Comments on Brazilian structural change during 2000-2008

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ABSTRACT

Improvements on the production of national accounts data in Brazil favor the Brazilian economy structural analysis by input-output techniques. The quarterly publication of national accounts involving twelve production sectors allows the working out of tabulations at constant prices ever since 1992. Besides, updated supply and use tables have been provided in both 12 sectors x 12 commodities and 56 sectors x 110 commodities, with deflators, allowing the calculation of past supply and use tables at constant prices. Taking advantage of these developments, two aggregation versions were selected for analyzing structural change for the 2000-2008 period, one showing the services sector in greater detail, and the other giving more room to industry sectors, both covering a total of 12 sectors. These two aggregation alternatives paves the way to identifying both major industrial and services structural trends, but the analysis converged to industry and in particular to its technological change. Simulations over 2000-2008 show a slight decreasing of intermediate consumption participation in total national production required to meet the final demand requirements of 2008, suggesting a loss of intermediate transactions specialization during the period. This trend is more pronounced for the Brazilian manufacturing industry. The results reinforce the views that a deindustrialization process have happened in the Country during the recent past, with loss of technology intensity. The utilization of intermediate input coefficient analysis in conjunction with SUT tables, however, give important insights for corrective policies.

Introduction

The purpose of this paper is to report the first results of an alternative way of performing structural analysis, using directly SUT data bases. This is the reason for indicating in the title that just "comments" on changes of the Brazilian economic structure, and not a full analytical work, will be provided. Still in relation to the title, the analysis of structural change was taken as the analysis of "changes in input-output coefficients", as Anne Carter wrote at the beginning of the conclusions of hers "Structural Change in the American Economy" (CARTER A.P., 1970, p.217).

Technology, which is a major issue in Brazil at the moment, was a special concern of the study, and care was taken so as to promote the identification of technological changes in the period 2000-2008 as indicated by changes of intermediate consumption coefficients. Accordingly, two levels of aggregation, both of 12x12 dimension, were adopted and called "standard" and "technological".

The standard version had this name because corresponds to the aggregation pattern utilized by IBGE[1], both for its quarterly published national accounts, and for the more aggregated of their annually published supply and use tables (SUT). The technological version, on the other hand, gives more room for the industrial sectors, ranking them according to technological content in accordance with other studies, particularly IEDI 2011, which will be referred to towards the end of the text.

The Brazilian supply and use table framework

Figure 1 shows schematically an n sectors x m products supply and use table in the format adopted by IBGE. Essentially, it presents, in each of its cells, figures corresponding to the activities of taxation, production, and imports in the supply side, and intermediate and final consumption in the use side. Besides, a value added tabulation is also given by sector. The level of occupation by sector is also provided at the bottom of the tables, allowing to systemically relating employment with national accounts variables on a yearly basis.

In the Brazilian version, the number of sectors (n) and of products (m) is given in a few alternatives, being its larger dimension 56 sectors x 110 products, and the smaller 12 sectors x 12 products. Regarding the tables titles, a brief description of them is provided below.

- ✓ **Production** shows the product output of each industry, summing up to their totals by sector at the bottom line (vector X') and by product at the right column (vector **q**).
- ✓ **Taxes on products** are the taxes charged on economic transactions, i.e., national consumption, investment, imports and exports.

[1] IBGE – Instituto Brasileiro de Geografia e Estatística, the national office of Brazilian statisitics – www.ibge.gov.br

Figure 1 – The Brazilian supply and use table framework

SUPPLY TABLE				
Margins + Taxes + National production + Imports	Margins and taxes by product	Production by sector and product Columns = n sectors Lines = m products (Matrix V')	Total production by product (Vector q)	Imports by product
∑ = TOTAL SUPPLY	∑ = Total taxes	∑ = Production by sector (Vector X')	∑ = Total production	∑ = Total imports

USE TABLE				
Intermediate consumption by sector and product Columns = n sectors Lines = m products (Matrix U)	Intermediate consumption by product (Vector u)	Final demand by activity and product Columns = Exports, Public and private consumption, Investments, Inventories change Lines = m products	Final demand totals by product (Vector E)	Intermediate consumption + Final demand
∑ = Intermediate consumption by sector (Vector u')	∑ = Total IC	∑ = Final demand by activity	∑ = Total FD	∑ = TOTAL USE = TOTAL SUPPLY

VALUE ADDED
Columns = n sectors Lines = value added items: labor and capital remuneration, social security, taxes and subsidies on production
Occupation by sector

- ✓ **Total supply** is the addition of the supply activities of production and imports as well as taxes and margins, and must equate to **Total use** so as to achieve the supply-demand balance of the economy in a given period, usually one year.
- ✓ **Intermediate consumption** is the part of the use table where the transactions needed for production are shown. Every good and service consumed by a sector, as shown on its respective column, is for production purposes. On the other hand, the lines show the sales of each sector, always for production purposes. The intermediate consumption table gives a fair idea of the technology and the productive mode of the country or region tabulated.
- ✓ **Final demand** is the last destination of the production, consisting of exports, private and public consumption, investments and inventory changes.
- ✓ **Value added items** comprise the compensation of employees, other net taxes on production, consumption of fixed capital and net operating surplus.

