Economics Bulletin

Volume 37, Issue 2

The economic effects of the elimination of taxation on investment: the case of ICMS in Brazil

Nelson Leitao Paes
Universidade Federal de Pernambuco/Universidade Federal do Mato Grosso

Abstract

This paper analyzes the economic impact of the exclusion of the state tax (ICMS) on investment in capital goods. Purchases of machinery and equipment in Brazil pay taxes as a consumption good and these taxes are refunded in 48 monthly installments without interest. We have used a general equilibrium model with two types of investment and disaggregation in the public sector. The results suggest a positive impact on the economy, but the loss of states revenue may reach 1.5%, which could be offset by an increase on consumption taxes. The greatest risks for this tax reform are concentrated in the short term, either by the loss of revenue, or because of a transitory drop in consumption and welfare.

This research was supported by the Brazilian National Council of Technological and Scientific Development [grant number 306148/2015-3].
Citation: Nelson Leitao Paes, (2017) "The economic effects of the elimination of taxation on investment: the case of ICMS in Brazil", *Economics Bulletin*, Volume 37, Issue 2, pages 1055-1067
Contact: Nelson Leitao Paes - nlpaes@yahoo.com.br.
Submitted: December 22, 2016. **Published:** May 08, 2017.

1. Introduction

Brazil is one of the few countries in the world that still impose taxes on investment, which increases the relative price of capital goods and introduces new distortions in the economy. This happens because its main tax, ICMS, is a tax on consumption, with similarities to a value added tax (VAT), but it is also levied on capital goods.

Until 1996, the ICMS paid on the acquisition of machinery and equipment could not be recovered. Companies that purchased capital goods at that time did not receive back the ICMS paid on these acquisitions. Everything changed with the approval of Complementary Law nº 87 of 1996, and the ICMS paid on the acquisition of machinery and equipment now could be fully and promptly recovered. However, the legislation changed again. Complementary Law nº 102 of 2000 resolved that the recovery of tax must be paid within 48 months.

Several authors have pointed out the impropriety that is associated with the taxation of ICMS on investment. Coelho (2014) highlighted that taxing investments goes against the nature of a tax on consumption, and makes ICMS far from an ideal VAT. Varsano (2014) and CNI (2014) also pointed to the taxation of ICMS on investment as a setback. On the other hand, the Brazilian states fear the resulting loss of revenue from the reduction of the ICMS tax base.

Silva et al. (2010) estimated the effective rate of ICMS on investment at 4% after the approval of Complementary Law nº 102 of 2000. The authors used data provided by the Federation of Industries of São Paulo and suggest the revision of the legislation as a way to reduce investment costs.

This article seeks to estimate the economic impacts of the withdrawal of ICMS on investment, i.e., the tax paid on the acquisition of capital assets would be immediately recovered by the companies. A general equilibrium model was built with disaggregation of investment and the public sector.

This study, therefore, properly aligns with a well-established branch of literature that tries to estimate the impacts of tax changes in the economy. In general, these studies are useful to evaluate tax reforms. Examples are the works of Fullerton et al. (1983), Auerbach and Kotlikoff (1987) and Altig et al. (2001).

In Brazil, several articles have tried to analyze tax changes and their effects on the economy. Some articles deal with general reforms that promote a substantial change in the tax system, such as Araújo and Ferreira (1999), in relation to the Proposed Constitutional Amendment (PEC) nº 46-A/1995, Paes and Bugarin (2006) for the PEC nº 41/1995 and Paes (2011), which analyzed the PEC nº 233/2008.

Other studies have tried to assess the impact of specific changes in taxation. For example, Silva, Paes and Ospina (2014) analyzed the change in the tax basis of social security contributions from payroll to consumption, Cavalcanti and Silva (2010) studied the reduction of taxes on the industry, and Barreto (1997) and Ellery and Bugarin (2003) dealt with the reform of social security.

The contribution of this paper is to deepen the analysis of the elimination of ICMS on investment. There is no study in literature estimating the impacts of the removal of ICMS on capital goods. This paper presents the expected effects of this change on the main economic variables and on the revenues of the public sector, particularly on the tax collection of the States.

Two simulations were conducted. In the first, the ICMS on capital goods is eliminated with a reduction in spending by the state keeping the budget balanced. In the second, the exclusion of ICMS on investment is financed by an increase of the ICMS rate on consumer goods in order to maintain the current level of spending in the states. The results in the first

simulation suggest that the loss of revenues of the state may reach 1.5% in the short term, which could indicate the need to increase taxes. Yet, in the second simulation, which includes raising taxes, the results show that the change is positive for the economy, especially in the long term, with increased capital, product and consumption. There are revenue gains at the federal and local level, but, in the short term, there are losses in consumption and welfare, which can become an obstacle to reform.

After this brief introduction, the next section presents the theoretical model used in this article. In the following section, the model is calibrated with data from the Brazilian economy in 2013. In section four, the main results are presented, and finally, in conclusion, we reinforce the argument in favor of the elimination of the ICMS on investment, with suggestions for the Brazilian tax policy.

2. Model

The model is a standard neoclassical one with two types of capital – machinery and equipment, and buildings and structures. The reason for this differentiation is that ICMS taxes each type of capital differently. The model also has three levels of government: local, state and federal, which helps to better understand the impacts of the exclusion of ICMS taxation on investment, particularly on state revenues.

