

## PERFORMANCE-BASED WAGES IN TAX COLLECTION: THE BRAZILIAN TAX COLLECTION REFORM AND ITS EFFECTS\*

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We use panel data from the Brazilian tax collection authority to examine the effects of a major incentive reform instituted in 1989 to improve tax enforcement. Beforehand, fine collections per inspection were relatively stable; however, a striking trend break occurred afterwards, which we attribute to the incentive reform not to changes in the macroeconomy or personal and corporate income tax rates. Our estimates suggest the growth in fines per inspection after the reform is about 75% above what it would have been without it and that there is substantial heterogeneity in the impact of the reform across tax regions.

Effective collection of tax revenues is a prerequisite for a sound economy. A nation's plan for economic development will founder if the government lacks the means to collect the funds mandated by that plan. Many countries have been plagued by the inability to collect sufficient tax revenues to finance government expenditures. It is, therefore, not surprising that many countries make reform of their collection systems a priority in economic development programmes.

Brazil instituted one such reform in 1989 to improve the enforcement of tax laws. The Brazilian reform provides monetary compensation to tax collectors based on their individual and group performance in finding and collecting taxes from tax evaders. Bonuses are paid with revenues raised in the collection of fines – for every dollar of fines collected, 68 cents are allocated to pay bonuses. An immediate implication of this is that the size of the rewards are quite significant; incentive bonuses frequently constitute more than twice the full salary of the individuals in the collection agency! Perhaps surprisingly, little is known about the effectiveness of performance-based wages for tax collectors in economies such as Brazil where tax evasion is widespread. This study attempts to narrow the gap in the literature by employing unique panel data sets from the Brazilian tax collection authority to examine the effectiveness of the reform.

The theory of incentives and mechanism design has much to say about the likely theoretical effects arising with a reform of tax collection agencies.<sup>1</sup>

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<sup>1</sup> See eg Becker and Stigler (1974), Besley and McLaren (1993), Chander and Wilde (1992), Flatters and MacLeod (1995), Graetz *et al.* (1986), Melamad and Mookherjee (1989), Menezes (1995) and Mookherjee and Png (1989; 1995). Rose-Ackerman (1996) provides an excellent survey of the literature on corruption.

Conceptually, one can divide the temptations affecting a tax collector into two categories: 'shirking' and 'corruption'. Shirking is the basic moral hazard problem: finding evaders is difficult work. A collector will, *ceteris paribus*, prefer to skimp on the necessary effort. Beyond the problem of generating sufficient effort on the part of its employees, the authority must also assure that its employees pass along information that they uncover in their investigative activities. Once the collector has made the determination that evasion has occurred, the collector may decide to use the information to his own advantage by extracting a bribe from the evader.

Flatters and MacLeod (1995) build a simple theoretical model to examine the problem facing a tax collection authority in an economy characterised by widespread tax evasion and corruptible tax collectors. They demonstrate that an optimal policy of raising a targeted level of tax revenue – a policy that minimises the tax authority's collection cost – must allow tax collectors to receive rewards for their collections. Flatters and MacLeod focus on bribes as a method for providing tax collectors with the necessary incentive to exert effort. From the perspective of tax collectors, illegal bribes and government approved bounties may be indistinguishable in that both are 'carrots' for exerting effort.

If one assumes that the Brazilian economy prior to the reform was similar to the economy studied by Flatters and MacLeod, and one further assumes that tax collectors view incentive bonuses paid by the tax authority and bribes as perfect substitutes, one may be able to postulate that, *ceteris paribus*, the average tax collector displayed the following behavioural response to the reform: (i) he increased his effort in the enforcement of tax laws and hence produced an increase in fine collection if the marginal incentive bonus paid by the tax collection authority was higher than the marginal illicit income he used to receive with bribe collection; or (ii) he did not increase his effort after the reform was introduced – and hence the reform was ineffective – because the incentive bonus paid by the tax collection authority was not higher than the illicit income he used to receive with bribe collection. This argument is undoubtedly simple since it abstracts from exogenous 'shocks' that may have influenced the average tax collector's behaviour in the period of study (such as the income tax reform described in Section 1 below). However, it underscores the fundamental incentives facing the average tax collector as well as the effectiveness of the reform.

In order to examine the quantitative impact of the Brazilian reform on fine collections, we construct a panel data set from information obtained by the Brazilian tax authority that spans six years, three years before and after the reform. The data are available for each of ten tax regions and are subdivided by type of examination, i.e., internal, external, and customs exams. The data provide information on fines collected, on the number of inspections, on the number of personnel involved in the collection, and on the hours spent on examinations. In addition, we have panel data on the fine revenue generated from each of 25 different taxes for the same time period. This latter data set is used to help isolate the tax-collection reform from the income-tax reform that occurred around the same time. To our knowledge, our data sets are the first

of their kind. No other study has yet provided empirical evidence on the likely effects of performance-based wages in economies with widespread tax evasion.

Our findings are stark. From 1987 to 1989 fine collections were relatively stable; however, a striking break in fine-collection growth rates occurred after 1989. Our estimates, robust to alternative specifications, indicate that after the reform fine collections per inspection were about 75% above what they would have been in the absence of the programme. The results also suggest that there is substantial heterogeneity in the impact of the tax-collection reform across tax regions, ranging from an increase of 19% to 145%. The change in growth rates is highly suggestive that the reform was successful in increasing collection efforts on the part of the auditors.

## 1. An Overview of Tax Collection Reform in Brazil

In Brazil, individuals, corporations, and goods and services are taxed by federal, state and municipal governments. Federal taxes are administered by the Secretaria da Receita Federal (SRF). The SRF is Brazil's equivalent of the US Internal Revenue Service. State and municipal taxes are administered by the local counterparts of the SRF; social security and medicare taxes are administered by the Instituto Nacional de Seguro Social (National Institute of Social Security).