Data preparation

In order to get the data in shape for being analyzed, the sequence described below was followed.

Conversion of the SUTs to constant prices

Given the purpose of prioritizing technological change, it is necessary to separate price changes from quantity changes, that is, value changes must mean just physical quantity changes, for technology, in the input-output framework, is expressed in terms of physical quantity proportions and their change over time.[2] In other words, the tables must be expressed in constant prices.

The SUTs published yearly by IBGE are at current prices, but provided with tables with values from the year before, thus allowing the calculation of deflators for any of its entries both in the supply and in the use tabulations. Individual deflators by entry, in a 110x56 dimension, however, proved to introduce too much noise in the figures obtained, generating too many inconsistencies. One way out would be to adopt deflators by line. One advantage of doing this is that as those deflators are equal by line in the supply and in the use tables, this would keep the balance supply x use of the tables after converted to constant prices. However, this would lead to the opposite problem, i.e., excessive uniformity in price changes over time, which does not hold for each specific entry, particularly in the case of imports, which are dependent also on exchange rates.

Therefore, it was adopted an intermediate solution, by aggregating deflators by product (line) into three columns in the supply side, namely imports, production, and taxes plus margins, and in two columns in the use side, respectively for intermediate consumption and final demand. Prices were fixed as in 2005 for reasons explained below (see **Construction of the SUTs at basic prices**), and the 2005 SUT was utilized as a basis upon which de deflators were applied, leading to obtaining a first version of the SUTs at constant prices for the 2000-2008 period, which we will call deflated SUTs.

Adjustment to exogenous constraints

Exogenous constraints are called here those variables that are determined by Brazilian national accounts observed data for the years analyzed, and are: taxes on products, imports, final demand (exports, government consumption, families consumption, investment and inventory changes), and value added by sector. These data, as mentioned, are provided in a quarterly basis by IBGE, along with deflators also calculated in a quarterly basis. As the SUTs are published in a yearly basis, these indexes were recalculated so as to cover periods of twelve months, leading to obtaining national accounts for every three months -March, June, September and December - but deflated for periods of twelve months. Thus, the rates of growth of the data corresponding to December are exactly the same as the yearly rates of growth given by IBGE in their national accounts publications for the period of one year. Value figures for these quarterly tables adjusted to 12 months deflators were also fixed in 2005.

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[2] Carter makes this point; see CARTER, A.P., 1970, p.22.

Back to the SUTs, the total lines of final demand at market prices, in the use side, were copied from the quarterly data as given by IBGE adjusted as above. The final demand transactions then were calculated observing the same proportionality of the total demand of the correspondent final demand tables of the deflated SUTs, thus assuring that their totals by activity coincided with the official data.

With respect to intermediate consumption, proportionality of its total in relation to the final demand total was maintained, and from that it was derived its column of totals by product, always in proportionality with the deflated SUTs. The transactions by intermediate consumption activity was then obtained, also observing the same proportionality with the column of totals as in the corresponding use table derived with the deflators. With this we completed the use table assuring for each year of the series a total final demand equal to the quarterly values yearly adjusted given by IBGE at 2005 prices.

Turning now to value added by sector, special care was also taken so as their aggregation in the standard version, i.e., in the same twelve sectors as given by IBGE quarterly publications, would observe the same rates of growth officially given. After adjusted, in order to disaggregate this twelve sectors into 55[3], proportionality was observed as in the 2005 SUT. This was necessary because no deflators are provided for the VA tables by IBGE.

By adding up the intermediate consumption and value added lines of totals, it was obtained a final version of the total production line of the supply table, or the transpose of X (vector X' in figure 1). The remaining of the production table was derived by keeping the proportions between its entries and their totals per column as in the deflated tables. Imports and taxes, on their turn, were adjusted by proportionality so as to observe the totals as given by the quarterly tables of IBGE at 2005 prices. Margins were adjusted by proportionality with total supply at basic prices (imports + production).

Thus, adjusted supply tables were also obtained for each year of the series, observing total compatibility with the quarterly data provided by IBGE. It should be observed, however, that while for the line totals the national accounts identities were observed, and so the identity between total supply and use, the same did not happen with each individual line, where total differences per product (or line) were observed between the supply and use tables in result of the deflators application. However, it was considered that it is better to leave these differences explicit, recurring to localized adjustments when necessary, than to obtain a balanced table by successive adjustments, as in the RAS procedure, but by doing so loosing track of the magnitude of inconsistencies that anyway will be there, affecting the outcome. This question will be object of further explanation latter.

[3] Although the higher SUTs aggregation level as published by IBGE is 56 sectors x 110 commodities, the 110x55 alternative was adopted so as to coincide with the higher aggregation level of the IO matrixes also published by IBGE for 2000 and 2005.

Construction of the SUTs at basic prices

As mentioned, for deriving the tables at constant prices, the year of reference was fixed at 2005, which is the year of the last input-output table published by IBGE. By doing so, a reliable reference was provided in order to calibrate the differences between consumption at basic and market prices obtained for the other years of the 2000-2008 series.

