

# Tax Credits Response to Tax Enforcement: Evidence from a Quasi-Experiment in Chile

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January 2012

## Abstract

Diesel in Chile receives a different tax treatment depending on its use. If diesel is used in industrial activities the diesel taxes paid can be fully used as a credit against VAT, but if it is used in freight or public transportation (basically trucks and buses) only a fraction of diesel taxes paid can be used as a credit against VAT. As a result of this different tax treatment firms have incentives to use “tax exempted” diesel in activities requiring “non tax exempted” diesel. This tax wedge therefore generates an opportunity for tax evasion. In this paper we analyze the impact of a tax enforcement program implemented by the Chilean IRS, where letters requiring information about diesel tax credits were sent to around 200 firms in 2003. Using different empirical strategies to consider the non-randomness of the selection of firms, we find that firms receiving a letter decreased their diesel tax credits by around 11%.

JEL: H26, H32

Keywords: diesel tax, tax evasion, tax enforcement

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## 1. Introduction

Gasoline and diesel are subject to specific taxes and VAT in Chile, but diesel is taxed at a much lower rate. Gasoline tax is equivalent to US\$1.27 a gallon while diesel tax is just US\$0.43 a gallon. Additionally, because diesel is used as a main input in several industrial activities it receives a special tax treatment depending on its use. Specifically, if diesel is used in industrial activities the diesel tax paid can be used as a credit against VAT and if diesel is used in freight or public transportation (basically trucks and buses) only a fraction of gasoline taxes paid can be used as a credit against VAT.<sup>1</sup> As a result of this different tax treatment firms have incentives to use “tax exempted” diesel in activities requiring “non tax exempted” diesel. This might be particularly easy to do for multi-products firms using diesel for several activities, allowing them to evade diesel taxes by claiming a larger tax credit than what is legally allowed. A similar practice was detected in the U.S. during the 80s where firms were buying exempted fuel to be used for on-road tax activities and then created several transactions among related firms to hide the tax evasion, a practice known as “daisy chain” (Marion and Muehlegger (2008)).<sup>2</sup>

In 2003 the Chilean IRS implemented a special auditing plan to detect diesel tax evasion and improve tax enforcement. For this purpose, the IRS selected first the firms that had had the largest changes in their tax credits reported between 2001 and 2002 and sent them a letter asking to voluntarily report more details of every diesel transaction during the last two and half years. In October of 2003, 205 firms received the letter asking them to submit the information within the next 30 days. The IRS received some type of information from 183 firms and after revising the information sent by the firms some of them were selected for an exhaustive and mandatory audit. This special enforcement plan was implemented only once in October 2003.

In this paper we use monthly data from October 2002 to September 2004, for all firms reporting diesel tax credits in all sample periods when filing VAT, to estimate the impact of receiving the IRS letter requesting tax information on the amount of diesel tax credits

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<sup>1</sup> The fraction has changed over time. Currently is 80% (after hundreds of trucks blocked the main highway for 3 days in 2008 requesting subsidies from the government to compensate the spike in oil prices).

<sup>2</sup> More specifically, firms purchased untaxed diesel fuel and resold it to affiliates to make it more difficult to audit the transaction. Then the affiliate resold the diesel to retail gas stations as diesel for which taxes had been collected.

claimed. Firms receiving the letter can perceive its message as an increase in the probability of being detected, which should decrease their evasion activities (Allingham and Sandmo (1972), Sheffrin and Triest (1992)). The dataset contains detailed information about many relevant dimensions for each firm: size based on sales (very small, small, medium and large)<sup>3</sup>, number of different economic activities, tax regime (accrual based accounting, cash flow accounting, presumptive tax regime), and the year the firm started its operations.

