

OIL EXPLOITATION REGULATIONAL FRAMEWORK AND EFFECTS IN THE SECTOR AND ITS RELATION TO THE WHOLE ECONOMY: THE CASE OF BRAZIL'S 1997 CHANGE

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ABSTRACT

The world lives a context of energetic pre-crisis, and Brazil has discovered new big reserves of the “black gold”, which led to changing the regulation framework of its exploitation in the country. This paper focuses in analysis, from last years, the changes in oil production and tries to evaluate its effects in growth of production and its links to the rest of Brazilian economy. Using data derived from the I-O matrix in the supply side, and Balance of Payments data, we try to see if there were meaningful changes in the period 1998-2007 from the period 1990-1997 in terms of the oil sector linkage to the rest of the economy, technological modernization, its relation to employment and average earnings, and its impacts in the external insertion of the country (exports and dividends balance).

Key Words: OIL; Brazil; I-O Matrix; Leontief

1 INTRODUCTION

The change in the regulatory framework of the Brazilian petroleum industry led to significant impacts on the sector. Almost immediately there was a reduction in profit margin (gross operating margin) and an increase of production efficiency, a fact

Revista Estudos do CEPE, Santa Cruz do Sul, n35, p.7-27, jan./jun. 2012

verified by the reduction of the coefficients. Data released by the IBGE, through national accounts, and the use of Input-Output method will allow to prove these assumptions.

The current context of imminent energetic crisis, given the imbalances between estimated demand and supply of fuels in the near future((IEA 2010)(IMF 2011)(Ramírez Domínguez 2007)), puts the oil and gas (and its derivatives) subject on the center of the geopolitical stage. It assumes a key role in development strategies.

The importance of this theme is clear. Control and access to natural resources has been one of the traditional axis when thinking about underdevelopment and its overcoming, since this kind of economies present generally a strong trend in primary-exports dependence to global economy. For them, commodities are a main link to the world and an important income source, being directly related to the vulnerability for different national economies. On the other hand, oil is related to the car's industry, and is strategic for military purposes.

Taking that into account, many Latin American governments, and among them Brazilian policy makers have made changes in the regulatory framework of oil and gas production, in face of the new (but not unpredictable) world energy conditions and when faced to new discoveries.

Analyzing the history of policy and its effects for the Brazilian case serves as background upon which it is possible to contrast the potential of actual changes. Therefore, the aim of this paper is to assess the results of the new regulatory regime instituted from 1995 to 1998, synthesized mainly by the Oil Law (Law n. 9.748), approved in 1997. It ended the state's monopoly over exploitation, refining and trading, among other major changes. It tries to use an input-output approach to identify possible effects on: industry linkages and technological change, effects on wage and employment level, and on external positioning of Brazil.

In order to achieve these objectives, the paper is divided in 4 parts, beyond this introduction. In the next section, Brazilian oil industry is briefly overviewed. Then, we focus on describing the main changes brought by 1997 Oil Law, to create some tentative hypothesis on possible effects that could be detected when comparing

input-output tables. Finally, we take input-output data from the period 1988-1997 and 1997-2005³, and try to identify changes, dividing them between those that could be related with the new regulation, and those derived from other identified causes.

The paper finishes discussing the reach of that policy in terms of structural changes, highlighting its limitations throughout the period. It also tries to highlight the strong limitations that an input-output approach to such a theme shows.

2 OIL INDUSTRY AND PRODUCTION IN BRAZIL

Oil industry is well known for being very intensive in capital. In the late XIX century this became true mainly because of the rapid economic concentration of many wheels by some entrepreneurs, as Rockefeller.

As one of the most exploited natural resources on Earth, and since the technical restraints on its extraction make it more and more difficult to take off the ground after the first 20-40% ((IEA 2010)) content of a field, has tended to increase the capital intensity over time.

At first almost on the very surface of the ground many wheels flourished. After the biggest and easiest sources were depleted, the world has seen a significant part of production made offshore, onto below-sea fields.

The very high concentration of the oil industry was amplified in economic ownership by its very strategic natural status as a fuel for war purposes. Indeed, only after a big struggle in the US over anti-trust laws in the beginning of the century the overwhelming dominance of Standard Oil was softened. In the international arena, the nationalization pioneered in Mexico, and from the 1950's through the 1960's the same process and the creation of the OPEC by the main producers and Venezuela, were the counter reactions to the "seven sisters" domination over the world supply and markets. In many countries, whether advanced or peripheral, National Oil Companies – NOCs – were born to foster local wealth in that crucial energetic sector.