### 1.1. *The Bonus Programme for Tax Collection*

On December 22, 1988, the Brazilian government created a bonus programme to compensate tax officials for their efforts in collecting taxes and uncovering tax violations. The bonus or reward paid to tax officials is called *Retribuição Adicional Variável* (RAV). An executive committee, called *Comissão de Administração da Retribuição Adicional Variável* (CRAV), was created in March 1989 to manage the programme. The CRAV not only establishes the goals to be implemented by each tax agency, but also supervises and evaluates the performance of each tax agency. There are 110 tax agencies in the country: one central agency, ten regional agencies and 99 local agencies.

The programme, effective August 1989, pays bonuses on a monthly basis with revenues raised by the collection of fines imposed for noncompliance with tax provisions.<sup>2</sup> The programme's monthly revenues are equal to the difference between the total amount of fines collected during the month, properly adjusted for inflation, and the part of this total which is transferred to states and local governments. The programme's monthly revenues are deposited in a fund called *Fundo Especial de Desenvolvimento e Aperfeiçoamento das Atividades de Fiscalização* (FUNDAF). FUNDAF monthly revenues have been, on average, equal to 68% of the total amount of fines collected.

<sup>2</sup> When a tax collector uncovers tax evasion, the evader should be assessed a fine equal to 20% the amount of tax evaded – ie each dollar of tax evaded should yield 20 cents of fine revenue.

The RAV (or total bonus) paid to an official is composed of two types of rewards: an individual reward and a group reward. Both types of rewards increase with the amount of fines collected, so both the individual and the group have incentives to increase their productivity. Group rewards are paid with 30% of FUNDAF monthly revenues, while individual rewards are paid with the remaining 70%. The group reward, calculated according to the relative efficiency of the agency vis-a-vis other agencies in the country, equally compensates all officials within a given tax agency. The 110 tax agencies were ranked according to their performance each month, inducing managers to allocate resources efficiently within the tax agencies in light of the inter-agency competition.

Three basic factors are used to measure an agency's efficiency: (i) the amount of fines collected; (ii) the relative performance in reaching pre-established goals (total amount of taxes collected, number of inspections or examinations undertaken, and collection of overdue taxes and fines); and (iii) the size of the agency (in terms of the number of officials). The group reward is directly related to items (i) and (ii) and inversely related to item (iii). The first two items are used to determine the agency's total due compensation. An official's group reward is then obtained by dividing the agency's total compensation by the number of officials in the agency.

The individual reward compensates the official for his or her productivity, independently of the tax agency in which the individual worked. The individual reward is based on the supervisor's monthly evaluation of the individual's performance. Although there is an established and well-known set of objective criteria to be used in performance evaluations, the supervisor is given discretion to use subjective criteria as well. Each month the supervisor writes a report (*Boletim de Trabalho*) in which the individual's performance is graded on a scale from 0 to 70 points. If the official's performance grade is less than or equal to 21 points, the official cannot receive the RAV (neither the individual reward nor the group reward). Officials whose performance points are greater than 21 have their reports sent to the central agency, where performance points are summed up. The 'value of the point' is then determined by dividing the total amount allocated to pay individual rewards (i.e., 70% of FUNDAF monthly revenues) by the total number of points. An official's individual reward corresponds to the value of the point times the number of points the official received in the evaluation. The supervisor's individual reward equals the average of the individual rewards paid to his/her subordinates.

To understand better how an official's total reward is calculated, consider the following simple example. Suppose that there is only one agency in the country consisting of a supervisor and two officials, *a* and *b*. In a particular month, the officials collect a total of \$1,000 in fines. The FUNDAF revenue equals \$680 (i.e., 68% of total fines). The revenue available to pay group RAV equals  $0.3 \times \$680$ , or \$204. Since there are three officials, each receives \$68 as a group RAV reward. To calculate the individual RAV, we must have some information about each official's evaluation points. Suppose that official *a*

receives 60 points and official *b* receives 70 points in their evaluations. The supervisor's points should be equal to the average of his/her subordinates, or 65 points. The total revenue available to pay the individual RAV equals  $0.7 \times \$680$ , or \$476. The value of the point equals  $\$476 / (60 + 65 + 70)$  or approximately \$2.44. Officials *a* and *b* receive individual rewards equal to \$146.4 and \$170.8, respectively. The supervisor's individual reward equals \$158.6. Adding \$68 to each of the individual rewards, we obtain the total rewards paid to the officials.

While the individual official receives a base salary as well as the total bonus, their total compensation is limited. According to the 1988 Brazilian Constitution, public servants cannot receive a wage higher than the one received by a government minister. Thus, a minister's wage corresponds to a wage ceiling for the tax official. On July 21, 1992, the Parliamentary Inquiry Commission on Tax Evasion interviewed Mr. Nelson Pessuto, the president of the UNAFISCO (Tax Officials National Union). In the hearing, Mr. Pessuto, a senior tax auditor, disclosed information about his earnings. His basic salary was Cr\$ 1.9 million per month and his reward was about Cr\$ 5.9 million per month. It was mentioned in the hearings that rewards to officials varied from Cr\$ 4 million to Cr\$ 8 million. Indeed, in June 1992, total fines collected equalled Cr\$ 87.9 billion and the value of the point for a tax auditor was Cr\$ 72,548. For a tax auditor who received 60 points in his/her individual evaluation, the individual reward amounted to Cr\$ 4,352,880. The group RAV paid to auditors ranged from Cr\$ 826,374 (Porto Belém) to Cr\$ 4,016,651 (Novo Hamburgo). At this time, a minister's salary was about Cr\$ 9 million and the exchange rate was on the order of Cr\$ 2,300 per dollar.<sup>3</sup>

Whenever the official's due compensation exceeds this ceiling, the excess is taken away from the official and deposited in his or her name in a mutual fund, denoted 'Contingent Reserves', which is shared by all tax officials. The official can have access to this wage surplus if he/she does not reach the ceiling in one of the following six months. If, however, the official reaches the wage ceiling in every one of the following six months, he/she loses the excess wage, which has been deposited in the Contingent Reserves fund, to the collective. Revenues of the Contingent Reserves fund are saved and used as insurance against 'hard times' as well as to finance the collective's joint activities.

