CHAPTER 6

TAX AND GROWTH IN A DEVELOPING COUNTRY: THE CASE OF BRAZIL

Adolfo Sachsida[1]
Mario Jorge Cardoso de Mendonca[2]
Tito B. Moreira[3]

1 INTRODUCTION

There is a considerable debate over the relation between taxes and economics performance. Recently, Heady et al. (2011) elaborated a ranking of taxes stating that changing the tax mix in direction of more consumption taxes (and away from corporate income tax) would improve economic performance.

We follow the idea presented in Heady et al. (2011) and estimated a tax ranking for a developing country (Brazil). This paper contributes to the literature applying the methodology developed by Heady et al. (2011) to a single country. Instead of a panel data technique this paper makes use of a time series approach to verify the impact of taxes over the Brazilian GDP per capita.

The econometric results show a negative and statistically significant impact of the overall tax burden over per capita GDP. In average, an increase of 1 percent in the overall tax burden decreases GDP per capita by 0.3 percent. This result is very similar in magnitude with those presented by Heady et al. (2011). Furthermore, our policy prescription is very similar of that presented by Heady et al. (2011), that is, a revenue neutral fiscal policy which changes the mix of tax burden toward consumption taxes and away from corporate taxes has the potential to improve the economic performance.

Besides this introduction, section 2 presents the dataset and provides additional information about the Brazilian tax system, section 3 introduces the econometric results; section 4 explores the channel between tax burden and economic growth. Section 5 concludes the paper.

1. Institute for Applied Economic Research. E-mail: <sachsida@hotmail.com>. Adolfo Sachsida acknowledges the research grant from CNPQ. We acknowledge the comments from University of Kent macroeconomic seminar participants.
2. Institute for Applied Economic Research. E-mail: <mario.mendonca@ipea.gov.br>.
3. Researcher at Tribunal de Contas da União.

2 THE DATASET

There are not a lot of doubts to claim that Brazil faces one of the worst tax systems in the whole world. In February of 2016 Brazil counts 92 different kinds of taxes,[4] and the government is struggling for the Congressional approval of another two (a tax over big fortunes and a financial transaction tax over banking accounts). Not just that there are too many taxes in Brazil, but their legislation suffers an incredible number of changes in short time periods. For example, in the year of 2015 27 major changes in the tax legislation occurred.[5]

In a study about changes in the Brazilian Constitution and in the tax system, Amaral, Olenike, and Amaral (2013) showed that in 25 years Brazil experimented fifteen tax reforms, besides that several different types of taxes and contributions were created, and almost all taxes were increased. They conclude that, in 25 years, Brazil creates 309,147 new tax norms (29,939 by federal government, 93,062 by state governments, and 186,146 by local governments), in average each norm has 3,000 words. In this time period we had 31 new tax norms per day in Brazil. In October of 2013 the Brazilian tax system was composed by 262,705 articles (artigos), 612,103 paragraphs (paragrafos), 1,957,154 incises (incisos), and 257,451 aligns (alineas). Assuming that a single firm does not make business outside the border of the state which it is located, this firm would have to complain with an astonishing 3,512 tax norms.

Messias (2013) presents some numbers about the litigious related to taxes in Brazil. Lower bound estimation suggests that, in the year of 2013, there were US$ 330 billion related to litigious in taxes, or something around 15% of the Brazilian GDP. Just to give an idea of this amount, the same value for the US economy was around 0.2% of their GDP. In Brazil there are 16 tax suits for each 10,000 inhabitants. It is a much higher number than in the United States (1 for each 10,000 inhabitants), Canada (2 for each 10,000 inhabitants), United Kingdom (9 for each 10,000 inhabitants), or Sweden (13 for each 10,000 inhabitants).

According to the 2015 edition of Doing Business, a World Bank report which measures business regulations for local firms around the world, in Brazil a medium size company wastes 2,600 hours per year with tax bureaucracy. Catar and Arab Emirates are the fastest countries in this measure, with companies located there spending just 41 hours per year with tax bureaucracy. Developed countries around the world as the United Kingdom (110 hours per year), France (137 hours per year), the United States (175 hours per year), and Germany

4. See: <http://www.portaltributario.com.br/tributos.htm>.
5. See: <https://www.lsconcursos.com.br/principais-alteracoes-na-legislacao-tributaria-em-2015-d112.html>.

(218 hours per year) have a much faster way to deal with the tax bureaucracy than Brazil. And even other developing countries in the world as Mexico (334 hours per year), and Argentina (405 hours per year) performs better than Brazil. After Brazil, the second worst country in the sample is Bolivia where companies spend 1,025 hours with tax bureaucracy. That is, Brazil is almost three times slower than the second worst country in its ability to deal with the bureaucracy of taxes.

It is very clear that the Brazilian tax system is confusing, expensive, and decreases both the competitiveness of the Brazilian companies and the productivity of the economy. A tax reform is in much need, but to do that it is fundamental to have a better idea of the impact of taxes over the economic growth.