Households – There is a representative household that solves the following utility maximization problem subject to a budget constraint:

$$U_t = \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\sigma}}{1-\sigma} + A \cdot \ln(1-h_t) \right] \tag{1}$$

$$\begin{aligned} &(1+\tau_{ct}) \cdot c_t + \left(1+\tau_{it}^b\right) \cdot [k_{t+1}^b - (1-\delta_b) \cdot k_t^b] + \\ &(1+\tau_{it}^m) \cdot [k_{t+1}^m - (1-\delta_m) \cdot k_t^m] \\ &\qquad = (1-\tau_{ht}) \cdot w_t \cdot h_t + (1-\tau_k) \cdot r_t^b \cdot k_t^b + \\ &\qquad\quad (1-\tau_{kt}) \cdot r_t^m \cdot k_t^m + T_t \end{aligned} \tag{2}$$

Where β is the intertemporal discount rate, c_t is the consumption at time *t*, *A* is a preference parameter for leisure, h_t are the working hours at time *t*, τ_{ct} is the consumption tax rate at time *t*. On the investment side, for buildings and structures, τ_{it}^b is the tax rate on investments, k_t^b is the capital stock at time *t*, δ_b is the depreciation rate, and for machinery and equipment, τ_{it}^m is the investment tax rate, k_t^m is the capital stock at time *t*, and δ_m is the depreciation rate. The other variables are the tax rate on labor income, τ_h, wage at time *t*, w_t, the tax rate on capital income, τ_k, the rate of return on capital of buildings and constructions at time *t*, r_t^b, the rate of return on capital of machinery and equipment at time *t*, r_t^m and the transfers at time *t*, T_t.

As a result of the maximization problem, there are more than one equation for no-arbitrage between the return of capital in buildings and structures, and in machinery and equipment; an Euler equation and an equation for the relationship between consumption and leisure.

$$r_{t+1}^{m} = -\frac{(1+\tau_{it+1}^{m})\cdot(1-\delta^{m})}{(1-\tau_{kt+1})} + \frac{(1+\tau_{it}^{m})\cdot(1-\delta^{b})\cdot\left(1+\tau_{it+1}^{b}\right)}{(1-\tau_{kt+1})\cdot\left(1+\tau_{it}^{b}\right)} + \frac{(1+\tau_{it}^{m})}{\left(1+\tau_{it}^{b}\right)} r_{t+1}^{b} \tag{3}$$

$$c_{t+1} = \left\{\beta\cdot\frac{(1+\tau_{ct})}{(1+\tau_{ct+1})} \cdot \frac{[(1+\tau_{it+1}^{m})\cdot(1-\delta^{m}) + (1-\tau_{kt+1})\cdot r_{t+1}^{m}]}{(1+\tau_{it}^{m})}\right\}^{1/\sigma} \cdot c_{t} \tag{4}$$

$$h_{t} = 1 - \frac{A\cdot(1+\tau_{ct})\cdot c_{t}}{(1-\tau_{ht})\cdot w_{t}} \tag{5}$$

Firms – There is a representative firm which uses two types of capital in a Cobb-Douglas production function. The firm maximizes profits:

$$\pi_{t} = (k_{t}^{m})^{\alpha}\cdot\left(k_{t}^{b}\right)^{\gamma}\cdot {h_{t}}^{1-\alpha-\gamma} - w_{t}\cdot h_{t} - r_{t}^{b}\cdot k_{t}^{b} - r_{t}^{m}\cdot k_{t}^{m} \tag{6}$$

The first order condition and the hypothesis that firms are competitive, imply in the following equations:

$$w_{t} = (1-\alpha-\gamma)\cdot(k_{t}^{m})^{\alpha}\cdot\left(k_{t}^{b}\right)^{\gamma}\cdot {h_{t}}^{-\alpha-\gamma} \tag{7}$$

$$r_{t}^{m} = \alpha\cdot(k_{t}^{m})^{\alpha-1}\cdot\left(k_{t}^{b}\right)^{\gamma}\cdot {h_{t}}^{1-\alpha-\gamma} \tag{8}$$

$$r_{t}^{b} = \gamma\cdot(k_{t}^{m})^{\alpha}\cdot\left(k_{t}^{b}\right)^{\gamma-1}\cdot {h_{t}}^{1-\alpha-\gamma} \tag{9}$$

Governments – There are three levels of government in the model – federal, state and local. Each level keeps its budget balanced. Only the federal government makes transfers to households and only state taxes investment.

$$G_{lt} = \tau_{ct}^{l}\cdot c_{t} + \tau_{ht}^{l}\cdot w_{t}\cdot h_{t} + \tau_{kt}^{l}\cdot\left(r_{t}^{b}\cdot k_{t}^{b} + r_{t}^{m}\cdot k_{t}^{m}\right) \tag{10}$$

$$G_{st} = \tau_{ct}^{s}\cdot c_{t} + \tau_{ht}^{s}\cdot w_{t}\cdot h_{t} + \tau_{kt}^{s}\cdot\left(r_{t}^{b}\cdot k_{t}^{b} + r_{t}^{m}\cdot k_{t}^{m}\right) + \tau_{it}^{b} \cdot[k_{t+1}^{b} - (1-\delta_{b})\cdot k_{t}^{b}] + \tau_{it}^{m}\cdot[k_{t+1}^{m} - (1-\delta_{m})\cdot k_{t}^{m}] \tag{11}$$

$$G_{ft} + T_{t} = \tau_{ct}^{f}\cdot c_{t} + \tau_{ht}^{f}\cdot w_{t}\cdot h_{t} + \tau_{kt}^{f}\cdot\left(r_{t}^{b}\cdot k_{t}^{b} + r_{t}^{m}\cdot k_{t}^{m}\right) \tag{12}$$

G_{lt} is the local spending, G_{st} for the state spending and G_{ft} is the federal spending.

