Are Medium Sized Businesses in Peru on the "Wrong" Side of the Laffer Curve?*

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Abstract

We exploit a quasi-experiment that led a group of businesses to face a lower corporate tax rate in 2017, and study how reported business activity and tax revenue responds to corporate tax rates in Peru. Our preliminary results suggest that "medium sized" businesses in Peru that experienced a drop (-58%) in their corporate tax rate in 2017, paid less taxes (36% on corporate tax and 9% on VAT) on that year and thus are not on the downward sloping side of the Laffer curve. The sign of the impact on VAT is explained by a null impact on income and a positive impact on acquisitions. We hypothesize that these results highlight that a positive shock on "real" business activity could translate in less VAT collection in a context with low fiscal capacity.

1 Introduction

The impact of corporate tax rates on business activity and tax revenue is a topic still highly contested in both academic and policy circles. While recent work has estimated the elasticity of employment with respect to the corporate tax rate to be around -0.4, this evidence is mostly concentrated in advanced economies, with strong fiscal capacity such as Germany and the US (see Fuest and Siegloch [2018], Giroud and Rauh [2017], Ljungqvist and Smolyansky [2018]). Presumably, in settings where evasion is widespread, changes in the tax rate might not induce the same responses in reported business activity. To study this topic, we exploit a recent quasi-experiment that takes place in Peru, where a group of "medium-sized" businesses faced a lower corporate tax rate in 2017.

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While responses in reported business activity should not be confused with "real" responses in business activity, the former one is what actually determines tax revenue. Thus, even if we cannot answer how corporate tax rates affect "real" business activity (we only have data on reported variables), we can study how the corporate tax rate affects tax revenue. In particular, are "medium sized" business in Peru on the downward sloping side of the Laffer curve? In the simplest model possible of optimal linear taxation (e.g. Piketty and Saez [2013] pp.410-411) the revenue maximizing linear tax rate would be just a function of the elasticity of the tax base to the tax rate ($t^* = \frac{1}{1+e}$). Thus one would only need to know e for a given group of businesses and the tax rate they face to know on which side of the Laffer curve they are (for a review on the evidence in the US see Goolsbee et al. [1999]). However, the model might need to be slightly modified if the change in the tax rate induces not only a change in its tax base but also on other tax bases (e.g. a change in a tax rate over profits affect profits but also income and acquisitions in a setting where there is VAT).[1]

We apply the synthetic control method to estimate how businesses are affected by the introduction of a new tax regime, whose distinctive feature is a lower corporate tax rate, and which is available only to a subset of businesses. We find suggestive evidence that a drop in the corporate tax rate over profits decreased the corporate tax liability and VAT of treated businesses, which means that they are not on the downward sloping side of the Laffer curve. To understand the VAT result, we look separately at income (determines VAT debits) and acquisitions (determines VAT credits). We find no evidence that reported income was affected, while we find that reported acquisitions increased. These results should be considered preliminary as there are still not enough post-treatment periods available to reach more definitive conclusions.

In section 2, we overview the main characteristics of the Peruvian tax system and the implications of a tax reform that took place in 2017. In section 3, we present the dataset that will be used and provide some basic summary statistics of it. In section 4 we present the empirical strategy that takes advantage of the quasi-experimental nature in which some businesses moved to a new tax regime that was created in 2017. In section 5 we show preliminary results on reported levels of corporate taxes, VAT, profits, sales, acquisitions, and net assets. Section 6 presents several robustness checks. Section 7 concludes.

2 A primer on the Peruvian tax system

In 2016, total tax revenue in Peru was approximately 16.1% of its GDP. The average tax to GDP ratio in Latin America and the Caribbean was 22.7% and Peru had the fourth lowest ratio after Guatemala (12.6%), Dominican Republic (13.7%), and Venezuela (14.4%).[2] Part of the reason why tax levels are low in Peru is due to the high levels of informality observed in the country. Using information from the national household survey for employment[3] we find that 59% of the occupied labor force worked in a business that was not

[1] Also see Sanyal et al. [2000] for a model where a corrupt tax administration leads to a lower revenue maximizing tax rate.
[2] These figures come from OECD [2018].
[3] ENAHO: "Encuesta Nacional de Hogares".

formally registered with the national tax authority and 47.3% of employees were working without a contract, which indicates that a large proportion of economic activities in Peru operate under the shadow economy not paying their corresponding tax obligations.

The main sources of tax revenue in Peru are the value added tax, VAT (which represented 50.8% of all tax revenue in 2017), followed by income tax (34.6% of tax revenue), and consumption tax (5.7%). The VAT rate is 18% although some goods and services, mostly related to agriculture, are excluded from the VAT obligations. Additionally, as we will explain in detail below, not all businesses are required to pay VAT. Income tax in Peru is further subdivided into five categories: tax on income from leases (0.01% of all tax revenue), tax on income from sales of assets (1.5%), corporate income tax (16%), personal income tax for independent workers (0.01%), and personal income tax for employees (8%). Furthermore, there are various corporate income tax regimes in Peru. Such regimes were subject to major changes starting in January 2017. In the next subsections we explain in detail the tax regimes for businesses in Peru before and after the 2017 reform.

2.1 Tax regimes for businesses before 2017

Before the 2017 reform, businesses in Peru were required to register in one of the three available regimes of corporate income tax: the NRUS[4], the RER[5], and the General Regime (GR). The NRUS is a tax regime directed to micro businesses registered as legal persons with monthly sales and purchases below S/.30,000. Additionally, to be considered eligible for the NRUS a business should have total asset valuation under S/.70,000 and should operate in only one location. Under this regime, the value added tax (VAT) and the corporate income tax (CIT) are grouped into a single fee that businesses pay on a monthly basis. Before the 2017 reform, the NRUS had five different categories depending on the sales and purchases. These categories would determine the monthly fee to be payed as specified in Table 1. Businesses registered in the NRUS are not required to keep any type of accounting books. They are only required to submit basic sales and purchases information to the tax authority via web, mobile phone app, or by submitting a physical copy to authorized banks. In 2016, 38.4% of all businesses registered formally to the tax authorities in Peru were registered in the NRUS.

The RER is a simplified tax regime for medium-sized businesses. To be eligible for this regime, firms should have yearly sales and purchases belows S/.525,000, their total asset valuation should not exceed S/.126,000, and should have ten or fewer employees. Under this regime, firms are required to pay the VAT[6] as established in the tax code. Additionally, firms pay a 1.5% tax on their total sales that substitutes the corporate income

[4]In Spanish, "Nuevo Régimen Único Simplificado", New Unique Simplified Regime.

[5]In Spanish, "Régimen Especial de Renta", Special Tax Regime.

[6]The VAT general rate established in Peru corresponds to 18%. However, there are goods and services that are excluded from VAT or that are taxed at different rates such as some type of medications.

tax. Firms are required to keep accounting books detailing the registry of sales and purchases and are also required to submit monthly declarations with information about their general operations. Businesses registered in the RER are not required to submit annual declarations to the tax authorities, a requirement that before the 2017 reform only applied to businesses under the GR. In 2016, 24.6% of businesses were registered in the RER.

Finally, firms in the GR are required to pay corporate income tax, VAT, and need to keep five different accounting books detailing their sales, purchases, inventory, and balance sheets. Before the 2017 reform, the tax rate for the corporate income tax was set at 28%. The base for the 28% corporate income tax corresponded to income less of allowed deductible expenses, which consisted of all purchases that were related to the main economic activity of the firm. In 2016 36.8% of businesses were registered in the GR. Table 2 summarizes the main characteristics of each tax regime before the 2017 reform.

2.2 The 2017 tax reform

The 2017 tax reform established three main changes in the tax code for businesses. First, it eliminated categories 3, 4, and 5 from the NRUS described in Table 1. This limited businesses that are eligible for this regime to have monthly sales under S/.8,000. Second, it increased the corporate income tax rate from 28% to 29.5%. Third, it introduced a new tax regime for medium and small businesses called the RMT[7]. Firms that want to register under the RMT need to have annual sales under 1,700 UIT[8], which is equivalent to S/.6,885,000 in 2017. The only difference between the RMT and the GR is in the rate established for the corporate income tax. Under the RMT, profits under 15 UIT are taxed at 10% and every unit exceeding this limit is taxed at the GR tax rate of 29.5%. This is the key policy change we exploit in this paper. While for a group of businesses the tax reform implied no change in tax rates or a slight increase upwards (e.g. businesses in RER or RG), other businesses experienced a drop in their tax rates over profits as high as 18 percentage points.

In Figure 1 we plot the relationship between businesses' sales and the effective rate of taxation, defined as the total tax liability expressed in terms of total profits, under each regime before and after the reform. We simulate the tax liability assuming a profit margin of 20%. Note how the five different categories in the NRUS generated five different discontinuities in the effective rate of taxation before 2017. After the 2017, only two categories of the NRUS survived and we observe a transition to the GR represented by the increasing effective tax rates in the RMT.