This paper uses Brazilian quarterly data, from the period Jan/2002 to June/2015, to estimate the impact of taxes over GDP per capita. After that we are able to elaborate a tax growth ranking suggesting the better mix of taxes to improve Brazilian economic growth rate. Table 1 describes each variable adopted in this study.

TABLE 1
Description of the variables

Baseline model	
Real GDP per capita	Quarterly real GDP per capita data. Build from information available at Brazilian Institute of Geography and Statistics (IBGE).
Physical capital stock (k)	This time series was build from information collected in Ipeadata.[2]
Physical capital stock per economically active population (Kpea)	Refers to the physical capital stock divided by the size of the population classified as economically active.[3]
Human capital stock (h)	Refers to the average years of schooling of the population over 25 years old
Human capital stock (h2)	Refers to the percentage of illiteracy among individuals older than 15 years old. Data from Ipeadata.
Population (pop)	Refers to the size of the Brazilian population. Build from information available at Brazilian Institute of Geography and Statistics (IBGE).
Population economically active (PEA)	Refers to the size of the Brazilian economically active population. Build from information available at IPEADATA (refers to six Brazilian metropolitan areas).
Overall tax burden (total tax revenue / GDP)	This time series was build following the methodology suggested by Orair, Gobetti, Leal, and Silva (2013)[4] and relies in Brazilian official data.
Tax structure variables[1]	
1) Income tax	Taxes related to income
1.1) Personal income tax	Taxes related to personal income
1.2) Corporate income tax	Taxes related to corporate income

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Baseline model	
2) Consumption tax	Taxes related to consumption and production
3) Physical capital tax	Taxes related to physical capital
3.1) Recurrent tax on properties	Recurrent taxes on physical capital
3.2) Non-recurrent tax on properties	Non-recurrent taxes on physical capital

Elaborated by the authors,

Obs.: Two other variables were included in the regressions to verify the robustness of the results. Their inclusion does not change qualitatively the results of taxes over growth. These variables refers to a measure of openness of the Brazilian economy (as it can have impact on growth), and a measure of fiscal imbalances (since it can be related to the fiscal policy). Trade openness is measured as the ratio of imports to GDP; and the debt to GDP ratio is measured by the size of the Brazilian gross debt divided by GDP. Again, the inclusion of these variables does not have a qualitative impact on the results.

Notes: [1]The annex presents a table showing where each tax is allocated between income, consumption or physical capital tax.

[2] Ipeadata is an initiative of the Institute for Applied Economic Research to collect and make available in one site several socio-economic time series data for the Brazilian economy. See: <www.ipeadata.gov.br>. More information about the construction of the physical capital time series can be obtained in Morandi and Reis (2004). After the construction I compare it with another capital stock series, kindly provided by Roberto Ellery Jr. The correlation between them is 0.93.

[3] Population economically active is the size of the population which satisfies two criteria: a) are working or looking for jobs; and b) are older than 15 years old.

[4] Rodrigo Orair kindly provided us with the update data until June/2015.

A brief overview of the Brazilian tax mix can be seen in table 2. As can be seen during the period Brazilian tax system relies a lot on consumption taxes (75.2 percent of the taxes revenue come from this source), followed by income taxes and taxes over capital stock or wealth (mainly the recurrent ones). Furthermore, we can infer that this tax mix was constant over the period of our analysis.

TABLE 2
Brief Overview of the Brazilian tax structure, percentage of each tax in relation to the overall tax burden

Tax structure	Average	Maximum	Minimum	Standard deviation
Personal income tax	10.8	14.32	8.63	1.32
Corporate income tax	9.9	13.29	6.49	1.61
Consumption tax	75.2	80.37	68.77	3.04
Non-recurrent tax on properties	0.6	1.00	0.35	0.17
Recurrent tax on properties	3.4	7.12	1.51	1.92

Source: Secretaria do Tesouro Nacional (National Treasury).
Elaborated by the authors.

3 ECONOMETRIC RESULTS

In this section we analyze the effects of taxes over economic growth in the Brazilian economy using quarterly data from the period Jan/2002 to June/2015. The econometric strategy to verify the impact of the tax mix over growth will closely follow Heady, Johansson, Arnold, Brys and Vartia (2009). The major difference is that in this paper we will use time series techniques to check the tax mix effect

over a specific country, while Heady at all (2009) adopt panel data techniques in a set of OECD countries.

