Tax evasion: Is this a government fight, or can anyone join?

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Introduction

- **Tax evasion and informal activities** There is a broad literature on different aspects of this phenomenon and reasons why individuals try to conceal their economic activities (e.g., Friedman et al. 2000; Johnson et al. 1998a,b; Loayza 1996; Schneider and Enste 2000, 2002; Schneider and Neck 1993).
- Two broad policy approaches to tackle tax evasion can be identified: **deterrence and enabling compliance**.
- **Deterrence**: main approach towards tax evasion.
    * **Evasion penalties** are generally imposed as a percentage of the additional tax payable.
    * **Detection probabilities** based on the proportion of tax returns audited.

Introduction

- **Enabling**: measures that encourage compliance by preventing people from engaging in tax evasion, enabling the legalization of previously informal work and change attitudes (Renooy et al., 2004; SBC, 2004; Slemrod, 1992; Williams, 2006);
    - Individuals are viewed as social actors who are usually inclined to comply with the law, partly because of their belief in the rule of law and partly as a matter of long-term self-interest (Kagan and Scholz, 1984; Murphy, 2008).
    - Cooperation rather than coercion.
- Understanding the interplay between the deterrence and enabling approaches and how alternative policy instruments can be used to tackle tax evasion seems the main contribution of the paper.

Taxes... Why?

Why do people pay taxes?

- *Alm, McClelland and Schulze (1992)* : Not only those factors suggested in Becker (1968) such as punishment and deterrence policies, but other issues such as ethics (moral) and transparency with regard to the ends of those taxes collected are important.
- *(Alm, 1988; Beck and Jung, 1989a; Scotchmere Slemrod, 1989)* There might be uncertainty on enforcement and tax strucutre(unclear tax codes, lack of training for auditors). They understand that decision (to pay taxes) might be able to reduce the probability of being audited later.
- *Cowel and Gordon (1988)* They value what they get in return, and should therefore pay even more whey they are receiving from the government exactly what they want in the first place.
- *Kahneman and Tversky (1979)* They attribute a large weight on events with low probability and react differently with losses than wins. As any fine payment is a loss, they prefer not to engage in any risk component.

Optimal Tax - What should be done?

Optimal Tax and evasion:

- Cremer and Gahvari(1993), Usher (1986) and Kaplow(1990): Optimal commodity taxation in the tax evasion context. While the first one also characterizes optimal purely random audit strategies the last two papers look down to the role of auditing strategy.
- Such random strategies are known to be suboptimal compared to more general policies, such as cut-off rules (Reinganumand Wilde, 1985; Border and Sobel, 1987; Mookherjeeand Pnj, 1989; Scothmer, 1988 and Cremer et al, 1990).

Optimal Taxes ... Still

The involvement of consumers and firms in tax evasion is well-documented in the literature.

- *Das-Gupta and Gang (1996)* propose a matching mechanism - essentially a comparison of buyer's and seller's record of transactions - to improve auditing for value added tax evasion.
- *Boadway, Marceau and Mongrain (2002)* study an economy where tax evasion requires a collusion behavior for every pair of agents (firm and consumer).
- *Chang and Lai (2004)* introduce the possibility of interaction between buyers and sellers and find that a collaborative tax evasion might be an equilibrium result.
- *Gordon and Li (2008)* consider an environment where firms can avoid tax payments by shifting entirely to cash transactions. When firms do not use the financial sector they avoid leaving any paper trail of their transactions.

Practical Enabling Measures Around the World

$\Rightarrow$ **Tax rebates on home maintenance expenses** have been available in France under the Universal Service Employment Cheque (*Chèque Emploi Service Universel, CESU*) scheme. Individuals can purchase cheques from their local bank or post office to pay for domestic service work in the home. For example, for a job valued at 20 euros, the employer can contribute 10 euros and of the remaining 10 euros due to be paid by the individual household, 50% can be recovered in the form of a tax credit.

$\Rightarrow$ **Tax reductions for labour costs** on home repairs and household services have been introduced in Italy, Luxembourg and Sweden. In Finland, it is possible to deduct thirty percent of the wage cost of other domestic services (including household cleaning and gardening).

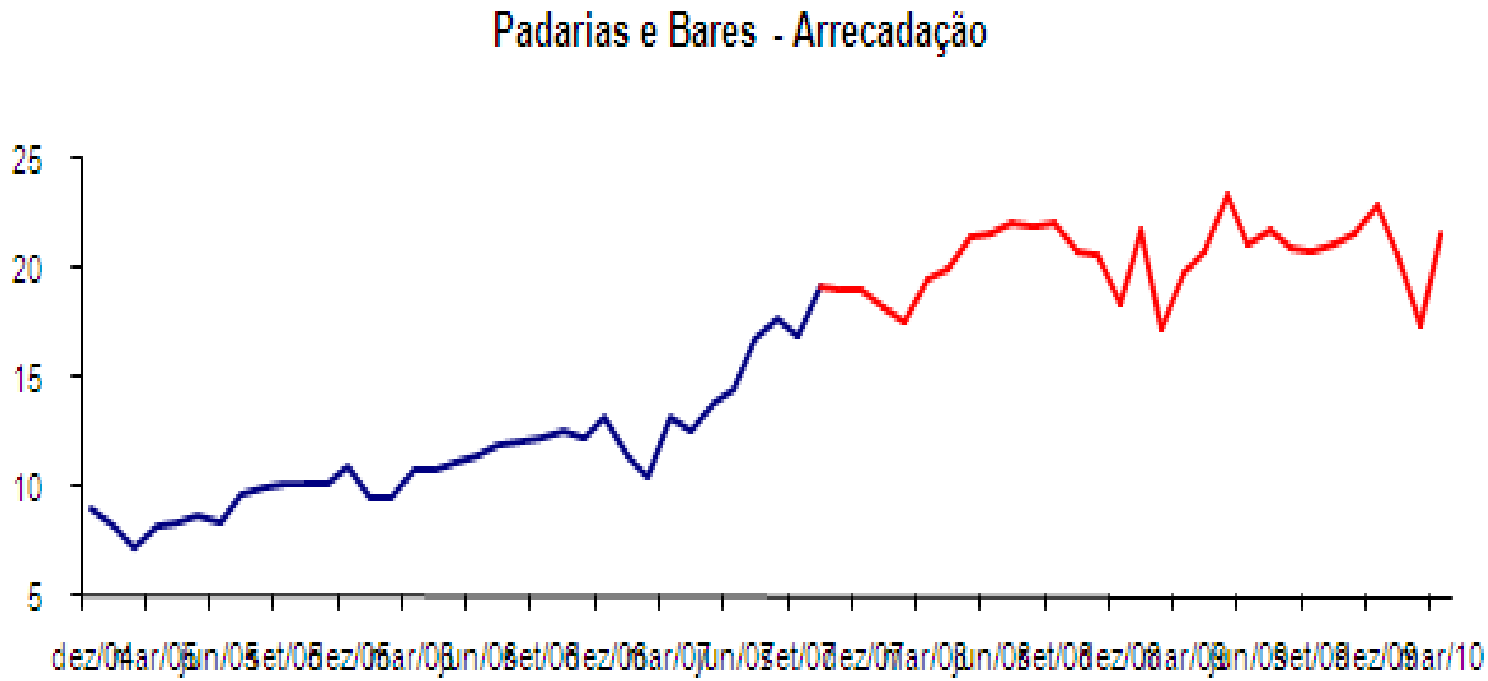
$\Rightarrow$ The Danish Home Service Scheme: Registered businesses provide services to households for which the government offers a **reimbursement proportional to the cost**.