The history of the 1970's and its oil price shocks is well known, and was followed by a depressed price situation from the 1980's to the 1990's. Other producers like Russia and the increase in offshore production countervailed temporarily the OPEC cartel.

2.1 History of Oil production in Brazil

In Brazil, the creation of PETROBRAS in 1953, a state NOC based on monopoly over national resources, seemed somehow caricatured. From the early twentieth century some perforations had been done in several regions, but the result generally was very poor. It seemed as that this big country wasn't a potential source at all for the black gold.

The turmoil in the industry's oligopoly, though, increased the urge to find other supply sources out of conflict regions, mainly Middle East, also including some African regions. This soon led to an impressive development in the offshore extraction, in particular.

In parallel, a similar pattern was followed in Brazil's oil sector. In recent years Brazilian's oil industry has been in a constant growth, outstanding GDP growth. The overall contribution to the GDP has been estimated as 2,44% in the 1960's, 2,79% in the 1970's, almost doubling in the 1980's to 4,20%(Aragão 2005).

Following the general low prices and neoliberal policies during the 1990's, the industry's output diminished to 3,36% of GDP, but after the Oil Law, it's estimated that reached a contribution around 5% on average up to 2003.

The increase in production from the 1980's on was due to the discovery of gigantic fields in sea shelf. The Marlim, Albacora and Roncador fields were discovered in the 1980's, and part of its development would only be done when the international oil prices started to recover from a near two-decade low phase.

It's important to note that the state monopoly was not only on production, but also on trade of oil and derivatives. The state influence was double-sided: from one part, it kept important investment levels in the beginning, when the risks were high.

But during the debt crisis that followed the oil crisis, and the surge in inflation rates in Brazil from 1980's until mid 90's, PETROBRAS had to deal with a low-price scenario and a weak public sector that started to pull, rather than push financial excedents from it.

2.2 World context, economic policy and changes in 90's

From the mid 80's, the world oil sector has seen increasing mergers of petroleum companies, in a process that ended up creating companies known as mega majors. In particular the merger of Exxon and Mobil in 1998 generated the biggest oil company in world's history up to then. This movement counterpointed the increase in importance of NOCs that took place since some time before the oil shocks (Yergin, Edwards 1991). It came in hands with neoliberal policies, as seen in BP privatization in late 80's and France government leaving Total's and Elf's ownership to the private sector in the 90's (BORGES, 2011).

In a context of low-prices, the increase in costs coming from environmental policies added to the ultimate financialization (Lapavitsas, 2009) and importance of the financial sector, pushing for increased returns by pressure over the oil companies' shares.

It's important to note the extent of such policies and the impact it had on the oil sector. After the easing on antitrust laws in the advanced economies, Latin American and African countries were pressed to privatize and de-regulate financial and real sectors of the economy. The results of the process in the early 2000's were clear: instead of "seven sisters", the industry started to refer to the biggest groups (Exxon Mobil, Royal Dutch/Shell, BP, Chevron Texaco and TotalFinaElf) as the five sisters.

Nonetheless, the huge spare capacity that existed during the whole period compensated the spikes provoked by the Iraq wars during the 1980's and 1990's, mainly by the swing supplier role assumed by Saudi Arabia.

In Brazil, during all the 1990 decade the neoliberal policy was broadly implemented. In PETROBRAS, the ownership was reduced from 80% to 50%, in an attempt to free the market and private sector ownership, and by 1997 the state's monopoly over production was terminated. The prices were gradually liberalized, starting from 1990.

3 THE CHANGES IN REGULATORY FRAMEWORK

The modification in Brazilian oil regulatory framework started with the Constitutional Amendment n. 9, approved in November, 1995. But it was only enforced when the Law n. 9.478, from 08/06/1997 (Oil Law), which regulated the liberalization of the sector, was approved based on the possibilities opened up by such amendment.

As we briefly saw in the preceding section, the liberalization was part of the neoliberal policy that prevailed over the entire 1990 decade. From that moment until recent years, every enterprise, foreign or national, private or state owned, could begin to extract, transport, refine, and trade – import and export – oil⁴. The long term state monopoly was over.

To support this new framework, new institutions were created, to supervise and control the sector's activities, and to allow the formulation and execution of a sectoral policy (BNDES, 1998). Those institutions were the ANP (National Petroleum Agency) – tied to the Energy and Mines Ministry – and the CNPE (National Council of Energetic Policy) – a consulting organization for the President⁵.