In sum, the RAV programme provides incentives which affect behaviour at two levels – the individual inspector and the agency. The competition amongst tax agencies and the group bonuses give managers a clear incentive to reallocate their staffs in ways which will increase group performance along dimensions specified by the group criteria, i.e. the amount of revenues collected and the number of inspections undertaken.

<sup>3</sup> Field interviews were conducted by one of the authors in January 1993. The consensus of participants and supervisors was that a majority of tax officials in the country received bonuses, which placed them at the wage ceiling. Not surprisingly, the most common complaint was that the maximum allowable total bonus was too low.

### 1.2. *Income Tax Reform and Other Efforts to Improve Tax Collection*

The RAV system was one of a number of measures taken during this period to increase compliance and collection of taxes in Brazil. Inflation rates over 1,000% have motivated a number of actions by the federal government to avoid corrosion of tax revenue. For example, tax liabilities have been fully indexed as of 1992. During the period we examine, individual marginal income tax rates were reduced from 45% to 25%. Non-financial corporations also faced reduced marginal rates from 45% to 35% in 1987; in 1989, the basic corporate income tax rate was reduced from 35% to 30%. Other changes were also instituted to encourage compliance: average custom tax rates were reduced by 20%, tax forms for small corporations were simplified, withholding procedures were adopted and developed for payment of interest, and procedures for income tax withholding were simplified.

The SRF has also directed effort towards enforcing tax compliance on the part of the 30,000 largest companies (those with monthly gross receipts of at least US\$ 150,000) and has developed a special audit programme to investigate compliance by 600 large companies known for tax avoidance. It has also targeted individuals not in compliance by developing programmes to seize the assets of 115,000 taxpayers whose tax liability has not been entirely paid and to assess the economic profiles of 300,000 who failed to file tax returns.

The RAV and the other measures undertaken by the SRF to increase collection of taxes in Brazil led to an increase in the ratio of total amount of federal taxes collected to GDP from 14.8% in 1988 to 17% in 1992. A crude way of illustrating the influence of the RAV programme in the expansion in collection of federal taxes is to compare the ratio of federal revenues originating with auditing effort to total federal revenues for the 1988 and 1992 years. This ratio increased from 3.42% in 1988 to 27.86% in 1992! While formally quantifying the impact of the RAV on tax collections is desirable, suitable data for such a detailed analysis are not available. Consequently, the focus of the subsequent sections is to estimate the impact of the RAV programme on fine collection efforts.

## 2. Data

The data for this study were provided by the Coordenação de Fiscalização (i.e., the Inspections Division) of the SRF. They cover auditing and collection activities for the years 1987 to 1992, i.e., three years before and after the reform. The SRF provided two separate data series for our analysis. One set contains data for each of the 10 tax regions on fines collected and on resources devoted to fine collection, including the number of inspections, the average number of auditors and high-level supervisors assigned (AFTNs), and employee hours.<sup>4</sup> These variables are disaggregated by examination type: (i)

<sup>4</sup> We were not provided hours-related data for 1992.

external, (ii) internal and (iii) customs examinations.<sup>5</sup> The other data set contains information from external examinations on fines collected and hours spent in collection activities for each of 25 different taxes, e.g., income and excise taxes. This latter data set will be used to help isolate the RAV reform from the income tax reform that occurred around the same time.

The key variable of interest is fine collections per inspection. Fines per inspection, as opposed to the level of fines, will better capture changes in productivity by the collection officials as noted in the figures below. The analysis of fines per inspection is complicated both by the fact that the sample period was a time of hyperinflation and the currency was converted on four occasions. To overcome these complications, the SRF indexed the data to account for monthly inflation changes. It was then straightforward to convert the indexed data into real values of the Brazilian currency as of 1992, the Cruzeiros Reais (CR\$).

Fig. 1 presents the time-series change for the unweighted average annual fine collections (in billions of 1992 CR\$) over the ten tax regions for external, internal, customs, and total examinations. From 1987 to 1989, fine collections were relatively stable; however, a striking trend break occurred after 1989, which is especially pronounced in 1991 and 1992. Indeed, between 1989 and 1992 average fine collections increased by 585%! Interestingly, the rapid growth in fine collections is driven almost exclusively by growth in fines from

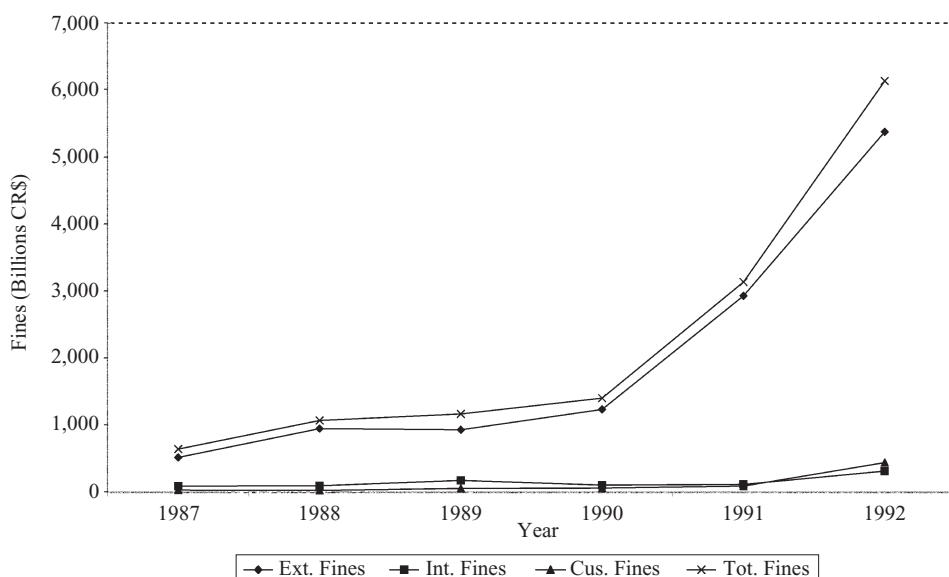


Fig. 1. *Average Annual Fine Collections*

<sup>5</sup> The key difference between external and internal exams is the types of materials inspected. When conducting an external examination, an auditor visits an individual firm or taxpayer and inspects the financial and fiscal records of the entity. When conducting an internal examination, an auditor examines a taxpayer's return.

external exams. This trend break is highly suggestive that the RAV programme was successful in increasing collection efforts on the part of the auditors, particularly external auditors.