In Table 3 we report the share of businesses in each regime before and after the reform, as well as the revenue collected by the tax authority from each regime. We note that before the 2017 reform, GR

[7] In Spanish, "Régimen Mype Tributario", SME Tax Regime.

[8] UIT stands for "Unidad Tributaria Impositiva" (Taxing Unit). In 2016, 1 UIT=S/.3,950 and in 2017, 1 UIT=S/.4,050.

was the most common regime for businesses in Peru followed by the NRUS and the RER. Although there does not seem to be a large disparity in the proportion of businesses registered in each regime, we note that the distribution of revenue is concentrated in businesses registered under the GR. Whereas the total revenue coming from businesses registered in the NRUS and the RER combined did not represent 1% of total government revenue in 2016, corporate income taxes from the GR represented almost 16% of total government revenue. By comparing Tables 3a and 3b we are able to identify some of the effects of the 2017 reform. First, the proportion of businesses registered under the GR decreased from 38.4% to 14.4%. Second, revenue collected from the GR decreased from S/.16,495 million to S/.15,499 and even the revenue collected from the RMT is not enough to offset the lost revenue from the GR.

Finally, is is worth noting how the share of businesses registered under the NRUS did not change although the 2017 reform eliminated three categories of this regime. A business with monthly income between S/.8,000 and S/.30,000 was eligible in 2016 for the NRUS. With the 2017 reform, such businesses were required to register in other regime and a great share of these businesses transitioned to the lowest categories of the NRUS rather than going to other tax regimes.[9]

3 Data and descriptive statistics

The main dataset we use comes from the tax administrator of Peru, which is the "Superintendencia Nacional de Aduanas y Administración Tributaria" (SUNAT), and it consists on the universe of corporate tax returns filed during the period 2010-2017 to SUNAT.[10]

Businesses have to report either monthly and/or annually to SUNAT, depending on the tax regime under which they operate. In terms of their reporting obligations, RUS businesses have to declare their income (and starting in 2017, they also report acquisitions) to SUNAT monthly through "Formulario 1611".[11] We have annualized data of these reports.

Except for RUS businesses that do not have to pay the VAT, all businesses have to report monthly to SUNAT their levels of sales, acquisitions, and other information in order to compute their VAT corresponding to that month. They report these figures in PDT 0621 and we have annualized data from this report.

RG and RMT businesses also have to make an annual declaration to the SUNAT where they report more detailed level information regarding sales, acquisitions, assets, liabilities, and other information, in order to recompute their corporate tax for that year (we also have access to these reports).

[9] 54% of businesses that operated in NRUS 3 moved to NRUS 1-2 in 2017; 33% for NRUS 4 and 27% for NRUS 5.

[10] More in particular, we have annualized data from all filed "Formulario 1611", annual corporate tax returns filings, annualized data from PDT 0621 and monthly reported employment levels.

[11] RUS businesses are the only ones that should complete this form.

Finally, all businesses should report monthly to SUNAT the number of workers employed in their businesses. We have this data on a monthly basis although we take the annual average in our analysis.

Table 4 shows some summary statistics. It is clear from the table below that Peru is undergoing a period of mayor increase in its number of formal businesses, going from 1.3 million businesses in 2010, to 1.8 million in 2017, which represents an increase of 43%.

Also, a high percentage of these businesses operate under a "simplified tax regime". Roughly 55% of the firms operate under one of these regimes in 2010 (RUS or RER) and 85% in 2017 (RUS, RER or RMT), where a great part of this increase is explained by the introduction of RMT in 2017. This new regime is responsible for the drop in the number of businesses in the RG regime in 2017, as 70% of RMT businesses in 2017 operated under the RG regime in 2016. A remaining 21% corresponds to businesses that entered SUNAT's database in 2017, 7% operated under RER in 2016 and 2% under NRUS.

4 Empirical strategy: synthetic control estimates

Our main empirical strategy consists on identifying a group of businesses that faced a lower corporate tax rate as a consequence of the 2017 reform (treatment group), and comparing their post-reform business activity with that of a synthetic control. The synthetic control estimator (Abadie et al. [2015],Abadie et al. [2010]) is a data-driven approach for estimating treatment effects, which is particularly useful when the parallel trends assumptions does not hold in a classical difference-in-differences framework.

Our objective with this methodology is getting an estimate of the counter-factual value of an outcome for a group of treated businesses that faced a lower corporate tax rate in 2017. Once we get this estimate, with the observed value for the respective outcome, we get an estimate of the impact of the treatment (i.e. drop in corporate tax rate) on the outcome.

More formally, let $Y_{i,t}^N$ be the outcome that would be observed for a group of businesses i at time t, if it experiences no "treatment" (i.e. no drop in corporate tax rate) in 2017. Also, label the indexes i such that only the group of businesses $i = 1$ faced a lower corporate tax rate in 2017, while the rest (J groups) were untreated. Let $Y_{i,t}^I$ be the outcome that would be observed for group i if it is treated in 2017. Thus, it is clear that $Y_{i,t}^N = Y_{i,t}^I$ for $t < 2017$, as the tax cut starts on 2017.[12]

Following Abadie et al. [2010], let $\alpha_{i,t} = Y_{i,t}^I - Y_{i,t}^N$ be the impact of the intervention at time t for group of businesses i. We could rewrite this as $Y_{i,t}^I = Y_{i,t}^N + \alpha_{i,t} D_{i,t}$ where $D_{i,t}$ is a dummy variable equal to 1 if group

[12] We assume there are no anticipation effects given that RMT was announced on December 2016. If there were anticipation effects, it could be the case that $Y_{i,2016}^I \neq Y_{i,2016}^N$. Another assumption needed is the stable unit treatment value assumption (SUTVA), which basically means that outcomes of untreated businesses are not affected by the implementation of the treatment on treated businesses.

of businesses i faces a lower corporate tax rate at time t. From this equation, it is clear that the coefficient of interest is $\alpha_{1,2017}$ (the causal effect of the intervention on the group of treated businesses) which we could compute if we had an estimate of $Y^N_{1,2017}$. To estimate the latter one, we assume $Y^N_{i,t}$ is given by the factor model as in Abadie et al. [2010]:

$$Y^N_{i,t} = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \epsilon_{i,t} \tag{1}$$

With δ_t unknown time fixed effects, Z_i observed covariates that do not depend on t or the intervention, λ_t is a vector of unknown factors, μ_j are unknown factor loadings, and $\epsilon_{i,t}$ are shocks independent across time and group of businesses with zero mean.

Given a vector of weights $W = (w_2, w_3, ..., w_J)'$ with $\sum_{j=2}^{j=J} w_j = 1$, Abadie et al. [2010] shows that if certain conditions are satisfied, then the following estimator of $\alpha_{1,2017}$ has a bias that goes to 0, the larger the number of pre-intervention periods we have relative to the scale of the shocks $\epsilon_{i,t}$:

$$\hat{\alpha}_{1,2017} = Y_{1,2017} - \sum_{j=2}^{j=J} w_j Y_{j,2017} \tag{2}$$

The conditions that need to be satisfied are that the weighted average of the control can mimic the history of the treatment group. Formally, considering that in our case we have three pre-treatment periods (2014, 2015, 2016), we need that:

$$\sum_{j=2}^{j=J} w_j Y_{j,2014} = Y_{1,2014} \tag{3}$$

$$\sum_{j=2}^{j=J} w_j Y_{j,2015} = Y_{1,2015} \tag{4}$$

$$\sum_{j=2}^{j=J} w_j Y_{j,2016} = Y_{1,2016} \tag{5}$$

$$\sum_{j=2}^{j=J} w_j Z_j = Z_1 \tag{6}$$

To implement this strategy, we need to define a treatment group and a group of potential "donors" to the synthetic control (which we call "donor pool"). We describe how we define theses groups in subsections 4.1. In subsection 4.2 we describe the implementation of the estimation presented above.

4.1 Treatment group and "donor pool"

The treatment group we want to construct is composed of businesses for which the introduction of RMT implies a large drop in their corporate tax rate on profits, relative to a counter-factual scenario in 2017 with

no RMT. Given that we can not directly consider this group (as we do not know the actual and counter factual tax rate of each business beforehand), we need to consider a group of businesses for which we have reasons to believe that the introduction of RMT had a negative impact on their tax rates. First, we only consider businesses that reported positive levels of sales, acquisitions, employees, corporate taxes, sales taxes, net assets and profits in the years 2014-2016. We need this condition to be able to assess the pre-trends.[13] Second, we only consider businesses that operated in the RG during 2014-2016 and whose sales each year were less than 525,000 Soles. These are businesses that either did not find it profitable to operate under RER in previous years, or due to other requisites of RER unrelated with the income of the business, they were not eligible for that regime. We add this condition with the intention of reducing the likelihood that a businesses in our treatment group would decide to operate as RER in 2017. This is a desirable trait of the treatment group as we want to include those businesses that are supposed to shift to RMT in 2017 and not to RER, as shifting from RG to RER does not only induces a shift in the tax rate but also on reporting requirements.[14] Once we have identified these businesses, we take the average across all these businesses and the resulting aggregate is our treatment group.