Equilibrium – Equilibrium requires supply and demand for labor and the two types of capital are equal. Furthermore, goods market also clear:

$$(k_t^m)^{\alpha} \cdot \left(k_t^b\right)^{\gamma} \cdot {h_t}^{1-\alpha-\gamma} = c_t + G_t + [k_{t+1}^b - (1-\delta_b) \cdot k_t^b] + [k_{t+1}^m - (1-\delta_m) \cdot k_t^m] \quad (13)$$

G_t is the sum of public spending from federal, state and local governments.

Model Solution – Substituting equations (5), (7), (8), (9), (10) and (11) in (3), (4) and (13) determines a system of dynamic equations that solves the model:

$$\left[\frac{\alpha}{k_{t+1}^m} - \frac{(1+\tau_{it}^m)}{(1+\tau_{it}^b)} \cdot \frac{\gamma}{k_{t+1}^b}\right] \cdot (k_{t+1}^m)^{\alpha} \cdot \left(k_{t+1}^b\right)^{\gamma} \cdot {h_{t+1}}^{1-\alpha-\gamma} = -\frac{(1+\tau_{it+1}^m) \cdot (1-\delta^m)}{(1-\tau_{kt+1})} + \frac{(1+\tau_{it}^m) \cdot (1-\delta^b) \cdot \left(1+\tau_{it+1}^b\right)}{(1-\tau_{kt+1}) \cdot \left(1+\tau_{it}^b\right)} \quad (14)$$

$$\begin{aligned} &(1-\tau_{ht}) \cdot (1-h_{t+1}) \cdot (k_{t+1}^m)^{\alpha} \cdot \left(k_{t+1}^b\right)^{\gamma} \cdot {h_{t+1}}^{-\alpha-\gamma} \\ &= \beta \\ &\cdot \frac{\left[(1+\tau_{it+1}^m) \cdot (1-\delta^m) + (1-\tau_{kt+1}) \cdot \alpha \cdot (k_{t+1}^m)^{\alpha-1} \cdot \left(k_{t+1}^b\right)^{\gamma} \cdot {h_{t+1}}^{1-\alpha-\gamma}\right]}{(1+\tau_{it}^m)} \\ &\cdot (1-\tau_{ht}) \cdot (1-h_t) \cdot (k_t^m)^{\alpha} \cdot \left(k_t^b\right)^{\gamma} \cdot {h_t}^{-\alpha-\gamma} \end{aligned} \quad (15)$$

$$\begin{aligned} &(k_t^m)^{\alpha} \cdot \left(k_t^b\right)^{\gamma} \cdot {h_t}^{1-\alpha-\gamma} \\ &= \frac{\left(1+\tau_{ct}^l+\tau_{ct}^s\right) \cdot \left|\frac{(1-\tau_{ht}) \cdot (1-h_t) \cdot (k_t^m)^{\alpha} \cdot \left(k_t^b\right)^{\gamma} \cdot {h_t}^{-\alpha-\gamma}}{A \cdot (1+\tau_{ct})}\right|^{1/\sigma}}{1-\left(\tau_{ht}^l+\tau_{ht}^s\right) \cdot (1-\alpha-\gamma) - \left(\tau_{kt}^l+\tau_{kt}^s\right) \cdot (\alpha+\gamma)} \\ &+ \frac{G_{ft} + \left(1+\tau_{it}^b\right) \cdot [k_{t+1}^b - (1-\delta_b) \cdot k_t^b] + (1+\tau_{it}^m) \cdot [k_{t+1}^m - (1-\delta_m) \cdot k_t^m]}{1-\left(\tau_{ht}^l+\tau_{ht}^s\right) \cdot (1-\alpha-\gamma) - \left(\tau_{kt}^l+\tau_{kt}^s\right) \cdot (\alpha+\gamma)} \end{aligned} \quad (16)$$

The numerical solution was obtained using Broyden algorithm with Matlab software.

3. Calibration

The model was calibrated with Brazilian data for 2013.

Aggregate Variables – From National Accounts, consumption/GDP (C/Y) = 0.6040, total public spending/GDP (G/Y) = 0.1858, investments in machineries and equipment /GDP

(Im/Y) = 0.0778, investments in buildings and structures/GDP (Ib/Y) = 0.1324 and the capital share of income, θ = 0.4258.