Let us begin with a simple estimation of the impact of the overall tax burden over the Brazilian economic growth. Table 3 presents this result. The physical and human capital and the population are major sources for growth in the economic textbooks. In table 3 we present two different proxies for each one of these variables. The effect of physical capital over growth is positive in all four regressions (and statistically significant in three of them). The effect of human capital over growth is positive and significant in three specifications (and statistically insignificant in the other one). As soon as there are a lot of critics about how to measure human and physical capital, we will not detail our analysis here. The idea of this paper is to verify the impact of taxes over growth, and in line with it we can infer about a negative impact of the overall tax burden over real GDP per capita. Column (1) of table 3 shows that an increase of 1 percent in the overall tax burden decreases real GDP per capita by 0.3 percent, and similar results are presented in the other columns. The four columns in table 3 present similar qualitative results about the negative, and statistically significant, effect of the overall tax burden over per capita GDP. This reinforces and gives more confidence to the negative effect of taxes over growth showing the robustness of the tax results.

TABLE 3
The effect of the overall tax burden over real GDP per capita

Dependent variable: Ln of real GDP per capita	(1)	(2)	(3)	(4)
Baseline model				
Ln of physical capital (k)	2.46*** (.539)	1.42*** (.413)		
Ln of human capital (average years of schooling)	-0.58 (.773)			
Ln of population (population)	1.01 (.731)		-0.18 (.588)	
Control variable				
Ln of the overall tax burden (total revenues / GDP)	-0.32*** (.107)	-0.33*** (.103)	-0.38*** (.122)	-0.33*** (.103)
Other proxies				
Ln of per worker physical capital (kpea)			0.75 (.459)	1.42*** (.413)
Ln of human capital (illiteracy rate of population over 15 years old)		-0.52*** (.176)	-1.35*** (.223)	-0.52*** (.176)
Ln of economically active population (PEA)		0.12 (.433)		1.55*** (.343)

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Dependent variable: Ln of real GDP per capita	(1)	(2)	(3)	(4)
Constant	-82.01*** (24.19)	-34.34*** (9.38)		-34.34*** (9.38)
Observations	54	54	54	54
	F(4, 49) = 211.87	F(4, 49) = 246.38	F(4, 49) = 170.79	F(4, 49) = 246.38
	Adj R-squared = 0.940	Adj R-squared = 0.948	Adj R-squared = 0.927	Adj R-squared = 0.948

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level.
Obs.: The inclusion of lags does not change qualitatively the results. The inclusion of other variables as trade openness, a trend variable, and the debt ratio to GDP do not change qualitatively the results.

In the next step, let's follow Heady et al. (2009) and change our estimative from level variables to first differences. The idea is that we can replicate a long run pattern by a short run relationship with an error correction term. Additionally we can include other control variables in the regression to check the robustness of the econometric findings.

Table 4 verifies the effect of changes in the overall tax burden over growth (growth rate of real GDP per capita). Because our human capital proxies are in annual basis, we include its fourth difference to verify if results would change. Again, the tax results are robust to it. In all the specifications we find a negative and statistically significant effect of the overall tax burden over growth, ranging from -0.12 to -0.23. That is, a 1 percent increase in the overall tax burden would decrease growth by a value between 0.12 and 0.23 percent. This result is robust to a wide range of different specifications.

TABLE 4
The effect of changes in the overall tax burden over growth

Dependent variable: growth rate of real GDP per capita	(1)	(2)	(3)	(4)
Baseline model				
ΔLn of physical capital	0.49 (.581)	1.84** (.880)		
ΔLn of human capital	-3.31*** (4.37)			
Δ4Ln of human capital		-0.14 (.117)		
ΔLn of population	0.41 (2.46)	1.44 (3.66)		
Control variable				
ΔLn of the overall tax burden (total revenues / GDP)	-0.12** (.052)	-0.23*** (.077)	-0.16** (.074)	-0.15** (.059)

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Dependent variable: growth rate of real GDP per capita	(1)	(2)	(3)	(4)
Other proxyes				
ΔLn of per worker physical capital (kpea)			1.68** (.831)	0.82 (.728)
ΔLn of human capital (illiteracy rate of population over 15 years old)				1.14*** (.290)
Δ4Ln of human capital (illiteracy rate of population over 15 years old)			0.02 (.063)	
ΔLn of economically active population (PEA)			1.37 (1.31)	0.53 (1.07)
Error correction$_{-1}$	-0.254** (.099)	-.485*** (.152)	-0.814*** (1.41)	-0.488*** (.135)
Constant	0.02** (.008)	-0.004 (.012)	0.001 (.006)	0.01** (.006)
Observations	53	50	50	53
	F(5, 47) = 24.92	F(5, 44) = 6.63	F(5, 44) = 13.08	F(5, 47) = 19.16
	Adj R-squared = 0.697	Adj R-squared = 0.364	Adj R-squared = 0.552	R-squared = 0.670

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level. The inclusion of other variables as change in the trade openness and in the debt to GDP ratio did not change qualitatively the results.