Practical Enabling Measures

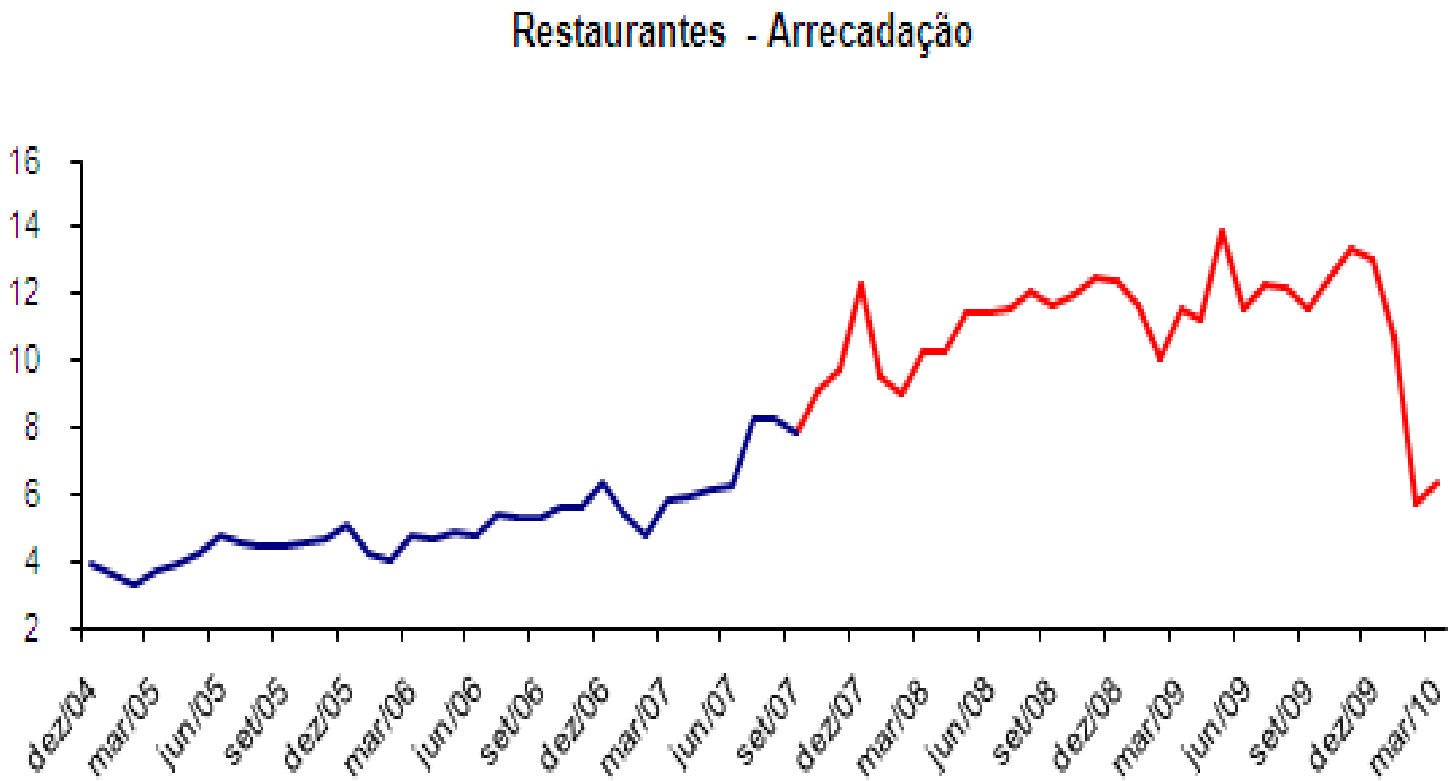
Enabling Measures in Brazil

- Nota Fiscal Eletronica (Electronic Fiscal Receipt):
  - Policy goal: reach **hard-to-tax establishments** such as bars, restaurants and small bakeries which usually do not provide any receipt of transactions.
  - Electronic emission of fiscal receipt in order to improve auditing in sales;
  - Created an electronic platform to combat tax evasion.
- São Paulo Fiscal Receipt (*Nota Fiscal Paulista*) in 2007.
  - This program entitles consumers a **rebate of up to thirty percent of the taxes collected** in their retail purchases. To request the receipt costumers have to use their social security number or a firm's identification number for business services.