Accordingly, imports by intermediate consumption sector and by final demand activity were estimated utilizing coefficient tables derived from the 2005 IO matrixes of IBGE. For the intermediate consumption sectors, this estimate was done by multiplying the input imports coefficient matrix as provided by the 2005 IO tables by the diagonalized total production vector by sector (vector X) of each year. In the same way, the final demand imports were estimated by multiplying an input matrix obtained by dividing the final demand imports by activity as given in the 2005 IO tables by the respective total demands at market prices, and then multiplying it by the correspondent final demand vectors at market prices of each year also diagonalized.

The totals of imports by product thus obtained was then adjusted so as to coincide with the totals of imports by product of the supply tables at 2005 prices derived as above, and the imports by intermediate consumption and final demand transaction recalculated by proportionality so as to add up to these totals by product. Finally, by adding them by column, it was obtained the total line of imports by sector and activity, which was discounted from the use table at market prices column totals.

In relation to taxes and margins, their intermediate consumption sector and final demand activity 2005 totals were obtained by subtracting the imports totals lines by activity as in the 2005 IO tables from the difference between the totals line of the use tables at market priers and at basic prices provided with the IO matrix. From this point, analogous treatment to the one just described for the imports was applied, so as to obtain the line totals of taxes and margins by intermediate consumption and final demand activity for each year.

Finally, a discount line was also necessary to be calculated in order to account for the differences between the totals per line (or product) of the supply and use tables accruing from their conversion to constant prices of 2005, mentioned at the end of the section above. These differences were subtracted from the total per line and distributed by column of both intermediate consumption and final demand observing proportionality with the relation between the corresponding entry and total per line as in the use table at market prices. By doing so, the additions per line of the use table were equalized to the totals per line of the supply table. However, due to the inclusion of these differences in the entries, the totals per column of the use table became different from the totals adjusted so as to maintain the identity VA+CI = X' constructed above. Thus, corrections by column were necessary also to keep the equation valid, resulting in the discount line mentioned above. [4]

[4] In this case the procedure is analogous as the one proposed by Guilhoto and Sesso - GUILHOTO, J.J.M., U.A. SESSO FILHO (2005).

Aggregations 12x12

As mentioned in the Introduction, once the SUTs were obtained at basic prices for each year of the 2000-2008 period, they were aggregated in two 12x12 versions, called respectively "standard" and "technological", so as to allow to analyze impacts both in what relates to services and industry. As mentioned in the introduction, the "standard" aggregation has this name because corresponds to the aggregations adopted by IBGE when publishing both its 12x12 version of the SUTs, as well as the quarterly published national accounts. The label "technological", on the other hand, indicates a focus on technological content. In this case, out of the twelve sectors, ten are industrial, and arranged so as to reflect the technological content of the production activities in three levels, high, medium and low, as Table 5 shows.

Table 1 - Technological aggregation

High Technology	Extraction of crude petroleum and natural gas, Pharmaceutical products, Computer, electronic and optical products, Other transport equipment.
Medium technology	Chemicals and chemical products, Basic metals and metal products, Machinery, equipment and utilities, Motor vehicles, Mining and quarrying products (less oil and gas)
Low technology	Food, beverages and tobacco, Textiles, wearing apparel, leather and related products, Wood, paper and cellulose, Construction, electrical domestic appliances, furniture.

These technological levels were defined with basis on other studies (IEDI 2011) and within the constraints of the IBGE classification. Thus, "Extraction of crude petroleum and natural gas", for instance, was ranked as a high technology activity in view of the deep water technologies developed for exploring oil and gas in the off-shore basins. In the same way, "Other transport equipment" was also ranked as a high technology activity because contains the construction of airplanes.

Analysis

Evolution of intersectoral coefficients at basic prices

Table 2 shows the variations of what we called 'u coefficients" over the period of analysis for the standard 12x12 aggregation.

Table 2 – Ratio between total intermediate consumption per product and total production (u coefficients) – Standard aggregation