In Table 5 we are going to disentangle the tax burden in its different components. This will allow us to estimate a tax rank of the effect of different types of taxes over real GDP per capita. We follow the same tax division adopted by Heady et al. (2009), that is, income taxes (personal income tax and corporate income tax), consumption taxes (included here are the production taxes), and property taxes (recurrent and non-recurrent property taxes).[6]

All of the baseline variables are statistically significant at 1 percent level, and all of them have the expected signal. As predicted by theory, in the long run, real GDP per capita is positively affected by physical and human capital, and by the size of the economically active population. Following the results, we can infer that taxes over the capital stock (mainly the recurrent ones) are the worst for economic growth. In other words, a higher level of GDP per capita can be obtained changing the tax system in direction of income and consumption taxes, and decreasing the taxation over the capital stock.

6. The annex provides a full description of where each tax was allocated.

TABLE 5
The effect of the overall tax burden over real GDP per capita, and the tax rank

Dependent variable: Ln of real GDP per capita	(1)	(2)	(3)	(4)
Baseline model				
Ln of per worker physical capital (kpea)	1.70*** (.449)	1.65*** (.454)	1.06*** (.358)	1.04*** (.364)
Ln of human capital (il-literacy rate of population over 15 years old)	-0.51*** (.174)	-0.50*** (.181)	-0.85*** (.141)	-.80*** (.204)
Ln of economically active population (PEA)	1.55*** (.339)	1.57*** (.353)	0.94*** (.271)	.97*** (.286)
Control variable				
Ln of the overall tax burden (total revenues / GDP)	-0.22* (.126)	-0.24* (.132)	0.003 (.110)	-0.009 (.129)
Tax structure variables				
1) Income taxes	-0.139 (.094)			
Personal income taxes		-0.056 (.056)		
Corporate income taxes		-0.057 (.050)		
2) Consumption taxes			0.138 (.285)	.072 (.297)
3) Property taxes			-0.069*** (.022)	
Recurrent taxes on property				-.059*** (.021)
Other property taxes				.005 (.051)
Constant	-37.95*** (9.59)	-37.69*** (9.89)	-18.73** (7.81)	-19.12** (8.09)
Observations	54	54	54	54
	F(5, 48) = 202.26	F(6, 47) = 162.79	F(6, 47) = 312.36	F(7, 46) = 267.02
	Adj R-squared = 0.950	Adj R-squared = 0.948	Adj R-squared = 0.972	Adj R-squared = 0.972
Revenue-neutrality achieved by adjusting	2 and 3	2 and 3	1	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level.

Table 6 verifies the impact of changes in the tax mix over real GDP per capita growth. In relation to real GDP per capita growth, corporate income taxes seem to be the worst of them, followed by taxes in the capital stock (mainly recurrent ones). The policy prescription here is clear: changing the tax system toward consumption taxes, or personal income tax, can improve economic growth.

TABLE 6
The effect of changes in the tax mix over growth

Dependent variable: growth rate of real GDP per capita	(1)	(2)	(3)	(4)
Baseline model				
ΔLn of per worker physical capital (kpea)	1.81** (.857)	1.29 (.840)	0.39 (.494)	0.53 (.509)
Δ4Ln of human capital (illiteracy rate of population over 15 years old)	0.09 (.084)	0.004 (.091)	-0.02 (.048)	-0.02 (.049)
ΔLn of economically active population (PEA)	1.50 (1.34)	1.36 (1.28)	0.55 (.771)	0.75 (.801)
Control variable				
ΔLn of the overall tax burden (total revenues / GDP)	-0.04 (.115)	0.02 (.116)	0.12 (.076)	0.12 (.089)
Tax structure variables				
1) Income taxes	-0.163* (.084)			
Personal income taxes		-0.030 (.045)		
Corporate income taxes		-0.115** (.042)		
2) Consumption taxes			0.283 (.191)	0.225 (.212)
3) Property taxes			-0.049*** (.012)	
Recurrent taxes on property				-0.037*** (.012)
Other property taxes				0.028 (.038)
Error correction$_{-1}$	-.768*** (.144)	-.700*** (.141)	-.197* (.110)	-.195* (.112)
Constant	-.768*** (.006)	.002 (.006)	.006 (.003)	.004 (.004)
Observations	50	50	50	50
	F(6, 43) = 10.46	F(7, 42) = 10.59	F(7, 42) = 39.80	F(8, 41) = 33.87
	Adj R-squared = 0.536	Adj R-squared = 0.578	Adj R-squared = 0.847	Adj R-squared = 0.842
Revenue-neutrality achieved by adjusting	2 and 3	2 and 3	1	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level.

3.1 Comparing our results with the International Evidence

The comparison of our results with those presented by Heady et al. (2009) is straightforward. In their paper the tax ranking is the following: the best taxes should rely on immovable property (recurrent taxes over immovable property), followed by consumption taxes, personal income taxes, and the worst of them corporate income taxes. In our paper, the worst taxes are related with both capital stock (recurrent taxes) and corporate income taxes. And the best ones are related to consumption and personal income taxes.

Besides some differences, the policy prescriptions are very similar between our findings and those of Heady et al. (2009). Both papers suggest that a change toward consumption taxes would improve growth. And both paper strongly advice against taxes over corporate income.