One of the main difficulties in identifying the effects of receiving the letter from the IRS is that firms were not randomly selected to receive it. As a matter of fact, the firms receiving the letter are quite different from the firms not receiving it in many dimensions that might potentially be correlated with tax evasion. For example, 66% of the firms to which the IRS sent letters were large firms, while only 16.1% of the ones not receiving it were large; all of them are under accrual accounting tax reporting regime, compared to only 55.1% among firms that did not receive the letter.<sup>4</sup> Given that the assignment to treatment conditions was not random, the identification strategy we use is different from the one used in the literature of tax evasion based on experimental methods (Kleven et al. (2011), Fellner et al (2009), Wenzel and Taylor (2004), Blumenthal et al. (2001), Slemrod et al. (2001)).

Even though the firms were not randomly selected and the two groups actually differ in some relevant dimensions, we have the advantage of knowing the selection criterion used by the IRS to choose the firms to which send the letter to.<sup>5</sup> The IRS ranked the firms based on their changed in tax credits claimed between 2002 and 2001 and sent a letter to the first 205 firms with the largest change. Therefore, the empirical strategy we used to identify the effects of the letter on the diesel tax credit claims by the firms consists of two steps. First, we balance the sample using a propensity score method such that notified and not notified firms are similar in observable characteristics. Considering the selection process we cannot achieve total balance, but the matching allow us to compare across firms that are in the common

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<sup>3</sup> The standard classification used by the government is based on annual sales: less than US\$100,000 are very small firms; between US\$100,000 and US\$1,000,000 are small firms; above US\$1,000,000 but below US\$4,200,000 are medium firms; and more than US\$4,200,000 are large firms.

<sup>4</sup> In some other dimensions the two groups of firms are not too different, for example 36.6% of the firms to which the letter was sent have only one economic activity and 55% are more than 10 years old, compared to 39.9% and 52% among the firms not receiving the letter respectively.

<sup>5</sup> Even though the non-random selection creates a potential bias that needs to be controlled for, it prevents the problems with the Taxpayer Compliance Measurement Program (TCMP) studies where taxpayers were aware that the selection was random (Long and Schwartz (1987)).

support. Second, using this subsample we estimate a difference in difference impact of the letter controlling for the selection process implemented by the IRS to choose the “treated” firms. The selection equation is estimated using the change in the amount of tax credit claimed by each firm between 2002 and 2001. We find that receiving the letter reduced diesel tax claims by 11%.

In general, the results show a significant impact of the letter sent by the IRS, asking firms to voluntarily report some information on their diesel tax credits, in reducing the amount of tax credits claimed by firms. The results are consistent with other results in the literature showing that just receiving a letter from the IRS has an impact on tax compliance because it causes a substantial increase in the perceived detection risk (Fellner et al (2009)). In that sense, the results show that the IRS in Chile can successfully reduce diesel tax evasion by affecting firms’ perceived cost on non-compliance. However, it is important to interpret our results as a short-term impact of receiving a letter from the IRS once, which might differ or not from either a long-run impact or receiving multiple IRS letters over time.

## **2. Fuel Taxes in Chile**

Fuel taxes were enacted in Chile in 1986, justified as an instrument to finance road construction, especially after a strong earthquake that struck the country in 1985. It is specific tax collected by the seller at the first sell or import. The diesel tax rate is four times lower than the gasoline tax rate with a rate of 1.5 UTM by m<sup>3</sup>, equivalent to 0.44 US dollars per gallon, as opposed to 6 UTM by m<sup>3</sup> for gasoline.<sup>6</sup> The gasoline tax is high relative to the United States, but not relative to Europe, while the diesel tax (for transportation) is relatively low.