u coefficients	2000	2001	2002	2003	2004	2005	2006	2007	2008
Agriculture, forestry and fishing	0,0269	0,0295	0,0313	0,0305	0,0318	0,0324	0,0317	0,0305	0,0270
Mining and quarrying	0,0173	0,0186	0,0201	0,0208	0,0202	0,0208	0,0205	0,0196	0,0191
Manufacturing	0,1874	0,1819	0,1822	0,1859	0,1831	0,1794	0,1726	0,1701	0,1668
Electricity, gas, water supply and sewerage	0,0254	0,0267	0,0262	0,0264	0,0266	0,0265	0,0266	0,0265	0,0263
Construction	0,0077	0,0072	0,0074	0,0070	0,0068	0,0067	0,0068	0,0070	0,0069
Wholesale and retail trade	0,0315	0,0305	0,0292	0,0303	0,0301	0,0307	0,0309	0,0312	0,0315
Transportation, storage, postal and courier activities	0,0286	0,0306	0,0313	0,0307	0,0302	0,0298	0,0293	0,0291	0,0301
Information and communication	0,0237	0,0253	0,0242	0,0249	0,0258	0,0271	0,0276	0,0282	0,0291
Financial and insurance activities	0,0341	0,0317	0,0308	0,0293	0,0284	0,0273	0,0290	0,0316	0,0327
Real state activities	0,0081	0,0081	0,0087	0,0085	0,0087	0,0090	0,0091	0,0091	0,0088
Other services	0,0424	0,0412	0,0421	0,0415	0,0400	0,0402	0,0396	0,0382	0,0387
Administration, Health and Education (Public)	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
TOTAL at basic prices	**0,4331**	**0,4311**	**0,4337**	**0,4359**	**0,4316**	**0,4300**	**0,4236**	**0,4210**	**0,4172**
Imports coefficients	0,0497	0,0493	0,0433	0,0433	0,0464	0,0471	0,0528	0,0588	0,0644
Conversion to constant prices correction	0,0048	0,0017	0,0015	-0,0033	-0,0015	0,0000	-0,0003	-0,0006	-0,0023
Taxes and margins coefficients	0,0346	0,0359	0,0367	0,0370	0,0365	0,0358	0,0357	0,0359	0,0361
TOTAL at market prices	**0,5222**	**0,5181**	**0,5151**	**0,5129**	**0,5131**	**0,5130**	**0,5118**	**0,5151**	**0,5153**

The u coefficients are the ratios between the totals per product consumed in the intermediate transactions (vector **u** in Figure 1) and the total output per year (summatory of the vector **q** elements, see also Fig.1). Figures per sector for imports, conversion to constant prices correction, and taxes and margins coefficients, are analogous, so as to add to the totals at market prices, that are the ratios between total intermediate consumption at market prices and total output per year.

We can see that the totals at basic prices have a rather stable trend until 2003, and then a quite pronounced decreasing trend from 2004 to 2008. According to CARTER, 1970, this behavior is contrary to what should be expected, that is, a slightly increasing participation of the intermediate consumption at basic prices in total production, reflecting that *"later technologies use slightly more intermediate inputs but less primary inputs, labor and capital"* (p.37). In other words, according to Professor Carter, technological progress is expected to bring along more specialization and division of labor, and thus more intermediate activity.

Comparison with the evolution at market prices: influence of taxes and imports

In order to have some insight on whether these reasons hold for the decreasing behavior pointed out, let us examine the trends of the total intermediate consumption at market prices. To get to these values, we just saw that we must add imports, taxes and margins, and the residuals of the conversion into constant prices coefficients to the total intermediate consumption at basic prices. Regarding the constant prices coefficients, one can notice that it actually does not have any effect on the 2000-2008 trends due to its small magnitude, which in the end is a good result for dispensing with deflator adjustments. Taxes and margins, on the other hand, show some increase over the 2000-2008 period, endorsing recurrent and widespread criticism of innumerous analysts on the deterrent role that the Brazilian taxation system and policies have over national development.

However, it is in the imports that it seems to be concentrated the bulk of the issue. This can be better observed by indexing table 2 by fixing 2000 values at 100, as table3 shows.

Table 3 - u coefficients indexed, 2000 = 100 - Standard aggregation

u coefficients indexed	2000	2001	2002	2003	2004	2005	2006	2007	2008
Agriculture, forestry and fishing	100	110	116	113	118	120	118	113	100
Mining and quarrying	100	108	117	121	117	121	119	113	111
Manufacturing	100	97	97	99	98	96	92	91	89
Electricity, gas, water supply and sewerage	100	105	103	104	105	104	105	104	104
Construction	100	94	97	92	89	88	88	91	90
Wholesale and retail trade	100	97	93	96	96	97	98	99	100
Transportation, storage, postal and courier activities	100	107	109	107	105	104	102	102	105
Information and communication	100	107	102	105	109	114	117	119	123
Financial and insurance activities	100	93	90	86	83	80	85	93	96
Real state activities	100	101	107	105	107	111	112	112	109
Other services	100	97	99	98	94	95	94	90	91
Administration, Health and Education (Public)	-	-	-	-	-	-	-	-	-
TOTAL at basic prices	**100**	**100**	**100**	**101**	**100**	**99**	**98**	**97**	**96**
Imports coefficients	100	99	87	87	93	95	106	118	129
Conversion to constant prices correction	100	36	31	-69	-31	0	-7	-13	-49
Taxes and margins coefficients	100	104	106	107	106	104	103	104	104
TOTAL at market prices	**100**	**99**	**99**	**98**	**98**	**98**	**98**	**99**	**99**

This indexed table shows clearly that imports did take room from intermediate consumption from 2004 on, increasing 29% its participation in total production in 2008 as compared to 2000, from 4,97% to 6,44% as table 2 shows. Table 3 also makes it clear that, on the other hand, is was the manufacturing industry that lost more ground in intermediate consumption share, getting down to 89 from 100 in 2000, or from 18,7% to 16,7%, as the third row of Table 2 indicates.

