From Revenue to Value Added Taxes: Welfare And Fiscal Efficiency Effects In Brazil.[•]

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Abstract: *This paper presents an evaluation of the impacts from the PIS/PASEP and COFINS tax reform, which started to be collected by means of two regimes associated to domestic flows (cumulative and non-cumulative) and to levy imports of goods and services. This evaluation is made with a Computable General Equilibrium (CGE) model adapted to new fiscal system characteristics and specified to simulate the impacts on welfare indicators in Brazil. The effects were computed in two steps: the change from the cumulative regime to new (mixed) taxation regime and the full reform. The results show that this reform would have caused a deterioration of macroeconomic, labor market and welfare indicators.*

Key words: PIS/PASEP and COFINS, fiscal policy, taxation reform, computable general equilibrium, welfare.

Resumo: Este artigo apresenta uma avaliação dos impactos econômicos da reforma tributária do PIS/PASEP e da COFINS, que passaram a ser arrecadados através de dois regimes associados a fluxos domésticos (cumulativo e não-cumulativo) e a onerar as importações de bens e serviços. Esta avaliação foi feita com um modelo de equilíbrio geral computável adaptado para as novas características do sistema tributário e especificado para simular os impactos sobre indicadores de bem-estar no Brasil. Foram calculados os efeitos foram de duas etapas da reforma tributária: da mudança do regime cumulativo para o novo regime e da reforma completa. Os resultados mostraram que esta reforma teria causado deterioração de indicadores macroeconômicos, do mercado de trabalho e de bem-estar.

Palavras-chave: PIS/PASEP e COFINS, política fiscal, reforma tributária, equilíbrio geral computável, bem-estar.

Área 4: Economia do Setor Público

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1. Introduction

From 2003 to 2004 took place a taxation reform in Brazil that affected two taxes: (1) "Contribuição do Programa de Integração Social e de Formação do Patrimônio do Servidor Público (PIS/PASEP)" and (2) "Contribuição para a Seguridade Social (COFINS)". [1]

The PIS/PASEP was created in the 70's during the implementation of the labor market reforms that had finished with the employment stability, while the COFINS originated from FINSOCIAL, in the context of the 1982 Brazilian external debt crisis.

From the promulgation of the 1988 Constitution, several initiatives took place in the scope of the Union aiming at changing the Brazilian tributary system. Among the changes that had been implemented, the most significant ones were: (1) the introduction of the "Contribuição Provisória sobre Movimentação Financeira (CPMF)" in 1993, and (2) the PIS-COFINS tax reform, that was started in 2003 and was completed in 2004.

Prior to this reform, PIS and COFINS were cumulative taxes that levy firms' gross revenue. By means of this reform, in 2003 the incidence of PIS on firms' gross revenue was changed to on firms' value-added, that is, this tax was converted to a non-cumulative one. In 2004, the COFINS was subject to a similar change and both taxes started levying imports of goods and services.

Table 1, below, presents the recent evolution of some amounts of taxes collections: Total, Union (broad Federal Government) and PIS-COFINS. Once the later are federal taxes, their joint collection is compared to the Union values.

Table 1: Tax collection and PIS-COFINS participation(R$ millions – nominal values)

Year	Total	Union (1)	PIS-COFINS (2)	(2)/(1)
1998	271,856	186,561	24,786	13.3%
1999	309,420	215,915	40,366	18.7%
2000	358,414	248,004	47,046	19.0%
2001	407,108	280,740	55,506	19.8%
2002	479,638	335,441	62,132	18.5%
2003	543,140	377,081	72,870	19.3%
2004	634,930	442,280	94,709	21.4%
2005	………………	………………	109,948	…………..

Source: Receita Federal (2005).

It is observed an increase in the participation of PIS-COFINS collections in the Brazilian public sector (Union) fiscal revenue and that from 1998 to 1999 and from 2003 to 2004 this share increased in a more significant way. In the first period: (1) COFINS rate applied on firm's total gross revenue was raised from 2.0% to 3.0%, and (2) PIS and COFINS started levying Financial Institutions (Law 9718/98). In 2004, the year in which the reform was completed, this participation was higher than 21%

The table 2, below, shows the four main tax groups in Brazil: (1) the total state level value-added taxes (ICMS)[2], (2) all forms of Income Tax (IR)[3], (3) PIS-COFINS, and (4) the Social Security Contributions (SSC – from employees and employers).

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[1] Henceforth, these taxes will be referred as PIS and COFINS, respectively.
[2] ICMS stands for "**I**mposto sobre **C**irculação de **M**ercadorias e **S**erviços" and it is a type of value-added (sales) tax collected by the 27 Brazilian States.
[3] Income Tax on Individual (IRPF), Income Tax on Firm (IRPJ) and Income Tax withheld at source (IRRF).

Table 2: Main taxes in Brazil (R$ millions – nominal values)

Year	ICMS (1)	IR (2)	PIS-COFINS (3)	SSC (4)	(3)/(1)	(3)/(2)	(3)/(4)
1998	60,886	47,724	24,786	46,641	40.7%	51.9%	53.1%
1999	67,885	55,215	40,366	47,425	59.5%	73.1%	85.1%
2000	82,279	59,916	47,046	55,175	57.2%	78.5%	85.3%
2001	94,267	69,494	55,506	61,060	58.9%	79.9%	90.9%
2002	105,386	90,763	62,132	71,028	59.0%	68.5%	87.5%
2003	120,233	99,850	72,870	80,730	60.6%	73.0%	90.3%
2004	138,275	110,308	94,709	93,765	68.5%	85.9%	101.0%
2005	…………	124,618	109,948	…………	…………	88.2%	…………

Source: Receita Federal (2005).