It is possible that fine collections increased simply because more taxpayers were audited. In Fig. 2 we present the average annual number of inspections. The figure shows that on the contrary the average number of total inspections experienced a rapid decline in the first year of the programme, and then stabilised in the subsequent two years. The large decline was driven by a 80% drop in internal inspections between 1989 and 1990. However, it appears that there was a reallocation of resources towards the more lucrative external examinations in the first two years of the reform with a 23% increase in 1990 and a 43% increase in 1991 relative to 1989. By 1992, though, the number of external exams returned to near their pre-reform levels while the fines collected continued their upward trend. Given the dramatic, and opposite, changes in fines and inspections, it is instructive to examine how the ratio of fines per inspection varied over the period as this measure is more likely to better capture the productivity of the agents. In Fig. 3 we present the ratio for the total as well as by examination type. While the ratio of external fines to external inspections exhibits largely the same relationship as demonstrated in Fig. 1, the ratio of total fines to total inspections is dampened substantially by the concurrent changes in internal inspections.

While overall inspections were falling after the reform, the tax authorities may have boosted collection efforts by increasing the number of AFTNs and employee hours. In Figs. 4 and 5, we present the average annual number of AFTNs and average annual number of employee hours devoted to fine

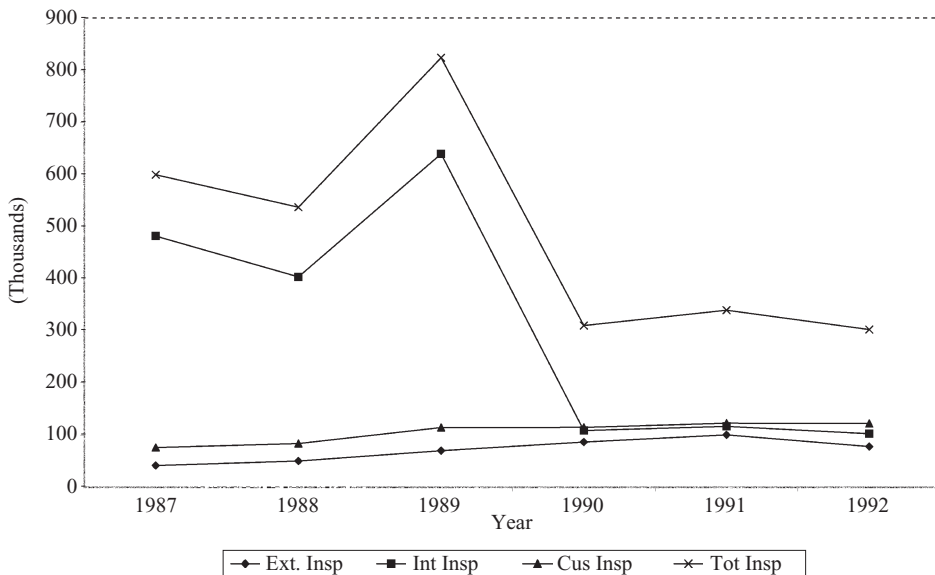
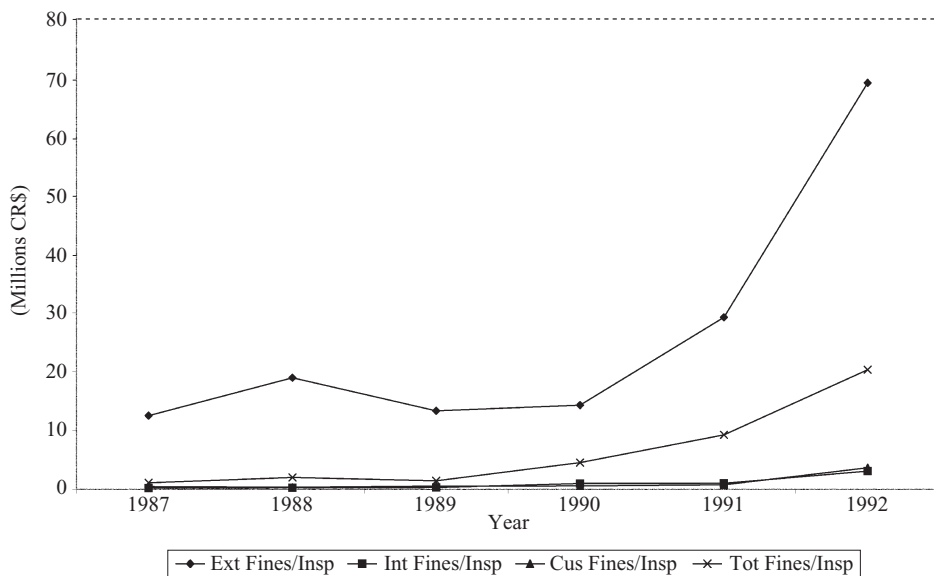
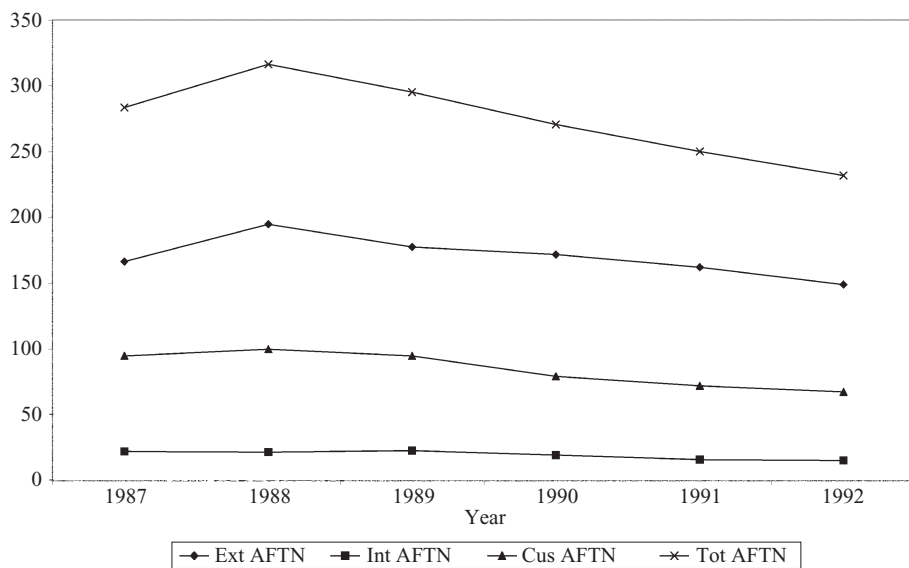