ANP was created to regulate and overview the economic activities of the sector, and to contract exploration, development and production concessions. Decretes n. 2.455 and 2.457 were edited in 01/14/1998 to stablish it and CNPE.

The CNPE⁶ was created to do strategic planning of this energy source, in order to promote a rational use of the country's energy supply, grant energy to the entire nation, and to establish import/export policies and reserve policies for the oil, and electrical sector.

In a further attempt to expand the oil market/sector, PETROBRAS was stimulated to associate with other companies, and create subsidiaries for logistics operations. In particular, the company was enforced by law to offer its infra-structure, upon negotiation with the entrants (Freitas, Almeida 2003). But facing social resistance the company remained with a golden share owned by the State.

The government share in royalties and taxes was settled during the same year⁷ (BNDES, Banco Nacional de Desenvolvimento Econômico e Social 1998), as shown in Table 1.

Table 1: Taxes and Royalties on Oil production – Brazil 1998

	Amount	Payment
Signature Bonus	By contract winner	once
Royalties	10%*	Monthly
Special Participation**	0 to 40%	Quarterly
Occupation or Area holding	depending on surface and geology	Yearly

*up from 5% before the new regulation(BRASIL 2007), (AFONSO, GOBETTI , BARBOSA 2001)

** To exceptionally big volume or high profitable fields

3.1 Changes and possible ex-ante visualized effects

From 1999 to 2005, ANP did seven rounds of licitations. More than 500 exploration blocks were ceded to 72 foreign and national oil companies, 36 of them markedly foreign⁸.

PETROBRAS signed several joint ventures and cooperation contracts, among other strategic changes to face the new competitive environment (Freitas, Almeida 2003). Even though the company won about 50% of all ten rounds of licitations, the majority was won in association with other companies (Vazquez 2010).

First of all, the more direct change and probable to detect in the auxiliary tables for an I-O analysis is the fiscal impact. The new policy enforced from 1997 implied that the government increased its tax revenue⁹.

Since the first round was made in 1999, and from technical characteristics of the oil industry, from finding to starting producing in any oil field, it takes from 7 to 10 years, we would only expect detectable changes in the structure derived from the direct operation of foreign enterprises in the sector at least from 2006 on.

Another foreseeable change in respect to the brake of monopoly in production is about how PETROBRAS reacts to the new environment (BNDES, 2000). First because of the predictable upsurge in competition; secondly, because of the bigger fiscal extraction from its revenues, and, at last from official stimuli indicated above in section 3.

In that respect, the association with other companies gives access to better financial funding. More rationality in the costs control, such as public services, could be expected, and the wage relative costs evolution. From an increased interaction between companies, we could predict an increase in coefficients from within the sector or supply chain. At last, since the import could from 1997 on be done more freely by new agents, some changes in imports composition can be expected, although from the 2004 the government started to value local content promises in buys when doing the concession rounds.

4 COMPARISON OF THE PERIOD BEFORE AND AFTER THE REFORM

For analysis the impacts occurred after reform was utilized the Input-output Matrix from 1985 to 2005, published by IBGE. It is important to highlight, first of all, there

was an important change in sectoral social accounts in IBGE¹⁰ in the year 2000. The number of sectors has added from 43 to 55, and for our study was much better for the details level presented for each sector.

Because of that, the change in sector numbers, instead of focusing on differences in the levels of coefficients from 1996 to 2000-2005, a comparison between signs of changes and speed (year average change) was preferred. The main comparison for coefficients was the period from 1985-1996 and that of 2000-2005¹¹. From all the sectors that could be compared, we selected the ones that showed important dynamic evolutions.

In contrast, the distribution of derivatives (gasoline and diesel, mainly) is not directly observable in the input-output data available, limiting the possible extent of the evaluation about imports. According to the expected changes, we divide the analysis of the data gathered in: technical composition, import coefficients, labor impacts and fiscal impacts.

4.1 Technical Coefficients

Using the transactional matrix T, we can calculate the Technical Coefficient (x_{ij}). The equation that describes the Technical Coefficient is:

$$x_{ij}^k = \frac{A_{ij}}{Y_{ij}} \quad (1)$$

The coefficients variation can be estimated using the last two Input-Output tables, so:

$$\Delta x_{ij} = \frac{x_{ij}^{k+n}}{x_{ij}^k} \quad (2)$$

This coefficient measures the participation of sector in the total output. After mathematics manipulation Leontief observed that were possible to find the direct and indirect impacts of the sector consumption in total production. If the coefficient is growing, we can conclude that sector participation in the total production is growing too. On the other hand, is possible that production of specific sector is growing or the total production is decreasing. But if the second hypothetic is true, is expected that coefficient of all sectors grown too. In the case the table 2 the annual average cooperation there is growing whole another decreased, except the steel and derivate sectors.