Tax Parameters – To calculate the tax parameters, it was necessary to disaggregate revenues by taxable basis (consumption, investment, capital income and labor income) and by the levels of government (federal, state and local). An initial difficulty is the calculation of the tax rate on investment. The law determines the incidence of ICMS in machinery and equipment only, so buildings and structures are not reached by the tax ($\tau_i^b = 0$). Companies pay the full ICMS rate when investing in machinery and equipment, and the tax amount is returned in 48 monthly installments without any interest. Therefore, the effective tax rate is equivalent to the difference in the amount of ICMS paid at the time of the investment and the present value of 48 returned parcels divided by the value of the investment. We used the short term real interest rate charged from firms as the discount rate. According to the Inflation Report of the Brazilian Central Bank, this rate was at 0.74% per month in December 2013. So the effective tax rate on investment in machinery and equipment was set at $\tau_i^m = 1.76\%$. For other parameters, the following table summarizes the results:

Table I – Tax Parameters

A	B	C	D	E	F
Labor Income	Total Revenue (% GDP)	12.2	Total Labor Income Rate	= column (C) / (1- θ)	$\tau_h = 21.3\%$
	Federal (% GDP)	7.3	Federal Rate		$\tau_h^f = 20.4\%$
	State (% GDP)	3.3	State Rate		$\tau_h^s = 0.6\%$
	Local (% GDP)	1.6	Local Rate		$\tau_h^l = 0.3\%$
Capital Income	Total Revenue (% GDP)	5.3	Total Capital Income Rate	= column (C) / θ	$\tau_k = 12.4\%$
	Federal (% GDP)	3.9	Federal Rate		$\tau_k^f = 9.1\%$
	State (% GDP)	0.7	State Rate		$\tau_k^s = 1.6\%$
	Local (% GDP)	0.7	Local Rate		$\tau_k^l = 1.7\%$
Consumption	Total Revenue (% GDP)	17.6	Total Consumption Rate	= column (C) / (consumption/GDP)	$\tau_c = 30.3\%$
	Federal (% GDP)	9.2	Federal Rate		$\tau_c^f = 15.2\%$
	State (% GDP)	7.2	State Rate		$\tau_c^s = 13.1\%$
	Local (% GDP)	1.2	Local Rate		$\tau_c^l = 2.0\%$

Capital, Depreciation and Rates of Return – Initially we set the rate of return of investment in buildings and constructions to be equivalent to the basic interest rate for the economy (SELIC) in December 2013 ($r^b = 4.09\%$) and the annual rate of depreciation of buildings and structures ($\delta^b = 0.018$) - this is equivalent to an average estimate of 55 years of lifespan of the property. The capital stock of buildings and structures can then be calculated by $k^b = (Ib/Y)/\delta^b = 7.3754$. The rate of return of capital in machines and equipment can be obtained from equation (3) at steady state, $r^m = 7.48\%$. The stock of capital in machinery and equipment came from equation (8) at steady state, $k^m = 1.6697$. Depreciation of machinery and equipment can be calculated by $\delta^m = (Im/Y)/k^m = 0.0466$.

Wages and Hours of Work – Wages was calculated from equation (7) at steady state ($w = 1.8269$) and hours of work by equation (9) also at steady state ($h = 0.3143$).

Preference Parameters – The intertemporal discount rate was obtained from equation (4) at steady state, ($\beta = 0.9825$), and the leisure preference parameter came from equation (5) at

steady state, ($A = 1.0770$). The elasticity of intertemporal substitution of consumption, σ, was set at 0.7, same as Cavalcanti (2010).

Fiscal Variables – Local and state spending, and transfers were obtained by equations (10), (11), and (12), respectively - ($G_l = 0.0208$; $G_m = 0.0909$; $T = 0.1737$). Federal spending was calculated by the difference between total public spending (G/Y), and state and local spending, so, $G_f = 0.0741$.

4. Results

Two simulations were performed. In the first, the elimination of the investment tax was financed by a reduction in the spending of the state government. In the second simulation, the removal of ICMS on investment was financed by an increase in state taxation of consumption, so, the reform is neutral for the state.

4.1 Adjustment of state spending

Long Term Results – The elimination of ICMS on investment financed by a reduction in state spending has a positive impact on the economy.

Table II – Long Term Results

Variable	Long Term Results
Capital Stock – Machines and Equipment	+2.2%
Capital Stock – Buildings	+0.5%
Hours of Work	+0.1%
Consumption	+0.5%
Output	+0.5%
Federal Transfers	+0.7%
Federal Spending	0.0%
State Spending	-1.0%
State Consumption Tax Rate	+18.2%
Local Spending	+0.5%
Welfare	+0.2%

The tax distorts the choice of the type of investment by firms, and with its removal, the investment increases more in machineries and equipment and less in buildings and structures. Working hours increase less than capital stock, since the tax on investment also distorts firms' choice of capital and labor.