Impacts according to technology intensity

This brings the technological issue to the discussion, for it is in the manufacturing aggregate that technology is more concentrated. For doing so, we will recur now to Table 4, which is the equivalent to Table 3, but for the technological alternative of aggregation.

Table 4 - u coefficients indexed, 2000 = 100 - Technological aggregation

u coefficients indexed	2000	2001	2002	2003	2004	2005	2006	2007	2008
Agriculture, forestry and fishing	100	110	116	113	118	120	118	113	100
High technology products	100	108	119	121	120	119	111	107	97
Chemicals and chemical products (MT)	100	93	92	97	96	93	90	90	89
Basic metals and metal products (MT)	100	101	104	101	100	100	96	96	98
Machinery, equipment and utilities (MT)	100	104	102	104	105	104	103	101	100
Motor vehicles (MT)	100	99	100	107	116	119	117	119	112
Mining and quarrying products (less oil and gas) (MT)	100	103	112	113	96	100	96	98	96
Food, beverages and tobacco (LT)	100	100	100	97	95	97	97	95	93
Textiles, wearing apparel, leather and related products (LT)	100	97	100	97	91	81	76	73	69
Wood, paper and cellulose (LT)	100	97	95	97	94	89	87	78	81
Construction, electrical domestic appliances, furniture (LT)	100	95	99	96	91	90	87	90	89
Services	100	99	99	98	97	97	98	99	102
TOTAL at basic prices	**100**	**100**	**100**	**101**	**100**	**99**	**98**	**97**	**96**
Imports coefficients	100	99	87	87	93	95	106	118	129
Conversion to constant prices correction	100	36	31	-69	-31	0	-7	-13	-49
Taxes and margins coefficients	100	104	106	107	106	104	103	104	104
TOTAL at market prices	**100**	**99**	**99**	**98**	**98**	**98**	**98**	**99**	**99**

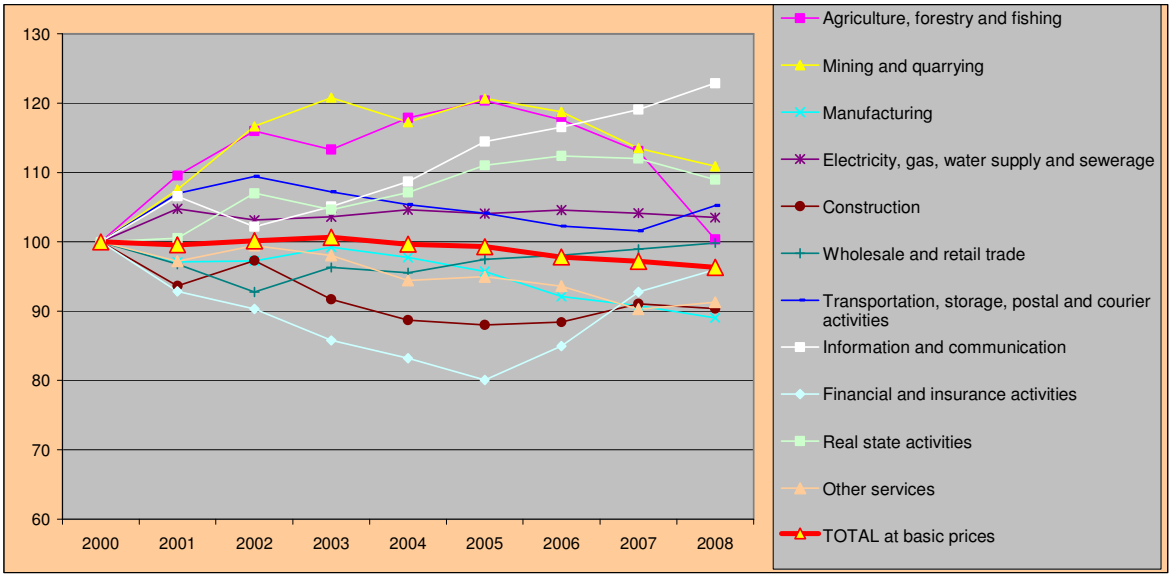
The technology levels, as in Table 1, are indicated between brackets after the activity name for the medium (MT) and low (LT) technology levels. We can see that the high technology products, in a first glance, did not suffer much of a decrease in intermediate transactions participation, scoring in 2008 97% of its share in 2000. However, if we examine the trend over the whole 2000-2008 period, we notice a dramatic change occurring in 2003, when, after reaching a peak of 121%, its participation index plunged to the 97% figure of 2008.

If we put these data on a graph, these trends become easier to follow, as graphs 1 and 2 below show respectively for the standard and technological levels of aggregation. The red curve can be regarded as a resultant, being the same in both graphs, for it corresponds to the u coefficient of the total intermediate consumption at basic prices, with a clear declining trend. If we take it as a common reference guide, we will see some important differences of the behavior of the other curves in relation to it, though the resultant obviously remains the same.