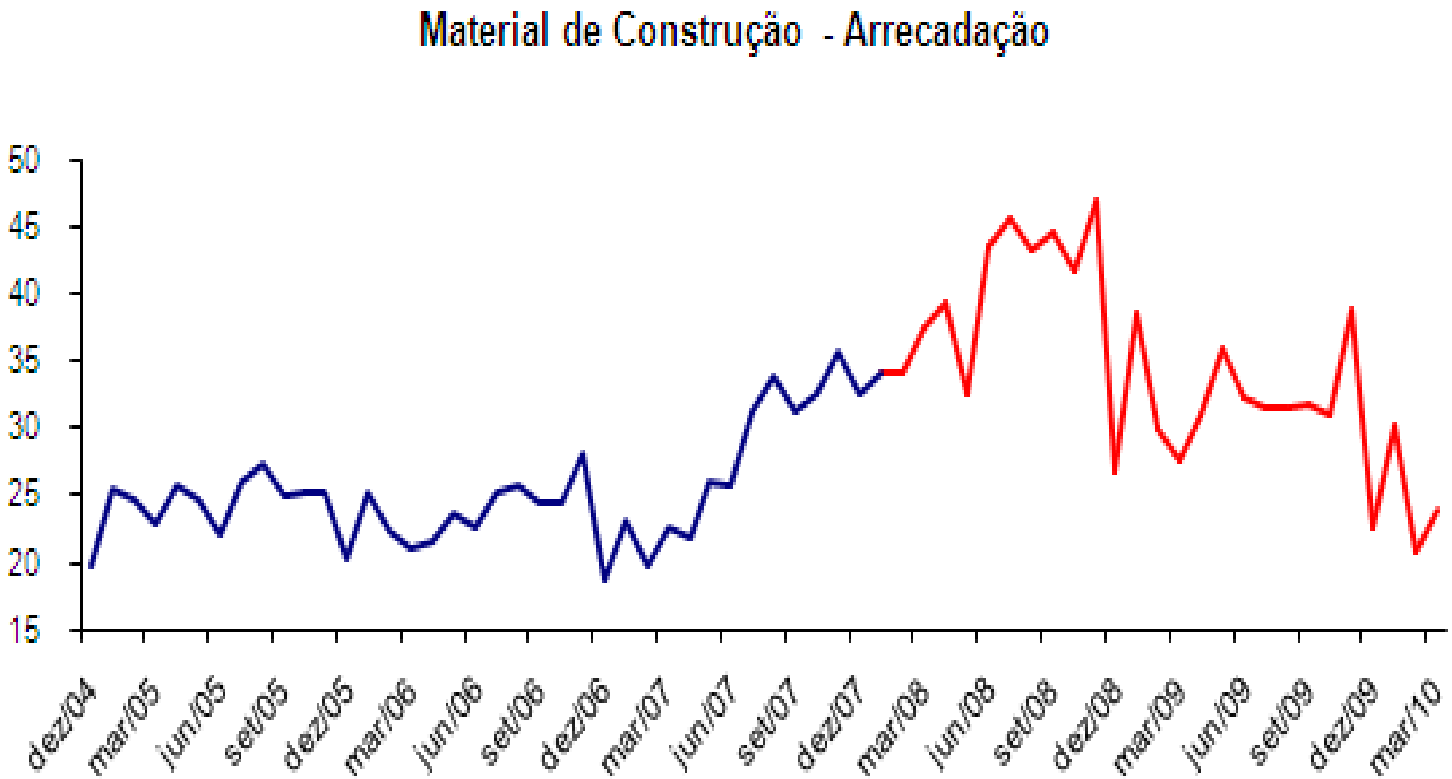
Nota Fiscal Paulista



Nota Fiscal Paulista



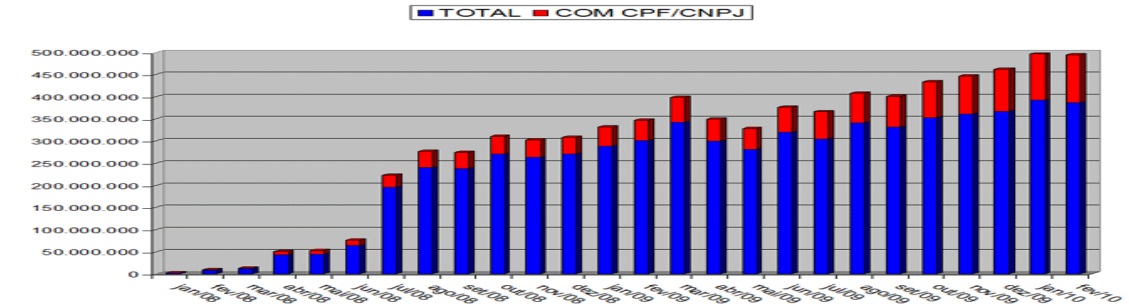
Nota Fiscal Paulista



Nota Fiscal Paulista - Program Evaluation

Estado	Nome Programa	Incentivo*	Data de inicio	Valores distribuidos*	Usuarios Cadastrados*	Notas/Cupons Fiscais registrados*	Estabelecimentos cadastrados*
SP	Nota Fiscal Paulista	30% do ICMS recolhido	out/07	R$3.115.614.172,01	8.480.715	8.832.579.690	620.025
AL	Nota Fiscal Alagoana	ate 30% do ICMS recolhido	nov/08	n/d	83.384	n/d	n/d
DF	Nota Legal	ate 30% do ICMS e ISS recolhido	ago/08	R$23.013.588,26	765.793	3.519.589	38.583
CE	Sua Nota Vale Dinheiro	n/d	dez/04	n/d	n/d	n/d	n/d
RJ	Cupom Mania	Sorteios de premios	set/09	n/a	n/a	n/a	n/a
GO	Nota Show de Bola	Cultural	jan/09	n/a	n/a	n/a	n/a
PI	Sua Nota Bate um Bolão	Cultural	mai/09	n/a	n/a	n/a	n/a
BA	Sua Nota é um Show	Cultural	jan/02	n/a	n/a	n/a	n/a

* Informacao referente a consulta feita nos sites oficiais dos programas em 21/07/2010.



Nota Fiscal Paulista - Program Evaluation

Table 2 - Mean comparison					
before	**All**	**SP**	**SP, DF, CE, AL, RJ**	**GO, PI, BA**	**Others**
sales tax nominal	517,194.18	4,691,906.70	1,376,036.77	252,998.14	331,315.73
sd	*891,954.73*	*559,816.65*	*1,674,415.58*	*171,508.84*	*358,378.66*
sales tax real	486,623.52	4,405,217.93	1,271,162.90	229,311.02	311,769.71
sd	*837,080.49*	*430,341.90*	*1,567,248.57*	*153,419.74*	*336,460.26*
sales tax third sector nominal	204,105.77	1,768,990.55	558,564.61	94,641.73	130,695.15
sd	*331,390.32*	*212,484.36*	*623,084.65*	*56,660.15*	*121,001.02*
sales tax third sector real	1,920.21	16,602.80	5,147.46	859.74	1,230.13
sd	*3,108.34*	*1,552.80*	*5,816.23*	*509.51*	*1,136.78*
after	**All**	**SP**	**SP, DF, CE, AL, RJ**	**GO, PI, BA**	**Others**
sales tax nominal	735,683.36	6,480,753.13	1,668,318.09	203,696.63	466,579.80
sd	*1,265,234.66*	*689,091.79*	*2,192,010.62*	*200,388.24*	*485,750.67*
sales tax real	611,716.93	5,382,987.00	1,412,925.23	170,507.20	388,338.84
sd	*1,048,118.55*	*447,702.41*	*1,807,670.64*	*157,405.58*	*402,925.64*
sales tax third sector nominal	299,894.81	2,597,027.32	701,613.99	89,201.23	185,162.81
sd	*502,738.56*	*291,406.68*	*871,530.78*	*89,600.28*	*165,489.60*
sales tax third sector real	2,491.73	21,557.07	5,940.83	748.32	1,540.79
sd	*4,156.93*	*1,800.83*	*7,170.19*	*702.59*	*1,369.64*

