

**Take the wind out or hoist the sails? Heterogeneous treatment effects of a behavioral intervention on to promote tax compliance and social security contributions among microentrepreneurs**

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## Abstract

**Background** An alarming number of people are without access to retirement, especially the self-employed, who in most countries have no automatic access to social security and depend on voluntary contribution. In Brazil, the MEI Program (Microempreendedor Individual or Individual Microentrepreneur) offers a subsidized alternative for informal entrepreneurs to formalize their businesses and to be included in the social security system. In order to increase the payment rate of the contributions of entrepreneurs formalized as MEIs, the Brazilian government sent printed booklets by mail in 2014. Before, MEIs would need to download and print the bills from an official website.

**Objectives** In this study, we estimate the effects of the booklet intervention and evaluate its heterogeneous treatment effects. **Research Design** A difference-in-difference model is used to estimate treatment effects. **Subjects** Study participants included a probabilistic sample of 66,734 entrepreneurs formalized as MEIs in Brazil. **Measures** Monthly indicators of payment of contributions by MEIs were observed between 2011 and 2014 in a total of 2,145,952 monthly observations. **Results** The intervention had a significant and positive effect in the month of the intervention, increasing payment rate in 3.87%. This effect diminishes over time and is negative in the seventh month after the intervention. Treatment benefited mostly those with irregular payment behavior before the intervention and had a negative effect for those with more ex-ante consistent payment patterns. **Conclusions** A simple behavioral intervention may increase contribution payments but it should be tailored to previous behavior in order to maximize cost efficiency and avoid backfiring.

## 1. Introduction

Microentrepreneurs represent a relevant portion of economic activity, especially in developing countries. At the same time, they account for a disproportionately large part of informal sector activity (Schneider & Ernste, 2013). With some estimates suggesting that only 20% of the self-employed are formalized in Latin America (FORLAC, 2014), their inclusion into the formal market remains a formidable roadblock for development. Apart from constraints to firms' access to credit and growth, informality carries at least two major problems. On the one hand, it reduces state revenues because informal entrepreneurs usually do not pay income taxes. On the other hand, most of the self-employed do not contribute to social security and, thus, are usually not eligible for social security benefits. This makes them more vulnerable to market fluctuations and also increases their chance to fall into a poverty trap in old age (Bosch, Fernandes, & Villa, 2015).

In recent years, several developing countries have made separate efforts to tackle these problems. To increase business formalization and the owner's access to social security, both Brazil and Uruguay adopted innovative programs that combine the collection of social security funds and taxes.

In Uruguay, the system allows small business owners with low incomes to opt for a unified and combined tax and social security contribution once they formalize their business (ILO Social Protection Department, 2014). The Brazilian *Individual Microentrepreneur* program (*Microempreendedor Individual* or MEI in Portuguese) includes a unified payment scheme that combines a flat tax and a highly subsidized social security contribution (approximately US\$17 per month in total). The program is geared

toward small business owners with up to one employee and yearly revenues limited to BR\$60,000 (approximately US\$18,000).

Despite much participation in the Brazilian program (more than 5 million individuals formalized as MEIs from 2009 to 2016), the payment compliance is relatively low, with less than 60% paying their monthly contributions. In this scenario, the main goals of the program are not reached, as nearly half of the formalized self-employed continue to evade taxes and, in the absence of payment, are not eligible to social security benefits.

This lack of regular payments by many MEIs suggests that intentionality and rational calculus is probably not the only factor driving their behavior. The fact that MEIs went through the formalization process suggests that its benefits were alluring enough. However, failure to make the regular payments leaves them at risk of penalties and ineligible for social security. In this paper, we explore whether distributing information, sending reminders, and increasing ease through which taxes can be paid significantly affect MEIs' payment behaviors.

At the program's onset, MEIs had to access the program's official website and print out the bills to pay them at any bank ATM machine. It was possible to print out the whole year's bills in advance, but bills had to be paid one by one. In 2014, in an attempt to increase the payment rate, the Brazilian government mailed participants booklets composed of the monthly payment bills for the entire calendar year.

We examine this initiative's effect on payment compliance in a differences-in-differences approach by analyzing a dataset of 2,145,952 monthly payment observations for 66,734 MEIs before and after the sending of the bill booklet. This analysis allows us to estimate the impact of this intervention on individual payment rates for a period of up to seven months after booklet receipt.