Acosta-Ormaechea and Yoo (2012) investigate the relation between changes in tax composition and long-run economic growth (a panel of 69 countries with at least 20 years of observations in the period 1970-2009). They find that increasing income taxes while reducing consumption and property taxes is associated with slower growth over the long run. They also conclude that social security contributions and personal income taxes have a stronger negative impact over growth than corporate income taxes. They suggest that a shift from income taxes to property taxes has a strong positive association with growth. Furthermore, a reduction in income taxes while increasing value added and sales taxes is also associated with faster growth.

Angelopoulos, Economides and Kammas (2007) present an endogenous growth model to study the growth effects of the composition of government expenditure and the associated tax burden. They estimate the model using 5 years average data from a set of 23 OECD countries during the period 1970 to 2000. In relation to the tax burden, their econometric results suggest that labor income tax rates are negatively related to growth, whereas capital income and corporate income taxes rates are usually positively related to growth.

Ojede and Yamarik (2012) estimates a panel data model for states in the United States, and find that property taxes lowered both short and long run growth, sales taxes lowered long run growth, and income taxes did not have any effect in short and long run economic growth.

Xing (2012) estimates the effects of revenue-neutral tax structure changes on the long-run level of income per capita. The data set refers to yearly panel data observations for 17 OECD countries over the period 1970-2004. In contrast to previous studies, he did not find a robust ranking of different types of taxes in terms of their growth effects. The econometric results did not provide compelling evidence

favoring consumption taxes over income taxes, or favoring personal income taxes over corporate income taxes. The only robust result appears to be that shifts in tax revenue towards property taxes are associated with a higher level of income per capita in the long run. Table C resume the main findings of the literature about tax and growth.

TABLE 7
International results about tax and growth

Tax over:	Personal income	Corporate income	Consumption	Property	Capital income
Angelopoulos, Economides and Kammas (2007)	- (labor income tax)	+			+
Heady et al. (2009)	-	-	+	+	
Acosta-Ormaechea and Yoo (2012)	-	-	+	+	
Ojede and Yamarik (2012)	No effect	No effect	- (long run)	- (short and long run)	
Xing (2012)	No evidence	No evidence	No evidence	+ (long run)	
Our Results	+	-	+	-	

4 THE CHANNEL BETWEEN THE TAX BURDEN AND GROWTH

An important question is about the channel from which taxes affect growth. In this section we estimate the impact of taxes over investment, labor participation and total factor productivity.

Table 8 presents the effect of taxes over both the labor force participation rate (the rate between economically active population and the population over 15 years old) and the rate of private investment to the capital stock.[7] The labor force participation data is easy to construct and relies in official data from Brazilian Institute of Geography and Statistics (IBGE). However, there are a lot of problems associated with the construction of the private investment data for the Brazilian economy.[8] The private investment series adopted here was kindly provided by the Department of Macroeconomics at Institute for Applied Economic Research.[9] The private investment series adopted here excludes from the investment the amounts spent by the government and by state owned companies. Santos and Pires (2009), and Santos et al. (2011), provide more information about the construction of the private investment series.

7. The use of the rate between private investment to the capital stock of economically active population (kpea) does not change qualitatively the econometric results.

8. I acknowledge here Roberto Ellery Jr., Victor Gomes, Jose Roberto Afonso, and Rodrigo Orair for their kindly help to understand the problems associated with the private investment data and for their help providing me with their time series data.

9. This series was provided by the head of the department, Dr. Claudio Hamilton dos Santos and Researcher Vinícius Augusto Lima de Almeida.

The first line of table 8 provides us with information about the effect of the overall tax burden over both the labor rate participation and the rate of private investment to capital stock. In all four regressions this effect is negative, but statistically not significant. Column 1 states that increases in the personal income tax decreases labor force participation rate. Column 2 suggests that increases in both consumption and recurrent taxes would increase labor force participation rate, but the coefficient of consumption taxes is much bigger suggesting a higher impact of this variable. In other words, if we change taxes from personal income to consumption we would expect an increase in the labor force participation rate, which is clearly a pro-growth tax policy. Still in table 8, columns 3 and 4 verify the tax effect over the rate of private investment to capital stock. None of the relations are statistically significant (in table 10 we will explore in more details this relation).