With respect to our "donor pool", it consists on businesses that operated under the RG regime in 2014-2016 but were ineligible for the RMT regime in 2017 due to having reported an income of 6,715,000 Soles (1700 UIT) or higher in 2016.[15] In addition, we only consider those with reported positive levels of sales, acquisitions, employees, corporate taxes, sales taxes, net assets and profits in the years 2014-2016. None of these businesses could have (in theory) shifted to the RMT regime, and even if they had shifted, their effective tax rate should not have been different than if they have stayed in the RG regime given their size.[16]

[13] One could argue that profits need not be positive, but if we consider businesses that run at a loss or with zero profits or sales, a change in the average tax rate would not induce changes in tax liabilities and so it would not be of much relevance to study their response to a change in the tax rate.

[14] To rule out outliers, we only keep business whose effective tax rate over profits during each of the pre-treatment years is between 5-60%. Note that the tax rate over profits for RG businesses during 2014-2016 was 28% but businesses could deviate from this ratio in our records for at least two reasons. First, in the annual tax report that is filled through a software provided by SUNAT, the corporate tax liability generated in the year appears in two different places: in a section where the corporate tax liability is automatically computed by the software, and in the profit and loss statement where the individual has to manually input the amount of the corporate tax liability. At the moment, we only have access to the manually inputted corporate tax liability, which could be inadvertently left blank (and which we would register as zero). Second, we have data on "profits before taxes" that is registered at the profits and loss statement but actually the measure of profits that is used to compute the corporate tax is a slightly modified measure of this, which accounts for certain exonerated incomes and compensable losses.

[15] Legislative decree 1269 stipulates that a business cannot enter the RMT regime if its annual income in the previous year surpassed 1700 UIT.

[16] An alternative "donor" pool that could be considered is that of businesses that reported as RER businesses in the past and that presumably would stay in the same regime in 2017. One disadvantage of this pool is that we can no longer study variables that are only registered in the annual tax return. Another disadvantage is that unless we could know beforehand for which firms would RER be more profitable than RMT in 2017 given their relationship between profits and income (e.g. business with relatively low income and high profits would prefer RER; in the opposite case they would prefer RMT), then the introduction

Given these definitions, we reach a total of 20,565 businesses in the treatment group and 2,599 in the control. Of these 20,565 (2,599) businesses, 19,849 (2,539) still appear in SUNAT's database in 2017 and only 1.7% of the treated businesses switch to RER, while a majority switches to RMT (76.5%). The remaining stay in RG and only a tiny fraction switches to NRUS (0.06%). With respect to the "donor pool", 99.6% stay in RG.

In addition, we only consider a balanced panel in our baseline specification (i.e. only consider businesses that report sales, acquisitions, employees, corporate taxes, sales taxes, net assets in 2017). This means we only consider businesses that operated as RG or RMT in 2017, as only these businesses report net assets and profits. We discuss this in more detail and the robustness of our results when considering an unbalanced panel in section 6.

4.2 Implementation and inference

To implement this strategy we first re-define the "donor pool" in the following way. We create 175 groups of businesses according to the state/province where they operate and economic sector, aggregating across the businesses in the "donor pool" defined in 4.1.[17] We take average values within these groups to construct 175 state-sector aggregate businesses which comprise our final "donor pool".[18]

Second, we define the predictor variables used to match the treatment and the synthetic control. We run a separate regression for each of the eight outcomes we are interested in and for each of those regressions, we consider as predictor variables the lags of the outcome variable. We then use the synthetic control methodology to find the synthetic control, matching over each pre-treatment year average values for a given outcome. For all these estimations we use the package by Galiani and Quistorff [2016]. Given that it would not be possible to match the treatment group and the "donor pool" on the levels of the variables (e.g. the "donor pool" has businesses with income higher than 6,715,000 Soles in 2016, while the treated group's income is capped at 525,000) we match on the trends of the outcome variables as described in Galiani and Quistorff [2016].

To ensure that we are able to construct a proper synthetic control, we follow the approach of Cavallo et al. [2013] and check that our treatment group lies in the convex hull of the control units for each of our outcomes. Figure 2 shows these results where we see that the condition is satisfied.

Regarding inference, we run placebo tests to determine the statistical significance of our results. The procedure, outlined in Galiani and Quistorff [2016], consists on estimating the same model on each of the

of RMT would also induce a drop in the effective tax rate for these businesses, as those that find it profitable to switch to RMT would do and the rest would keep the same tax rate as before in RER.

[17] There are seven economics sectors and we consider twenty five states/provinces. Nevertheless, for many combinations of sector-state, there are zero businesses with the characteristics described in 4.1, and thus the actual number of groups considered for our synthetic control estimation is lower. The exact number is depicted in the regression tables.

[18] This step of reducing the size of the "donor pool" is not necessary but greatly reduced processing time.

potential donors (d), as if the treatment was assigned to the respective donor. The "donor pool" in each case is the set $D - d$ where D is the set of potential donors used in the estimation of the model that considers the actual treated group. After running the model for each $d \in D$ we get a distribution of "in place" placebo effects $\hat{\alpha}_{d,2017}$, $\forall d \in D$.

If the main estimate is larger (in absolute value) than most of the placebo estimates, then it is unlikely that the result we obtain occurs by chance. Formally, the statistic we construct to capture this is a two sided p-value which represents the share of placebo estimates that are larger (in absolute value) than the main estimate:

$$\text{p-value} = \frac{\sum_{d \in D} \mathbb{1}\left[|\hat{\alpha}_{d,2017}| > |\hat{\alpha}_{1,2017}|\right]}{\#D} \tag{7}$$

Nevertheless, as described in Galiani and Quistorff [2016], Abadie et al. [2010], these p-values could be too conservative if donors are not well matched in the pre-treatment period (in each of their respective placebo estimates).[19] To correct for this, we also conduct inference on pseudo t-statistics and consider the standardized p-value:

$$\text{Standardized p-value} = \frac{\sum_{d \in D} \mathbb{1}\left[\frac{|\hat{\alpha}_{d,2017}|}{RMSPE_d} > \frac{|\hat{\alpha}_{1,2017}|}{RMSPE_1}\right]}{\#D} \tag{8}$$

Where $RMSPE$ is the pre-treatment (2014-2016) root mean squared prediction error.

5 Results

We show results on eight different outcome variables. First, we check whether being in the treated group effectively led to a reduction in the effective corporate tax rate over profits in 2017.[20] Figure 3a shows that the treated group effectively saw a drop in the corporate tax rate while the synthetic control seem to have faced a slight change in the opposite direction. This is consistent with the tax changes that occurred in 2017, as the tax rate for RG businesses increased from 28% to 29.5% and the introduction of RMT implied a lower corporate tax rate for businesses with "small" enough profits, as discussed in 2.2. Figure 3b shows our estimate $\hat{\alpha}_{1,2017}$ which is equal to -0.58. This means that, as a consequence of the introduction of RMT, businesses in the treated group faced a corporate tax rate over profits 58% lower.

[19] An example, just to understand how these situations could arise, could be the case of a treated group for which we can find a synthetic control that perfectly matches its history but for which the opposite is true in each of the placebo estimations. This could potentially lead each of the placebo estimates to be too high in absolute value (if, for example, the synthetic of the donor in the pre-treatment period ends up being consistently higher or lower than the donor due to a poor fit in that period.)

[20] The variable is constructed as the ratio of corporate tax liability generated (variable 490 in the annual tax return) and profits before taxes (variable 484-485 in the annual tax return).

With respect to the statistical significance of this result, Figure 4 plots the results of the placebo tests described in 4.2. Visually, we see that the main estimate seems to be well below most of the placebo estimates. Table 6 confirms this observation, as we see that the p-value in column 1 is 0.028 (although the standardized p-value in this case is much higher so it is important to do robustness checks on this result, which we discuss in section 6).

Second, we show the impact on the corporate tax rate (% over income).[21] Figures 5a, 5b and 6 depict a similar picture than the one shown before: the treated group experienced a drop in its effective corporate tax rate (measured as a share of its income). Table 6 shows that the standardized p-value for this estimate is 0.028.

Third, we show results when we consider the amount of the annual corporate tax liability. Figures 7a, 7b seem to follow the same pattern as before and we see that, as a consequence of the introduction of RMT, treated businesses generated a corporate tax liability 34% lower in 2017. Nevertheless, Figure 8 and the relatively high standardized (0.423) and non-standardized p-value (0.338) we see in Table 6 suggest that these results should be taken with caution and that we can not entirely rule out a scenario where the corporate tax liability of these businesses remained practically unchanged. It is possible to observe a drop in the corporate tax rate over profits but not a drop in the corporate tax liability amount if the policy change also induces an increase in the reported profits before taxes.

Figure 9a shows precisely this scenario. While profits in the synthetic control remained basically unchanged from 2016 to 2017, they rose in the treated group in 2017. Figure 9b shows that because of RMT, businesses in the treated group reported profits (before taxes) 24% higher. Again, Figure 10 and the p-value and standardized p-value in column 7 of Table 6 suggest that these results should be taken with caution.