It is observed that, in 1998, the PIS-COFINS amount was equivalent to 52% of the Income taxes amount and 53% of the Social Security collection. Henceforth, its amount grew faster than the other amounts, presenting, between 1998 and 2004, a growth rate of 282%, followed by IR with 131%. Following this path, in 2004 the PIS-COFINS exceeded all revenues from Social Security Contributions, becoming the third bigger tax group, surpassed only by ICMS and all forms of Income Tax. Again, as in Table 1, it deserves mention the significant increase in the ratios presented in the last three columns, in Table 2, from 2003 to 2004.[4]

Based on data presented in both tables it seems reasonable to expect that the PIS and the COFINS evolution during 2003 and 2004 have been affected by the two changes in their taxation regimes: (i) the introduction of a non-cumulative form of incidence for both taxes and (ii) their incidence on imports of goods and services.

In order to better understand this taxation reform the table 3, below, identifies the main federal laws that had accomplished these changes, with a summary of their content and beginning date. Despite the analysis will focus on economic variables, some aspects of the related legislation deserves be emphasized, in order to justify some methodological issues.

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[4] These ratios also significantly increased in 1999.

Table 3: Main Federal Laws related to PIS-COFINS reform

Legal Instrument	Changes	Starting date
Law 10637/2002	Establishment of non-cumulative regime for PIS on domestic flows (from firm's revenue to value-added)	January 2003
Law 10833/2003	Establishment of non-cumulative regime for COFINS on domestic flows (from firm's revenue to value-added)	February 2004
Law 10865/2004	PIS and COFINS start levying imports of goods and services. Several tax exemptions are established.	May 2004
Law 10925/2004	Reduction of PIS and COFINS rates on agricultural inputs, public roads concession, postal services and tourism package selling firms. PIS and COFINS rates on crops and cattle products were reduced to zero and a forecasted credit system ("crédito presumido") is created to agribusiness activities.	November 2004
Law 11033/2004	PIS and COFINS rates on printed media were exempted.	January 2005
Law 11051/2004	The time period for using the PIS-COFINS credit to investment goods is reduced. Outsource in transport operations and software services were exempted. Extended the exemption or reduced rate to benefit all manufactured food	January 2005

The Law 10637 (December 2002) introduced the non-cumulative regime for PIS. The main modification was the change of its rate and incidence base, from 0.65% on firm's gross revenue to 1.65% on firm's value added, following a credit and debit system similar to the one adopted by the ICMS. Despite the Federal Government would intend generalize these changes, exceptions and exemptions were established for: firms that have chosen the income tax bill estimation form based on "Lucro Presumido" (a type of profit estimation based on a fixed percentage of revenues), firms that were under the "SIMPLES" taxation system, firms located in the "Zona Franca de Manaus", Financial Institutions and the sectors whose collection system is called "antecipação monofásica"(a single-phase anticipation process). Finally, by means of this law exports were totally exempted from this tax.

By means of the Law 10083 (December 2003), one year after the beginning of the non-cumulative regime for PIS, a similar regime was also established for COFINS the tax rate should be changed from 3.0% on gross revenue to 7.6% on value-added. Beyond allowing the exceptions and exemptions mentioned in the previous paragraph, the option to stay in the old cumulative regime was given to many kinds of activities,[5] among them: health insurance firms, values monitoring and transport services, cooperative societies, telecommunications services and media companies, public multi-modal transportation services, health services provide by hospital or similar units and all kinds of educational services.

The taxation reform was completed by means of the Law 10865/2004 (March 2004) by which PIS and COFINS started levying imports of goods and services. The basic percentage tax rates were the same for domestic flows, 1.65% and 7.60%, summing up to 9.25%, but levying a different base from that one that is considered for Import Tariff (CIF value) collection. In the PIS-COFINS case, beyond the imports CIF value, must be added the Import Tariff (IT), the "Imposto sobre Produtos Industrializados (IPI)" (a tax on manufactured products), the ICMS (mentioned before), and the own PIS-COFINS. Thus, the final effect of this extended base is a multiplier that magnifies the original (nominal) legally established tax rates.

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[5] Exemptions were established by means of 17 paragraphs in the law.

Here again, some exemptions were introduced, for example, all imports under drawback regime and all imported equipments and input goods to the "Zona Franca de Manaus" were totally exempted from these taxes. Besides, some specific goods were also exempted, such as: press paper, intermediate inputs for aircraft and boats (maintenance and construction), equipment for the audiovisual industry, petrochemical nafta and natural gas.

The significant amount of exceptions, mainly exemptions or suspensions, common to the laws previously mentioned, created a subsequent pressure for the extensions of these benefits, being these the main aspect of the Laws 10925, 11033 and 11051. As example of this process, the Law 10637, which created the non-cumulative regime for the PIS, was later modified by the Laws 10684, 10833, 10925 and 10996, in a period of only two years from the original edition. Specifically for this work, this "mutant" characteristic caused a significant difficulty to simulate the economic effects of changes in the PIS-COFINS taxation regimes in the context of a dynamic quantitative analysis.

Considering all the previous information, the PIS-COFINS reform was basically characterized by the introduction of their: (1) incidence on firms' value-added (non-cumulative regime), (2) incidence on imports of goods and services and (3) new rates (1.65% for PIS and 7.60% for COFINS) on value-added and imports. Also, after the PIS-COFINS taxation reform, these taxes were operating under two regimes: (1) the (previous) cumulative and (2) the (new) non-cumulative. As pointed earlier in Tables 1 and 2, the PIS-COFINS collections presented significant increase in 2004 and due to the relative importance of these collections, it seems reasonable to expect that these reform effects on Brazilian economy were not negligible and deserves to be addressed.

Given these characteristics, the implementation of PIS-COFINS reform basically induced relative prices changes in the Brazilian economy and, consequently, the economic agents rethought their resource allocation decisions, which characterize a general equilibrium phenomenon. From the individuals' and families' point of view, modifications in the relative prices structure can significantly alter their welfare, by means of the changes in the structure of the real incomes and the expenditure of these agents. Besides, the taxation system together with the social public expenditure has been considered very ineffective in changing our income distribution[6]. Therefore, it seems very appropriate to assess the economic impacts from the PIS-COFINS taxation reform by means of a computable general equilibrium (CGE) model.