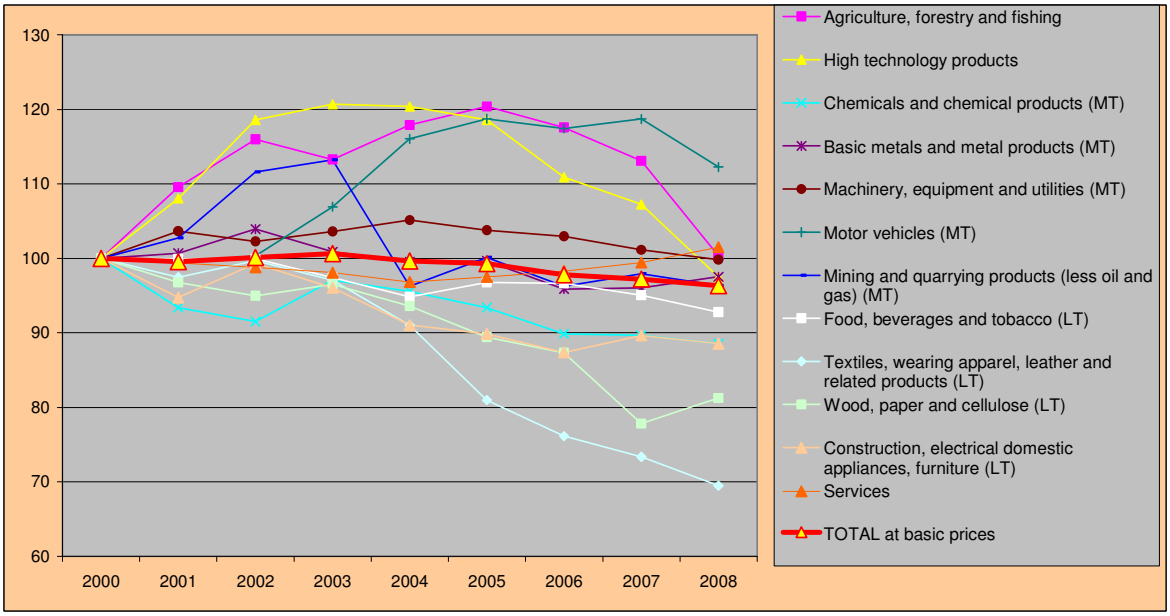
In the first graph, with the exception of the information and communications sector, we can see that all the others tend to follow the behavior of the resultant in a rather ordered manner, led by the industrial sector. Given the imports behavior that we have seen above, we can conclude that this movement is towards a new productive sector more dependent on external than on internal industrial production.

The second graph, on the other hand, adds to this conclusion by showing how this behavior varies in function of technological content. If we analyze it in conjunction with graph 3, which further aggregates it into three technological levels, we see that the low technology sectors are the ones that until 2008 had lost more ground in the intermediate transactions of the economy. This, however, is aggravated by the more accelerated decrease of the high technology products from 2005 on.

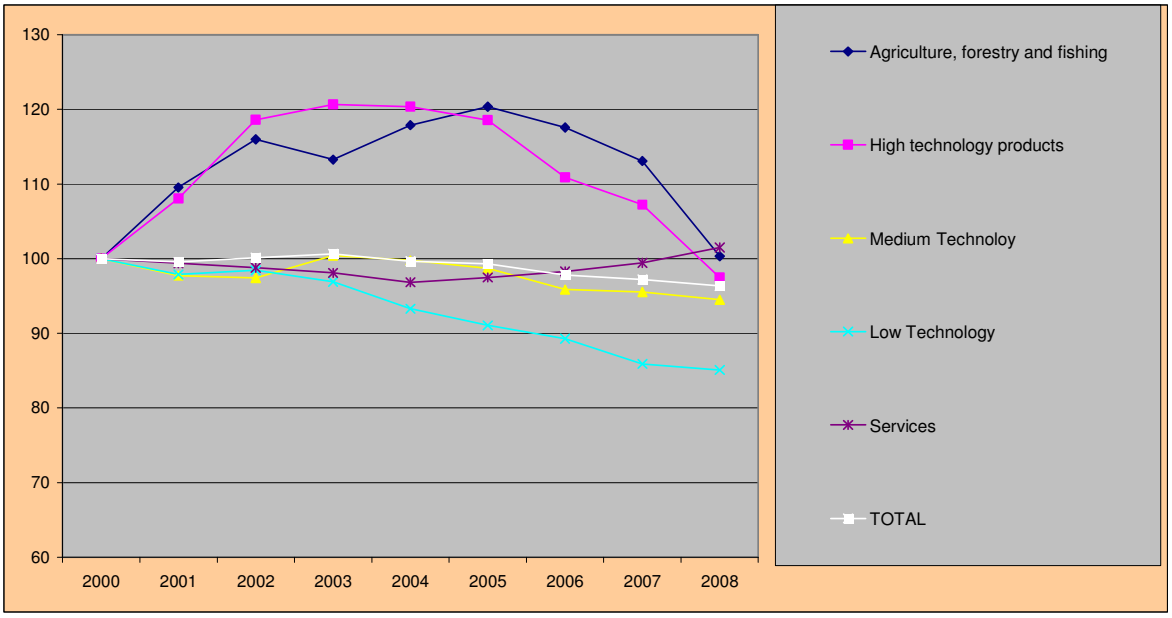
Graph 1 – u coefficients indexed, 2000 = 100. Technological aggregation