An interesting result emerges when we look at what happens with VAT generated by treated business. Figure 11a shows that the introduction of RMT had a negative impact on VAT generated by treated businesses. Figure 11a shows that the impact corresponds to a 9% drop in VAT. While visually the impact does not seem to be significant (see Figure 12), its standardized p-value shown in 6 is actually 0. To understand how we reach to this result, we decompose the sources of VAT (income and acquisitions) and see how each of these were affected by the introduction of RMT.

Figure 13a shows that the impact on reported income is practically zero. However, Figure 15a suggests that this is not the case for acquisitions. We see that the introduction of RMT led treated business to increase their reported acquisitions by 4.2% (with a standardized p-value of 0.028). Thus, the evidence presented here suggest that the lower corporate tax rate led to a decrease in VAT collection, because it led to an increase in acquisitions that was not matched by an increase in reported sales. We discuss these results in more detail in section 7.[22]

[21] For the income variable, we consider the sum of the monthly income reported by businesses in PDT 0621 (variable 301).

[22] It could be hard to reconcile how we can have a null impact on sales, a positive impact on acquisitions and a positive impact

Finally, Figure 17a shows that net assets were not affected by the introduction of RMT.

6 Robustness checks

A concern that arises is what to do with attrition and missing data in this setting. In the baseline specification shown above, we considered the balanced panel of businesses that reported in 2017. The concern with this approach is that attrition and non-reporting is (potentially) endogenous to the tax rate and working with a balanced panel in this way could introduce bias in our estimates and does not consider extensive margin responses. We hypothesize that the bias would most likely be negative on income or "productivity", although not necessarily. It could be negative if, for example, with a high tax rate only "sufficiently" productive businesses (or those that had a "good enough" productivity shock in 2017) would remain operating, while with a low tax rate businesses with lower productivity would still remain operational. If this were the case, then in our control group in 2017, only the "sufficiently" productive ones from 2016 would remain, while in the treated group businesses with lower productivity would also have remained operational. An approach that can overcome these concerns consists on imputing zero on each variable in 2017 when missing, and for businesses that did not operate in 2017, instead of dropping them from the sample, consider as if they have reported 0 on each variable.[23] Imputing zeros in this way does not introduce bias in our estimates and jointly considers intensive and extensive margin responses. We call this the unbalanced panel.[24]

Table 7 shows results considering the unbalanced panel. As the unbalanced panel also considers business that in 2017 operated under the RER regime, we can only look at outcomes that both RER, RG and RMT businesses report and that is why we do not show results that consider profits or net assets. Overall, the results go basically in the same direction as before (although in this case we no longer find an impact on acquisitions) but the standardized p-values are generally higher in this specification.

Another robustness check we perform has to do with the definition of the treated group. In an additional specification we add the condition that businesses can never surpass eight employees during 2014-2016 (and always) more than one employee. We do so to prevent even more the case of including businesses in the treatment group that switch to to RER in 2017. We also add the condition that businesses must have profits between 2-35 UIT in each pre-treatment year. We want to avoid including businesses with small enough profits so that a change in the tax rate leads to an "irrelevant" change in tax liability and we also want to

on profits. To reconcile these, note that the measure of profits we consider is a measure of profits that not only considers sales and purchases but many other categories (such as wages, renting of a machinery or place of work, other administrative and financial expenditures).

[23] If a business exits the formal sector in 2017, it is implicit in that action that its reported ("formal") sales, profits, etcetera were 0.

[24] Formally, this is also a balanced panel, with the caveat that non-operating business in 2017 have a value of 0 for each variable of interest.

avoid including businesses with high enough profits such that a change from RG to RMT does not impact the tax rate.[25] A final requirement we add in this group is that profits over income should be higher than 3% to rule out businesses with extremely low profits margins. For these businesses, even if there is a substantial change in the tax liability (relative to 2016) as a consequence of the reform, it would still be irrelevant given the size of the business. Results for this group are found in Table 8.

Finally, we pick yet another treatment group, in this case we pick a group of small sized business that operated under the RG regime in 2014-2016 with less than 4 employees, less than 200,000 Soles of income and an yearly corporate tax liability lower than 3,500 Soles. Results for this group are found in Table 9.

7 Conclusions

The results in this study should be considered preliminary as there are still not enough post-treatment periods available to reach more definitive conclusions. We rely on a single data point (the year 2017) in the post-treatment period, while we hope to add data from 2018 in the near future, as well as access the monthly level data in PDT 0621 (instead of the annual averages) as another way of increasing the number of post-treatment periods.

With this caveat in mind, our results suggest that "medium sized" businesses in Peru that experienced a drop (-58%) in their corporate tax rate in 2017, paid less taxes (considering the corporate tax and VAT) on that year and thus are not on the downward sloping side of the Laffer curve.

While the lower corporate tax rate may have led to an increase of 24% in the amount of profits reported, this increase was not enough to offset the drop in the tax rate, which translates in a drop on the amount of the corporate tax generated in 2017 (-36%).[26] With respect to the VAT, we find that the drop in the corporate tax rate actually led to a drop in VAT of 9.2%. This is the opposite to what we (perhaps) would expect in a context with no misreporting and where a drop in the tax rate promotes business activity.

To understand the nature of the VAT result, we look separately at income (determines VAT debits) and acquisitions (determines VAT credits). We find no evidence that reported income was affected, while we find that reported acquisitions experienced an increase of 4.2%. Our reading of this result is that it could be a function of differential misreporting between income and acquisitions. If income is more likely to be evaded than acquisitions (which seems plausible due to third party reporting and also because businesses have no incentives to misreport acquisitions), then its elasticity with respect to a tax rate could be lower even if "real" income and acquisitions shared the same elasticity. Under this hypothesis, a drop in the corporate tax rate

[25] To understand the latter, consider a business A that every year has profits equal to 15 UIT and business B with profits equal to 1700 UIT. Both businesses paid 28% over profits in 2016. Although both businesses entered the RMT regime in 2017, businesses A paid 10% over profits in 2017, while businesses B paid 29.3% over profits.

[26] Although some of these effects are not very robust as seen by their high standardized p-value in some specifications.

that leads to an increase in "real" business activity would lead to an increase in reported acquisitions but not necessarily on reported income. The joint effect would be that a positive shock on "real" business activity translates in less VAT collection, once we allow for misreporting. While we do not have data on "real" business activity to prove this, our preliminary results on reported VAT, income and acquisitions are consistent with this hypothesis.

8 Tables

Table 1: NRUS categories before the 2017 reform

Category	Monthly sales and purchases Limit (S/.)	Monthly fee (S/.)
1	5,000	20
2	8,000	50
3	13,000	200
4	20,000	400
5	30,000	600

Table 2: Special Tax Regimes in Peru before the 2017 reform

Regime	Sales and purchases limits	Assets limits	Employees limits	Main tax obligations
NRUS	S/.30,000. monthly	S/. 70,000	-	Monthly fees from S/.20 up to S/.600
RER	S/.525,000 annually	S/. 126,000	10	1.5% of sales + VAT
GR	-	-	-	Corporate income tax 28% + VAT

Table 3: Distribution and revenue from tax regimes before and after the 2017 reform.

(a) Tax regimes in 2016.

Regime	Distribution of businesses	Revenue	Revenue/Government income (%)	Revenue/GDP (%)
NRUS	36.9%	185.2	0.18	0.03
RER	24.7%	334.9	0.32	0.05
RMT	-	0	0	0
GR	38.4%	16,495.8	15.94	2.53

(b) Tax regimes in 2017.

Regime	Distribution of businesses	Revenue	Revenue/Government income (%)	Revenue/GDP (%)
NRUS	36.7%	140.3	0.13	0.02
RER	23.6%	322.9	0.31	0.05
RMT	25.2%	904.1	0.86	0.14
GR	14.4%	15,499.2	14.68	2.53

Note: Revenue is reported in millions of S/. and does not include VAT payed in each regime. There were a total of 1,738,000 businesses registered by the end of 2016, and 1,779,000 by the end of 2017.

Table 4: Number of businesses in SUNAT's database (figures expressed in 100,000 of businesses)

	2010	2011	2012	2013	2014	2015	2016	2017
Total (100,000)	12.6	13.5	14.7	15.7	16.6	17.5	18.0	17.9
Regimes (% Total)								
RG	44.2	42.9	41.4	39.7	38.5	37.4	36.7	14.3
RMT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.1
RER	17.7	19.5	20.9	22.1	23.2	24.0	24.6	23.5
RUS	37.5	37.1	37.3	37.7	37.9	38.1	38.3	36.5
Files tax return (% Total)								
Annual return	38.8	37.8	36.8	36.1	35.2	33.6	30.8	33.4
PDT 0621	62.3	62.7	62.6	62.2	62.1	61.9	61.7	62.9
Form 1611	38.3	38.0	38.3	38.6	38.7	39.0	39.1	37.7
Economic activity (% Total)								
Agricultural	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.5
Fishing	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
Mining	0.5	0.6	0.7	0.7	0.9	0.8	0.7	0.9
Manufacturing	10.0	9.8	9.6	9.4	9.0	8.7	8.6	8.5
Other services	37.6	37.9	38.3	39.0	39.8	40.9	41.5	41.4
Construction	3.7	4.0	4.1	4.3	4.2	4.4	4.5	4.6
Retail	45.8	45.6	45.2	44.8	44.3	43.4	43.0	42.9

Notes: "Total" is the number of businesses that filed any tax return or presented an employment report to SUNAT in a given year; "RG" is the number of businesses whose last tax return filed in the year, indicated the business should be considered RG (analogous for RMT, RER and RUS); "Annual return" is the number of businesses that filed an annual corporate tax return in a given year (analogous for PDT 0621 and form 1611); "Agricultural" is the number of businesses that filed any tax return or presented an employment report to SUNAT in a given year and that operate in the agricultural sector according to their CIIU (analogous for other sectors). Source of data is SUNAT.