To avoid effects on production, firms can claim a tax credit for all or a share of the diesel tax paid used in activities different from transportation in public roads. Starting in October 2001, companies from the trucking industry can claim a credit for a share of their diesel purchases, whereas passenger transport companies could only recover 20% of their toll

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<sup>6</sup> The monthly tax unit (UTM) is an index used to maintain the value of taxes in constant money. In October 2011, one UTM was worth 38,634 Chilean pesos, around 77 US dollars.

expenses<sup>7</sup>. Specifically, companies owning or leasing trucks with a gross weight of 3.86 tons or higher can claim 25% of their diesel tax paid as a tax credit against the VAT.<sup>8</sup>

Tax revenue, credit claims and the number of firms claiming the tax credit have changed over time because of changes in diesel prices and regulation. The diesel tax revenue increased between 2000 and 2009 by 97.9%, while over the same time period, diesel VAT credits increased by 192.3%. The percentage of diesel taxes paid that can be claimed as VAT credit has been raised from 48.06% to 70.9% during the same period. Absent of a diesel price change, the recovery rate (VAT credit / diesel tax revenue) of each firm should be constant over time unless there is either a change in their productive process modifying the amount of diesel used or a normative change.

The recovery rate can also be affected by changes in consumer behavior, namely tax avoidance and evasion. The diesel tax credit creates a wedge in diesel prices depending on its use: there is a price for diesel used in transportation, a lower price for diesel used in the trucking sector and an even lower price for diesel used in manufacturing. These different prices generate incentives to use “tax exempted” diesel in activities that should pay diesel tax. The fact that there is no third-party reporting associated to diesel taxes in Chile might exacerbate the incentives to evade or avoid the tax as it has been empirically shown in many studies (Klepper and Nagin (1989), Long and Swingden (1990), Christian (1994), Andreoni et al (1998), Slemrod (2007)).

Tax evasion can occur in several different ways. Firms can buy diesel for manufacturing, and then use it for transportation, firms can pay services with diesel, and transportation firms can claim the diesel credit for all their operations, not only for their national use which is what they are legally allow to do. Additionally, diesel from a firm can be used for the diesel cars of the owners and managers of the firm. Some of these mechanisms were detected by the

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<sup>7</sup> The Law No. 20.278 increased the share of toll expenses that can be recovered to 35% starting on January 2009. We will not consider the passenger transportation industry because it does not have a diesel tax credit.

<sup>8</sup> The Law No. 19.764 established a phase-in period of 3 years of the diesel tax credit. The share of the diesel tax paid that could be claimed as tax credit was 10% in 2001-2002, 20% in 2003 and 25% since January 2004. Then, the Law No. 20.278 increased the share to 80% for the period between July 2008 and June 2009. Finally, the Law No. 20.360 established a recovery share based on annual sales. Firms with annual sales below 18.600 UTM can claim as a tax credit 80% of their diesel tax paid, firms with sales above 18,600 UTM and below 42,500 UTM can claim 50%, and firms with sales above 42,500 UTM can claim 38%.

IRS, which motivated the implementation of a special enforcement program for diesel taxation with the goal of reducing its evasion.

### **3. The Diesel Tax Enforcement Program**

In 2003 the Chilean IRS implemented a special auditing plan to detect diesel tax evasion and improve tax enforcement. The IRS selected the firms that had had the largest changes in the tax credits reported between 2001 and 2002 and sent them a letter asking to report more details of every diesel transaction.

The letter said: “The IRS will start an auditing program for taxpayers claiming diesel tax credits. For this reason you should send the following information to the IRS

- Diesel purchases between January 2001 and August 2003
- Diesel tax paid
- Quantity and fraction of diesel used by vehicles
- List and registration number of vehicles owned by the firm, including year, maker, model, mpg and monthly miles traveled.

The requirement to send this information does not imply you are going to be audited. In case your firm is selected for a detailed auditing you will receive a new letter from the IRS.”

On October of 2003, 205 firms received the letter asking them to submit the requested information within the next 30 days. As it was mentioned before, firms were chosen according to their previous increase in diesel tax credit. Using the IRS data we replicate this decision rule and find out that the letter was not sent to 22 of the top 200 firms<sup>9</sup>, and that the letter was also sent to 20 firms that were not in the top 200.<sup>10</sup>

The IRS received some type of information from 183 firms out of the 205 that received the letter and after revising the information sent by the firms, some firms were selected for an exhaustive and mandatory audit. This special auditing plan was implemented only once in October 2003.