Graph 2 – u coefficients indexed, 2000 = 100. Technological aggregation

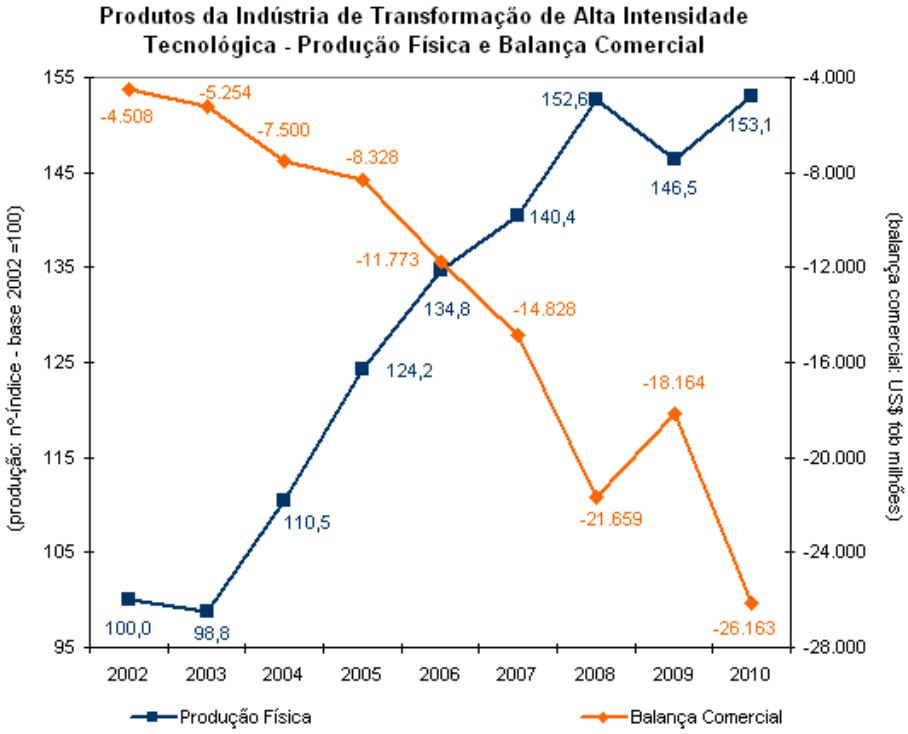


Graph 3 - u coefficient aggregated by technological level, 2000 = 100



These findings reinforce concerns on the recent weakening of the Brazilian industry technological basis by academic and consulting sectors. One of these analyses, for instance, provided the graph reproduced below (Graph 4), which compares the evolution of the high technology industry production with its trade balance from 2002 to 2010.

Graph 4 High technology industry production and trade balance, Brazil 2002-2010



SOURCE: IEDI 2011

The left axis shows production indexes (2002 = 100) and the right axis shows the trade balance for the high technology industry. The contrast between the two trends, increasing production with increasing dependence on imports, not only complies with the findings just exposed, but updates them to 2010.

Mapping the diffusion of impacts

One can argue, with reason, that it is possible to infer from Graph 4 that the national supply of intermediate high technology goods should have decreased from 2003 on, in view of the behavior of their production and imports. However, this conclusion can be substantially improved if we turn to the analysis of intermediate coefficients, particularly if combined with the SUTs framework.

The data preparation steps described above gives room for this employment of the SUTs. Let us suppose, for instance, a corrective policy that would result in an increase of 24%, that is the difference between the high technology u coefficients for 2003 and 2008 (see Table 4), in the supply of intermediate input requirements of the Computer, electronic and optical products industry. This can be simulated in the 110x55 SUT at market prices by just changing the total intermediate consumption of that industry in 2008 accordingly.

The results are shown in Table 5, obtained by the difference between the new 12x12 SUT generated by the change and the previous one. We can see that the feasibility of such a measure is dependent on a complex network of impacts, generated by the entailed changes in intermediate consumption coefficients[5]. The table, however, helps by organizing the impacts by type of economic activity, sectors and commodities, for this reason called a impact diffusion map.