Table 6: Synthethic control estimates: main treatment group

	Corporate tax (% profits)	Corporate tax (% sales)	Corporate tax	VAT	Income	Acquisitions	Profits before taxes	Net assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimate	-0.576	-0.376	-0.358	-0.092	-0.007	0.042	0.24	-0.002
Standardized p-value	0.521	0.028	0.423	0.0	0.634	0.028	0.394	0.845
p-value	0.028	0.183	0.338	0.746	0.944	0.676	0.465	1.0
Number of placebos	71	71	71	71	71	71	71	71
Matching on trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Results consider a balanced panel of businesses that have non-missing data for each of the 8 variables considered in all years from 2014 to 2017. See definition of treatment and control group in Section efsubsec:treatmentControlGroup. All variables were scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and are constructed with the "synth and "synth_runner packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Table 7: Synthethic control estimates: main treatment group (unbalanced panel)

	Corporate tax over sales	Corporate tax	VAT	Income	Acquisitions
	(1)	(2)	(3)	(4)	(5)
Estimate	-0.499	-0.475	-0.151	-0.021	-0.0
Standardized p-value	0.027	0.151	0.74	0.616	0.863
p-value	0.192	0.26	0.589	0.904	1.0
Number of placebos	73	73	73	73	73
Matching on trends	Yes	Yes	Yes	Yes	Yes

Notes: Results consider an unbalanced panel of businesses that have non-missing data for each of the 8 variables considered in all years from 2014 to 2017. See definition of treatment and control group in Section efsubsec:treatmentControlGroup and details for the construction of the unbalanced panel in section efsec:robustness. All variables were scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and are constructed with the "synth and "synth_runner packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Table 8: Synthethic control estimates: first robustness group

	Corporate tax (% profits)	Corporate tax (% sales)	Corporate tax	VAT	Income	Acquisitions	Profits before taxes	Net assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimate	-0.58	-0.377	-0.329	-0.078	-0.004	0.057	0.29	-0.005
Standardized p-value	0.014	0.521	0.028	0.155	0.465	0.183	0.577	0.831
p-value	0.028	0.183	0.366	0.761	0.972	0.549	0.366	0.958
Number of placebos	71	71	71	71	71	71	71	71
Matching on trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Results consider a balanced panel of businesses that have non-missing data for each of the 8 variables considered in all years from 2014 to 2017, with more than one and less than eight employees and profits between 2-35 UIT. See definition of treatment group in Section efsec:robustness. All variables were scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and are constructed with the "synth and "synth_runner packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Table 9: Synthethic control estimates: second robustness group

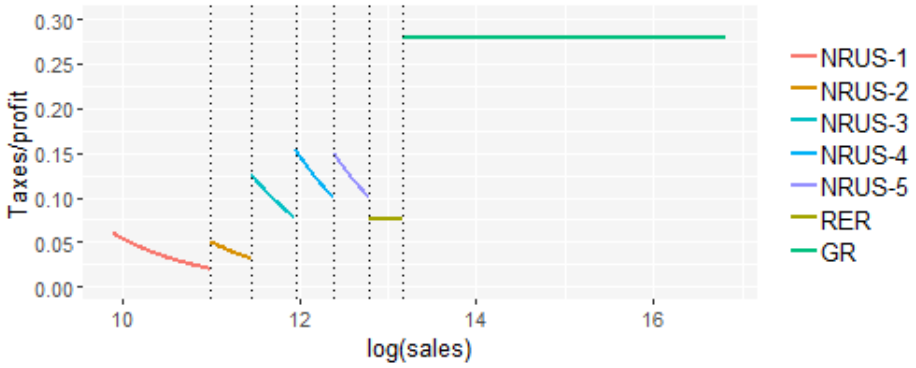
	Corporate tax (% profits)	Corporate tax (% sales)	Corporate tax	VAT	Income	Acquisitions	Profits before taxes	Net assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimate	-0.679	-0.304	-0.254	-0.13	-0.015	0.082	0.692	0.069
Standardized p-value	0.0	0.085	0.704	0.451	0.803	0.028	0.352	0.732
p-value	0.014	0.282	0.465	0.634	0.887	0.451	0.141	0.676
Number of placebos	71	71	71	71	71	71	71	71
Matching on trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Results consider a balanced panel of businesses that have non-missing data for each of the 8 variables considered in all years from 2014 to 2017, with less than four employees, profits lower than 3,500 Soles and income lower than 200,000 Soles. See definition of treatment group in Section efsec:robustness. All variables were scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and are constructed with the "synth and "synth_runner packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

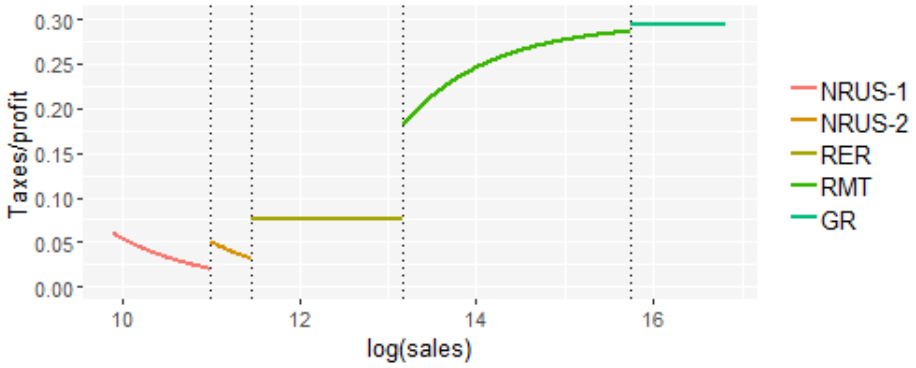
9 Figures

Figure 1: Effective tax rate for businesses before 2017 reform

(a) Taxes over profits in 2016.



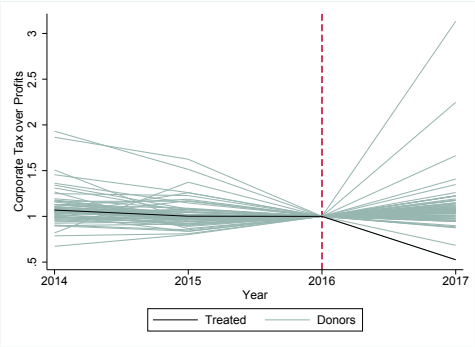
(b) Taxes over profits in 2017.



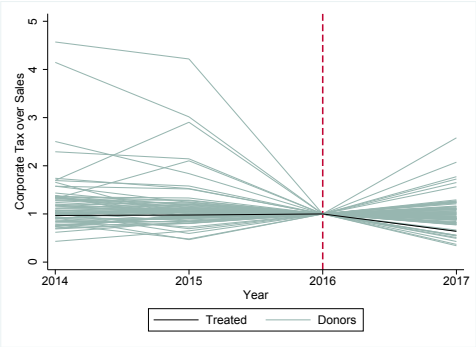
Note: We simulate the tax liability for businesses with a profit margin of 20%. VAT liability is not calculated, only the corresponding part for the corporate income tax. Each vertical dashed line represents the sales-purchases limit for each regime.