This study makes two main contributions—one to the literatures on tax compliance and social security contributions and another to the broader literature on behavioral interventions. First, it analyzes an intervention aimed at increasing a combined payment of social security and taxes that is still rather unexplored (Bosch, Fernandes, & Villa, 2015). Hereby, it contributes to the literature on formalization of microentrepreneurs and the argument that business-related benefits of formalization might not be enough to secure the formalization of a majority of microentrepreneurs with limited growth potential (Schoar, 2010). Furthermore, previous behavioral interventions on tax compliance have focused on messages or reminders (e.g., Kleven, Knudsen, Kreiner, Pedersen, & Saez, 2011; Hallsworth, List, Metcalfe, & Vlaev 2017). The booklet intervention, however, also increased the convenience of payment by simplifying the burden of obtaining the bills, facilitating the payment process, and reducing nonfinancial costs (such as time and effort) related to it. To our knowledge, this is the first impact evaluation of an intervention to increase tax compliance that includes a convenience component to use microdata.

The second contribution is related to heterogeneous effects of the intervention. Different individuals and firms may react in diverse ways to the same treatment, and heterogeneous treatment effects have already been documented in the literature on tax compliance and social security contributions (e.g., Beshears, Choi, Laibson, Madrian, & Milkman, 2016). Knowing who is more or less affected by a specific intervention may be fundamental to customize the intervention at hand, increasing its efficacy and cost efficiency. Unlike other treatments that seek to induce individuals to engage in a new behavior (like formalizing the business), the booklet initiative tried to increase compliance of microentrepreneurs with *ex ante* nonuniform payment histories. We argue that the pre-intervention payment behavior may be correlated to a set of unobserved preferences and behavioral traits that can be useful in predicting treatment effects. We compare treatment

effects across different levels of pre-intervention compliance and, thus, explore a driver of the magnitude of treatment effects that has been scarcely approached in the current behavioral change literature.

In the next section, we present a literature review on interventions aimed at increasing social security contributions or at enhancing tax compliance. Next, we discuss heterogeneous treatment effects of behavioral interventions. We describe in the following section our dataset and identification strategy, as well as empirical results. Finally, we discuss the findings and conclusions with implications for theory and policy makers.

## **2.1. Social Security Contributions and Tax Compliance**

Even though formal workers are usually forced to contribute to public social security systems, retirement payments from the public system are often insufficient, even in developed countries (Benartzi & Thaler, 2013). For this reason, academics and policy makers have delved into strategies to increase voluntary contributions for retirement such as 401(k) plans (Poterba, Venti, & Wise, 1996) or the Saver's Credit program, in which individuals can take a tax credit for their retirement contributions (Ramnath, 2013). In recent years, behavioral economic approaches contributed to the topic by testing and analyzing how to increase voluntary savings through a change in the default settings (Madrian & Shea, 2001), automatic payment escalation (Benartzi & Thaler, 2013), social interactions (Duflo & Saez, 2003), and social norms interventions (Bailey, Nofsinger, & O'Neill, 2004).

In contrast to the individual entrepreneur setting, these studies analyze cases in which retirement saving decisions need to be made only once. The actual payments are then

performed automatically (e.g., 401(k)). In the case of the MEI program, in contrast, there are two critical moments of decision. The first one concerns formalization itself and represents the decision of the small business owner to formalize based on the perceived benefits and obligations. The second is related to the decision to comply with the monthly contributions. This process occurs repetitively every month and, thus, is more vulnerable to failure due to behavioral backlashes such as limited attention (Taubinsky, 2014).

The literature on tax compliance, however, deals with a behavior that is structurally more similar to the payment of contributions of MEIs in two ways. First, taxes have to be paid repeatedly over time (although usually on a yearly basis). Second, tax payment is not so much about a new choice than about complying with the laws and regulations that should, in principle, have been accounted for in the decision to formalize in the past.