TABLE 8
The tax channel over economic variables

Dependent variable:	Ln of the labor participation rate (1)	Ln of the labor participation rate (2)	Ln (private investment / k) (3)	Ln (private investment / k) (4)
Ln of the overall tax burden (total revenues / GDP)	-0.02 (.031)	-0.006 (.047)	-0.21 (.489)	-0.91 (.740)
Tax structure variables				
1) Income taxes			.345 (.329)	
Personal income taxes	-.027** (.012)			
Corporate income taxes	-.019 (.012)			
2) Consumption taxes		.170* (.093)		-1.037 (1.251)
3) Property taxes				
Recurrent taxes on property		.012* (.006)		.105 (.067)
Other property taxes		.014 (.019)		-.092 (.193)
Constant	-.723 (.039)	-.411** (.172)	117.68* (60.02)	71.38 (48.08)
Observations	54	54	50	50
	F(5, 48) = 8.97	F(6, 47) = 7.00	F(12, 37) = 100.01	F(14, 35) = 107.81
	Adj R-squared = 0.429	Adj R-squared = 0.404	Adj R-squared = 0.960	Adj R-squared = 0.968
Revenue-neutrality achieved by adjusting	2 and 3	1	2 and 3	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level. In the labor participation rate equations the regressions included a linear and a quadratic trend. In the private investment equations the regressions included the GDP, the price index, physical and human capital, the size of economically active population, an interest rate (selic rate), and four lags of the private investment.

Table 9 takes a close look about changes in the tax mix over changes in both the labor force participation rate and in the rate of private investment to physical capital stock. In the first line all four specifications suggest a negative impact of overall tax rate over both labor participation and private investment. Columns 1 and 2 straight a pro-growth tax policy: changing the tax mix from personal income to consumption taxes would increase labor force participation rate. However, Column 4 suggests that an increase in consumption tax would decrease investment, which is clearly a bad idea in terms of economic growth. The joint analysis of tables 8 and 9 suggest that increases in the recurrent taxes on property would have the double benefit of increase both the labor force participation rate and the private investment rate.

Maybe our private investment series is not capturing the real investment in the economic sense of the term. Let's explore this idea better in table 10.

TABLE 9
The effect of changes in the tax mix over economic variables

Dependent variable: growth rate of the labor force participation	ΔLn of the labor participation rate (1)	ΔLn of the labor participation rate (2)	ΔLn (private investment / k) (3)	ΔLn (private investment / k) (4)
ΔLn of the overall tax burden (total revenues / GDP)	-0.05** (.021)	-0.02 (.030)	-0.89** (.337)	-1.50***
Tax structure variables				
1) Income taxes			.246 (.205)	
Personal income taxes	-.020*** (.006)			
Corporate income taxes	.005 (.009)			
2) Consumption taxes		.147** (.059)		-1.384** (.580)
3) Property taxes				
Recurrent taxes on property		.006* (.004)		.160** (.047)
Other property taxes		-.015 (.015)		-.181 (.148)
Error correction$_{-1}$	-.424*** (.114)	-.472*** (.119)	-.883*** (.225)	-.392** (.187)
Constant	.0004 (.001)	.0003 (.001)	.022 (.030)	-.047** (.022)
Observations	53	53	49	49
	F(4, 48) = 12.59	F(5, 47) = 7.74	F(9, 39) = 5.32	F(11, 37) = 14.28
	Adj R-squared = 0.471	Adj R-squared = 0.393	Adj R-squared = 0.447	Adj R-squared = 0.752
Revenue-neutrality achieved by adjusting	2 and 3	1	2 and 3	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level.

An important issue is to precisely understand the concept of private investment. If an individual builds a house to live, or spends some money improving it, this is not an investment in the economic sense. Investment is something that will increase the production of the economy. However, our private investment series does not take it into account. To deal with this problem table 10 disentangles investment in two components: *i*) construction; and *ii*) machinery and equipment's.[10] More details about the problems associated to private investment time series, and how this new investment series was constructed can be obtained in Santos et al. (2015).[11]

Table 10 reproduces the investment equations for both construction and machinery and equipment's. The results are very clear in pointing out different behavior for these investment series. In all for specifications the overall tax burden negatively affects investment. Columns 1 and 2 suggest that changing taxes to consumption would improve investment in construction. However, columns 3 and 4 suggest that the investment in machinery and equipment's are negative affected by the overall tax rate, but not for the tax mix. It is important to observe that if we change the tax mix to consumption the overall tax rate loses its statistical significance to decrease investment. In other words, a change of the tax mix toward consumption taxes would increase investment.

TABLE 10
The tax channel over investment

Dependent variable:	Ln of construction (1)	Ln of construction (2)	Ln machinery and equipments (3)	Ln machinery and equipments (4)
Ln of the overall tax burden (total revenues / GDP)	-0.42* (.223)	-0.03 (.252)	-0.68* (.345)	-0.07 (.411)
Tax structure variables				
1) Income taxes				
Personal income taxes	-.057 (.087)		-.136 (.134)	
Corporate income taxes	.016 (.085)		.137 (.131)	
2) Consumption taxes		1.002* (.562)		1.04 (.915)
3) Property taxes		.859 (.987)		.772 (1.60)
Recurrent taxes on immovable property				
Other property taxes				

(Continues)

10. This new dataset was kindly provided by Dr. Claudio Hamilton dos Santos and Vinícius Augusto Lima de Almeida.
11. They argue that investments made in construction are majorly made by families and government, and that the investments in machinery and equipment's are mainly due to non-financial companies.