Fig. 2. *Average Annual Inspections*



Fig. 3. *Average Annual Fines per Inspection*Fig. 4. *Average Annual AFTNs*

collection. Unlike the one-time sharp decline in inspections, the total number of AFTNs began a downward trend in 1988, while total hours expanded by at least 75% from 1987–9, but then were relatively stable in the first two years after the reform. Although masked in the figures, there was a 15 (25)%

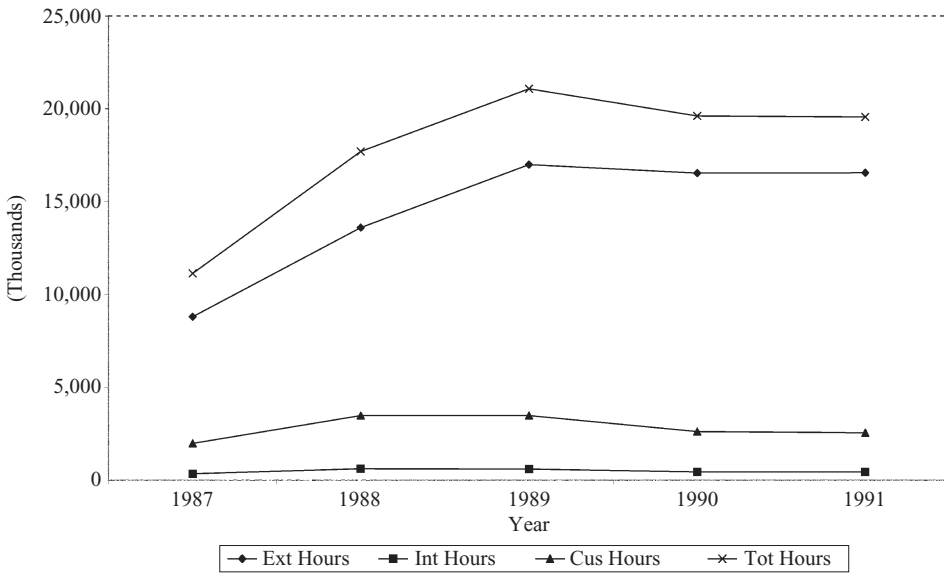


Fig. 5. *Average Annual Hours*

reduction in the average number of internal AFTNs (internal hours) between 1989 and 1990; however, this decline in internal officials and hours is small compared to the 80% decline in inspections shown in Fig. 2. This descriptive evidence suggests that the surge in fine collections, especially external fines, was not driven solely by a massive reallocation of human resources within the tax agency. It is possible, however, that internal AFTNs substituted their job activities after the reform, from internal examinations toward in-house support to external audits. This could explain why there were small declines in internal officials and hours but a sharp decline in internal examinations.

### 3. Empirical Models and Results

The preceding figures are informative in that they suggest that the time-series change in fines is much more dramatic than changes in collection activities such as the number of inspections and the number of auditors employed. In this section we move beyond a simple descriptive analysis to test formally whether the change in fines per inspection is significant after controlling for collection resources and whether the break is due to the RAV programme. To fix ideas, we initially assume that there is no tax-region specific heterogeneity, which, if true, implies that OLS provides unbiased estimates of the RAV effect. We then test the sensitivity of the OLS estimates to the presence of tax-region specific fixed effects, followed by models that permit regional trends. Finally, we test whether the substantial change in fine collections comes from the RAV programme rather than from a change in compliance induced by concurrent tax reforms.

### 3.1. *No Unobserved Heterogeneity*

The base empirical model for tax region  $i (i = 1, \dots, 10)$  in time period  $t (t = 1, \dots, 6)$  is given as:

$$\ln(F_{it}) = \ln(X_{it})\beta + \phi RAV_t + \gamma t + \delta(tRAV_t) + \alpha + \varepsilon_{it}, \quad (1)$$

where  $\ln(F_{it})$  is the natural log of total fine collections per inspection,  $\ln(X_{it})$  is a  $(1 \times K)$  vector of the natural log of productivity variables such as the number of AFTNs and the number of hours,  $RAV_t$  is a dummy variable that equals 1 for years with the RAV programme in effect,  $t$  is a linear trend,  $t^*RAV_t$  is a trend break based on the passage of the RAV programme, is a constant, and  $\varepsilon_{it}$  is a mean zero random error that permits conditional heteroskedasticity.<sup>6</sup> The specification permits the RAV programme to affect both the level ( $RAV_t$ ) and the growth rate ( $tRAV_t$ ) of fines per inspection.