In the literature on public policy interventions, messages stand out as a cost-efficient way to increase tax compliance. Starting with Coleman (1996) various authors have relied on field experiments to test the influence of messages (delivered mostly as mailed letters) on compliance through deterrence and manipulating the perception of monitoring and enforcement (Kleven et al., 2011; Reckers, Iyer, Reckers, & Sanders, 2010; Slemrod, Blumenthal, & Christian, 2001). Non-deterrence approaches were used to understand how social effects, particularly social norms (Blumenthal, Christian, & Slemrod, 2001; Fellner, Sausgruber, & Traxler, 2012), cooperation, fairness and morality (Ariel, 2012; Hallsworth et al., 2017), relate to tax payment. Other non-deterrence approaches included the role of information and tax reminders (Del Carpio, 2014; Hallsworth et al., 2017).

While most of these studies look at tax reporting as the dependent variable, few had the administrative data available to look at tax payment and even fewer took place in developing countries. There are four randomized field experiments that more closely resemble our setting. In Chile, Pomeranz (2015) detected increases in declared value

added tax (VAT) based on a deterrence letter from the Chilean Tax Authority. Ortega and Sanguinetti (2013) found a result in the same direction in Venezuela, with higher effects for the deterrence messages compared to non-deterrence. In Argentina, Castro and Scartasini (2015) also observed significant effects for deterrence messages on property tax payment, while a non-deterrence approach (conveying social norms or the use of tax money by the state) had no impact. A study with a similar setting in Peru presents conflicting results. Del Carpio (2014) showed that social norm messages were more effective in increasing compliance with property tax payment than deterrence messages or pure reminders. Deterrence messages had a very limited (and partly insignificant) effect on compliance in comparison with the control group, whereas the social norm message increased compliance by 20% compared to the control group.

The aforementioned studies focus on two main types of interventions: information and reminders. Nevertheless, a third important dimension—convenience—has not been investigated. Even if entrepreneurs are convinced they should pay their contributions and remember to do so, the payment may not be accomplished if the process of payment is too burdensome.

The intervention with booklets sent to MEIs in Brazil worked on the dimensions of information and reminder but also affected the convenience of payment, since it precludes the necessity of accessing the internet and printing the bills. While the effect of convenience has been explored in consumer behavior as an effective mechanism to reduce the costs and resources required to make a purchasing decision (e.g. Berry, Seiders, & Grewal, 2002; Kelley, 1958; Yale & Venkatesh, 1986), it has not been explored in the literature on tax compliance or social security contributions.

One exception is the study by Bosch et al. (2015), which evaluates this same booklet intervention, but using data aggregated at the municipality level. Their dataset, however,



presents two important limitations. First, as they observe averages at the municipality level, no heterogeneous treatment effects at the individual level could be estimated. Second, the payment rate was imprecisely measured, as they observed the total number of payments made in the month and the not number of MEIs who paid their monthly contributions. Thus, if MEIs would pay contributions in advance, payment rates could be higher than 100% in some municipality-months. They identify an “action and backslide pattern” with short-lived effects, similar to those identified in other long-term behavioral intervention studies (e.g., Allcott & Rogers, 2014). In the month in which the booklet was delivered, compliance increased 6.8%, while this effect dropped to 3.6% and 2.1% in the next two months and to a nonsignificant effect in consecutive months.

Also absent from the literature has been the extent to which individual heterogeneity interacts with the behavior intervention on tax compliance and social security contributions. In other words, who are the individuals who respond to interventions that increase convenience and information?

## **2.2. Heterogeneous Treatment Effects of Behavioral Interventions and Past**

### **Behavior**

Individuals who receive behavioral interventions are different from each other in multiple dimensions, from socioeconomic backgrounds to personality traits. These differences may render distinct effects on the treatment at hand, generating heterogeneous treatment effects. For instance, Ferraro and Price (2013) showed that a descriptive social norm intervention based on mail messages to reduce water consumption had a higher effect for the least price sensitive consumers with the highest water consumption levels. Beshears et al. (2016) concluded that the effect of changes in default options on retirement

decisions was higher for low-income compared to higher income individuals. Costa and Kahn (2013) estimated that effects of the Home Energy Reports were higher for politically liberal households than for conservative ones.