We start our assessment by contrasting the evolution of technical coefficients from the input-output tables for Brazil, as shown in Table 2. Being the direct link (buys of oil sector from other sectors) and representing backward relations, breaks in tendencies or in velocities can show the effect of structural changes. It is important to remark that while many sectors slow down the period from 1985-1996 to 2000-2005; the Oil refining increases in the period.

Table 2: Technical coefficients variation (%) – Oil Sector – Brazil – 1986-2005 – Selected linkages

	Variation		Annual Average	
	1985- 1996	2000-2005	1985-1996	2000-2005
Business Services	36,3%	23,7%	2,6%	3,6%
Transport & Logistic	80,4%	14,9%	5,0%	2,3%
Financial Institutions	266,6%	-22,7%	11,4%	-4,2%
Machines & Equipment	-37,5%	-30,0%	-3,8%	-5,8%
Electricity, Water and Light	210,4%	34,5%	9,9%	5,1%
Oil refining	8,6%	77,6%	0,7%	10,0%
Steel and derivates	0,5%	201,1%	0,0%	20,2%

Source: Based on IBGE

From it, we can see no special changes in business services. It kept a similar evolution, increasing a little bit the rate of growth of the coefficient¹². Transport & Logistic followed a similar pattern, with slowing speed¹³. The same applies for the machines & equipment linkage, in the opposite evolution, which could be seen as less national content of the relation, which will be analyzed in section 4.1.

Meaningful changes can be noted, nevertheless in 4 of the selected sectors. First, the biggest change can be noted in Financial Institutions relation. From growing 11,4% a year, in the period before 1997, it was reduced in 2000-2005 by 22,7%. Other factor, besides the law change and companies associations, must be noted. The evolution of internal interest rates, with the huge increase in 1994-1996, and posterior relief from the late 1990's, accounts as an important factor.

Significative change was on the oil sector consumption of steel and derivates. But taking in to account the huge difference in levels, with absolute levels in the second period being much lower than during 1986-1997, the meaning of the changes loses some significance.

Finally, trade with oil refining sector has seen a significant increase, which could be linked to the increase in the number of new actors put into scene from 1997.

**Table 3: Total intersectoral impact variation (%) – Oil & Gas Extraction – Brazil
– 1986-2005 – Selected linkages**

	Variation	Anual Average		
	1985-1996	2000-2005	1985-1996	2000-2005
Business Services	44,1%	15,7%	3,1%	2,5%
Transport & Logistics	51,3%	20,0%	3,5%	3,1%
Financial Institutions	241,0%	-13,4%	10,8%	-2,4%
Machines & Equipment	-39,3%	-25,1%	-4,1%	-4,7%
Electricity, Water and Light	147,6%	35,8%	7,8%	5,2%
Oil refining	8,3%	58,2%	0,7%	7,9%
Steel and derivatives	-10,6%	38,3%	-0,9%	5,6%

Source: Based on IBGE.

In conclusion, the increase in expenses with electricity, water and light was importantly reduced. The search for a less energy and water intensive development can be somehow expected in a more tight cost control derived from the competitive pressure, and other factors as the inflation control over administrated prices such as public services could be accounted too.

The same linkages show different evolutions when assessing the total impact of the oil sector in them (Table 3)¹⁴. In this case, the only big changes are the increase of an intra supply chain impact with oil refining, and that of Steel and derivatives, and the decrease in the interdependence with the Financial Sectors.

The overall picture shows, nonetheless, that the total impact of the sector certainly didn't grow in a significant manner.

4.2 Import Coefficients

The accounting of imports in an input-output framework is usually divided into two important groups: competitive imports and noncompetitive imports. (Miller and Blair, 2009)

For our analysis, the kind of importation more important is the noncompetitive import that is not domestically produced. The coefficient is estimated using the import vector and total production vector:

$$m_{ij} = \frac{M_{ij}}{Y_{ij}} \quad (3)$$

The evolution of the import coefficients shade lights on some questions mentioned above.