Source: Mattos, Rocha and Toporcov (2011)

Enabling Measures in Brazil

Tabela 4 - Sales Tax Collection - Brazilian States								
	Nominal Sales	Nominal Sales tax and non-linear effect	Nominal Sales third sector	Nominal Sales tax third sector and non-linear effect	Real sales tax	Real Sales tax and non-linear effect	Real sale tax third sctor	Real sales tax tertiary sector and non-linear effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep
dummy_nf_sp	-23,142.419	-20,402.999	-10,665.395	-7,183.553	-20,756.902	-24,358.956	-92.991	-68.526
	(35,514.482)	(36,981.310)	(13,217.855)	(11,803.343)	(25,120.989)	(27,300.260)	(111.632)	(99.151)
dummy_nfxsp	375,801.400		181,208.541		292,699.822		1,435.914	
	(276,334.467)		(125,680.845)		(189,984.130)		(897.897)	
nfp07sp		515,289.948		294,843.198		253,832.202*		842.067
		(548,861.335)		(202,279.943)		(148,249.975)		(571.771)
nfp08sp		-226,573.637		-194,818.618		118,018.692		925.195***
		(362,802.541)		(130,938.626)		(90,098.946)		(331.000)
nfp09sp		-45,879.489		-70,422.501		-169,721.136		414.587
		(226,032.619)		(82,666.952)		(172,642.624)		(638.632)
nfp10sp		-326,586.010***		-102,195.615***		49,292.475		1,050.472
		(84,109.013)		(31,231.985)		(212,211.968)		(795.450)
dummy_nf_al	-62,760.330	-63,625.897	-11,479.660**	-11,703.581**		-56,961.396*	-92.104**	-92.092**
	(41,590.911)	(42,409.499)	(5,150.277)	(4,913.191)		(32,033.631)	(42.917)	(40.920)
dummy_nfxal	33,883.543	29,565.482	13,097.086*	12,086.651*	24,940.903	26,334.713*	104.145*	95.677**
	(25,621.909)	(21,346.637)	(7,501.353)	(6,544.090)	(17,355.775)	(15,697.095)	(58.257)	(47.877)
dummy_nf_rj	54,493.440**	53,219.778**	13,863.682	13,917.579	36,955.888**	32,110.767**	95.043	95.666
	(21,655.332)	(21,788.303)	(8,564.346)	(8,557.345)	(16,279.066)	(14,352.211)	(66.485)	(67.753)
dummy_nfxrj	-309,075.526**	-318,938.231	-31,828.134	-16,016.005	-148,143.619	-175,538.323	17.698	55.826
	(150,360.859)	(210,484.749)	(67,357.792)	(77,400.293)	(106,493.285)	(153,966.085)	(499.685)	(581.831)
dummy_nf_df	13,968.570	12,483.091	200.387	878.538	-19,636.587	6,236.268	-3.540	-2.242
	(9,494.154)	(10,120.261)	(3,046.234)	(3,157.896)	(12,034.143)	(8,597.153)	(27.977)	(28.716)
dummy_nfxdf	-68,232.203***	-68,795.235***	-22,904.001***	-23,456.055***	-35,151.275***	-36,430.000***	-152.542***	-155.559***
	(9,807.425)	(10,219.653)	(7,361.544)	(6,953.889)	(8,521.757)	(8,636.723)	(53.629)	(51.913)

Source: Mattos, Rocha and Toporcov (2011)

NFP and ICMS collection

Table 7 -Sales Tax in São Paulo: Sectors Terciary X Secondary and Primary

	Nominal Sales tax sectors panel	Nominal Sales tax sectors - PCSE	Nominal Sales tax sectors panel and NFP non-linear	NominalSales tax sectors-PCSE and NFP non-linear	Real Sales tax sectors panel	Real Sales tax sectors - PCSE	Real sales tax sectors panel and NFP non-linear	Real Sales tax sectors-PCSE and NFP non-linear
	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep	coef/ep
NFP terciário	390,044.178***	390,131.951***			233,364.951***	233,473.796***		
sd	(67,101.088)	(46,123.818)			(46,621.948)	(31,839.939)		
NFP terc 2007			133,339.233	138,436.290			84,704.771	87,593.294
sd			(167,090.378)	(96,689.904)			(117,125.636)	(70,486.382)
NFP terc 2008			322,092.212***	320,299.004***			205,345.133***	204,585.151***
sd			(92,545.311)	(54,481.185)			(64,871.458)	(39,562.213)
NFP terc 2009			436,322.355***	444,739.684***			255,095.743***	260,508.148***
sd			(89,975.070)	(59,174.120)			(63,073.823)	(42,450.659)
NFP terc 2010			632,692.146***	607,858.882***			356,596.137***	340,453.725***
sd			(145,580.306)	(83,224.510)			(102,053.093)	(60,355.986)
primay sector		-1,977,165.157***		-1,979,323.636***		-1,801,870.101***		-1,802,921.182***
sd		(47,393.277)		(43,801.138)		(31,427.801)		(30,144.040)
Secondary sector		-170,177.964***		-172,750.001***		-201,559.551***		-202,848.922***
sd		(36,218.333)		(34,624.804)		(25,972.729)		(25,048.830)

Source: Mattos, Rocha and Toporcov (2011)

Estimation for Brazil

Table: NFP Estimation

	l(ICMS) Rob	**l(ICMS) Ep: Bs**	**l(ICMS) Rob**	**l(ICMS)t Ep: Rob**	**l(ICMS)t Bs**	**l(ICMS)t Rob**
	(1)	**(2)**	**(3)**	**(4)**	**(4)**	**(6)**
	coef/ep	**coef/ep**	**coef/ep**	**coef/se**	**coef/se**	**coef/se**
nfsp	0.002	0.002	-0.012	0.008	0.011	0.039
	(0.016)	(0.016)	(0.044)	(0.015)	(0.017)	(0.025)
nfsp*t	0.015	0.015	0.011	0.052**	0.050***	0.048**
	(0.020)	(0.017)	(0.021)	(0.022)	(0.017)	(0.023)
ms	sim	sim	sim	sim	sim	sim
ano	sim	sim	sim	sim	sim	sim
ms*ano	no	no	sim	no	no	sim
R2	0.678	0.678	0.689	0.559	0.556	0.570
N	1.678	1.678	1.678	1.607	1.607	1.607

nota: *** p¡0.01, ** p¡0.05, * p¡0.1. Fonte Mattos, Rocha e Toporcov (2013).