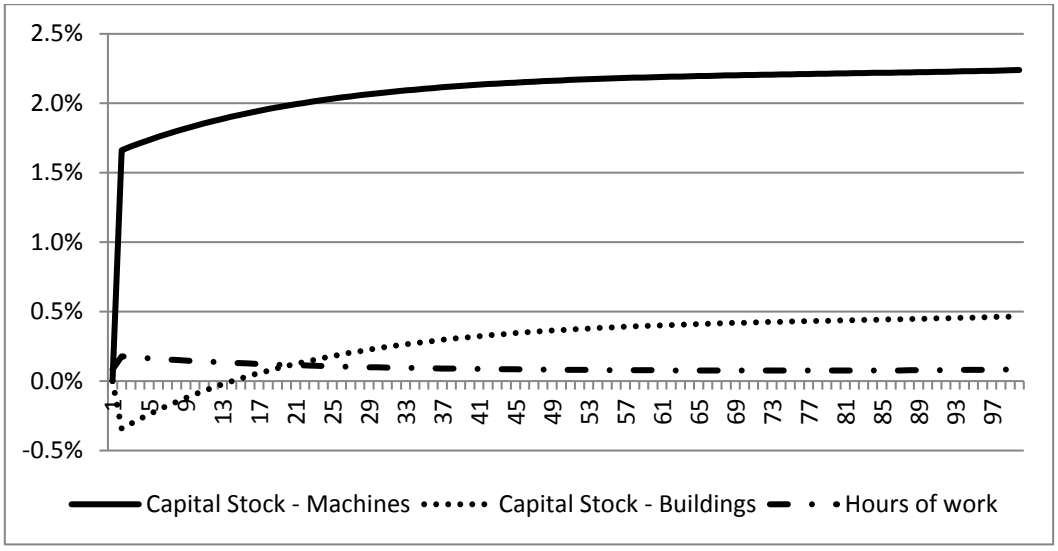
By hypothesis, the spending of federal government is kept fixed. The removal of distortions in the economy ends up increasing revenues of federal and local governments. The revenue increase is targeted for households' transfers in the federal case and for public expenditure in the local case.

State government loses 1% of its revenue, which implies a reduction of the same magnitude on its expenses. It can be a major difficulty for states in Brazil. The crisis in the country has been especially difficult for state finances.

Welfare increases since the growth of consumption was larger than the increase in the hours of work.

Transition Results – When considering the transition of the economy to its new steady state, it is possible to analyze the behavior of the variables throughout the trajectory of the economy. Figure 1 shows the transition results for production factors.

Figure 1 – Transition: Production Factors



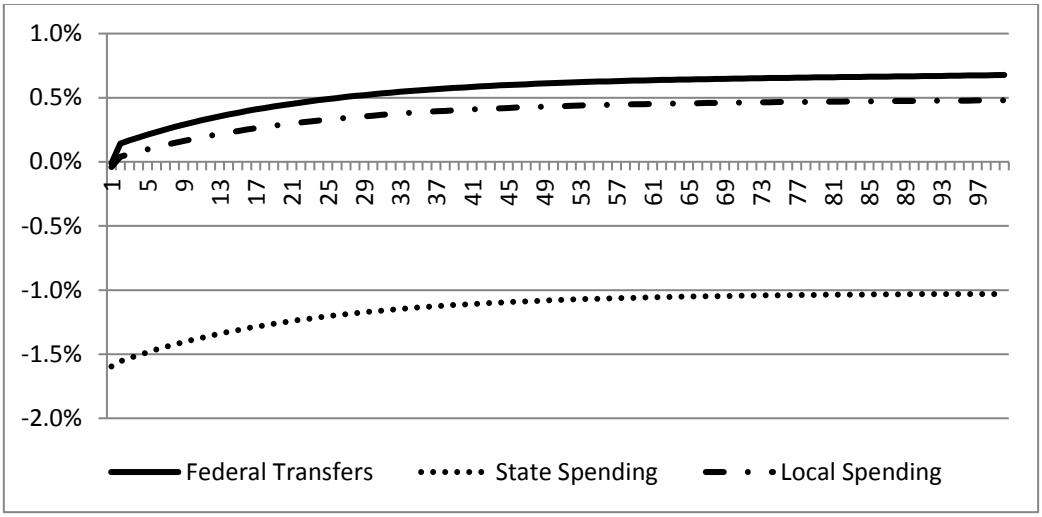
Capital stock of machineries and equipment quickly reacts to the elimination of the tax, with investment being largely directed to this type of capital. Capital stock continues to grow over the trajectory, but at lower rates, until stabilization is attained in the new steady state.

On the other hand, investment in buildings and structures decreased substantially, reducing the stock of this type of capital in the short term. It is only in the 12th year after the beginning of the reform, that capital stock of buildings returns to the previous level. As the economy grows, investment in building and structures increases and the capital stock rises in the long run.

Working hours grow immediately after the reform, responding to the decrease of consumption and the increase in capital stock. However, as the investment became cheaper and the production turned more capital intensive, the hours of work had to change to suit this new condition. The reduction in working hours is more than offset by increase in labor, due to the production growth. In the new steady-state equilibrium, labor increase, but is less than the capital stock in buildings.

Regarding public finances, Figure 2 shows the results.