Table 5 – Example of impact diffusion mapping in intermediate consumption

	Intermediate consumption at basic prices - 2008 (1 000 000 R$ of 2005)												
	Agriculture, forestry and fishing	High technology products	Chemicals and chemical product	Basic metals and metal product	Machinery, equipment and utilities	Motor vehicles (MT)	Mining and quarrying product	Food, beverages and tobacco (LT)	Textiles, wearing apparel, leather	Wood, paper and cellulose (LT)	Construction, electrical domesti	Services	**Total**
1 Agriculture, forestry and fishing	54	0	22	0	0	0	0	420	5	7	0	9	**517**
2 High technology products	16	3.273	243	0	184	155	34	2	1	108	16	2.493	**6.524**
3 Chemicals and chemical products (MT)	197	-24	480	58	72	40	18	47	29	41	199	408	**1.566**
4 Basic metals and metal products (MT)	-1	-31	3	127	73	63	0	-3	0	1	37	-1	**266**
5 Machinery, equipment and utilities (MT)	4	-150	-11	-14	72	-53	-16	-4	0	-2	-27	135	**-68**
6 Motor vehicles (MT)	2	0	2	0	4	174	0	1	0	0	1	116	**303**
7 Mining and quarrying products (less oil and gas) (MT)	8	0	29	74	3	1	21	0	0	1	16	0	**155**
8 Food, beverages and tobacco (LT)	89	2	14	0	2	0	0	314	13	1	1	220	**657**
9 Textiles, wearing apparel, leather and related products (LT)	2	1	3	0	2	1	2	2	109	1	4	37	**163**
10 Wood, paper and cellulose (LT)	1	0	18	4	4	2	2	12	3	72	38	117	**274**
11 Construction, electrical domestic appliances, furniture (LT)	0	-33	-7	2	-2	-12	0	-2	-1	0	-65	-357	**-478**
12 Services	25	579	207	86	144	111	35	178	55	54	68	2.352	**3.894**
13 Intermediate consumption at basic prices	**397**	**3.616**	**1.003**	**339**	**557**	**482**	**96**	**966**	**215**	**284**	**287**	**5.530**	**13.772**
Imports	**20**	**978**	**369**	**113**	**105**	**161**	**6**	**-188**	**44**	**-2**	**57**	**-321**	**1.342**
Taxes	**-1**	**229**	**-3**	**-1**	**-12**	**-15**	**2**	**10**	**4**	**-2**	**-14**	**17**	**215**

This brings the attention for the important contribution that the SUT framework can give for disentangling direct and indirect effects according to relevance. Besides the advantages of tabular layouts for comparative analysis, the magnitude of the figures themselves can be utilized. Filters could be set, for instance, to eliminate values within predetermined limits, giving more visibility to greater impacts, leading to the working out of critical production

[5] Anne Carter discusses in debth the complexity of this spreading of indirect impacts, that she calls “trigger effects” (CARTER, A.P., 1970, p.154).

chains. Tables of numbers as the one of the figure are within the reach of common understanding, making the indirect impacts appraisal easier. The SUT framework, used in this way, for instance, could promote the organization of interdisciplinary groups of discussion, independently of their mastering of input-output theory, what would be essential for a decision making procedure based on input-output analysis.

Conclusions

The focus of the analysis was on recent industrial technology evolution in Brazil, getting to the conclusion that, along deindustrialization, there is a decreasing trend of industrial technology intensity. Thanks to the structural approach adopted, new views of the problem, complementary to previous studies, are provided. In particular, important insights on the proportions of the problem in terms of intermediate transactions were generated, paving the way to further appraisals leading to the devising of production and technology corrective policies. The utilization of SUT tables, in conjunction with intermediate direct coefficients, was essential for reaching these results, showing considerable potential to map the diffusion of indirect impacts over the whole economy.

With this we reach the end of these comments. The follow-up shall start by a proper examination of the intermediate consumption impacts of Table 5 which, of course, has to be complemented with the impacts on all other basic accounts of the SUT, i.e., supply, use, value added and occupation, as shown in Fig.1. Hopefully, constructive propositions will be worked out towards the use of SUTs as an efficient tool to map the diffusion of indirect impacts on the economy.

References

CARTER, A.P. **Structural change in the American Economy**. Cambridge, Harvard University Press, 1970.

EUROPEAN COMISSION. **Eurostat manual of supply, use and input-output tables.** Luxembourg, Office for Official Publications of the European Communities, 2008.

FISHER, J.C.; PRY, R.H. A simple substitution model of technological change. **Technological and Social Change** 3, 75-88, 1931.

GUILHOTO, J.J.M., U.A. SESSO FILHO (2005). **"Estimação da Matriz Insumo-Produto à Partir de Dados Preliminares das Contas Nacionais"**. Economia Aplicada.

IBGE. **Instituto Brasileiro de Geografia e Estatística** – www.ibge.gov.br.

IEDI. Instituto de Estudos para o Desenvolvimento Industrial. **Carta IEDI n. 454** - *A Indústria de Transformação por Intensidade Tecnológica: O Desafio de Crescer Sem Deteriorar Ainda Mais o Saldo Comercial* – 11th February 2011.

MILLER R.E.; BLAIR P.D.. **Input-output analysis: foundations and extensions**. Second Edition, New York, Cambridge University Press, 2009.

PAIXÃO, P. An Application of Leontief's Model to the Assessment of Innovation Policies Under The Triple Helix Concept. Paper presented at the congress Triple Helix 5, Turim, Italy, 18-21/05/2005 (CD).

PAIXÃO, P. **A procedure for scenarizing by changing direct input coefficients observing a supply and use tables framework**. Paper presented at the XVI International Input-Output Conference, Istanbul, 02-06/07/2007, available at the site www.IIOA.org.

PAIXÃO, P. **The utilization of a supply and use model for prospecting the electricity market**. Paper presented at the XVII International Input-Output Conference, São Paulo, 12-17/07/2009, available at the site www.IIOA.org.