Even though the potential importance of the PIS-COFINS reform, the evaluation of its effects using CGE models was only made by Silva *et al.* (2004)[7]. They present a descriptive section for a broader "tax reform" proposed by the Brazilian government, characterizing the participation of the main indirect taxes, before the PIS-COFINS tax reform. They simulated the implementation of PIS-COFINS reform and also test a possible incidence change for the social contribution of employers.

Although the taxation characteristics in Brazil are very well modeled and they provided useful results to evaluate the potential impacts of the referred reform, some characteristics and assumptions in their study deserves be comment. First, the model's database (Social Account Matrix) is for 1998 and the use of more recent data would more accurately express the features presented by the economy in the period in which the reform was implemented.

Second, they estimated the impacts from the implementation of legal tax rates, not from the effective rates. As presented earlier, the PIS and COFINS legal rates and incidence form were subject to many exemptions and exceptions that made them different in relation to the effectively applied rates. Then, simulating the implementation of legal rates might not induce the same impacts that would be induced by the effectively implemented reform.

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[6] Robinson and El Said (2003) discussed the relationship between CGE Analysis and Income Distribution/Poverty issues. For some aspects of Brazilian fiscal system and inequality see *"Gasto Social do Governo Central: 2001 e 2002"*, Ministério Fazenda, November 2003 and *"Gasto Social do Governo Central: 2001 - 2004"*, Ministério Fazenda, April 2005.
[7] The model employed in this study was developed from Devarajan, Lewis and Robinson (1991).

Third, the model closure admitted full employment of labor and constant capital stocks, which nullify the impacts on GDP by assumption (GDP-neutral effects). Fourth, it is assumed in the simulations that the nominal exchange rate is endogenous while the general price index (GDP deflator) is fixed, which induce price-neutral effects (no changes in the aggregate price index). Considering the facts that the new PIS and COFINS rates were much higher than the previous ones, even though the changes in the incidence base, and that they started levying imports, it is possible to expect price increase and product decrease.

Finally, their focus was on the macroeconomic and the sectoral impacts indicators due to the reform, while we intend to extend the analysis towards individuals' and families' welfare effects, taking the advantage of a specific institutional modeling for these questions. Once there are some points that can be advanced, another evaluation that can to contribute to the analysis on the PIS-COFINS reform impacts on Brazilian economy is justified.

2. The CGE Model – main features

The CGE model used here is an extension from the model presented by Cury, Coelho and Corseuil (2005)[8] and, thus, it will be described in a shorter way, while further details can be found at the first paper cited above.[9]

2.1. The Product Market

2.1.1. Product Supply

Foreign product supply is modeled as being totally elastic,[10] while sectoral domestic supply is represented by a three steps nested production function, which considers three types of inputs: labor, capital and intermediate inputs.[11]

First, amounts of types of labor (F_1), given by the first order firm's profit maximization conditions, are combined in a composite labor (Ld_i) for each sector i, by a Cobb-Douglas function with constant returns to scale:[12]

$$Ld_i = \prod_1 F_{il}^{\beta_{li}} \tag{1}$$

where β_{il} is the share of each type of labor: unskilled informal (l1), skilled informal (l2), formal with low skill (l3), formal with average skill (l4), formal with high skill (l5), public servant with low skill (l6) and public servant with high skill (l7).[13].

Second, in each sector i, aggregated labor (Ld_i) and capital (K_i)[14] are associated by a constant elasticity of substitution (CES) function to obtain the production values (X_i):

$$X_i = a_i^D \left[\alpha_i Ld_i^{\rho_{ip}} + (1 - \alpha_i) K_i^{\rho_{ip}} \right]^{1/\rho_{ip}} \tag{2}$$

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[8] This model results from a series of developments made in the model proposed by Devarajan, Lewis and Robinson (1991), as can be seen in Cury (1998), Barros, Corseuil and Cury (2000a) and Coelho, Corseuil, Cury and Barros (2003).
[9] http://www.econ.fea.usp.br/novo_site/publicacoes/estudos_economicos/35_4/cury-coelho-corseuil.pdf
[10] Thus, Brazilian demands for imported goods are fully satisfied without facing external supply constraints.
[11] The model represents the 42 sectors of activities listed in the 2003 Brazilian National Accounts.
[12] This means that an identical increase of every type of worker results in an identical increase of the aggregate worker.
[13] Also, there are more 2 types of employers that are treated as labor and enter in the Cobb-Douglas aggregation.
[14] The model closure adopted in the simulations determines that the sectoral levels of capital are fixed.

where a_i^D is the CES shift parameter, α_i is the sector's i labor share in the production value and ρ_{ip} is the elasticity of substitution between capital and labor.

Finally, in the third step various intermediate inputs levels (INT_i) are obtained by a Leontief production function (e.g., fixed proportion to sector j total product, X_j):[15]

$$INT_i = \sum_j a_{ij} X_j \tag{3}$$

where α_{ij} is the technical coefficient of input j in sector i.

Domestic producers react to the relative price in domestic and international markets and the domestic output is divided by a constant elasticity of transformation (CET) function with imperfect substitution in products sold to these markets:

$$X_i = a_i^T \left[\gamma_i E_i^{(\rho_{it}+1)/\rho_{it}} + (1-\gamma_i) D_i^{(\rho_{it}+1)/\rho_{it}} \right]^{(\rho_{it}+1)/\rho_{it}} \tag{4}$$

where X_i, E_i and D_i are, respectively, the sector i's: total domestic production, exported volume and domestic output sold in internal market. a_i^T and γ_i are model's parameters and ρ_{it} is the elasticity of transformation.[16]

2.2. Demand for products

2.2.1. Families

Families are classified according to per head household income, level of urbanization and household head characteristics: poor urban families headed by active individual (f1), poor urban families headed by non-active individual (f2), poor rural families (f3), urban families with low average income (f4), urban families with average income (f5), rural families with average income (f6), families with high average income (f7), and families with high income (f8)[17].

They choose commodities' consumption levels to maximize utility subject to a budget constraint[18], according to a Cobb-Douglas functional form (similar to the production function presented earlier).