While some interventions aim to get individuals to enroll in a new program or start a new activity, recipients of behavioral interventions often already perform—at a higher or lower level—the behavior that is targeted. For example, in the case of the MEI program, the booklet intervention was not directed at formalization, but rather at compliance with payments after the decision to formalize had been made. Some microentrepreneurs were already (more or less) compliant with their monthly obligations expected by the program. The intensity by which the targeted behavior was conducted before the intervention is a rich source of information, as it may be correlated to a large set of unobserved variables that influence treatment effects. Individuals with more consistent pre-intervention behaviors may have stronger preferences or may be more attentive and less prone to forgetting. But, those who pay less regularly might be more subject to psychological biases such as bounded willpower and limited attention (Madrian, 2014). Consequently, the past behavior might be a good proxy for the presence of behavioral biases. Surprisingly, only a few studies have looked at treatment effects based on heterogeneity of the target behavior in the past. Those that capture this dimension do so mostly with descriptive social norm messages as the focal intervention.

Examples from the social psychology literature show that descriptive social norms can be efficient in increasing the behavior but can also have a negative effect on those individuals who perform above the norm (Cialdini et al., 2006). Due to the social norm message, they may perceive themselves as overperforming and, thus, reduce the intensity of the targeted behavior (Schultz et al., 2007). This is likewise shown in the only study that observed heterogeneous treatment effects based on previous tax payments. Castro and Scartascini

(2015) showed that a descriptive social message had a positive, but not significant, effect for non-compliers, while the effect was negative for those who had paid their taxes before. There is some evidence on the importance of past behavior heterogeneity on other types of interventions, such as reminders. In a study about the effect of reminders on gym attendance, Calzolari and Nardotto (2017) observed that the frequency of gym visits improved more for occasional than for frequent users. In another study, a field experiment that informed people about their credit scores and reminded them about the importance of timely payments for credit worthiness showed that only individuals with low credit scores benefited significantly from the intervention. Those with medium credit scores were unaffected by the messages, and those with high credit scores were even negatively affected (Bracha & Meier, 2014). Both cases highlight the potential of past behavior to predict treatment effects and indicate that the effects of interventions are negatively related to the intensity of the behavior pre-intervention.

### **2.3. Assessing Potential Hypothesis**

When hypothesizing on the impact of a reminder/convenience intervention on payment compliance, different mechanisms lead us to make different predictions.

One mechanism relies on the marginal impact of the intervention on the attention and effort that the action requires. If the microentrepreneur's willingness to pay (or to not pay) is a direct function of the attention and/or perceived effort associated with the task, then those who already pay regularly will benefit little from it. Their past behavior reveals that they are attentive and likely do not find the action too demanding (i.e., time consuming or cognitively/physically costly). Following the same rationale, those who never pay can be strongly impacted by intervention, as it significantly increases the microentrepreneurs'

ability to remember the payment day as well as the convenience of the payment task. Put simply, an hypothesis based exclusively on the marginal impact of attention and convenience would predict a decreasing impact of the intervention on behavior change as we move from ex-ante non-payers, to irregular-payers, to regular-payers.

One can even argue that those who already consistently paid the monthly contributions at some moment may have developed habits. Once individuals have well-established habits that lead them to perform well in the targeted behavior, introducing a new way of executing the task, even if objectively easier, can be deconstructive and, thus, perceived as costly. As a result, the habit may be interrupted (Wood, Tam, & Witt, 2005). For this reason, one could expect a weaker and even negative effect of the intervention among those who consistently paid the monthly contributions after formalization.

Another potential mechanism relies on the perceived short- and long-term value of the action. In the specific context of the booklet intervention, individual entrepreneurs acquire information about the benefits and obligations related to the program during the formalization process and can be expected to form a preference about compliance at this time. The business benefits of the program (such as issuing invoices, hiring one employee, or obtaining access to credit over the company) are not directly affected by noncompliance to payments in the short run because of lack of enforcement: up to 2017, no MEI had been cancelled due to late payments. Noncompliant MEIs do lose eligibility to social security benefits, however. In this sense, their payment behaviors may reflect preferences about the value of payment compliance. As such, microentrepreneurs who either never or very often paid the monthly contributions before the intervention can be thought of as holding “strong preferences” regarding the benefits of the MEI program. Once these preferences are set and settled over repeated payment (or nonpayment) decisions, it may be more difficult to change behavior through nudges (i.e., reminders) or

by increasing payment convenience. Irregular-payers, however, have, by definition, weaker preferences, with a less clear evaluation of the worthiness of compliance. Thus, following this mechanism, one could expect the effects to be stronger for irregular-payers than for regular-payers or non-payers.