(Continued)

Dependent variable:	Ln of construction (1)	Ln of construction (2)	Ln machinery and equipments (3)	Ln machinery and equipments (4)
Constant	3.86*** (.273)	4.71*** (.417)	3.65*** (.422)	4.63*** (.679)
Observations	54	54	54	54
	F(5, 48) = 40.87	F(5, 48) = 44.18	F(5, 48) = 57.02	F(5, 48) = 54.42
	Adj R-squared = 0.790		Adj R-squared = 0.840	Adj R-squared = 0.834
Revenue-neutrality achieved by adjusting	2 and 3	1	2 and 3	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level. All the regressions included a linear and a quadratic trend.

In table 11 we verify the impact of changes in the tax mix over investment in construction and machinery and equipments. Again a change to consumption taxes would improve investment growth.

TABLE 11
The effect of changes in the tax mix over economic variables

Dependent variable: growth rate of the labor force participation	ΔLn of the construction (1)	ΔLn of the construction (2)	ΔLn machinery and equipments (3)	ΔLn machinery and equipments (4)
ΔLn of the overall tax burden (total revenues / GDP)	-0.22* (.120)	-0.07 (.124)	-0.43 (.205)	-.005 (.222)
Tax structure variables				
1) Income taxes				
Personal income taxes	-.053 (.038)		-.112* (.065)	
Corporate income taxes	-.055 (.049)		-.003 (.084)	
2) Consumption taxes		.572** (.282)		1.223* (.599)
3) Property taxes		.010 (.017)		.043 (.030)
Recurrent taxes on property				
Other property taxes				
Error correction$_{-1}$	-.182* (.095)	-.150 (.094)	-.271** (.105)	-.251** (.104)
Constant	.004 (.005)	.004 (.005)	.007 (.009)	.005 (.009)
Observations	53	53	53	53
	F(4, 48) = 6.94	F(4, 48) = 8.57	F(4, 48) = 6.60	F(4, 48) = 6.67
	Adj R-squared = 0.313	Adj R-squared = 0.367	dj R-squared = 0.301	Adj R-squared = 0.303
Revenue-neutrality achieved by adjusting	2 and 3	1	2 and 3	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level.

Table 12 replies the econometric procedures but now for the effects of the tax burden over total factor productivity (TFP)[12]. More details about the construction of the TFP series can be obtained in Barbosa Filho and Pessoa (2009; 2014) The results show a negative effect of the overall tax burden over TFP. An overall increase of 1 percent of the tax burden would decrease TFP around 0.1 percent.

TABLE 12
The tax channel over total factor productivity

Dependent variable: Ln of the TFP	(1)	(2)
Ln of the overall tax burden (total revenues / GDP)	-0.08* (.052)	-0.11* (.060)
Tax structure variables		
1) Income taxes		
Personal income taxes	.015 (.020)	
Corporate income taxes	.018 (.021)	
2) Consumption taxes		-.168 (.141)
3) Property taxes		-.130 (.238)
Recurrent taxes on property		
Other property taxes		
Constant	.950** (.370)	.717* (.374)
Observations	51	51
	F(6, 44) = 290.78	F(6, 44) = 296.74
	Adj R-squared = 0.972	Adj R-squared = 0.972
Revenue-neutrality achieved by adjusting	2 and 3	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level. All the regressions included a linear and a quadratic trend and a lag for the TFP.

Table 13 takes a close look about changes in the tax mix over changes in the TFP. The overall tax burden affects negatively the TFP. But the tax mix sounds not to be important in relation to their negative effect over TFP.

12. The quarterly TFP data for the Brazilian economy was kindly provided by Silvia Maria Matos (FGV-IBRE) and reaches until the last quarter of 2014.

TABLE 13
The effect of changes in the tax mix over economic variables

Dependent variable: growth rate of the total factor productivity	(1)	(2)
ΔLn of the overall tax burden (total revenues / GDP)	-0.064 (.046)	-.08* (.051)
Tax structure variables		
1) Income taxes		
Personal income taxes	.008 (.014)	
Corporate income taxes	.002 (.020)	
2) Consumption taxes		-.112 (.117)
3) Property taxes		-.005 (.006)
Recurrent taxes on property		
Other property taxes		
Error correction$_{-1}$	-.359*** (.157)	-.337** (.158)
Constant	.004* (.002)	.004 (.002)
Observations	50	50
	F(4, 45) = 2.29	F(4, 45) = 2.31
	Adj R-squared = 0.095	Adj R-squared = 0.096
Revenue-neutrality achieved by adjusting	2 and 3	1

Notes: Standard errors are in brackets. *: significant at 10 % level; ** at 5% level; *** at 1 % level.

5 CONCLUSION

This paper analyses the effect of the tax burden over GDP per capita and its growth. Our paper follows the recent development in the literature of taxes and growth as stated by Heady et al. (2009).