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<sup>9</sup> Firms ranked in places 2,3,6,11,29,30,34,38,62,69,77,79,100, 115, 123, 147, 150, 153, 175, 193, and 196. .

<sup>10</sup> Ranked 202 to 223, except 210.

Theoretically, the letter sent by the IRS could potentially reduce the amount of tax credits claimed by firms after receiving it. Marion and Muehlegger (2008) using a simple model, where firms choose the fraction of untaxed diesel purchases they use to produce output conditional on their evasion cost, show that an increase in the probability of auditing by the IRS reduces the fraction of untaxed diesel purchases by the firms. If the letter sent by the IRS has the effect of increasing the perceived probability of being audited by the firms, then the amount of tax credits claimed should decrease from evading firms. The empirical question then is if this happens or not and to what extent.

## **4. Empirical Strategy**

### **4.1 Data**

We use IRS monthly data from October 2002 to September 2004 for firms reporting diesel tax credit every month during that period (N=3,462). Firms of four economic sectors were included in the enforcement program: transportation (except passenger transportation), manufacturing, commerce and construction. The data includes sales, VAT credits and debits, diesel credits, economic sector, accounting system/tax regime, number of different economic activities, age and size for 3,356 not notified and 106 notified firms.<sup>11</sup>

Table 1 shows summary statistics, separately for notified and not notified firm, of the data we use in the empirical analysis. The average monthly diesel tax credit is \$628,376 with a standard deviation of \$4,787,770 (in logs 11.32 and 1.78 respectively). The letter was sent to 4.02% of all diesel tax credit users in the sample. The firms claiming diesel tax credits are mostly very small firms (67.5%) and large firms represent only 13.5%. The main economic sector claiming tax credits is, as expected, transportation (69.5%), followed by manufacturing and construction. Regarding the type of tax reporting, 72.5% of the firms in the sample use accrual reporting and 20.1% pay according to presumptive tax. The average number of tax reported activities is 2.3, with a maximum of 17, and most of the firms are 10 years old or more.

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<sup>11</sup> The original data from the IRS have N=21,876 firms. However, we only use those firms that have claimed diesel credits in all the period analyzed to focus on the extensive margin response to the letters sent by the IRS.

Table 1 also shows firms' descriptive statistics by notification status -which is relevant to frame the empirical strategy- and the results of a t-test for the mean difference between notified and non-notified firms for each firm characteristic. Not surprisingly because the letter was not sent to a random sample of firms, the t-tests show that notified and not notified firms are statistically different in several dimensions. Notified firms have more activities (which can give more opportunities for evasion), are more likely to be in construction or commerce and less likely to be in transport, are less likely to be of small size and as expected have larger diesel tax credits. Interestingly, none of them file taxes either under a presumptive tax or cash-reporting regime. These large differences in observable firms' characteristics challenge the identification of the effect of the letter on the amount of diesel tax credits claimed by the firms receiving the IRS letter.

The most natural approach to estimate the effect of the letter is to compare the behavior of not notified firms (control group) with the one of notified firms (treatment group) before and after the letter was sent. However, using observations in the control group that are not relevant comparisons can bias the results and reduce the standard deviation of the coefficients without providing any additional information. For example, as previously noticed, there are no observations in the notified group with presumptive tax, and therefore does not seem relevant to have observations with this tax system in the control group. As an objective statistical method to keep only relevant observations we use propensity score to define the control and treatment groups (Imbens and Wooldridge (2009), Dehejia and Wahba (1999)).<sup>12</sup>

Table 2 shows the descriptive statistics for all firms in the common support of the sample. The number of observations in the control group in the common support sample is 464, and in the treatment group 105. Differences between the treatment and control group are now reduced and even completely disappear for some variables. However, because some differences still remain the empirical strategy used to identify the effect of the IRS letter on

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<sup>12</sup> The propensity score has as dependent variable a dummy with the value of one if the firm was notified and zero if not. The sample is restricted to the top 1.400 firms in the ranking constructed by the Chilean IRS that was used then to select firms to be notified. The regression is run in August 2003 (before the letter was sent). The controls included are logarithm of diesel credit, number of activities, dummies for economic sector, log of VAT and dummies for firm's age.



the amount of diesel tax credits claimed should attempt to separate the effect of the letter from the potential effect on different underlying characteristics between notified and not notified firms.