Figure 2: Time series for treatment and units in the "donor pool"

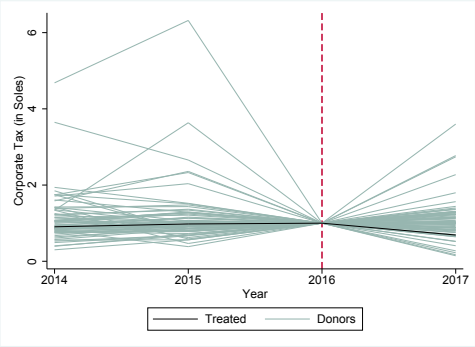
(a) Corporate tax (% profits)



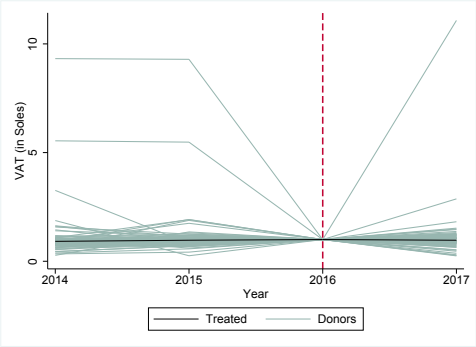
(b) Corporate tax (% income)



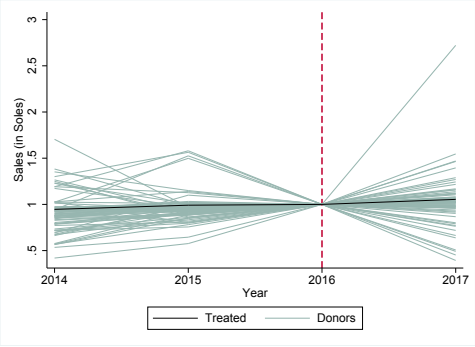
(c) Corporate tax (in Soles)



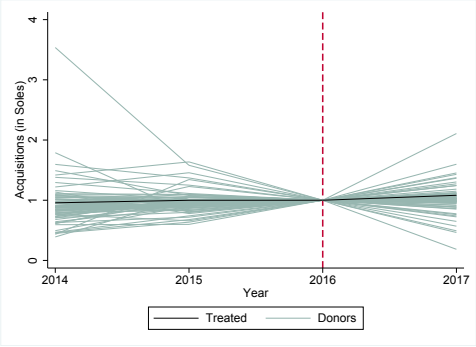
(d) Value added tax (in Soles)



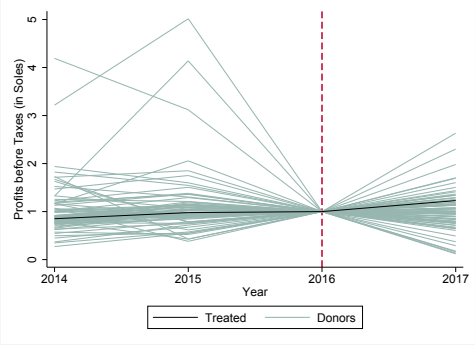
(e) Sales (in Soles)



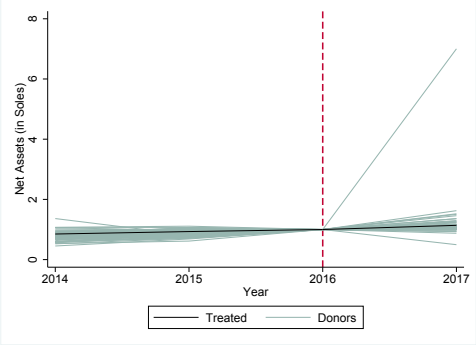
(f) Acquisitions (in Soles)



(g) Profits before taxes (in Soles)



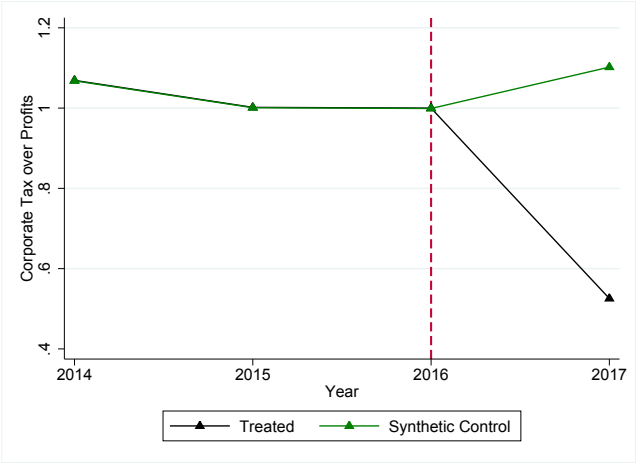
(h) Net assets (in Soles)



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 3: Corporate tax rate (% over profits): synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

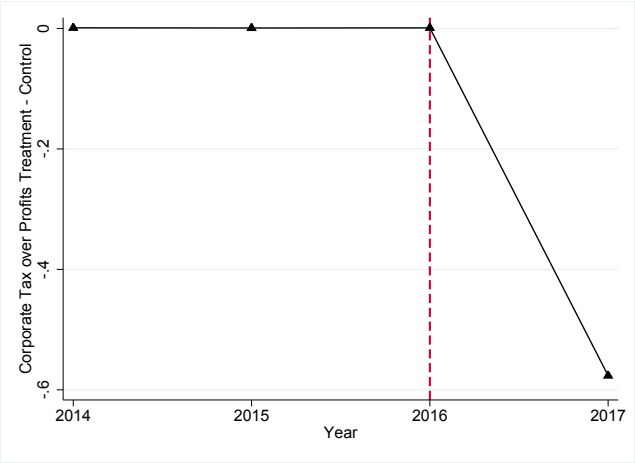
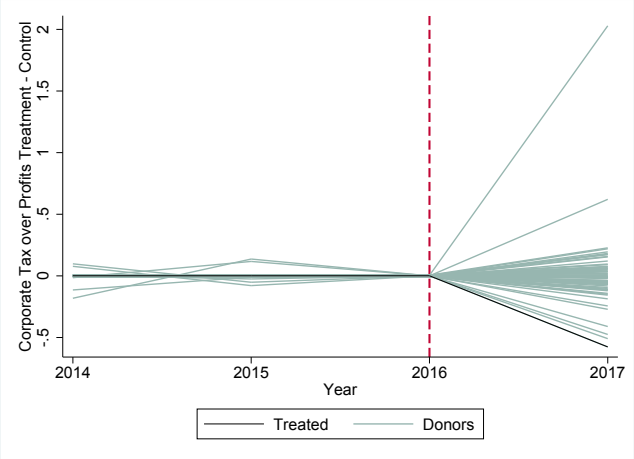


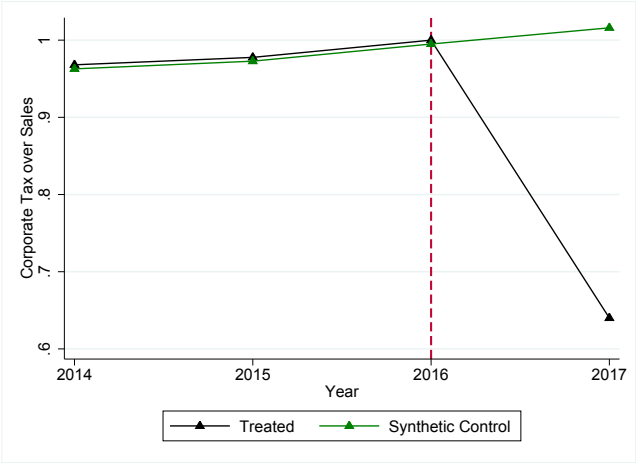
Figure 4: Corporate tax rate over profits: placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 5: Corporate tax rate (% over income): synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

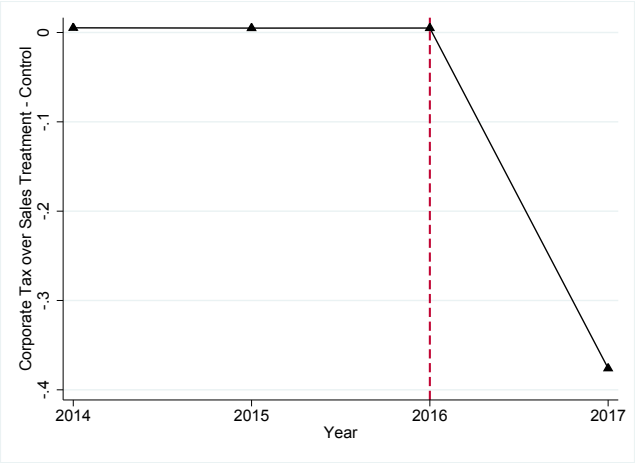
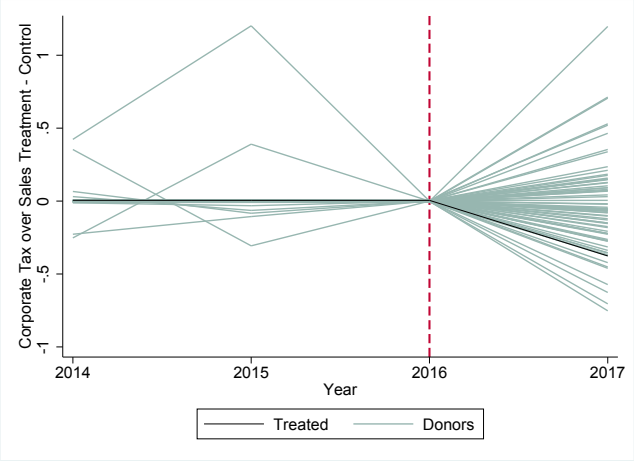