Families and firms consider demanded domestic and imported goods as imperfect substitutes that differ according to their source (domestic or external), as proposed by Armington (1969), and their utility are measured (in product quantity) by a CES function:

$$Q_i = a_i c \left[\delta_i M_i^{(\rho_{ic}-1)/\rho_{ic}} + (1-\delta_i) D_i^{(\rho_{ic}-1)/\rho_{ic}} \right]^{\rho_{ic}/(\rho_{ic}-1)} \tag{5}$$

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[15] It is worth mentioning that Devarajan *et al.* (1991) makes use only the first and third steps, by combining capital with labor and value added with intermediate inputs, in this order.

[16] There are no empirical estimates of Brazilian export elasticities using a CET structure for a highly disaggregated sectoral specification. Therefore, it was adopted the same procedure used in Cury (1998, pp. 112-113), which departed from the elasticities estimated by Holand-Holst, Reinert and Shiells (1994) to the American economy.

[17] The criteria for family divisions are explained in Base Data appendix of this paper.

[18] Actually, this utility maximization can happen along the consumers' lifetime. From the point of view of most practical applications, the maximization is on the goods and services available in a given period.

where M_i is the imported volume of good i, and D_i is the consumption of the domestic good i. a_ic and δ_i are parameters, while ρ_{ic} is the Armington elasticity of substitution between D_i and M_i.[19] Finally, Q_i indicates the utility derived from the consumption of good i.[20].

The external agents demand domestic goods, reacting to changes in relative prices as well. Similarly to the import demand form, the exports demand arises from a CES utility function that represents the imperfect substitution between products from the external regions and Brazil.

2.2.2. Firms

Firms demand commodities to satisfy their production requirements of intermediate inputs, according to the technical coefficients from the input-output matrix.

Due to the static nature of accumulation in the capital market, investments are important for product demand. Similarly to consumption, the investment is characterized as the purchases of certain goods and can be considered as a final consumption undertaken by firms. The savings represent this amount of resources and it is assumed that a share of it corresponds to investment in stocks of finished goods, while the remaining parcel represents the net investment required to expand production. The first share is defined based on a fixed proportion to the sectoral output, while the second is distributed exogenously among the sectors, reflecting information from the input-output tables (goods by sector of origin) and the matrix of sectoral composition of capital (goods by sector of destination and origin).

It is considered that investment goods are being produced but not used as increments of capital stocks. Thus, the model closure is closer to a medium-run type: constant capital stock, price flexibility and existence of involuntary unemployment in equilibrium.

2.2.3. Government

The Government consumption (GC) is derived from maximization of a Cobb-Douglas utility function subject to the budgetary constraint corresponding to the total expenditure that is fixed according to the total amount registered for the base year.

2.3. The Labor Market

Labor is a production factor used by firms and is classified into 7 types, according to contract status and schooling.[21] It is admitted that firms aim at maximizing profits under technological constraints conditions imposed by production function, in an environment where prices of inputs, production factors (labor and capital) and output are beyond their control. . Therefore, as a result of this maximization, for each type of workers, a specific demand curve is defined by the condition that their marginal productivities equalize their wages:[22]

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[19] These elasticities values were estimated by Tourinho *et al.* (2002) for the same sectors considered in the model.
[20] It can be interpreted as the quantity of a hypothetical mixed (imported and domestic) good that would be demanded by consumers.
[21] The labor treatment that follows is applied for the 5 types of private workers. The 2 types of public servants follow the traditional labor market closure of CGE models with either wage or employment being fixed. Therefore, there is no substitution between public servants and the private kinds of workers, in the sectors where there is no public companies. In the sectors where public and private firms coexist, the changes in the public-private composition of labor are related to the changes in the public-private composition of the sectoral representative firm.
[22] The derivative of the profit function in relation to the demanded quantity of each factor must be equal to the factors' price (first order condition).

$$P_i \partial X_i / \partial F_{il} = W_{il} \tag{6}$$

The labor market equilibrium (employment and wage) is determined by $E^/$, the intersection point between the demand curve (L^d) and the wage curve (S). The wage level defined by $E^/$ does not correspond to the labor supply (L^o), and the difference $L^o - L$ is the excess of labor supply that corresponds to the involuntary unemployment level (U) in the economy.[23]
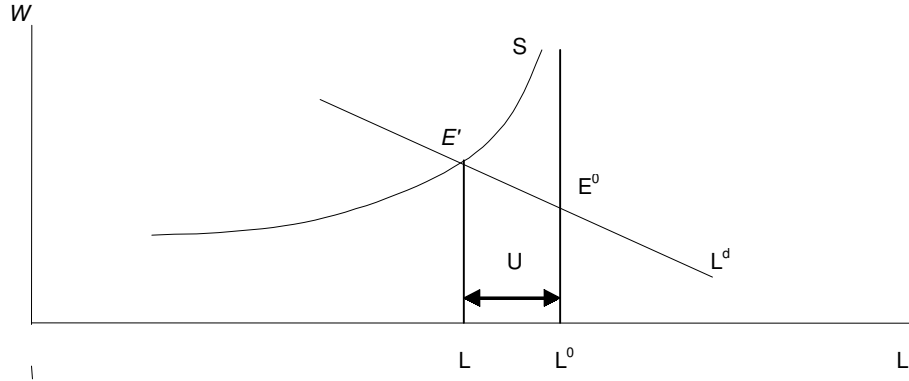

Figure 1 - Equilibrium in the labor market for a given type of labor

The wage curves adopted here represent the negative relation between the unemployment rate (U_l) and the wage level (W_l) for private worker l in Brazil:[24]

$$\ln W_l = \alpha_i - \beta_l \ln U_l \tag{7}$$

where β_l reflects the firm's bargaining power in offering lower wages according to unemployment rate.[25]

After defining the aggregate levels of employment, wages (w_l) and unemployment, for each type of workers, their sectoral wages (w_{li}) are found by means of the sectoral relative wage differentials. Using a sector and worker specific demand curve (equation 6), the sectoral employment level of each type of labor (F_{il}) is determined and, then, aggregated by a Cobb-Douglas function (equation 1) defining the sector i's composite labor.