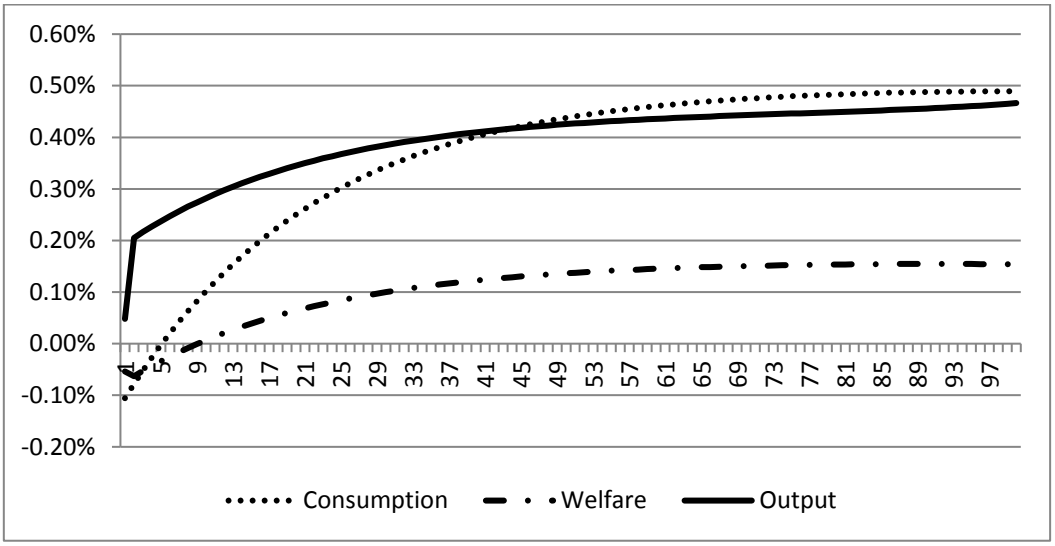
Figure 2 – Transition: Public Finance



As the economy grows, revenues of the federal and local governments also increase gradually. As federal spending is kept constant, the increase in federal revenue is entirely directed as transfers to households. Revenues of local government are fully targeted for spending. Both are benefited from by the elimination of distortions in the state tax on investment. Since the state needs to cut spending to maintain its balanced budget, its losses in the short term exceed 1.5%. As the economy grows, the revenues of the state partly recover, but still, force spending to be reduced by 1%.

The next figure shows the transition for other relevant economic variables.

Figure 3 – Transition: Output, Consumption and Welfare



Reduction in the cost of investment in machinery and equipment stimulates the rapid growth of output, increasing working hours in a very short term. Output continues to grow during all the transition, although at lower rates, to stabilize at almost 0.5% above its previous steady state.

Consumption is negatively impacted by the lower relative price of investment, so households prefer more investment and less consumption. The impact, however, is very short and from the 4th year after reform, consumption is already showing growth.

Welfare also falls during the short term, both by the reduction of consumption and also because of the increase in working hours. Welfare only returned to its pre-reform level in the 8th year after the reform, but the short-term losses were small.

This simulation shows the impact that the simple removal of taxation of ICMS on investment would have on state finances. As the loss was relatively pronounced, especially in the short term, a second scenario could be helpful. In the next simulation, state government increases the tax on consumption, in order to make the reform neutral.

4.2 Increase state consumption taxation

Long Term Results – The removal of the tax on investment, even with increased taxation of consumption, has a positive effect on the economy by stimulating the accumulation of capital, and therefore other macroeconomic variables such as consumption and output.

Table 3 – Long Term Results

Variable	Long Term Results
Capital Stock – Machines and Equipment	+2.3%
Capital Stock – Buildings	+0.5%
Hours of Work	+0.2%
Consumption	+0.4%
Output	+0.5%
Federal Transfers	+0.7%
Federal Spending	0.0%
State Spending	0.0%
State Consumption Tax Rate	+18.2%
Local Spending	+0.5%
Welfare	+0.1%

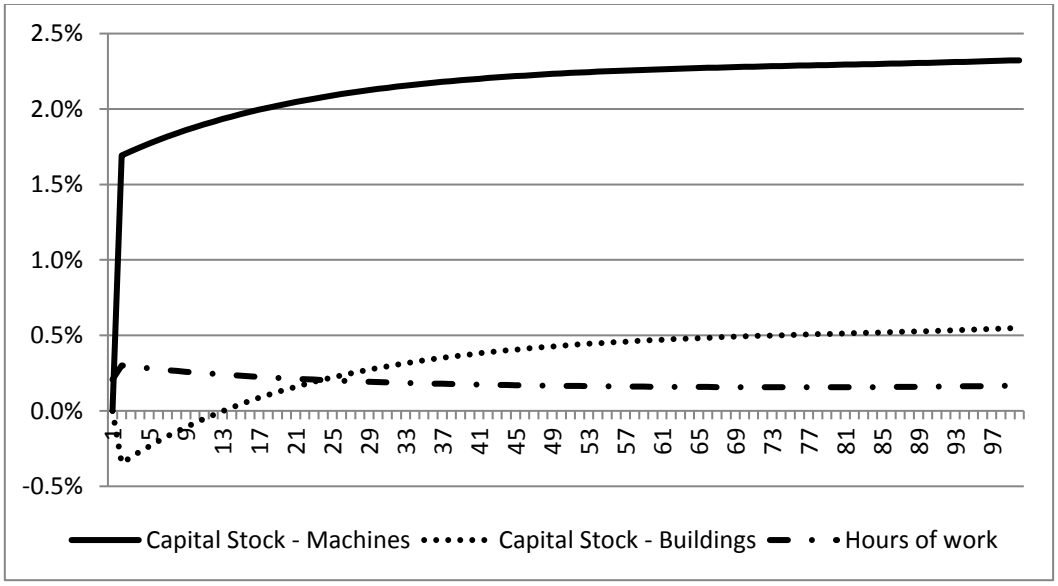
The end of the distortions caused by taxation on investment has positive impacts on the economy, increasing capital stock and working hours. The results of the current simulation are slightly lower than the previous one, since it aggravated the distortion caused by taxation of consumption, which ultimately affect the entire economy.

Again, hypothetically, the federal government spending was kept fixed, but now it is also assumed that the same goes for state expenditure, since the tax change was neutral to the state. Tax revenues of the federal and local governments increased. The rise in federal revenue is directed to transfers and the increase in local revenue boosts public spending. The nominal rate of ICMS on consumer goods increased from 18% to 18.2% in order to offset the loss of revenue from the removal of taxation on investment.