Of course, it is also possible that both mechanisms are at work. In this case, a direct implication is that the intervention would produce stronger effects among those who (a) face relatively weaker preferences and (b) can still significantly benefit from the increased attention and convenience associated with the new payment method: the irregular-payers.

### **3. Data and Method**

This section describes the MEI program, the original intervention, the data, the study sample, and our identification strategy.

#### **3.1. The Individual Entrepreneur Program (MEI)**

The subjects of interest in this paper are formalized small business owners who are registered as MEIs. The program was implemented by Brazil's federal government in 2009 to foster formalization by greatly simplifying the bureaucracy and reducing costs of formalization for small entrepreneurs with up to BR\$60,000 (currently about US\$18,000) annual revenue. Small business owners who qualify as individual entrepreneurs pay very reduced taxes and undergo an expedited process for opening and maintaining a formal business.

This formalization possibility is particularly attractive as a subsidized way into the country's social security system. The biggest social benefit is eligibility to a lifelong retirement of minimum wage once the self-employed individual reaches the retirement age (currently 60 years of age for women and 65 for men) and has contributed for at least

15 years. For example, when a female microentrepreneur formalizes as an MEI at 45 years of age, she needs to make 15 years of continuous contributions to retire. However, years in which the individual contributed to the social security system in the past (i.e., through contract jobs) are deducted from the minimum contribution period of 15 years. Notably, the social security contribution under the individual entrepreneur program is equivalent to only 5% of the minimum wage, whereas other categories of self-employed workers pay at least 12%. Under this extremely subsidized scheme, the total amount paid in 15 years of contributions is received by the entrepreneur in only nine months of retirement pay. Formalization also provides the self-employed with several social protections, such as disability benefits and paid sick leave after one year of contributions, as well as paid maternity leave for women after 10 months of contribution. In the case of death of the self-employed, the family is entitled to monthly life insurance payments as long as one child is less than 21 years of age.

However, the government's program goals depend on microentrepreneurs' compliance. This means access to social security is guaranteed only if the monthly contribution is paid. The booklet intervention was motivated by a low compliance rate, with approximately half of the MEIs missing to fulfill their monthly payment obligation.

### **3.2. The Booklet Intervention**

Before 2013, microentrepreneurs formalized as MEIs needed to access the program's website and print the bills in order to pay their monthly contributions in a bank or a federal "lottery house" (which offers basic banking services). In 2014, the Brazilian Ministry of Social Security modified the payment system. A booklet with bills for payment of the monthly contributions was sent by mail to all 3 million individual entrepreneurs formalized by the end 2013.

The format of the booklet resembled bills from department stores, which are very common in Brazil, and it essentially offered two main advantages. First, the presence of the physical booklet could serve as a reminder (e.g., placed along with all the “to-be-paid” bills). Second, it made the payment process more convenient since the participants no longer had to go to the federal Social Security website to access their bills and did not have to print them.

Due to logistical issues at the federal level, the booklets were delivered on different dates to different states over a four-month period from February to May 2014 (Bosch et al., 2015). This scattered distribution of the booklets is fundamental for our identification strategy, as it allows us to separate intervention effects from general macroeconomic fluctuations that may affect payment.

### **3.3. Data and Identification Strategy**

Data on the payment of the individual MEI contributions is publicly available at the website “Portal do Empreendedor” (Entrepreneurs’ Portal). A full report of every payment made since the business was formalized may be obtained provided one has the business ID number, known as the CNPJ (Cadastro Nacional de Pessoas Jurídicas). The business IDs are public information in Brazil (they are printed on receipts and can be found on most companies’ websites), although they are not organized in a consolidated and publicly available database. Credit bureaus and other information providers consolidate the business IDs and sell the information for marketing purposes. Thus, we acquired 66,734 business IDs of individual entrepreneurs who formalized their businesses from 2010 to 2013, from 512 randomly selected municipalities in regions that received bills by mail in April (from the states of Rio Grande do Sul, Santa Catarina, and Paraná)

and in May (from the state of São Paulo). Among the owners of these businesses, 16,715 formalized in 2010, 15,251 in 2011, 19,147 in 2012 and 15,621 in 2013.