First of all, we see that for many sectors the import coefficient estimated is negligible for many of the selected sectors, as transport & logistics, public services, oil refining and Steel and derivatives.

Business services keep a similar tendency over the whole time. Notably, we see a spike in between the year 1996 and 2000 (0,004332716 to 0,014409772), that could be related to the entrance of foreign companies.

The increase in renting services appears as the most significative change relating to imports¹⁵, backed by a difference in levels.

At last the machines and equipment sector shows an increase in the reduction of the imports relation, but it should be noted that the difference in levels acts in a contrary sense (0,003429603 in 1996 to 0,006011574 in 20005).

**Table 4: Import coefficients – Resources and Use Table – Brazil – Oil & Gas
Extraction – 1986-2005 – Selected linkages**

	Variation		Annual Average	
	1985- 1996	2000-2005	1985- 1996	2000-2005
Business Services	-75,5%	-47,8%	-11,1%	-10,3%
Transport & Logistics	-	-	-	-
Financial Institutions	92,1%	5,1%	5,6%	0,8%
Machines & Equipment	-0,9%	-28,0%	-0,1%	-5,3%
Electricity, Water and Light	-	-	-	-
Oil refining	-	-	-	-
Steel and derivatives	-	-	-	-
Renting	0,0%	11,3%	0,0%	1,8%

Source: Based on IBGE

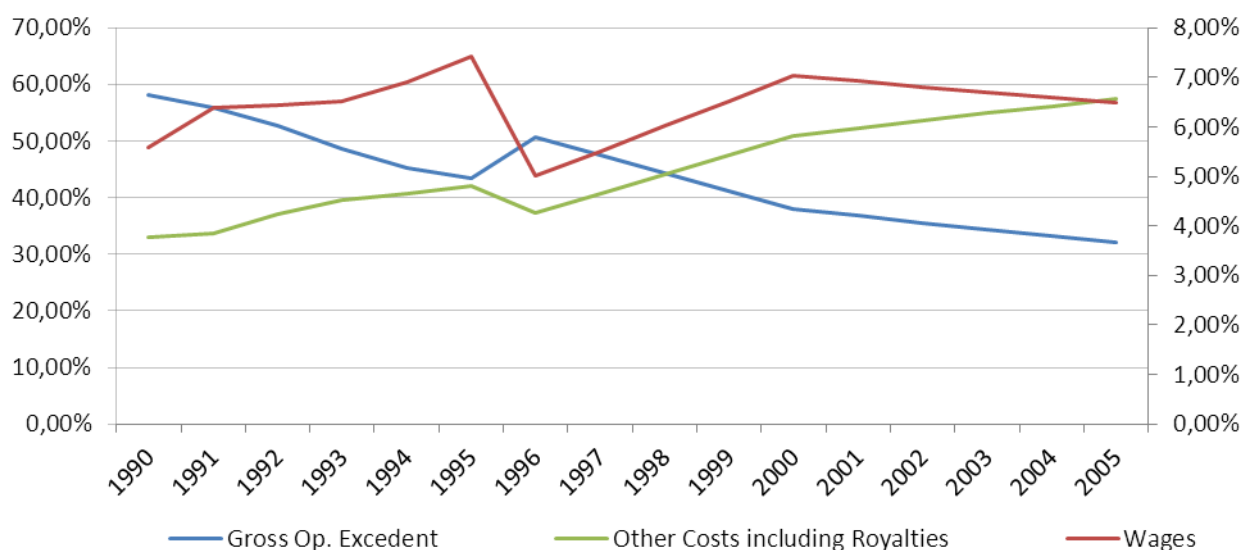
4.3 Employment – wages change

Analyzing the auxiliary table of factor remuneration, we can clearly devise some structural changes (see Figure 1). The wages as part of total value had a tendency to grow, which changed from 2000¹⁶ into a slight decrease (from 7,03% to 6,48%).

$$w_{ij} = \frac{W_{ij}}{Y_{ij}} \quad (4)$$

This variable is so important for measure the participation the labor factor in product. Considerable economists have been describe about this variables (Marx, Sraffa, Robinson) but this economists has conclude that rate labor/product is higher, is a most important variable for explain the prices variations.