#### 4.2 Econometric Specification

As it was previously mentioned, the notified firms in the sample are not comparable to the not notified firms even after considering only the observations in the common support. As a result, the difference in outcomes of treated and untreated firms might be biased as a measure of the effect of the enforcement program. To avoid this potential bias we consider two empirical strategies. First, we estimate the effect with a difference in difference model using the following empirical specification:

$$TaxCredit_{it} = \beta_0 + \beta_1 T_i A_t + \beta_2 T_i + \beta_3 A_t + \beta_4 X_{it} + \varepsilon_{it} \quad (1)$$

where  $T_i=1,0$  indicates if the firm was notified,  $A_t=1,0$  indicates if the observation is before or after the letter was sent,  $TaxCredit_{it}$  is the diesel tax credit (the outcome of interest) of firm  $i$  in period  $t$  and  $X_{it}$  a set of firm  $i$  characteristics: number of activities, economic sector, VAT reported, firm age and firm size. As usual, the identification assumption in this empirical strategy is that notified and not notified firms have a parallel trend on their diesel tax credits.

The second empirical strategy adds a selection correction to the difference in difference estimation. Even though the firms were not randomly selected and the two groups actually differ in some relevant dimensions, we know the selection criterion used by the IRS to choose which firms to send letters to. The unique criterion was to send letter to the top 200 firms with the largest changes in tax credits used between 2002 and 2001. Therefore, we can identify the effect of the letter on the diesel tax credit claims by the firms estimating a difference in difference impact between control and treatment groups considering the selection process implemented by the IRS to choose the “treated” firms.<sup>13</sup> The selection equation is estimated considering the change in the amount of tax credit claimed by each firm

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<sup>13</sup> In some studies using ordinary audits the selection is also endogenous but not known, which makes it difficult to control for the selection bias (Erard (1992)).

between 2002 and 2001. The empirical specification used is:

$$TaxCredit_{it} = \beta_0 + \beta_1 T_i A_t + \beta_2 T_i + \beta_3 A_t + \beta_4 X_{it} + \beta_5 IMR + \varepsilon_{it} \quad (2)$$

$$Pr(T_i = 1) = \alpha_0 + \alpha_1 \Delta Ranking_i + u_i \quad (3)$$

where  $\Delta ranking_i$  is the IRS ranking based on the change in the total amount of diesel tax credits claimed between 2002 and 2001. Equation [3] is the selection equation and equation [2] is the difference and difference equation adding the inverse Mills ratio. The identification assumption is that notified and not notified firms have a parallel trend on their diesel tax credits considering their selection.

## 5. Results

Table 3 shows the results of estimating equation (1) using the panel of firms with random effects.<sup>14</sup> The variable notification is a dummy equal to 1 for the firms receiving the IRS letter, the variable After Letter is a dummy equal to 1 for all the months after the letter was sent, and the variable Letter\*After Letter is the interaction of the two variables whose coefficient represents therefore a difference in difference estimator.

The first column shows the results without any controls, column (2) adds month and year dummies, and column (3) includes additional explanatory variables related to firm characteristics. The difference in difference estimator is statistically significant and shows that the receiving the IRS letter decreased the amount of tax credits claimed by the firms in 13.5% on average. This result is robust across the three models estimated.

Table 4 shows the results of estimating equations (2) and (3), which allows to eliminate the potential bias introduced by the non-random selection of firms. As in Table 3, the first column shows the results of the estimation without any controls; the second column includes months and year dummies in the regression; and the last column includes some firms' characteristics. The top panel in the table shows the treatment effect, where the difference-in-difference estimator shows again a significant impact of the letter on diesel tax credit claims. On average, the letter reduced the amount of credits reported by the treated firms in 11%.