Table: No Lineares

				Tabela				
	logTotal real	**logTotal real**	**logTotal real**	**logTotal real**	**logterc real**	**logterc real**	**logterc real**	**logterc real**
	Ep: Rob	**Ep: Rob**	**Ep: AR(1)**	**Ep: AR(1)**	**Ep: Rob**	**Ep: Rob**	**Ep: AR(1)**	**Ep: AR(1)**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	coef/ep	**coef/ep**	**coef/ep**	**coef/ep**	**coef/se**	**coef/se**	**coef/se**	**coef/se**
nfsp	-0.001	-0.046	-0.008	-0.028	0.009	0.039	0.019	0.428**
	(0.015)	(0.035)	(0.017)	(18.861)	(0.015)	(0.025)	(0.021)	(0.172)
nfsp*2007	0.023	0.018	0.155**	0.157**	0.041	0.036	0.171*	0.172*
	(0.025)	(0.026)	(0.062)	(0.061)	(0.040)	(0.040)	(0.094)	(0.094)
nfsp*2008	-0.020	-0.013	-0.166**	-0.166**	-0.016	-0.009	-0.230*	-0.227*
	(0.019)	(0.021)	(0.085)	(0.084)	(0.044)	(0.044)	(0.121)	(0.120)
nfsp*2009	0.015	0.018	-0.066	-0.065	0.024	0.028	-0.041	-0.038
	(0.016)	(0.017)	(0.068)	(0.068)	(0.034)	(0.034)	(0.108)	(0.107)
Controles	sim	sim	sim	sim	sim	sim	sim	sim
ms	sim	sim	sim	sim	sim	sim	sim	sim
ano	sim	sim	sim	sim	sim	sim	sim	sim
ms e ano	no	sim	no	sim	no	sim	no	sim
R2	0.674	0.685	0.993	0.993	0.559	0.569	0.987	0.987
N	1.678	1.678	1.651	1.651	1.607	1.607	1.581	1.581

Table: Erros persistentes (AR(1))

Tabela 7 - (log) Arrecadao Real e tercirio. Erros persistentes (AR(1))

	logTotal	logTotal real	logterc real	logterc real
	(1)	(2)	(3)	(4)
	coef/ep	coef/ep	coef/se	coef/se
dummy nfsp	-0.012	0.981***	0.013	0.425**
	(0.017)	(0.351)	(0.021)	(0.172)
dummy interao nfsp	0.086***	0.089***	0.099**	0.103**
	(0.031)	(0.030)	(0.047)	(0.047)
Controles	sim	sim	sim	sim
ms	sim	sim	sim	sim
ano	sim	sim	sim	sim
ms e ano	no	sim	no	sim
R2	0.993	0.993	0.987	0.987
N	1.651	1.651	1.581	1.581

Table: Placebo

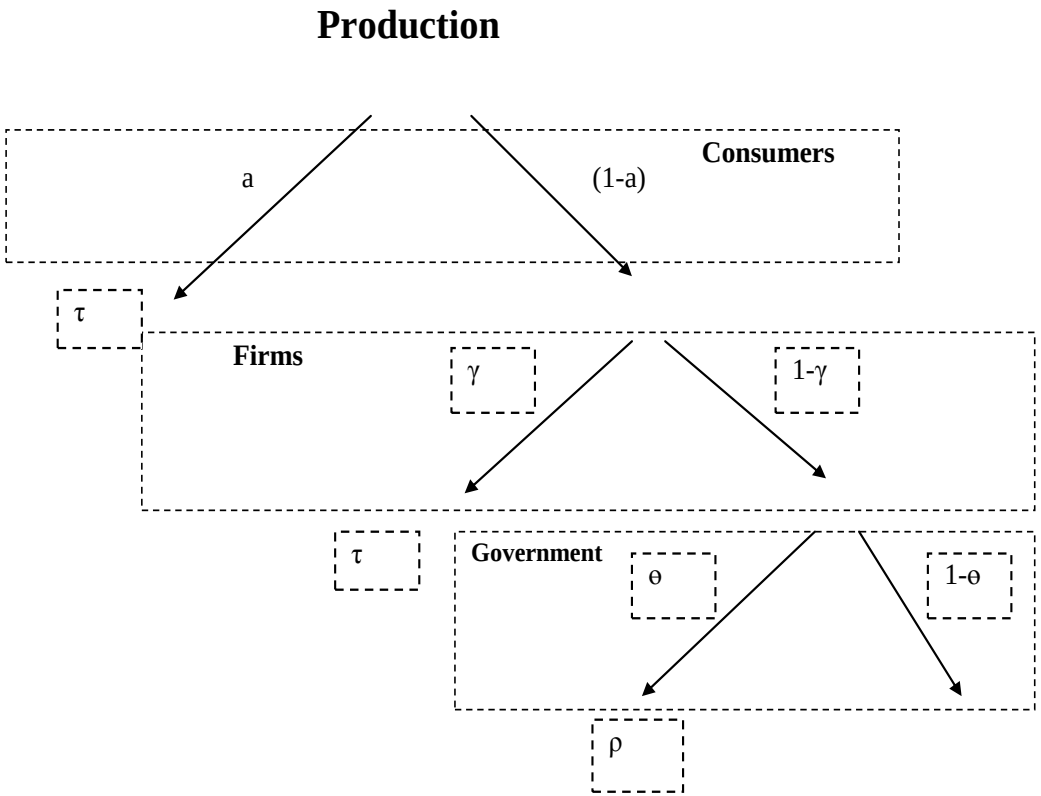
Tabela 8 - Setor tercirio com placebos: AL, RJ e DF. Erros persistenstes

	logterc real AL	logterc real AL	logterc real RJ	logterc real RJ	logterc real DF	logterc real DF
nfp	0.015	0.267	0.019	0.390**	0.021	0.393**
	(0.030)	(0.249)	(0.021)	(0.171)	(0.021)	(0.172)
nfp*t	0.098	0.093	-0.020	-0.026	-0.057	-0.053
	(0.082)	(0.082)	(0.050)	(0.050)	(0.058)	(0.058)
Controles	sim	sim	sim	sim	sim	sim
ms	sim	sim	sim	sim	sim	sim
ano	sim	sim	sim	sim	sim	sim
ms e ano	no	sim	no	sim	no	sim
R2	0.973	0.973	0.987	0.987	0.987	0.987
N	1.581	1.581	1.581	1.581	1.581	1.581

Our model

- **Firms**: Retail sales tax (RST) evasion and tax remittance responsibility. Receipts not automatically issued. Large number of firms try to evade sales taxes and their cost depend on fraction of sales unreported and not on a particular sale.
- **Government**: standard auditing procedures as well as reward households for a role of individual tax enforcers.
- **Consumers**: Small buyers have no incentive to call for a receipt (no effect on price of goods and on government purchases) unless when they earn for that. Hard to coordinate them.
    - Upon purchasing goods agents must decide whether they request a receipt for their purchase.
    - Request receipts is time consuming.
- If a consumer request the receipt: firm remits RST to the tax authority.
    - The government then send a portion of the tax collected back to the consumer.