The combination of growth in working hours with increased consumption makes the welfare virtually unchanged in the long run.

Transition Results – Figure 4 presents the transition for production factors.

Figure 4 – Transition: Production Factors



The capital stock in machinery and equipment grows substantially in the early years of the change, due to its lower relative price, not only in terms of consumption, but also in relation to investment in buildings and structures. The reverse effect occurs with investment in buildings. Its relative price becomes higher and a part of the investment is diverted to machinery and equipment. Thus, capital stock of buildings is reduced in the short term, with a slow recovery following the growth of output.

Working hours have the same behavior as aggregate capital and increase in the short term. However, as investment in machinery and equipment becomes cheaper, firms slowly use a little more capital and little less working hours. Even so, working hours have a positive performance throughout the transition.

Figure 5 – Transition: Public Finance

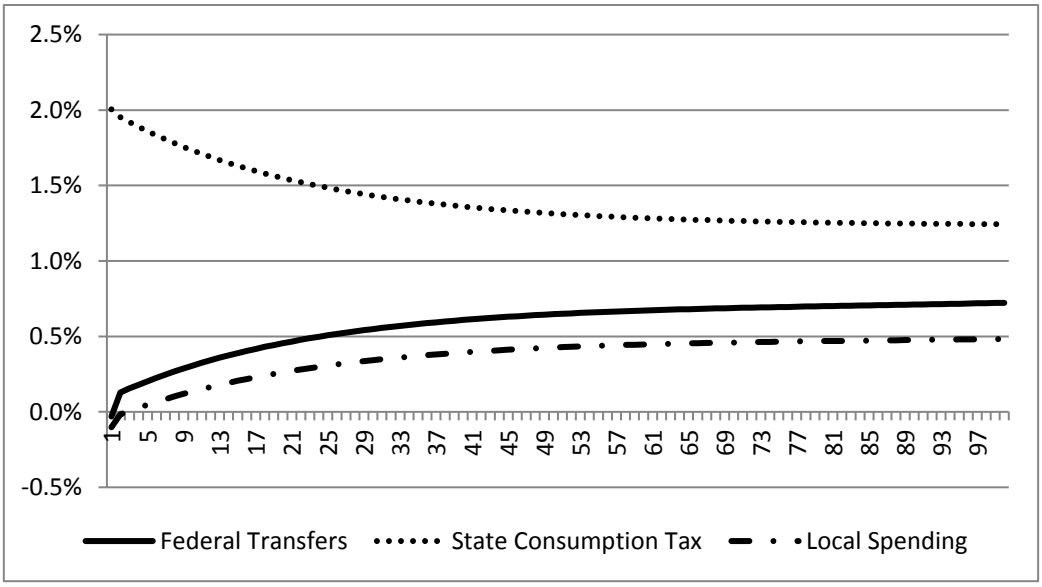


Figure 5 illustrates the results for the public sector. Tax revenues of the federal and local government grow following the trajectory of output. The state needs to increase the rate of ICMS on goods more sharply in the short term, from 18% to 18.4%. However, as the economy and consumption grow, the rate required to maintain a balanced budget of the state is reduced gradually to 18.2% in the long run. Therefore, from the public sector point of view, the elimination of taxation on investment has positive impacts and a seemingly modest cost to state with a small increase in the ICMS rate on consumer goods.

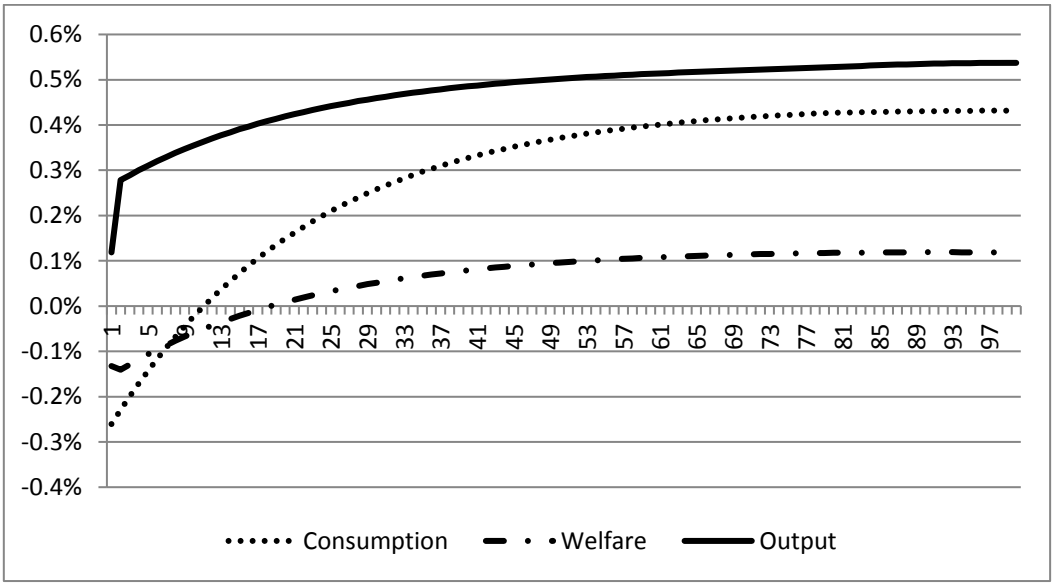
Finally, the transition trajectories for consumption, output and welfare are presented at Figure 6.