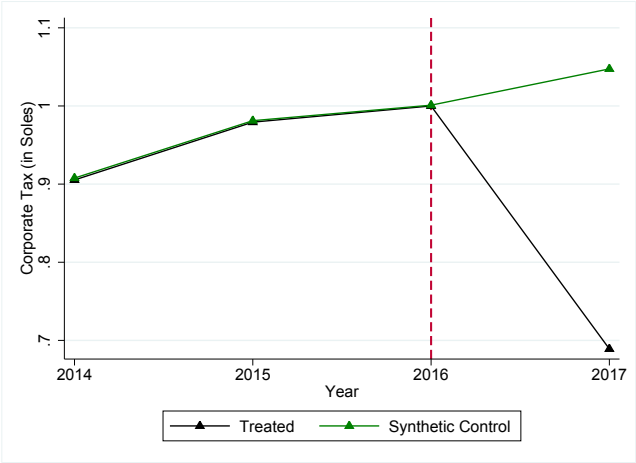
Figure 6: Corporate tax rate (% over income): placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 7: Corporate tax: synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

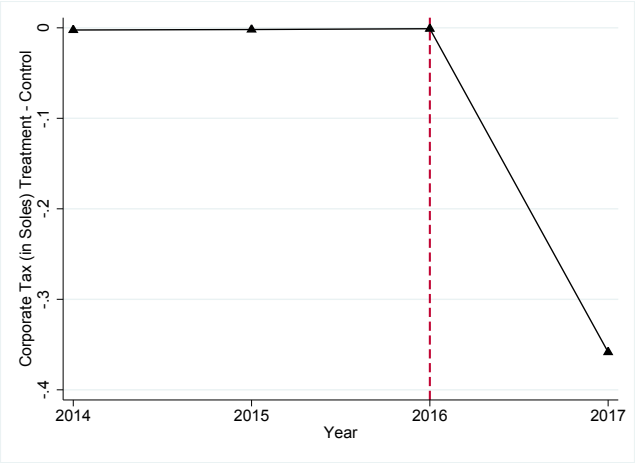
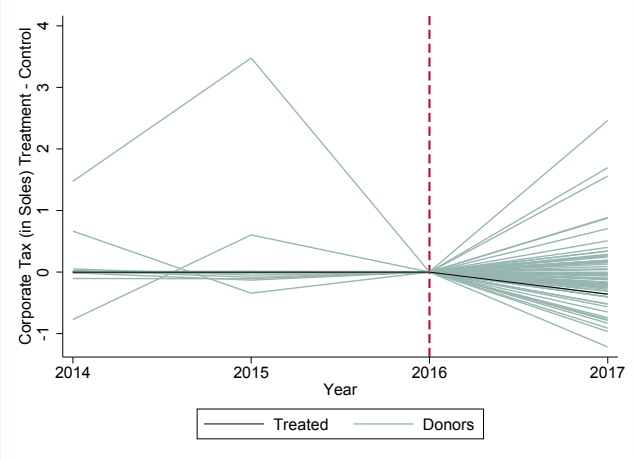


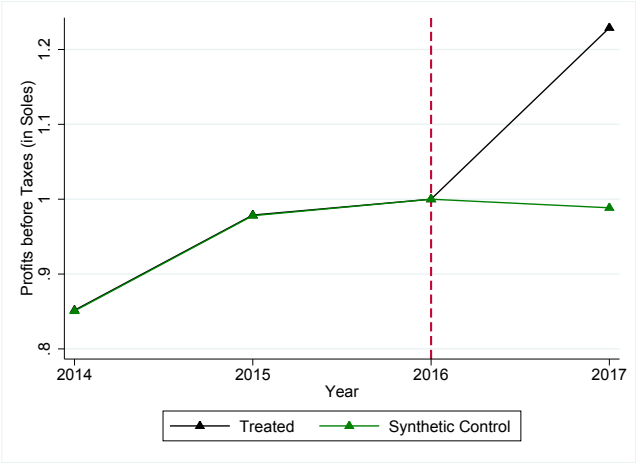
Figure 8: Corporate tax: placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 9: Profits before taxes: synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

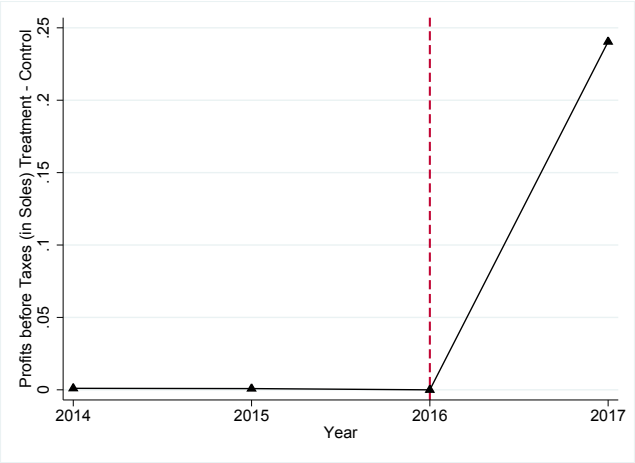
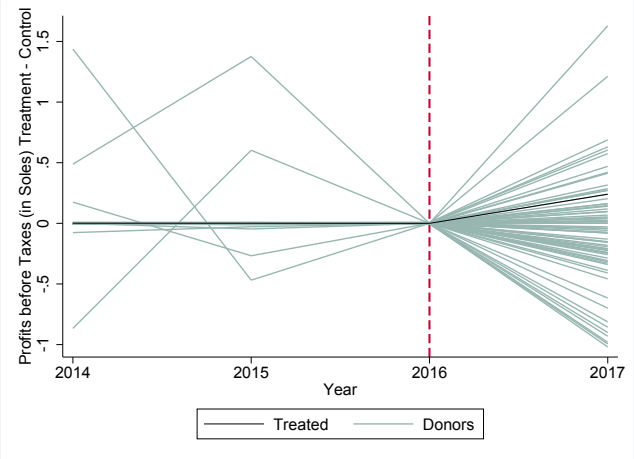


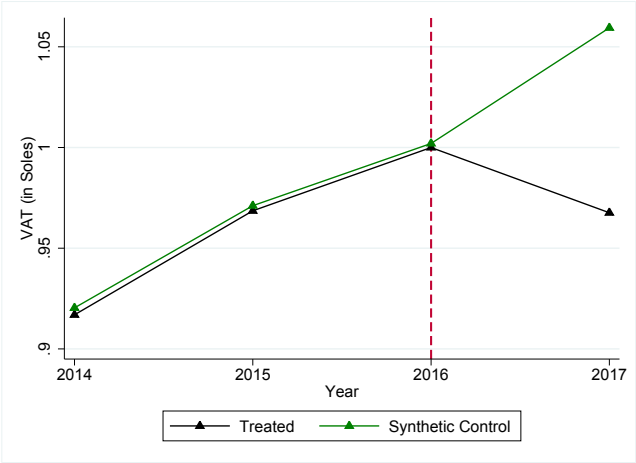
Figure 10: Profits before taxes: placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 11: Value added tax: synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

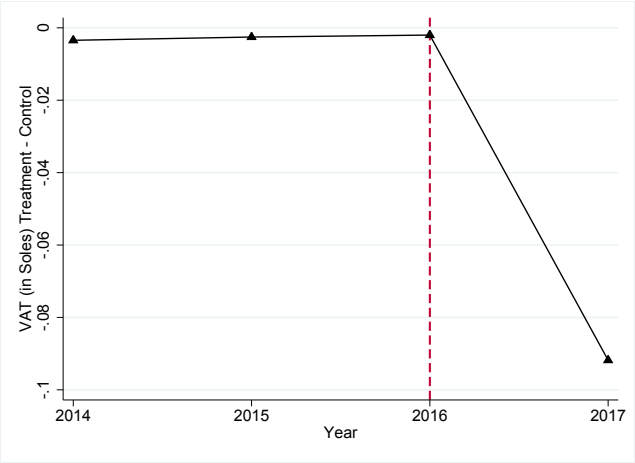
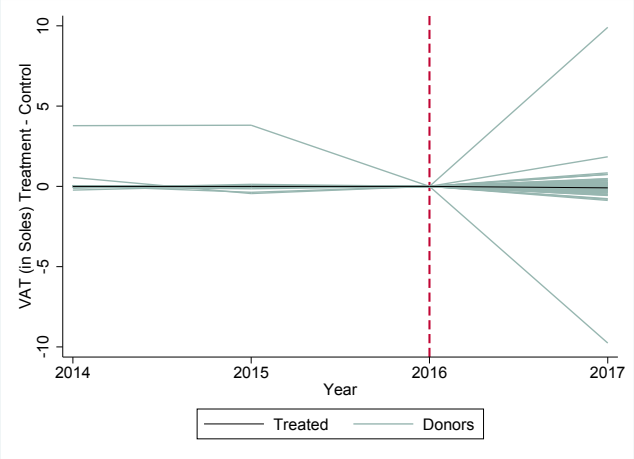