Our model



Our model

- Firms face two distinct risks of being audited.
  1. Firms are subject to **individual auditing**, i.e., consumers decide the proportion of their purchase they will request receipts.
  2. On the portion of sales that a receipt was not issued, firms can decide whether to collect taxes or not.
     - If firms evade taxes they are subject to being detected by the government with a positive probability, which we call **government auditing**.
     - Each unit of output concealed from the tax authorities by firms entails a (increasing) resource cost.
- Perfectly competitive production of goods and coordination problem on the part of comsumers exclude the possibility of under-reporting prices and collusion between consumers and firms. Difference between our paper and C-L(2004) and B-M-M(2002).

Our model

The government chooses:

1. how much to audit (θ, **auditing probability**),
2. the correspondent **fines** (ρ) in case firms are caught cheating,
3. **retail sales taxes** (τ) and
4. **tax rebates**, ϕ.

Both individual and government auditing procedures are costly.

$\Longrightarrow$ Individual Auditing: the government pays a benefit in the form of tax rebate;

$\Longrightarrow$ Government Auditing: cost proportional to the fraction of the number of firms audited.

Overview of the Results

- Characterization of the optimal tax and trade-off between traditional versus individual auditing.
- If the unit cost of an auditing is zero, the planner will set the optimal retail sales tax and the optimal expected penalty to the same level.
- If consumers either spend a fixed amount of their time on auditing or do not spend time requesting receipts, the optimal rebate rate is zero.
- Three regimes: (i) without *individual auditing, (ii)* with both *government and individual auditing* policies and (iii) with *individual auditing* only.
    - **Compliance** is higher when both auditing policies are in place, but **welfare** is higher if individual auditing is the only tax enforcement policy.

The Economy - Firms

- Each firm uses labor L_t to produce a single perishable good y_t.
  - Production technology: $y_t = L_t$.
- The output of firms is sold at a consumer price p_t and sales are subject to a retail sales tax (RST) τ_t.
  - Taxes are remitted to the government only by retail businesses, triggered by sales to final consumers.
  - This remittance system creates opportunities for avoidance and evasion.
- The enforcement of the tax rules is stochastic and occurs either due to consumer's actions or due to government's auditing measures and procedures.

Firms: Three decisions

1. a_t: proportion of a consumer's purchases for which s/he asks for receipts in period t.
   Firms remit taxes in the amount of $a_t \tau_t (p_t L_t)$.
2. $(1 - a_t)(p_t L_t)$: proportion of sales not subject to individual auditing.
   The firm may evade taxes by reporting a fraction γ_t of its sales.
   $H(\xi_t)$: concealment cost $\xi_t = (1 - a_t)(1 - \gamma_t)$.
3. With probability $\theta_t \in (0, 1)$, firm is caught evading taxes and pay a tax rate $\rho \geq \tau$.

- Firms maximize **expected profits** in each period $t \geq 0$,

$$\begin{aligned} \Pi^e \quad = \quad & p_t L_t - a_t \tau_t p_t L_t \\ & - \left\{ (1 - a_t) \left[\gamma_t \tau_t + (1 - \gamma_t) \theta_t \rho_t + (1 - \gamma_t) H(\xi_t) \right] \right\} p_t L_t \\ & - w_t L_t \end{aligned}$$

Firms

- Firms' optimal behavior:

$$\begin{aligned} \tau_t &= \theta_t \rho_t + H(\xi_t) - (1-\gamma_t) H_\gamma(\xi_t) \\ w_t &= [1 - T_t - \xi_t H(\xi_t)] p_t \end{aligned}$$

  where $T_t = a_t \tau_t + (1-a_t)[\gamma_t \tau_t + (1-\gamma_t)\theta_t \rho]$ is the expected tax that a firm pays to the tax administrator on each unit of output produced and sold.

- Assuming $H(\xi_t) = (\xi_t)^x$, $x > 1$ and combining equations (1) and (1):

$$\frac{w_t}{p_t} = P(a_t, \gamma_t), \tag{1}$$

- where
  $P(a_t, \gamma_t) = [1 - H(\xi_t) + (a_t + (1-a_t)\gamma_t)(1-\gamma_t) H_\gamma(\xi_t) - \theta_t \rho_t]$.

The Economy - Households

- Time endowment is normalized to 1.
- Household works L_t hours, enjoy leisure h_t and audit firms d_t.
  Preferences:
$$\sum_{t=0}^{\infty} \beta^t u(c_t, 1 - L_t - d_t) \tag{2}$$
  where c_t is consumption; $h_t = 1 - L_t - d_t$.
- **Auditing technology**
$$d_t = d(a_t) = \bar{d} a^{\delta} \tag{3}$$
  $\bar{d} \in (0, 1)$: upper bound on the leisure cost for auditing.
- The auditing technology satisfies $d(0) = 0$ and $d(1) = \bar{d}$.

The Economy - Households

- Tax rebate $\phi_t \in [0,1]$ an agent receives in time t.
- It depends on consumption receipts requested in $t-1$: $a_{t-1}p_{t-1}c_{t-1}$)
- The representative consumer faces the following budget constraint:

$$p_t c_t = w_t L_t + \phi_{t-1}\left(p_{t-1}a_{t-1}\tau_{t-1}L_{t-1}\right) \tag{4}$$

- The household chooses c_t, h_t and a_t taking as given prices and government policy instruments, where μ is the Lagrange multiplier on the consumer budget constraint equation (4). First two are Tradition F.O.C.. Last one translates the marginal benefits and costs of auditing (auditing trade-off).

$$\begin{aligned} c(t) : u_1(t) &= \mu_t p_t \\ h(t) : u_2(t) &= \mu_t w_t + \beta\mu_{t+1}\phi_t p_t a_t \tau_t \\ a(t) : u_2(t)d'(a_t) &= \beta\mu_{t+1}\phi_t p_t \tau_t L_t \end{aligned}$$

The government and aggregate resources

- The government finances its expenditures G by collecting taxes from the firms.
- TThe government finances its expenditures by levying proportional taxes on firms' sales and evasion penalties on sellers as below

$$G + \theta N = \{a(1-\phi)\tau + (1-a)\left[\gamma\tau + (1-\gamma)\theta\rho\right]\} L, \tag{5}$$

where N is a fixed unit cost of audit.