In Table 1 we present the OLS estimates of (1) for a variety of specifications. In specification (1) we see that the number of AFTNs has a positive and significant impact on fine collections per inspection. This is driven in large part by the efforts of external AFTNs, as seen in specification (2). Indeed, internal AFTNs are negatively related to fines per inspection, suggesting that

Table 1  
*OLS Estimates of the RAV Programme on Total Fines per Inspection*

Variable	(1)	(2)	(3)	(4)	(5)	(6)
AFTN	0.408 (0.104)				0.441 (0.283)	
Hours			0.359 (0.149)		-0.018 (0.319)	
External AFTN		0.660 (0.167)				0.363 (0.608)
Internal AFTN		-0.299 (0.175)				-0.131 (0.244)
Customs AFTN		-0.017 (0.123)				-0.726 (0.496)
External hours				0.979 (0.236)		0.999 (0.761)
Internal hours				-0.625 (0.232)		-0.685 (0.306)
Customs hours				0.068 (0.119)		0.636 (0.442)
RAV (=1 if year \$ 1990)	-1.461 (0.796)	-1.359 (0.735)	-0.341 (1.241)	-1.025 (1.241)	-0.614 (1.269)	-0.456 (1.382)
Trend	0.012 (0.204)	0.037 (0.197)	0.045 (0.209)	-0.142 (0.205)	0.010 (0.205)	-0.063 (0.223)
Trend $\times$ (RAV)	0.659 (0.241)	0.616 (0.230)	0.386 (0.323)	0.567 (0.314)	0.465 (0.324)	0.397 (0.347)
$\bar{R}^2$	0.664	0.690	0.496	0.586	0.517	0.623
no of obs.	60	60	50	50	50	50

*Notes:* Heteroskedasticity-robust standard errors are reported in parentheses.

<sup>6</sup> The logarithmic transformation, along with heteroskedasticity-robust standard errors, are used in order to control for the potential influence of large tax regions, e.g., Rio de Janeiro and São Paulo.

these inspectors are less productive. In specification (3) we replace AFTNs with the log of employee hours and note again that there is a positive relationship between collection activities and fines per inspection. However, as with AFTNs, the mix of hours matters in that higher external hours leads to higher collections but higher internal hours has a negative influence on fines per inspection. This suggests that there are likely strong diminishing returns to spending additional time on internal and customs inspections, but that additional time on external examinations generates a relatively large payoff.

It is possible that the production of fines per inspection depends on both the number of auditors and on the number of hours. To test this proposition we append the number of hours to the base specification (1) and report the results in specification (5). It appears that the number of AFTNs matter (weakly) for fine collections, but pooled hours do not as the estimate is economically and statistically insignificant. Disaggregating AFTNs and hours by examination type in specification (6) reveals that while both external AFTNs and hours have positive influences on fine collections per inspection, they are not statistically significant.

The primary focus in each of the specifications is the effect of the RAV programme on the level and growth of fines per inspection. Interestingly, the RAV programme has a negative effect on the level of fines per inspection, which is significant at the 10% level in specifications (1) and (2). However, the negative level effect is driven by the striking, positive trend break in fines per inspection after passage of the RAV programme, which suggests that post-reform growth rates increased over 60%. Indeed, in specifications not tabulated, the level effect is a significant 0.8 (i.e. the level is 80% higher after the reform) when the trend break is omitted. The results in specifications (1) and (2), however, make it clear that omitting changes in the growth rate is a misspecification. Notice that the impact of the RAV programme is weakened in models controlling for hours, likely owing to the fact that data on hours is missing in 1992 when fines per inspection were growing rapidly. This suggests that models that control only for AFTNs are likely to be more informative in identifying the impact of the RAV programme and thus the discussion in the next two subsections focuses primarily on those specifications.

### 3.2. *Regional Fixed Effects*

Neglected up to this point is the possibility that there are permanent region-specific influences that affect fine collections per inspection, possibly arising from differences in management style within tax agencies or from types of taxpayers residing in the region. Failing to control for these influences would result in biased estimates in Table 1 if the unobserved heterogeneity is correlated with collection activities. We relax the restriction that  $\alpha_i = \alpha$  for all  $i$  in Table 2 by estimating a fixed-effects model of fines per inspection. Based on the p-values from the Wald test of a common intercept, it appears that controlling for fixed effects is statistically important across all six specifications. Moreover, the fixed-effects results suggest that several of the coefficients from

Table 2  
*Fixed-Effects Estimates of the RAV Programme on Total Fines per Inspection*

Variable	(1)	(2)	(3)	(4)	(5)	(6)
AFTN	2.096 (1.153)				2.156 (1.448)	
Hours			0.122 (0.714)		0.163 (0.690)	
External AFTN		1.585 (0.720)				1.803 (0.917)
Internal AFTN		-0.124 (0.358)				-0.038 (0.379)
Customs AFTN		0.124 (0.614)				-1.588 (1.197)
External hours				0.797 (1.096)		0.393 (1.001)
Internal hours				0.744 (0.581)		0.619 (0.588)
Customs hours				-0.477 (0.468)		-0.113 (0.473)
RAV (=1 if year \$ 1990)	-1.734 (0.750)	-1.676 (0.709)	-0.456 (1.299)	-0.599 (1.396)	-0.877 (1.417)	-0.207 (1.531)
Trend	0.001 (0.155)	0.014 (0.150)	0.025 (0.165)	0.002 (0.255)	0.015 (0.161)	0.094 (0.213)
Trend $\times$ (RAV)	0.785 (0.228)	0.735 (0.221)	0.413 (0.313)	0.434 (0.361)	0.588 (0.361)	0.283 (0.427)
P-value of Wald Test of No Fixed Effects	0.000	0.000	0.001	0.021	0.001	0.035
$\bar{R}^2$	0.805	0.809	0.720	0.748	0.735	0.785
no of obs.	60	60	50	50	50	50

*Notes:* Heteroskedasticity-robust standard errors are reported in parentheses. All regressions control for fixed tax-region specific effects.

the OLS estimates in Table 1 are misleading. For example, the elasticity of fines per inspection with respect to AFTNs increases from 0.4 in specification (1) of Table 1 to 2.1 in Table 2. Likewise, in specification (2) the impact of external AFTNs more than doubles from 0.66 to 1.6 once one controls for regional fixed effects. Most importantly, though, controlling for fixed effects appears to strengthen the level and growth effect of the RAV programme on fines per inspection. The fixed-effect results in specifications (1) and (2) indicate that the RAV programme led to around a 75% increase in the growth of fines per inspection.