2.4. The Income Transfer Mechanisms

Here it will be presented the formation process of income flows received by families and firms. The remuneration of capital is paid to firms[26] and the labor earnings to workers. In each sector, the payments to capital are distributed to the firms according to the initial share in the total earnings of capital.

The eight types (h) of families receive earnings from the seven types (l) of labor according to the initial shares (ε_{hl}) of these workers in these families, which also receive the remuneration of capital transferred by firms (YK) according to the family h's share in these income flows (ε_{hk}). Finally, the families also receive net remittances from abroad (RE_h), adjusted by the exchange rate (R), and transfers

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[23] E^o would be the full employment level given by the interaction between labor supply and labor demand.
[24] A brief description of wage curves can be found in Cury, Coelho and Corseuil (2005). Broader explanation about them can be found in Blanchflower and Oswald (1990 and 1994).
[25] These parameter values were taken from Reis (2002), who estimated then for the Brazilian case.
[26] Small (self-employed people) and large (other firms).

from the Government (*TG*), in the form of payment of benefits (direct income transfers)[27] and as other transfers (essentially domestic debt interest)that are allocated to the families according to the initial shares (θ_{ht}). Therefore, the family *h's* income is:

$$Y_h = \varepsilon_{hl}.W_l + \varepsilon_{hk}.YK + (pindex).\theta_{hk}.TG + R.RE_h \tag{8}$$

2.5. The Government

The Government spends by consuming ($\sum_i CG_i$) and transferring resources to the economic agents. It plays a very important role in the process of determination of secondary income, once it also directs a share of its transfers to firms[28] as interests on the domestic debt and demands products. Similar to families, the sharing of government transfers to the types of firms follows the proportions observed in the base year (θ_k). Finally, it also transfers resources to abroad (*GE*) and its total expenditure is:

$$GG = \sum_i CG_i + pindex.(\theta_{ht} + \theta_k)TG + R.GE \tag{9}$$

To face all expenditures, the Government relies on three types of collections: (1) direct taxes levied on firms' and families' income (ϕ_h and ϕ_k, respectively), and (2) indirect taxes on domestic and imported goods (proportional to production (*X*), imports (*M*) and value added (*VA*) amounts). Besides these sources, it also receives transfers from abroad (gfbor) and, finally, there is the balance of the social security system (*SOCBAL*).[29] Thus, the Government total revenue is:

$$RG = \sum_h \phi_h.Y_{h.} + \sum \phi_k.Y.K + \sum_j (\eta_j + \xi_j).X_j + \sum_i (\pi_i + \sigma_i).VA_i +$$
$$\sum_i (\mu_i + \kappa_i + \gamma_i).M_i + R.PR + SOCBAL \tag{10}$$

where η_j are the tax rates on production, ξ_j and π_i are, respectively, the sector *i*'s PIS-COFINS rates on production value (cumulative regime) and on value-added (non-cumulative regime), σ_i and κ_i are, respectively, the ICMS-IPI tax rates on value-added and imports, μ_i is the tariff on imports, while γ_i are the PIS-COFINS rates on imports of commodity type *i*.

An eventual lack of government resources is defined as a government deficit that, together with domestic private (firms and families) and foreign savings, defines the amount of resources spent as investments.

The implementation of the PIS-COFINS reform changed the way by which the Government collects indirect taxes that levy domestic and imported commodities. Thus, the indirect tax revenue (INDTAX) from domestically produced goods is given by:

$$INDTAX = \sum_j \{(\eta_j + \xi_j) * (PX_j.X_j)\} + \sum_i (\pi_j + \sigma_j).(VA_i) \tag{11}$$

where $PX_j.X_j$ is the production value and VA_i, η_j, ξ_j, σ_j and π_j were presented with equation 10.

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[27] These transfers include the social security benefits as well as other programs such as unemployment benefits, income transfer social programs and other cash benefits.
[28] The same applies for labor supply.
[29] In fact, social security is treated as an agent apart from the Government in the model, not only because of the considerable amount of resources that it handles in Brazil, but also because of the contributions that it applies on either the company's income (here again in a different form), or on the installments of the added value of labor.

The presentation of this equation is very important to understand the way the implementation of the fiscal reform will be simulated. According to PIS-COFINS tax revenue data from "Receita Federal", all sectors are being levied in both cumulative and non-cumulative regimes. Then, the domestic part of the simulation will consist in applying the ξ_j and π_j tax rates that were verified in 2004 at sectoral level.

The other equation that contributes to the Government revenue and deserves mention is the indirect taxes on imports revenue, which is given by:

$$TARIFF = \sum_i \left(pwm_i \ .exr \right) * \left(\mu_i + \kappa_i + \gamma_i \right) M_i \tag{12}$$

where pwm_i is the external price of imports (in US\$), exr is the exchange rate, μ_i is the tariff on imports, κ_i is ICMS-IPI rates on Imports and γ_i are the PIS-COFINS rates on imports.

Again, this equation is important to understand the way that the fiscal reform will be simulated, once another feature of this reform was that the imports started being levied by PIS and COFINS taxes. Thus, the implementation of this part of the reform will consist in applying γ_i tax rates that were collected from import flows of commodity type i in 2004.

3. The Model Data Base

Almost all data used in the model and simulations are derived from a Social Account Matrix (MSC-2003) that was specifically made to be used in this research and contains all the quantities and prices information concerning for the model's base year (2003). Besides, all the model's coefficients and parameters obtained by means of a model calibration process are calculated from this data matrix.[30]

However, it deserves mention that it was made based on information from the latest officially published Brazilian National Accounts by Instituto Brasileiro de Geografia e Estatística (IBGE). Another set of data used to calculate the economic shocks that will be simulated and evaluated will be presented in the following section.