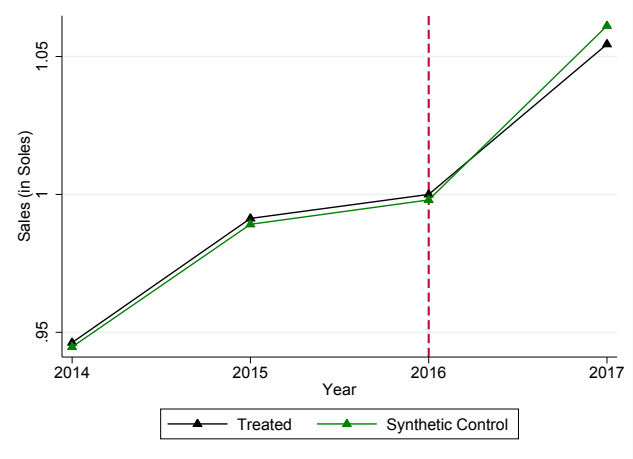
Figure 12: Value added tax: placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 13: Income: synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

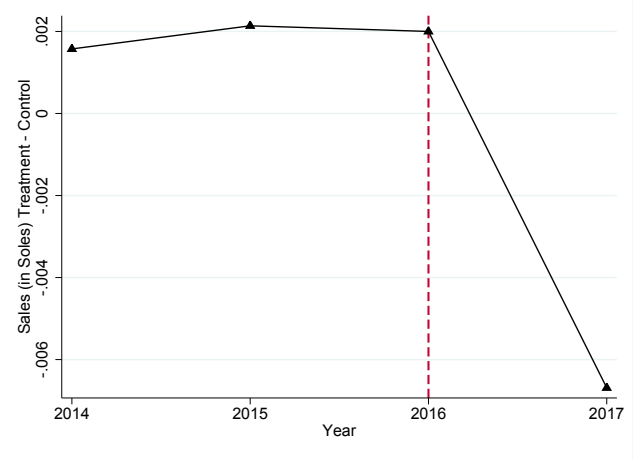
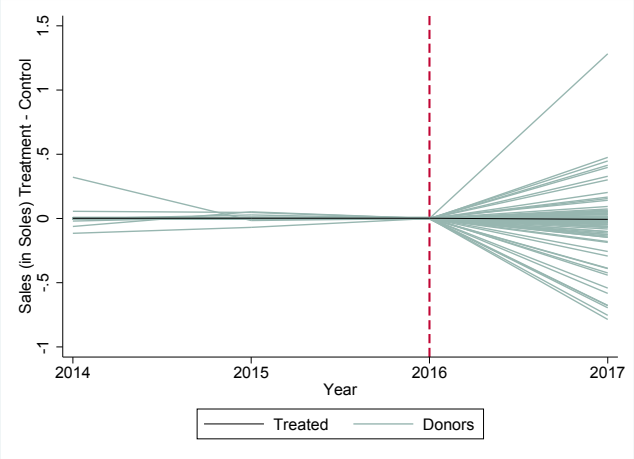


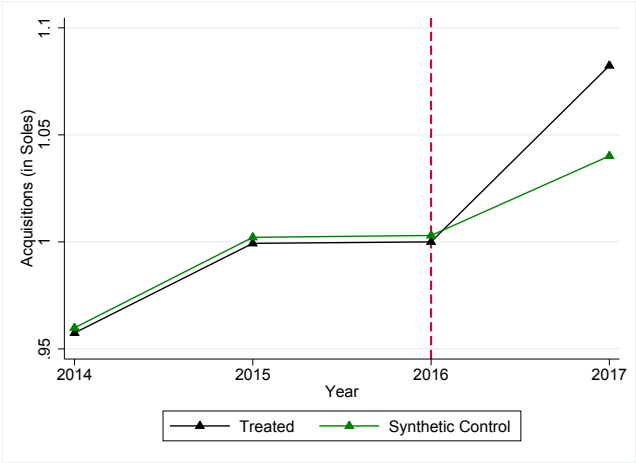
Figure 14: Income: placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 15: Acquisitions: synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

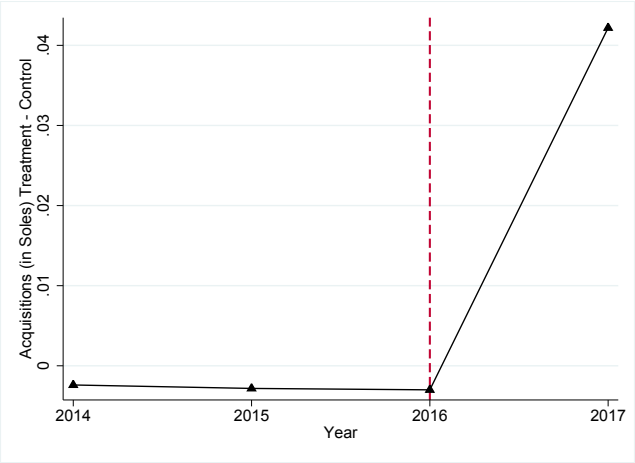
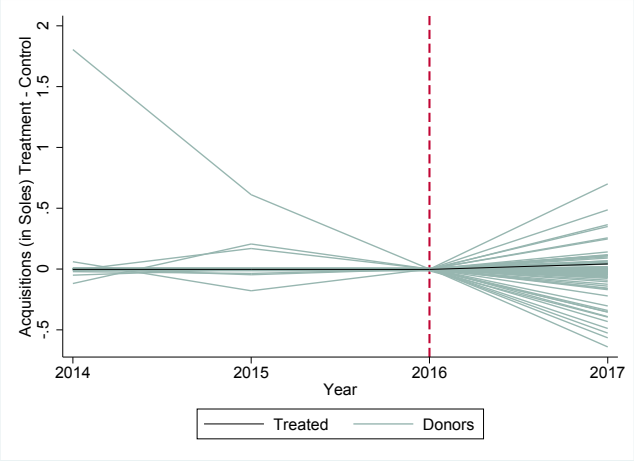


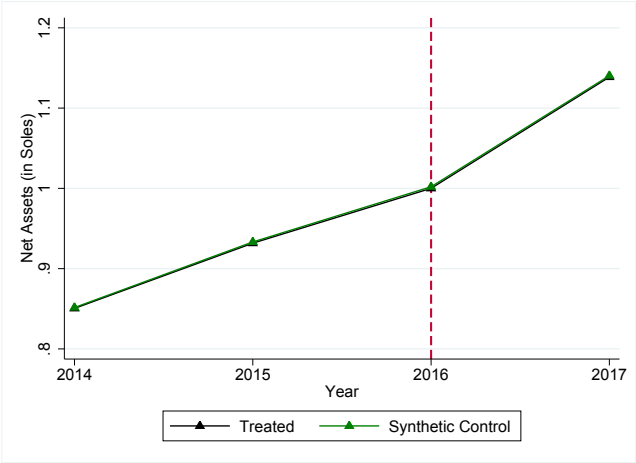
Figure 16: Acquisitions: placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

Figure 17: Net assets: synthetic control estimates

(a) Time series for treatment and synthetic



(b) Difference between treatment and synthetic

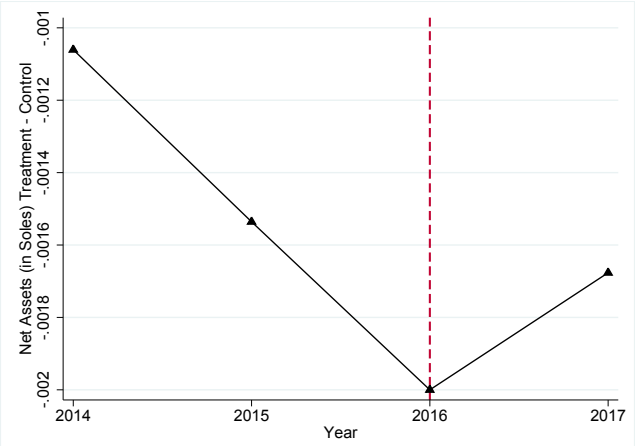
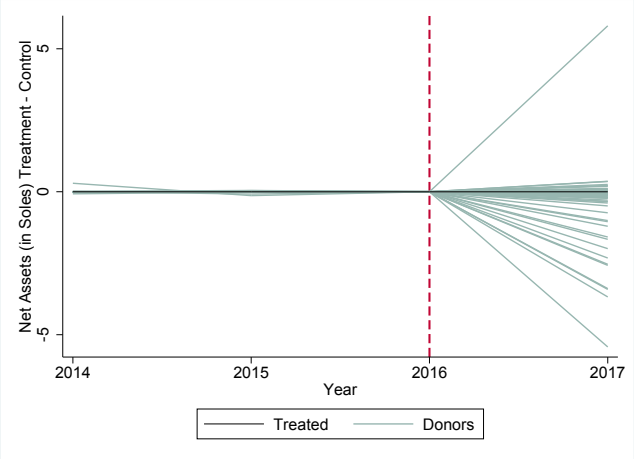


Figure 18: Net assets: placebo tests



Notes: All variables are scaled such that the value is 1 in the last pre-treatment period (2016). All synthetic control estimates and figures are constructed with the "synth" and "synth_runner" packages (Abadie et al. [2011], Galiani and Quistorff [2016]). Data source is SUNAT.

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