### 3.3. Regional Fixed Effects and Trends

A possible concern is that the national change in fine collections is being driven by a select few aggressive tax regions. To examine this possibility, in Fig. 6 we graph fine collections in 1989 against fine collections in 1990 for each of the 10 tax regions. The figure reveals that in the first year of the reform, 70% of the tax regions experienced an increase in fine collections. By 1991, however, all tax regions shared in the growth of fine collections, suggesting

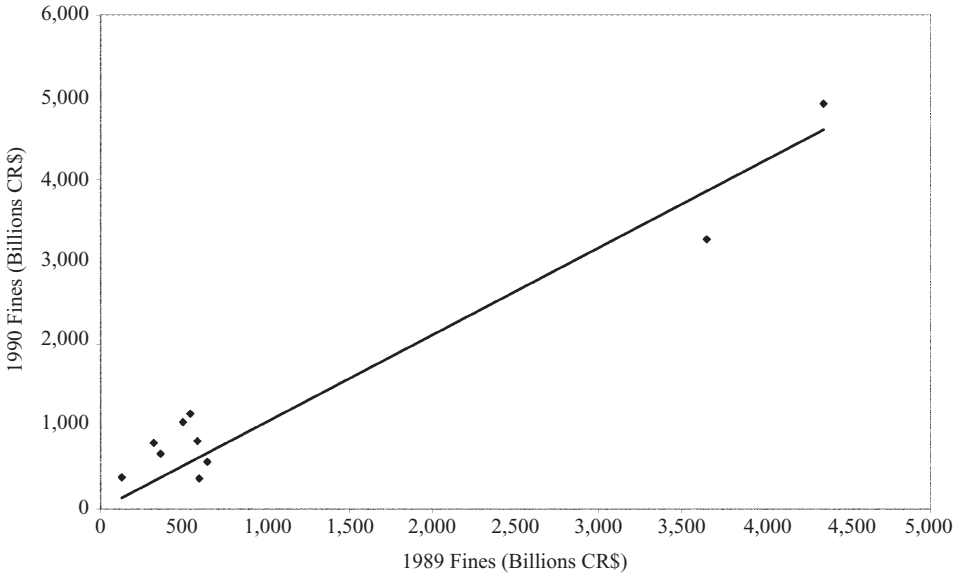


Fig. 6. *Tax Region-Specific Fines Before and After Reform*

that the incentives offered by the RAV programme were strong enough to stimulate collections even in the smaller tax regions.

To test formally for regional variation in the impact of the RAV programme we estimate an augmented version of (1) given by:

$$\ln(F_{it}) = \ln(X_{it})\beta + \phi RAV_t + \gamma t + \delta(tRAV_t) + \alpha_i + \mu_i t + \lambda_i(tRAV_t) + \varepsilon_{it},$$

where  $\alpha_i$  is a region-specific fixed effect,  $\mu_i t$  reflects region-specific trends, and  $\lambda_i(tRAV_t)$  permits region-specific trend breaks after passage of the RAV programme. Of particular interest in (2) is the regional variation in growth rates after passage of the RAV programme (i.e., the  $\lambda_i$  coefficients). To aid in interpretation we first estimated the full model to determine which region experienced the smallest programme effect (Region 9, which has Curitiba as the major city), and then re-estimated the model with Curitiba as the omitted region such that the coefficients can be interpreted as deviations from the low RAV-growth region. In this case, the overall trend-break coefficient ( $\delta$ ) represents the programme effect for Curitiba.

In Table 3 we present both the regional deviation in post-RAV growth rates as well as the total growth-rate effect (i.e.,  $\delta + \lambda_i$ ) for the model that controls for total AFTNs. Comparable results obtain in models with disaggregated AFTNs. As revealed in the table, there is substantial heterogeneity across regions in the estimated impact of the RAV programme, ranging from a 19% to a 125% growth-rate increase over and above that obtained in Curitiba. Moreover, these regional deviations are statistically significant in 6 of the 9 regions, while the total effect is significant in all regions except for Curitiba.

What might possibly account for the differential impact of the RAV pro-

Table 3  
*Regional Differences in the Impact of the RAV Programme  
 on Growth of Total Fines per Inspection*

Region (Major City)	Deviation from Region 9	Total effect
1 (Brasilia)	0.494 (0.292)	0.685 (0.200)
2 (Belem)	0.194 (0.219)	0.386 (0.140)
3 (Fortaleza)	0.730 (0.228)	0.922 (0.147)
4 (Recife)	0.939 (0.267)	1.128 (0.222)
5 (Salvador)	1.263 (0.318)	1.455 (0.296)
6 (Belo Horizonte)	1.059 (0.301)	1.251 (0.251)
7 (Rio de Janeiro)	0.259 (0.254)	0.451 (0.216)
8 (Sao Paulo)	0.469 (0.241)	0.661 (0.178)
9 (Curitiba)		0.191 (0.261)
10 (Porto Alegre)	0.221 (0.222)	0.413 (0.176)

*Notes:* The model estimated is the same as in column (1) of Table 2 with the addition of region-specific trends and region-specific trend breaks. Heteroskedasticity-robust standard errors are reported in parentheses.