- Economy's resource constraint:

$$c + G + \theta N + \xi H(\xi) L = L. \tag{6}$$

Optimal Tax and Audit Policy

- The objective of the social planner is to choose values of its tax instruments such that the agents utility levels and profits are maximized and the government is constrained to raise a given amount of revenue.

- **Ramsey Dual Approach**: the policy trade-off faced by the government when choosing tax-enforcement instruments

- **Ramsey Primal formulation**: the optimal taxation problem to characterize the optimal policies.

Optimal Tax and Audit Policy

- Buyers can be affected not only by the good's price (p) but also by the retail sales tax (τ) and the rebate rate (ϕ). Arguments of the buyer's indirect utility.
- Let $T^e = a\tau(1-\phi) + (1-a)[\gamma\tau + (1-\gamma)\theta\rho]$ be tax authority's expected sales tax revenue for each unit of output.
- Using the firm's first-order conditions and normalizing $w = 1$:
  $p = F(\tau, \phi, \theta, \rho)$, and then
  $v(p, \phi, \tau) = u[c(1/p, \phi, \tau), L(1/p, \phi, \tau), S(a(1/p, \phi, \tau))]$

- The structure of this problem is now analogous to the standard optimal commodity tax problem (Sandmo, 1974, Atkinson and Stiglitz, 1980) with one relevant difference:

  * the good's price is dependent on $\phi\tau$ and θ and, therefore, p is also an argument of the indirect utility of the consumer.

- In our problem, the optimal tax, the auditing probability and tax rebate rate depend on the response of labor supply to these policies rather than the changes in consumption. This occurs due to the relationship between the labor supply decision and the size of production. In other words, although the level of production is independent of the firm's decision regarding evasion (γ), it is related, via labor supply L, to the individual auditing time allocation a.

Optimal Tax and Audit Policy

- The planner's maximization problem can thus be written in the Lagrangian form as follows:

$$v(p,\phi,\tau)+\lambda\{-G-\theta N+L[a\tau(1-\phi) \tag{7}$$

$$+(1-a)(\gamma\tau+(1-\gamma)\theta\rho), \tag{8}$$

where λ is the Lagrangian multiplier on the government's budget constraint and the ordinary demand functions are $x = x(1/p, \phi, \tau)$ for $x = L$, a and γ.

- Our optimal choice of policies τ, θ and ϕ as a function of labor supply response, rather than consumption's choice.

Optimal Tax and Audit Policy

Proposition

Optimal auditing and tax-rebate policies must satisfy:

$$\left(\frac{\mu}{p}\right) L\frac{\partial p}{\partial \theta} = \lambda\left[L\left(\frac{\partial T^e}{\partial p}\frac{\partial p}{\partial \theta}+\frac{\partial T^e}{\partial \theta}\right)+T^e\left(\frac{\partial L}{\partial p}\frac{\partial p}{\partial \theta}-N\right)\right],$$

$$\left(\frac{\mu}{p}\right) L\frac{\partial p}{\partial \phi}-\mu p\tau aL = \lambda\left\{\begin{array}{c} L\left(\frac{\partial T^e}{\partial p}\frac{\partial p}{\partial \phi}+\frac{\partial T^e}{\partial \phi}\right) \\ +T^e\left[\frac{\partial L}{\partial p}\frac{\partial p}{\partial \phi}+\frac{\partial L}{\partial \phi}\right]\end{array}\right\},$$

$$\left(\frac{\mu}{p}\right) L\frac{\partial p}{\partial \tau}-\mu p\phi aL = \lambda\left\{\begin{array}{c} L\left(\frac{\partial T^e}{\partial p}\frac{\partial p}{\partial \tau}+\frac{\partial T^e}{\partial \tau}\right) \\ +T^e\left[\frac{\partial L}{\partial \tau}+\left(\frac{\partial L}{\partial p}\frac{\partial p}{\partial \tau}\right)\right]\end{array}\right\},$$

where $T^e = a\tau pL(1-\phi)-(1-a)pL(\gamma\tau+(1-\gamma)\theta\rho)-p\theta N-pG.$

- The optimum choice of policies must ensure that the net effect of policies on an individual's welfare is equal to their net effect on tax collection.

Trade-offs

Proposition

The trade-offs between (i) the auditing probability and the tax rebate rate and (ii) the retail sales tax and the tax rebate rate can be represented:

$$\frac{\frac{\partial p}{\partial \phi}}{\frac{\partial p}{\partial \theta}} = \frac{\left[T^e \frac{\partial L}{\partial \phi} + L\frac{\partial T^e}{\partial \phi}\right] + (\mu/\lambda)pa\tau L}{\left[-N + L\frac{\partial T^e}{\partial \theta}\right]}$$

$$\frac{\frac{\partial p}{\partial \phi}}{\frac{\partial p}{\partial \tau}} = \frac{\left[T^e \frac{\partial L}{\partial \phi} + L\frac{\partial T^e}{\partial \phi}\right] + (\mu/\lambda)pa\tau L}{\left[T^e \frac{\partial L}{\partial \tau} + L\frac{\partial T^e}{\partial \tau}\right] + (\mu/\lambda)p\phi aL}$$

Policy Trade-off II

- Government must consider the effect of changing either the audit probability or the tax rebate rate on tax revenues and prices.

$$\underbrace{\frac{\frac{\partial p}{\partial \theta}}{\frac{\partial p}{\partial \phi}}}_{1} = \underbrace{\frac{L\left(\frac{\partial T^e}{\partial \theta} - N\right)}{\left(L\frac{\partial T^e}{\partial \phi} + T^e\frac{\partial L}{\partial \phi} + (\mu/\lambda)pa\tau L\right)}}_{2}$$

1. Rate of substitution between θ and ϕ such that consumers' welfare via price (p) remains constant and an additional welfare effect ($(\mu/\lambda)pa\tau L$).

- θ only affects welfare through prices. ϕ distorts consumers' welfare via two channels, namely a tax collection effect, $[T^e(\partial L/\partial \phi) + L(\partial T^e/\partial \phi)]$, and a welfare effect.