4. Simulations and closure

4.1. Simulations – modeling issue

As presented earlier, pursuing to reduce the cumulative feature of the PIS and the COFINS, the taxation reform has changed part of these taxes incidence from the firms' gross revenue to their value-added and also established a legal (nominal) rate that should levy the later magnitude. Even though a tax on value-added is non-cumulative, the effective tax rate differs from the legal rate because it is established, by law, that to calculate the former rates that must be applied on the value-added amounts, it is necessary to consider the incidence of these taxes on the ICMS rates, which is sector specific. Besides, the legal and the applied rates can be different due to fiscal exemptions.

The PIS-COFINS *implemented* reform established that sectors and activities would be levied by a mixed taxation regime: a mix of the cumulative (previous) and the non-cumulative (new) regimes Thus, as exposed earlier, the domestic part of the simulation will consist in applying the tax rates on production and value-added amounts, calculated based on 2004 flows, at sectoral level.

More specifically, the economic shocks were calculated from data on PIS and COFINS by CNAE sectoral classification and by collection base (firms' gross revenue and value-added), obtained from the

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[30] Although the matrix will not be described here, further information on it can be requested with authors.

Secretaria da Receita Federal (SRF). Once the sectoral classification of CNAE and of matrix MCS-2003, which follows IBGE codification, are not the same, the sectors were matched assuring that the aggregated amounts of collections were equal.

The taxation reform has also established that, in general, the imports should be levied by a PIS rate of 1.65% and by a COFINS rate of 7.60%. The reform has also admitted different rates to PIS and COFINS on imports to the following sectors: machines and tractors (2,0% and 9,6%); automobiles, trucks and buses (2,0% and 9,6%); oil refinery (2,34% and 10,74%); pharmaceutical and perfumes (2,1% and 10,0%) and other food and beverages products (1,97% and 9,21%).

It is important to mention that the legal compound PIS-COFINS rates are not directly imposed on imports because the legislation establishes that to determine the rate to be applied it is necessary to use a specific formula by which these rates must interact with the ICMS and tariff rates on imports, besides themselves.

Also, the existence of special taxation regimes benefiting some import flows by exempting them from tariffs and/or indirect taxes, as for example, the imports under the drawback regime, can make the applied rates differ from the legal ones. Then, given these possible differences, the implementation of the incidence of PIS and COFINS on imports will consist in applying the tax rates that were verified from these flows in 2004.

Therefore, the impacts of the PIS-COFINS taxation reform will be simulated by implementing a mixed tax regime, which consists of the following features: (1) the taxes levy sector's revenue and value added, (2) application of the new tax rates on domestic flows (verified in 2004), (3) the taxes start levying imports and (4) application of the new tax rates on import flows (verified in 2004).

The taxation reform will be simulated in two steps. In the first step, the mixed taxation regime will be implemented (features (1) and (2)). Then, in the second step, the PIS-COFINS rates on imports are also implemented (features (3) and (4)), taking as database the resulting scenario from the first step. Thus, the results from the second step capture all the impacts of the taxation reform. Henceforth, these simulations will be referred as PCVA (domestic reform) and PCVAM (complete reform).

4.2. Closure

As previously mentioned, the model closure is closer to a medium-run type, since it is being assumed that: (1) sectoral capital stocks are constant, (2) prices are flexible, (3) involuntary unemployment exists in equilibrium and (4) trade balance is exogenous. The constancy of capital stocks is due to the fact that, in the model, the investment goods are being produced but not considered as increments of capital stock. The existence of involuntary unemployment in equilibrium is a consequence of the labor market modeling (section 2.3).

By admitting trade balance as exogenous, the exports adjust not only due to the price responsiveness of external demand but also to adjust the changes in imports, in order to maintain the trade balance unchanged.

Once one of the main purposes of the simulation is to evaluate the potential distributive impacts of the PIS-COFINS fiscal reform, the analysis will also focus on the impacts on employment, wages and household income. However, the impacts on selected aggregated variables will be presented in order to evaluate the magnitude of the macroeconomic effects.

5. Fiscal reform impacts

5.1. *Macroeconomic impacts*

Table 4, below, reports the simulated macroeconomic impacts of the PIS-COFINS total reform. The fiscal reform effects, which are the object under analysis, are presented in the first column (PCVAM). The impacts of domestic part of the reform are also reported (column PCVA), even they are not the focus of analysis.

Table 4: Macroeconomic Indicators (% change from base year)

	PCVAM	PCVA
GDP	-0.73	-0.52
Consumption	-1.46	-0.61
Investment	0.89	-0.67
Public sector revenue	1.25	-0.54
Public sector nominal deficit	-21.13	4.61
Exports	-2.47	-0.37
Imports	-3.17	-0.47
Employment	-1.72	-0.95
Numeraire Price Index	2.25	-0.24

Note: (1) real % variation, (2) from simulations results.

The overall impacts from fiscal reform are adverse, since it would induce a real GDP fall of 0.73%, an aggregate employment decrease of 1.72% and inflation of 2.25%. The effect on real GDP can be reflecting the fact that the elimination of the cumulativeness of these taxes had relatively strong negative effects on output at sectoral level and, therefore, on aggregate product.

The taxation of value-added (VA) induces an increase in its price, which is equivalent to a rise in marginal costs. To achieve the equilibrium, in perfect competition, the representative firm needs earn higher marginal revenue or reduce marginal costs, which can be done by reducing the VA components usage. Considering the way that the labor market operates and the model's closure features, this implies in a lower labor demand, inducing a decrease in wages, and so, reducing the available income and, consequently, consumption expenditure.

Also, by taxing imports, that is, increasing their prices in domestic market, the reform induces another adverse effect on aggregate consumption. Once domestically produced and imported commodities are not perfect substitutes, even changing the relative prices in favor of the domestic commodities, this price increase raise composite commodities prices in internal market. This relative increase in domestic prices induces the households to consume less, but substituting imported goods by larger amounts of domestic commodities. In a similar way, the firms tend to substitute in some extent import inputs by domestic inputs. However, this positive effect is not strong enough to offset the negative effect on consumption induced by the taxation of imports, and so, there is a second adverse impact on consumption demand.

The macroeconomic closure considers that the investment is determined by the savings behavior and that the Government consumption is fixed. This implies that the changes in the tax revenue affect the Government savings and, therefore, the public deficit and investment. Thus, the investment increases by

0.89% due to the rise of 1.25% in the public sector revenue, which induces a decrease of 21.13% in the public sector deficit.