Figure 1: Components of TVA and total production Value (% of total production value) – Oil & Gas Extraction –Brazil 1990-2005



Source: Elaborated by the author based on IBGE – National Accounts.*

As for the employment in the oil & gas extraction, during all the last decade from the past century the tendency was clearly diminishing. From 2000 to 2005 the sector could accommodate a large increase in the average wage level and the employment level, what in contrast with Figure 1 findings means that this was because of the huge growth in the industry output from 2000 to 2005 (in fact the total value of production more than tripled during these years). On the other hand, Gross Operational Excedent has declined year by year. If Oil and Gas prices have grown in the last year, and if the wages expend upon less than price is possible that Gross Operational Excedent declines.

4.4 Fiscal impacts

From Figure 1 we can already infer an increase in payments for government, shown by an increase in costs as part of total output in the oil and gas extraction sector.

But since royalties and other payments are not devised properly in Brazilian National Accounts, one must look to the direct data from other sources (ANP, 2009). This indicates a huge increase in royalties from 2000-2005 (from R\$ 284 millions to R\$ 4,4 billions), and the same for Signature Bonus (from R\$ 322 millions to R\$ 665 millions) and Special Participation (from R\$ 1 billion to almost R\$ 7 billions).

5 FINAL REMARKS

From the data presented, we conclude, first at all, that there was an increased participation of oil sector in production gross value, mainly since 1997. The second conclusion is that intersectoral participation of Oil and Gas extraction relative to other sectors (transport, electricians, steel) increased on average less than the oil refining sector being this the main evidence of the changes of the new regulatory framework. The increase of wages in the oil and gas extraction, coupled with an expansion of a lesser extent of the use of labor, raise evidence of increased competitiveness of the industry mainly driven by greater openness in the sector

Some results must be stressed in relation to this study. The first one is that in fact the input-output approach can help to identify trends from changes in regulatory framework. It's the case when assessing the fiscal and import impacts, and some technical changes in the oil and gas sector in Brazil during the period chosen.

I-O matrix, since it represents structural and more or less stable relations, was a good indication of profound changes in an industry. And even though the industry has a technical specificity that leads to long time delays, the case of a regulatory change over a monopoly state and the imposition of cooperation for the state company forced to changes even in a relative short time span. Definitively, this kind of study, the Input-Output methodology, is a valid support for verifications the impacts of change in regulation frameworks and their effects in the whole economy.

NOTES

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³ The last Input-Output data available from official sources in Brazil refers to the year 2005.

⁴ Though, the imports of gasoline and diesel were only totally liberalized in 2002, with the end of PPE tax and institution of the CIDE – “*Contribuição sobre Intervenção no Domínio Econômico*”(SILVA 2003).

⁵ By the edition of Decretes n. 2.455 and 2.457, from 01/14/1998.

⁶ “*Conselho Nacional de Política Energética*” or National Bureau on Energy Policy.

⁷ The Law n. 7.990, of 12/28/89, was complemented by Law n. 9.478/97 and Decrete n. 2.705/98

⁸ Foreign companies based on Angola, Argentine, Australia, Canada, Cingapur, Colombia, South Korea, Denmark, Spain, USA, France, Holland, India, Italy, Japan, Norway, Portugal, Panama and United Kindom.

⁹ Mainly as the “special participation” and the increase in royalties. Signature Bonus possibly wouldn’t be reflected as a tax income

¹⁰ Instituto Brasileiro de Geografia e Estatística, official organism responsible for National Accounts Statistics in Brazil.

¹¹ Tables for the years 1997-1999 were not publicized by IBGE.

¹² If we take into account the difference in level from 1996 to 2005, the evolution is negligible.

¹³ There was a significant difference in level from 1996-2000. Because of the methodological changes noted in the introduction of section 0, we can’t rely much on level differences.

¹⁴ Some problem with the quality of the data estimated by the IBGE can be seen in this analysis, since the coefficient for the same sector (which should constant and 1) is bigger than the unity.

¹⁵ The different methodologies could account for part of this, but the huge difference over the levels also supports this increase.

¹⁶ In terms of the total value added, the change is softer, expressed by a significant decline of the growth rate of wages as part of TVA.

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SYMBOLS

T : Transaction matrix

Y_{ij} : Gross production matrix

A_{ij} : Transaction coefficients matrix

X_{ij} : Transaction coefficients

x_{ij} : Technical coefficient

W_{ij} : Salary vector

w_{ij} : Salary coefficient

M_{ij} : Importation vector

m_{ij} : Importation coefficient

$fbcf$: Gross formation capital stock

pt_{ij} : Petroleum coefficient

Pt_{ij} : Petroleum vector

Δx_{ij} = Technical coefficient variation

k = Base year

$k + n$ = Annual variation