunity costs of the *patronal* 'alpha'-sector, of R$2.06/t CO2 equivalent, and of the peasnats 'alpha'-sector, of R$ 5.59/t CO2 equivalent.

3. The impacts and derived effects of exogenous actions, as those associate to a reduction scheme of deforestation and carbon emission, have been precisely measured and they are not trivial: the aggregated multiplier of income of Southeast Pará's economy is 1,81; the sectorial multipliers of product of both *patronal* 'alpha'-sectors and peasants one are, respectively, 3.82 and 3.73.
4. Due to those mediations, compensation scheme focused exclusively on the agents and oriented to the reduction of the output will produce systematic losses for local economy:
    a. Because it is compensated, for the local system, just part of the added value lost by the renouncement to the production, even when in a fair agreement paying equivalent values;
    b. Because larger number of concatenations ceases around the primary production that stops (primary process and manufacturing industry, trade), then other are created around the final goods that enter the local economy (through just trade), leading to a systemic differential loss.

   In such context, tension grows proportionally to the reduced benefit resulting from the renouncement of the production.
5. Compensation schemes to avoid expansion of the production paradoxically form endogenous tensions to enlarge the production on the local economy. Here, also, for two reasons:
    a. Because purchase power is formed without the corresponding production and
    b. Because, mediated by the multipliers, the purchase power derived of income increases creates additional demand.
6. The resolution of that tension that will vary with the complexity of the economy can result in effective expansion of the production, without the break of the contracts established with the agents targeting the contention. This happens because other agents can come to solve the tension, elevating the offer of goods by means of the same methods of the previous production, and, as they do not belong to the restraining scheme they cannot be restrained or sued by its enforcement mechanisms. This could create, in the local economies, two types of derived agents of the compensation scheme: a rentier, who does not deforest in his property, and a productive, who deforests to supply the rentier, who does not produce any more what he needs. The desired objective of the restraining program, in that context, can be very frustrated.
7. In cases, as the one of Southeastern Pará, in that the economy has other bases whose dynamics enlarges the wage mass and creates internal concatenations for expansion of the intermediary demand, the tension discussed in 4 grows as a result of the dynamism - that is to say, directly proportional to its polarization force. In these realities, it is difficult to suppose success for a policy centered in agents and only seeking the restraint by means of "non-production". A wide program centered in the elevation of the productive capacity based on technological fundaments compatible with low net balance of CO_2 emission seem to be necessary.

8. Compensation schemes to reduce the emission based on both improvement of existing productive systems and on development of new productive possibilities with defensible carbon balance, in detriment to the ones that present larger net emission, seem to be able to constitute base for win-win strategies: by means of which net emission could be reduced along with the expansion of the economy.

9. Moreover, exogenous pressure - rising prices to grains and meat in foreign and domestic markets, despite the current crisis, for exemple - are materialized in the form of purchasing power demanding "land" that exist only as support of "original forests". The production of land that from then takes place, the main process behind the deforestation, is autonomous and rely on methods that lie outside the formal institutions. So it is outside the scope of any scheme of "avoidance" oriented to the compensation by the state, from private agents, becoming the main leaking mechanism of all the activities to be avoided. It is essential, therefore, the effort to contain the market for land. In two ways:
    a. First, are required the formal and technical capabilities of the state to protect public assets as “original forest” a specific and distinctive asset of the region and the country;
    b. In the second, the forms of ownership must distinguish between property right on land and the right to environmental activities of original forest: the latter must not be reduced to the the first.

Altogether these results indicate the difficulties of a policy of emissions restraint that treats: a) just one side of the dialectic that opposes "agriculture" x "maintenance of the forest" and b) just one dimension of the economic system - the rural, for example. Paying the agents that control forest so that they give up producing does not eliminate the social needs that force the existence of that production. Established such needs, they create the agents that correspond them.

This poses the need of thinking deforestation restraining policies tightly connected with production policies - to be operated by mechanisms that favor the convergence of the agents' decisions with macro perspectives of development: local (configured spatially), endogenous (culturally rooted) and sustainable (based on knowledge and institutions that allow using the natural base of the Region without damaging it).

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