gramme across regions, e.g. Salvador compared to Curitiba? An examination of the data indicates that Salvador and Curitiba experienced many of the same changes immediately after the reform. For example, between 1989 and 1990, Salvador had an increase of 74% in external inspections, but a decrease of 8, 95, and 1% for external AFTNs, internal inspections, and external hours, respectively. The comparable figures for Curitiba are +66, -4, -51, and -1%. Where they diverge are with respect to internal hours and external fines—Salvador had increases of 7 and 88% in internal hours and external fines compared to Curitiba's decreases of 8 and 2%. Given Salvador's dramatic decrease in internal inspections, coupled with the increases in internal hours and external fines, the growth differences are suggestive that internal AFTNs substituted their job activities from internal examinations toward in-house support to external audits. It also seems plausible that the supervisors in Salvador were more aggressive in targeting taxpayers who offered a larger return, e.g. corporations, but data limitations prevent a closer examination of this possibility.

### 3.4. *The Macroeconomy and Tax Reform*

In the results presented in Tables 1 to 3, we identify the effect of the RAV programme with a post-1990 dummy variable and a trend break in fines per inspection. However, it is plausible that fines per inspection were also respond-

ing to some other macroeconomic factors, such as general business-cycle conditions and/or tax reform. It is not apparent *a priori* whether fines per inspection are pro- or counter-cyclical. In an economic downturn, tax revenues fall such that inspectors may become more aggressive in their attempts to collect fines; however, the number of inspections may increase as well, leading to an ambiguous change in the ratio. Alternatively, inspectors may become less aggressive due to general economic hardship, and may also reduce the number of visits due to fiscal constraints. Again, however, the ratio of fines per inspection is left ambiguous. We attempted to isolate the influences of trends versus cycles in fine collections per inspection by appending real GDP to the model in (1). However, at the aggregate level, real GDP experienced little time-series variation over the period, which implied that the model was poorly identified. Given how flat the business cycle was over the sample period, the post-1989 surge in fine collections per inspection appears not to have been driven by changes in the business cycle.

As noted previously, a number of reforms to income, custom, and value-added taxes were enacted during the sample period such that a change in taxpayer compliance might be driving the results. While the reforms lowered statutory marginal rates, simplified filing, and improved indexation, they also broadened the tax base and redistributed greater authority over VATs to the states, leading the Minister of Finance to conclude that 'the system could increase the tax burden because of the overlapping of some taxes' (da Nóbrega, 1989 p. 369). The RAV programme should affect fines collected across all types of taxes; however, if the tax reforms decreased effective tax rates and thus led to a significant improvement in compliance, we would then expect the trend break in fines per inspection to be stronger when we exclude fines collected from income, custom, or VAT taxes from the analysis. Alternatively, if effective rates rose and compliance deteriorated even further, then the capture of evaders

Table 4  
*Fixed-Effect Estimates of the RAV Programme on External Fines  
per Inspection by Tax Type*

Variable	(1)	(2)	(3)	(4)
Hours	0.339 (0.119)	0.344 (0.121)	0.312 (0.117)	0.316 (0.157)
RAV	-3.645 (1.046)	-3.721 (1.199)	-3.670 (1.112)	-3.247 (1.343)
(=1 if year \$ 1990)				
Trend	-0.372 (0.185)	-0.336 (0.212)	-0.427 (0.198)	-0.440 (0.225)
Trend $\times$ (RAV)	1.281 (0.282)	1.278 (0.322)	1.312 (0.300)	1.221 (0.356)
$\bar{R}^2$	0.690	0.841	0.852	0.849
no of obs.	139	121	127	100

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Specification (1) contains data on all 25 taxes, specification (2) excludes data pertaining to income taxes, specification (3) excludes data pertaining to customs taxes, and specification (4) excludes data pertaining to VAT taxes. All regressions control for fixed tax-specific effects.



would be easier such that the RAV programme effect is overstated by the inclusion of fines collected from income, custom, and VAT taxes.

To test this 'strong separability' hypothesis we use data on external examinations for 25 different types of taxes over 1987–92 and estimate a fixed-effects model of the log of external fines per inspection on the log of employee hours, the RAV programme variables, and dummy variables for the 25 different taxes. We then test the sensitivity of the RAV programme effect to potential changes in compliance by alternatively excluding fines obtained from income, customs, and VAT taxes. It is clear from Table 4 that the RAV programme effect is equally strong in all specifications, suggesting that there was not a pronounced change – if any at all – in compliance with income, custom, or VAT taxes.<sup>7</sup>

#### 4. Concluding Remarks

Our results suggest that the Brazilian tax authority's incentive programme was successful in its attempt to boost fine collections. After the incentive programme was implemented, we observed a sharp increase in fine collections in spite of a decrease in the total number of auditors employed by the tax collection agency. Most of the success can be explained by the auditors' performance when conducting external examinations. This was not accidental, however – not only was tax evasion ubiquitous in Brazil, but also the tax authority appeared to have reallocated auditing effort within the agency, in terms of in-house support, from low-productivity internal examinations toward high-productivity external examinations. Our results highlight the powerful role played by incentives in reforms of tax collection agencies.

Although performance-based wages seem to be very effective in increasing inspection effort and fine collections, one must be careful in evaluating the social desirability of such incentive schemes. The carrots introduced by incentive schemes may induce tax collectors to become overzealous and, as a result, to use improper methods of collecting taxes and fines. The danger of extortion must be factored in by the designers of incentive programmes. Unfortunately, there is no empirical evidence on appeals or complaints of extortion in Brazil. The increase in social benefit due to the implementation of the Brazilian incentive programme may, therefore, fall a little short of the programme's success rate in collecting additional fine revenues.

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<sup>7</sup> Note that the programme effect is larger in Table 4 than in Table 2 as the latter contain fines from all inspections while the former pertain to external collections only.

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