Exports fall due to the price-responsiveness behavior of external agents and the model external closure characteristics. First, the reform induces an increase in domestically produced commodities prices, which, by turn, causes a decrease in external demand by Brazilian commodities. Second, the rise of import prices and the reduction of internal absorption (activity) induce a fall in demands for imported commodities, and in order to not affect the trade balance equilibrium, exports must decrease.

The fall in aggregate consumption and exports more than offset the increase in investment and the fall of imports, thus, the PIS and COFINS reform induce a decrease in the national GDP (–0.73%) and employment (–1.72%).

Although the implementation of a mixed taxation regime alone (column PCVA) is a more stylized scenario, its effects can reveal some interesting results when compared to the effects from the complete reform (column PCVAM). We see that the effect on GDP would still be negative but less strong (–0.52% and –0.73%, respectively). Taking in account the effects of imposing the partial reform, we can see a fall in the total government revenue (–0.54 %), which would be the opposite result from the complete reform, showing the importance of PIS-COFINS taxation on imports, which would induce a decrease of public savings and, therefore a decrease in investment.

To better understand the relationship between public sector fiscal revenue and PIS-COFINS taxes, according to their three different sources, as shown in table 5, below, that presents the amounts for the model model base year (2003) and the two simulations scenarios.

Table 5: PIS-COFINS values, before and after taxation reform (2003 R$ millions)[1]

	Base (2003)[31]	PCVAM	PCVA
PIS-COFINS other than value added	62,686	31,528	31,877
PIS-COFINS on value added	11,577	44,647	45,168
PIS-COFINS on Imports	----	13,593	----
Total PIS-COFINS	74,025	89,588	77,057

Note: (1) real values deflated by model price index.

From the above data, we can verify that the total value collected in the partial reform (last column – PCVA) is very similar to the base value with an increase of just 4.1%. These results partially confirm the hypothesis that only changing the taxation regime would not significantly alter the total PIS-COFINS collection. On the other hand, when the taxation on imports are also simulated, the total value collected significantly increases by R$ 15,563 millions (+21.6%) with PIS-COFINS collection on imports (R$ 13,593 billions) representing almost 90% of that growth [32] This means that the imposition of PIS and COFINS on imports were the major determinants of fiscal revenue rise.

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[31] The base year total value of this table has a small difference from the data reported in table 1 and 2 above because the later has some deductions due to total taxes GDP participation methodology adopted by "Receita Federal".

[32] Despite not being a good method for comparison, the total value showed in table 4 agree with real value verified in 2004, when it is deflated, R$ 90,194. (see "Análise de Arrecadação da Receita Federal – Dezembro de 2004", in www.receita.fazenda.gov.br).

5.2. Sectoral impacts

In this section we will analyze the impacts at sectoral level, once each sector performance can vary in a significant way comparing to others. The analysis will be based on a combination of prices and quantities indicators, represented by real gross revenues.

Table 6: Five less and most benefited sectors (real gross revenue in PCVAM*)

Damaged sectors	change	Benefited sectors	change
Leather and shoes	-5.81%	Other chemical products	4,26%
Retail and wholesale trade	-2.79%	Non-iron metallurgy	2,04%
Steel industry	-2.33%	Non-metallic minerals	1,36%
Coffee industry	-2.16%	Companies services	1,20%
Sugar industry	-1.90%	Machines and tractors	1,11%

Note: (*) percentage change from base year; sectoral nominal gross revenue percentage changes were deflated by model price index

The least benefited sector, in table 6 above, is leather and shoes and its performance can be explained by the fall of quantity produced, basically due to decline in exports and consumption. The effects on Coffee and Sugar industries are understood by a similar explanation. The effects on Retail/Wholesale trade and Steel industry are explained in a different way. These two sectors are benefited in the taxation reform by paying a lower indirect taxes amount that reduces their production prices despite their increase of output.

On the other hand, the fifth most benefited sector is Machines and Tractors that would benefit from a quantity effect due to increase in import substitution and investment. On the opposite, company services sector is benefited from a price effect due to a difficulty in finding substitution for its products. The three most benefited sectors, Non-metallic minerals, Non-iron metallurgy and Other chemical products share the property of increases in production prices and quantities. These combinations of effects are possible in the context of a strong sectoral import substitution demanded for the market of intermediate inputs.

5.3. Impacts on employment and wages

Table 4 revealed that the reform would reduce aggregate employment (–1.72%). Table 5, below, reports the fiscal reform impacts on the employment by labor type (line PCVAM).

Table 5: change in employment from the base-year (%)							
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**
PCVAM	– 3,27	– 1,18	– 2,12	– 0,88	– 1,11	0,00	0,00
PCVA	– 2,03	– 0,45	– 1,05	– 0,20	– 0,44	0,00	0,00

Note: L1-unskilled informal; **L2**-skilled informal; **L3**-formal with low skill; **L4**-formal with average skill; **L5**- formal with high skill; **L6**- low skilled public servant; **L7**- highly skilled public servant.

The results show that employment would fall for all categories of workers in the private sector only. The public servants employment does not change because public sector does not follow the behavior of private sector concerning hiring/firing people and so, by assumption, their employment levels are fixed and their labor market adjust only by means of wages.

Among workers in the private sector, the effects would be more pronounced among the less skilled ones, regardless their labor contract status (L1 and L3). The second higher impacts would be on employment of more skilled workers, also regardless contract status (L2 and L5). The less affected category would be the formal with average skill worker (L4).

In our interpretation, with lower imports there will be a pressure to overvalue the exchange rate that will tend to make exports more expensive, which will be reinforced by an increase in input prices used to produce exported goods. The sectors in which exports are more sensible to price changes are the most traditional ones. Thus, by exporting less, there would be a tendency for these sectors to produce less and, therefore, to employ less workers, especially the less skilled ones.