Optimal Tax

Proposition

The optimal tax policies satisfy the following relationship:

$$\frac{T^e}{p} = \left[\left(\frac{\mu}{\lambda}\right)\left(\frac{1}{p} + \frac{p\phi a}{\frac{\partial p}{\partial \tau}}\right) - \left(\frac{\frac{\partial T^e}{\partial \tau} + \epsilon^{(L,\tau)}}{\frac{\partial p}{\partial \tau}}\right)\right]\left(\frac{1}{\epsilon^{(L,p)}}\right) \tag{9}$$

Optimal Tax I

- Traditional "Ramsey equation": $[\tau p(\partial L/\partial p)]/L = (\mu/\lambda)/p$.
- The more prices are tax-distorted by policies (large $\partial p/\partial \tau$), the closer the optimum tax should be to the case without evasion and tax rebates. In this case, τ achieves its optimal through price changes and no additional distortion is necessary.
- If $\partial p/\partial \tau$ is positive (negative) the interpretation is as follows. First, the larger the rebate income $(a\phi p)$ - in welfare terms (μ/λ) the higher (lower) the expected tax revenue should be.
- Second, the larger the distortion on the consumers' response to changes in the retail sales tax, i.e., the large $\partial T^e/\partial \tau$ and $\epsilon^{(L,\tau)}$, the lower (larger) taxes should be in order to minimize such distortion.

Optimal Policy Analysis

- If the unit cost of audit N is zero, the government will set $\tau^* = \theta^* \rho$.

- If $\delta = 0$, buyers spend a fixed amount of their time on auditing.
  - * The optimal rebate rate is zero ($\phi^* = 0$).
  - * A zero tax rebate rate is also optimal when a buyer does not spend time requesting receipts ($\bar{d} = 0$).

- Both policy instruments θ and ϕ affect the price of the consumption good, and hence the household consumption, but the tax rebate rate has an additional effect on a buyer's time allocation and income.

Functional Forms and Parameterization

$$\begin{aligned}
\underline{\textit{Preferences}}: \quad & u(c,h) = \frac{c^{1-\sigma}}{1-\sigma} + \kappa \frac{\left(1-L-S(a)\right)^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}, \\
\underline{\textit{Technology}}: \quad & F(L) = L, \\
\underline{\textit{Auditing Technology}}: \quad & S(a) = \bar{d}a^{\delta}, \\
\underline{\textit{Concealment Cost}}: \quad & H(\xi) = \xi^{\varkappa},
\end{aligned}$$

- Baseline values:

$$\begin{array}{llll}
\sigma = 1 & \eta = 0.4 & \kappa = 2.0 & \\
\bar{d} = 0.03 & \delta = 0.30 & \varkappa = 5.00 & N = 0.00
\end{array}$$

- The numerical exercise is divided in three steps: (i) without *consumer auditing*, *(ii)* with both *government and consumer auditing* policies and (iii) with *consumer auditing* only.

Government Auditing Only

Table 1 - Optimal Policies and Allocations

	$N = 0.00$	$N = 0.001$	$N = 0.005$
Retail Sales Tax τ^*	0.3116	0.3216	0.4013
Evasion Penalty ρ^*	0.3200	1.0000	1.0000
Detection Probability θ^*	0.9736	0.3213	0.3047
Sales Reported γ^*	0.9923	0.8652	0.5622
Consumption c^*	0.2210	0.2178	0.2035
Leisure h^*	0.6790	0.6790	0.6790
Welfare U^*	-0.9053	-0.9199	-0.9878

- When the cost of auditing increases, the detection probability decreases and firms react to it by reducing the amount of sales voluntarily reported.

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- When the cost of auditing increases, the detection probability decreases and firms react to it by reducing the amount of sales voluntarily reported.
- A lower level of compliance is associated with a smaller tax base and, welfare losses are greater the higher the unitary cost of auditing as well as the higher taxes are, which increases deadweight losses.

Government and Individual Auditing

Table 2 - Optimal Policies and Allocations

	$N = 0.00$	$N = 0.001$	$N = 0.005$
Retail Sales Tax τ^*	0.2801	0.2867	0.3160
Evasion Penalty ρ^*	0.9800	1.0000	1.0000
Detection Probability θ^*	0.2859	0.2864	0.3146
Tax Rebate ϕ^*	0.0775	0.0752	0.0661
Purchases with receipt a^*	0.6444	0.6422	0.6321
Sales Reported γ^*	0.6005	0.6003	0.5990
Consumption c^*	0.3306	0.3279	0.3158
Leisure h^*	0.5431	0.5430	0.5424
Auditing time $d(a^*)$	0.0263	0.0263	0.0261
Welfare U^*	-0.7628	-0.7713	-0.8103

- When both auditing policies are available, it is optimal to distort the labor-leisure decision the least and bear the cost of wasted resources with direct auditing.

Individual Auditing Only

Table 5 - Optimal Policies and Compliance

	$\bar{d} = 0.03^{\star}$	$\bar{d} = 0.03^{\star}$		$\delta = 0.30^{\star}$	
	$\delta = 0.30^{\star}$	$\delta = 0.00$	$\delta = 0.20$	$\bar{d} = 0.00$	$\bar{d} = 0.02$
τ^*	0.4355	0.2301	0.3992	0.2046	0.3882
ϕ^*	0.1718	0.0000	0.1688	0.0000	0.1718
a^*	0.6439	1.0000	0.7023	1.0000	0.6939
c^*	0.3306	0.3346	0.3291	0.3886	0.3483
h^*	0.5431	0.5354	0.5429	0.5114	0.5338
U^*	-0.7628	-0.7676	-0.7677	-0.6665	-0.7309

* : baseline values.

- As the individual auditing technology parameter δ decreases, total compliance increases.

Individual Auditing Only

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ϕ^*	0.1718	0.0000	0.1688	0.0000	0.1718
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c^*	0.3306	0.3346	0.3291	0.3886	0.3483
h^*	0.5431	0.5354	0.5429	0.5114	0.5338
U^*	-0.7628	-0.7676	-0.7677	-0.6665	-0.7309

* : baseline values.

- As the individual auditing technology parameter δ decreases, total compliance increases.
- If either $\delta = 0.00$ or $\bar{d} = 0.00$ full compliance is reached and no rebate is offered.

Welfare X Compliance

- **Compliance** is higher when both - *government and individual* - auditing polices are in place, but **welfare** is higher if *individual auditing* is the only tax enforcement policy.

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  - Welfare gains are mainly due to the fact that labor income and the tax rebate allow them to consume more, without giving up too much leisure.
- Compliance: Three tax enforcement regimes

Government Auditing Only:	56 percent,
Government and Individual Auditing:	85 percent,
Individual Auditing Only:	64 percent,

Conclusions

- We characterize optimal tax and audit policies where both consumers and tax administrators can engage in auditing.
- We also focus on the policy trade-off bw traditional versus individual auditing.
- Compliance is higher when both auditing policies are in place, but welfare is higher if individual auditing is the only tax enforcement policy.
- Extensions: heterogeneity across firms and consumers; good-specific sales tax rebates. Hard to tax sextors model. Firm and individual level data set.