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<sup>14</sup> The Wu-Hausman test does not reject random effects with respect to fixed effects.

This result is quite robust across the different specifications and is not much different in magnitude than the one estimated without a selection correction. It is also important to highlight in the results that the amount of tax credits claimed by firms increases with the number of different economic sector in which firms operate, which is consistent with the idea that is probably easier to evade taxes for multi-sector firms. On average, an increase in 1 economic sector reported is associated with an increase in almost 4% tax diesel credits claimed. Additionally, firms in the manufacturing sector and smaller firms claim less tax credits.

The bottom panel in the table shows the estimated selection equation, where it can be seen that the larger the ex ante difference in diesel credit, the more likely the firms would be notified.

We also consider the possibility that the letter would have reduced the amount of VAT credits claimed. However, the results presented in the Appendix show that there is no relationship between the reported VAT and the diesel tax credit. This is an interesting and maybe surprising result because the tax form used to claim diesel tax credits is the same used to report VAT debits and credits. Therefore, a letter from the IRS asking for information about diesel tax credits claimed could have implied a potential audit of everything reported in the same tax form. If firms were over-reporting diesel tax credits they could have been over-reporting VAT credits too, in which case a potential impact of the letter would be to reduce both. The empirical results, however, show an impact only on diesel tax credits reported. One potential explanation is that VAT has a self-enforcement mechanism and it is more difficult for firm to over-report credits because other firms are reporting equivalent debits. Another explanation is that firms believed that the IRS would potentially audit only the diesel tax credits, which is not unlikely as the IRS is organized in different auditing divisions for different taxes..

Finally, it is important to discuss the identification assumption in the empirical strategy we used, which is the existence of a parallel trend between notified and not notified firms. The estimated treatment effect of the IRS letter relies on the idea that in the absence of the letter, there would be no different trends in the diesel tax credits claimed between these two type of firms (notified and not-notified). We test this assumption doing a false experiment implemented with the data for the period before the notification. For this purpose, we estimated equations (1), (2), and (3) again but defining the dummy Notification as if the letter

was sent in March.<sup>15</sup> The results of this false experiment are reported in Table 5, which shows a non-significant treatment effect.

## **6. Conclusions**

A differential diesel tax treatment in Chile creates incentives for firms to use “tax exempted” diesel in activities requiring “non tax exempted” diesel. This might be particularly easy to do for multi-products firms using diesel for several activities, allowing them to evade diesel taxes by claiming a larger tax credit than the legally allowed.

In an attempt to reduce the potential evasion of diesel taxes and improve tax enforcement, the Chilean IRS sent a letter to some firms asking to voluntarily report more details of every diesel transaction during the last year. In this work we evaluate the impact of the letter on firms’ behavior. The results show a significant impact of the letter sent by the IRS in reducing the amount of tax credits claimed by firms. On average, treated firms reduce their tax credits claims by around 11% after receiving the letter. The results are consistent with other results in the literature showing that just receiving a letter from the IRS has an impact on tax compliance because it causes a substantial increase in the perceived detection risk. In that sense, the results show that the IRS in Chile can successfully reduce diesel tax evasion by affecting firms’ perceived cost on non-compliance. It would be important to consider in future research what happens in the long run. It could be possible that future letters would not have the same effect or even that the effect of the letter fades out in time and firms go back to their over-reporting practice.

Furthermore, the reduction in credit claims indirectly shows the existence of evasion in the diesel tax in Chile. The reason is that if there were no tax evasion, then the diesel credit claims would not be affected by the IRS notification letter. Therefore, the substantial impact the letter had on diesel credit claims can be interpreted as evidence of tax evasion.

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<sup>15</sup> The period after is therefore defined between March and August 2003, and the period before between January 2002 and February 2003. We also run false experiments choosing February or April as the month in which the letter was sent and the results were the same.

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