The decrease in employment of more skilled workers is due to the fall in the output of sectors that produce goods with higher technological content and demand this kind of worker in a more intensive way (automobiles, auto parts, electronic, electrical, and pharmaceutical).

Now, it will be presented the effects on wages by labor type. It is worth remembering that, it is assumed that the sectoral wage differentials are rigid. Thus, the wage structure can only react to the type of labor. As a consequence, we report, in table 6, below, the changes in real wages for each type of worker without any sector desegregation.

Table 6: change in the average wage from the base-year (%)							
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**
PCVAM	− 1,35	− 1,12	− 1,23	− 1,56	− 1,93	− 2,24	− 2,22
PCVA	− 0,89	− 0.44	− 0,66	− 0,38	− 0,82	− 1,07	− 1,03

Note: L1-unskilled informal; **L2**-skilled informal; **L3**-formal with low skill; **L4**-formal with average skill; **L5**- formal with high skill; **L6**- low skilled public servant; **L7**- highly skilled public servant.

Note that the general effect is a real wage fall. The wage of informal workers (L1 and L2) would fall relatively less comparing to the other categories. Among private sector workers, the decrease in wages would be lower among the less skilled workers (L1 and L3) and the fall strength is proportional to the increase in qualification. The higher reduction of public servants' earnings is due to the assumption that the equilibrium in their labor market is almost exclusively achieved by means of wages adjustments.

In general terms, it does not seem that there was a labor category that had benefited more or less from the reform. Classifying the workers from the most to the less benefited worker group, according to the impacts on employment, we would have the ordering: public servants, formal with average skill, highly skilled and low skilled. However, according to the impacts on average real wage, we would have almost the opposite ordering. The classification of workers into informal, formal private and formal public categories also does not show any pattern.

5.4. Impacts on household income

The effects of the fiscal reform on household income are presented in table 7, below.

Table 7: change in household income from the base-year (%)							
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
PCVAM	− 1.61	− 0.25	− 1.51	− 1.54	− 1.50	− 1.22	− 1.55	− 1.64
PCVA	− 0.95	− 0.28	− 0.90	− 0.93	− 0.86	− 0.75	− 0.88	− 0.93

Note: F1 – poor urban families headed by active individuals, **F2** – poor urban families headed by non-active individuals, **F3** – poor rural families, **F4** – urban families with low average income, **F5** – urban families with average income, **F6** – rural families with average income, **F7** – families with high average income, **F8** – families with high income.

The results show that all types of households have their real incomes negatively affected by the fiscal reform. It is notorious that only the poor urban families headed by non-active individuals (F2) would present a much lower decrease in their real income (–0.25%) comparing to the fall experienced by the other types of families (stronger than –1.20%). This would happen because this is the family (F2) whose total income presents the lowest dependency on labor earnings.

In the Brazilian economy, the labor income has a large weight in the generation of the household income. Nevertheless, income transfers have an important participation, mainly for the poor households by means of the social security retirement pensions and benefits, besides the direct transfers from social programs (as "Bolsa Família").

Considering the distribution of impacts on families' real income, it is not clear that the reform had affected the inequality in income distribution in Brazil. However, the reform had almost linearly reduced the average real income in the country and had induced a decrease in employment and consumption, then, it is possible to interpret the general impact from the reform as a welfare reducing one.

Table 8, below, reinforces the argument that the taxation reform would not have affected the inequality in income distribution.

Table 8: Income inequality indicators

	base year	PCVAM
Poor income / total income	5.86%	5.87%
20% poorest / 30% richest	9.02%	9.04%
20% poorest / 5% richest	23.19%	23.24%

Note: Poor (F1+F2+F3), 30% richest (F7+F8), 5% richest (F8)

Therefore, taking in account the income levels, the main losers of PIS-COFINS tax reform would be the poorest households. Even it is not so clear to infer that the reform would unequivocally worse the income inequality, it is reasonable to expect that it had increased the poverty gap once the poor families real income levels would fall, reducing more their, already low, consumption levels.

6. Conclusion

In this paper, we have investigated the effects of a change in the Brazilian Fiscal System on some economic indicators, also trying to infer the impacts on social welfare. More precisely, together with macro indicators we have estimated how wages and employment structures, as well as the household income distribution would react to the tax reform characterized by the introduction of a mixed (cumulative and non-cumulative) tax system for PIS/PASEP and COFINS, and by their incidence on imports of goods and services.

Despite the increase of Government fiscal revenues and the reduction in the public deficit, that induces increase in investment, the results show that the reform would have adverse effects on macroeconomic aggregates, as GDP, general price level, employment, consumption and external trade flows (exports and imports) would present lower magnitudes. Also, the intensity of changes induced by the reform would depend on the taxation level of PIS-COFINS on imports. As imports are taxed, the public sector indicators would become better but the adverse effects on other macroeconomic would be enhanced, except for investment. The implemented simulation reveals another important macro issue related with the model macro-closures. It seems that the effect in the composition of aggregate demand will depend on the closure choices.

For the labor market, we can notice a clear general deterioration, but the effects differ among categories of workers. The negative effects on the employment structure are concentrated among less skilled workers in the private sector (L1 and L3), regardless their labor contract status. The second higher impacts would be on employment of more skilled workers (L2 and L5), also regardless contract status. These effects are due to the decrease in exports of sectors that represent high shares in these workers distribution along productive activities. Again, the intensity of results would be enhanced with taxation of imports.

There would be a general welfare loss for all families. Only the poor urban families headed by non-active individuals would present a relatively lower fall in income due to their low dependency on labor earnings. All other families would present percentage changes in income very close to the others. Therefore, considering the income levels, the main losers of PIS-COFINS tax reform in the simulation are the poorest households. Even it is not so clear to infer that the reform would unequivocally worse the income inequality, it is reasonable to expect that the reform had increased the poverty, once the poor families' real income levels would fall, reducing more their, already low, consumption levels.

Finally, it deserves be emphasized that the imposition of PIS and COFINS taxes on imports induced a stronger and much more relevant impact than the effects related to domestic flows, which consisted in partially changing the tax base from firms gross revenue to firms value-added.

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