The econometric results pointed out for a negative effect of overall tax burden over both the level and the growth of GDP per capita. In relation to the level of GDP per capita, this negative effect ranges around -0.3. In other words, an increase of 1% in the overall tax burden decreases real GDP per capita by 0.3%. This is a strong and statistically significant negative effect of overall tax burden over GDP per capita. In relation to the growth level of GDP per capita, the change in the overall tax burden has a negative impact close to 0.15.

Furthermore, additional econometric results pointed out that a revenue neutral fiscal policy which changes the tax structure toward consumption taxes and

personal income taxes would improve economic growth. Besides that, we strongly recommend against both taxes over the capital stock (mainly the recurrent ones) and the corporate income taxes.

Finally, we were able to demonstrate that both the overall tax burden and its tax mix have negative impact over the labor force participation rate and private investment. And the overall tax burden has negative and statistically significant effects over total factor productivity. Decreasing the overall tax burden and changing the tax mix toward consumption and personal income taxes have the potential to improve real GDP and its growth rate for the Brazilian economy.

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ANNEX A

RELATION OF TAXES AND RESPECTIVES CLASSIFICATIONS

Esfera	Incidência	IncTipo	Simples
	Impostos sobre o consumo		Total
GF	Impostos sobre os produtos		IPI
GF	Impostos sobre os produtos		II
GF	Impostos sobre os produtos		IE
GF	Impostos sobre os produtos		Cofins
GF	Impostos sobre os produtos		Cide
GF	Impostos sobre os produtos		CS - outras
GF	Impostos sobre os produtos		CE - outras
GF	Outros impostos sobre a pr odução		SalEdu
GF	Outros impostos sobre a pr odução		Demais folha
GF	Outros impostos sobre a pr odução		Sistema S
GF	Outros impostos sobre a pr odução		Taxas - polícia
GF	Outros impostos sobre a pr odução		Taxas - serviços
GF	Outros impostos sobre a pr odução		CS - outras
GF	Outros impostos sobre a pr odução		CE - outras
GE	Impostos sobre os produtos		ICMS
GE	Impostos sobre os produtos		ISS
GE	Outros impostos sobre a pr odução		Outros impostos e taxas sobre a produção
GM	Impostos sobre os produtos		ISS
GM	Outros impostos sobre a pr odução		Taxas
	Impostos sobre a Renda		TOTAL
GF	Impostos sobre a renda		IRPF
GF	Impostos sobre a renda		IRPJ
GF	Impostos sobre a renda		IRRF
GF	Impostos sobre a renda		CE - Outras

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Esfera	Incidência	IncTipo	Simples
GF	Outros impostos correntes sobre a renda e propriedade		CSLL
GE	Impostos sobre a renda (governos estaduais retém mas não repassam ao Federal)		IRRF
GM	Impostos sobre a renda (governos municipais retem mas nao repassam ao Federal)		IRRF
			IR sobre rendimentos do trabalho
			IR sobre rendimentos do capital]
	Imposto recorrente sobre a riqueza (imposto sobre propriedade)		Total
GF	Outros impostos correntes sobre a renda e propriedade		ITR
GF	Impostos sobre os produtos		DPVAT
GE	Outros impostos correntes sobre a renda e propriedade		IPVA
GE	Outros impostos correntes sobre a renda e propriedade		IPTU
GM	Outros impostos correntes sobre a renda e propriedade		IPTU
	imposto sobre movimentacao financeira		Total
GF	Outros impostos correntes sobre a renda e propriedade		CPMF
GF	Impostos sobre os produtos		IOF
	Imposto não recorrente sobre a riqueza (imposto sobre o capital)		Total
GF	Impostos de capital		IC
GE	Impostos de capital		ITCD
GE	Impostos de capital		ITBI
GM	Impostos de capital		ITBI
GM	Impostos de capital		Contribuição de melhoria
	********* Ikperc = imp. capital perc + imp.propriedade perc		

(Continues)

(Continued)

Esfera	Incidência	IncTipo	Simples
	Contribuição social e previdência		Total
GF	Contribuições sociais		FGTS
GF	Contribuições sociais		PIS/Pasep
GF	Contribuições sociais		CS y- RGPS
GF	Contribuições sociais		CS - RGPS
GF	Contribuições sociais		CS - RGPS
GF	Contribuições sociais		CS - RPPS
GF	Contribuições sociais		CS - RPPS
GF	Não classificado		Dívida ativa - outros
GE	Contribuições sociais		Cont. previdenciárias
GE	Outros impostos sobre a pr odução		Outras contribuições sociais
GM	Contribuições sociais		Contribuições Previdenciárias
GM	Outros impostos sobre a pr odução		Outras contribuições sociais
GM	Outros impostos sobre a pr odução		Contribuições econômicas
	******** Iconprodperc = imp.consumo perc + contrib social e previdencia perc		