Output grows in the short term by the lower cost of investment in machinery and equipment, which also increase working hours. After the 4th year, output continues to grow, although at lower rates, stabilizing around an increase of 0.4%.

Consumption decreases in the short term by two factors - higher state consumption taxes and increased investment in machinery and equipment. However, as the economy grows, consumption recovers from the 9th year onwards. As investment begins to grow less, much of the increase in output is directed to consumption, which ends up with an increase of 0.4%, the same of output.

Welfare is affected in the short term by the increase in the working hours and by the decrease in consumption. Households therefore lose welfare in the early years of the reform, and recover only from the 12th year. But, welfare increase in present value (+ 1.86%), so the tax change has an overall positive impact on families.

Figure 6 – Transition: Output, Consumption and Welfare



The loss of welfare in the first periods after the reform is the biggest difficulty of eliminating taxation on investment. Although they are small, these losses in the short term can become an obstacle to reform, regardless of longer term gains.

5. Conclusion

This article has analyzed the impact of the removal of taxation of ICMS on investment in machinery and equipment in Brazil. This tax only occurs because the ICMS on capital goods is not immediately returned to companies, but only in 48 monthly installments without correction. In this study, we develop a general equilibrium model with disaggregation of investment and public sector.

Two simulations were performed for financing the exclusion of ICMS on investment: (i) reduce spending by state government; (ii) increase ICMS rate on consumer goods. The results suggest that the impact of the tax change was relatively large for state, with 1.5% revenue loss in the short term, which indicates that increasing taxes is really an option. But, even with a rising taxation on consumption, the change is positive for the economy. There was an increase of capital stock that was more pronounced in machinery and equipment, but also in building and construction, rising output, consumption and working hours.

In both simulations, the change was positive for the federal and local finances, with an increase in their revenues. For the state, in order to balance the budget, it would be necessary to increase the tax rate of ICMS on consumer goods, from the current 18% to 18.4% in the short term and 18.2% long term.

The greatest risk to the reform lies in the short term - loss of revenue in the first simulation and a decline in consumption and welfare in the second simulation. In the last case, although not a significant drop, the two variables take around 10 years to return to the level they were before the change. Even so, the magnitude of losses appears to be small compared to the potential future gains.

As a suggestion for tax policy, the most appropriate way seems to be to persist in seeking to enable a very fast compensation of ICMS paid on the acquisition of capital goods, by eliminating the taxation on investment. Even if this fast compensation is compensated by an increase in taxation of consumption, the change will bring gains for the Brazilian economy, reducing distortions and making the ICMS closer to a modern value added tax.

6. References

Altig, D.; Auerbach A.; Kotlikoff L.; Smetters K.; Walliser, J (2001) "Simulating fundamental tax reform in the United States". *American Economic Review* 91, 574-595.

Araújo, C. H. V.; Ferreira, P. C. G. (1999) "Reforma tributária no Brasil: efeitos alocativos e impactos de bem-estar" *Revista Brasileira de Economia* 53, 87-101.

Auerbach, A.; Kotlikoff, L. (1987) *Dynamic fiscal policy*, Cambridge University Press: Cambridge.

Barreto F. A. F. D. (1997) *Três ensaios sobre reforma de sistemas previdenciários*. PhD thesis, Escola de Pós-Graduação em Economia – Fundação Getúlio Vargas, Rio de Janeiro.

Cavalcanti, M. A. F.; Silva, N. L. C. (2010) "Impactos de políticas de desoneração do setor produtivo: uma avaliação a partir de um modelo de gerações superpostas" *Estudos Econômicos* 40, 943-966.

Coelho, I. (2014) "Um novo ICMS – Princípios para reforma da tributação do consumo". *Revista Brasileira de Comércio Exterior* 28, 30-49.

Confederação Nacional Da Indústria – CNI (2014). *O Custo tributário dos investimentos: as desvantagens do Brasil e as ações para mudar*, CNI: Brasília.

Ellery, R. G.; Bugarin, M. N. S. (2003) "Previdência social e bem-estar no Brasil" *Revista Brasileira de Economia* 57, 27-57.

Fullerton, D.; Shoven, J. B.; Whalley, J. (1983) "Replacing the U.S. income tax with a progressive consumption tax: A sequenced general equilibrium approach" *Journal of Public Economics* 20, 3-23.

Paes, N. L.; Bugarin, M. N. S. (2006) "Reforma tributária: impactos distributivos, sobre o bem-estar e a progressividade" *Revista Brasileira de Economia* 60, 33-56.

Paes, N. L. (2011) "Reforma tributária: os efeitos macroeconômicos e setoriais da PEC 233/2008" *Estudos Econômicos* 41, 276-302.

Silva, W. B.; Paes, N. L.; Ospina, R. (2014) "A substituição da contribuição patronal para o faturamento: efeitos macroeconômicos, sobre a progressividade e distribuição de renda no Brasil" *Revista Brasileira de Economia* 68, 517-545.

Varsano, Ricardo (2014) "A tributação do valor adicionado, o ICMS e as reformas necessárias para conformá-lo às melhores práticas internacionais**"** Banco Interamericano de Desenvolvimento – BID documento para discussão IDB-DP-335.