For a random subsample of 32,188 MEIs, we also acquired gender and age of the entrepreneur and for a smaller subsample (due to higher costs of the information) of 16,662 MEIs, we also acquired credit scores at the last month before the intervention. The individual reports of the 66,734 MEIs in our sample yielded a final sample of 2,145,952 monthly observations of payments from January 2012 to December 2014. The payment reports include the date in which the paper bill was issued, the due date, the amount due, and its components (service and/or commerce tax and social security contribution). In the month of formalization, a bill is automatically generated by the system, which allows us to use the oldest bill as an indicator of the date in which the business was formalized. Although we can identify the due date on each bill, we cannot isolate the exact payment date. In case bills were paid in advance or late, they will be considered as paid on the due month.

Through the reports, it is not possible to determine whether an MEI was cancelled or upgraded to another business category. For this reason, we treat any bills eventually issued or due after cancellation of MEI as not paid. However, both MEI cancellation and a change in company status are uncommon (less than 1% of the cases). It is probably the case that microentrepreneurs who closed their businesses did not cancel their MEIs. Surveys indicate that 83% of MEIs were actually conducting an entrepreneurial activity. The rest were either at a salaried job or unemployed and had never reported their new status to the program administrator (Bosch et al., 2015). As those inactive MEIs are less likely to respond to the printed bill intervention, our estimates of its effect may be underestimated. Table 1 summarizes the variables used in this study.



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Insert Table 1 Here  
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Our identification strategy relies on the natural experiment that resulted from the staggered delivery of the booklets over time in the different regions of the country. Thus, we use a difference-in-difference approach to estimate the effect of the intervention on payment using an OLS regression model on a panel of monthly observations for the MEIs in our sample:

$$Payment_{it} = \sum_{k=0}^7 \beta_k Post_k + \alpha_i + \gamma_t + \delta_t + \tau_{it} + \varepsilon_{it}$$

where the dependent variable is payment of dues for month t by MEI i. The main variables of interest are a series of dummies on the month of the intervention and in the seven following months ( $Post_k$ ). We consider a period of up to seven months in order to exclude observations from 2015, as bills due in that year were not included in the booklet. The regression includes *Time formal* ( $\alpha_i$ ), *Month due* ( $\gamma_t$ ) and *Year due* ( $\delta_t$ ) fixed effects (that control for seasonal and other macroeconomic changes), as well as CNPJ fixed effects ( $\tau_{it}$ ). We cluster standard errors by CNPJ.

The parameters of interest are the coefficients on  $Post_k$ . They estimate how payment rates change after the treatment relative to payment rates before the treatment, net of the common trend since formalization and all other fixed effects. The fact that treatment was not dispensed at the same time to all MEIs allows us to separate seasonal effects from treatment effects.

### 3.3.1 Heterogeneous Treatment Effects

For exploring heterogeneity of treatment effects across pre-intervention payment patterns, we consider three groups of MEIs with different payment behaviors in the first six months after formalization.

Thus, based on the payment behavior in the first six months, we define three groups of MEIs: The first group consists of those who paid all six contributions (*regular-payers*, 66% of MEIs). The second group includes only self-employed who did not pay any of the first six contributions (*non-payers*, 18 % of MEIs). The third group includes those who paid some but not all of the first six contributions (*irregular-payers*, 16% MEIs). Not surprisingly, the initial pattern of payment is highly predictive for the payment over longer periods of time. Among regular-payers, 71% continue to pay their contributions after two years, while these numbers drop to 16% in the group of irregular-payers and 3% in the group of non-payers. We perform robustness checks, and results hold when we consider payment patterns in the first 12 instead of six months.

We estimate different models for each of the three past behavior subsamples in order to evaluate heterogeneous treatment effects. We also estimate the models in the subsamples matching the three MEI groups on gender, age, and credit score to show the additional predictive power of past behavior.

## 4. Results

Payment rates in the regions that received the booklets in April and May ranged from 61% in 2010 to 59% in 2013. Figure 1 presents monthly payment rates by intervention month. The average payment rate is higher for MEIs in the south region of Brazil, who received the bills in April, compared to those in São Paulo, where the intervention occurred in May. There is a general downward trend in payment rates over time, which is associated with sharp drops in payment rates at the beginning of each year. This

suggests that small business owners tend to stop paying their monthly contributions at the beginning of a new year.

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Insert Figure 1 Here  
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It is possible to observe an increase in payment rates in both regions at the respective months of the interventions. In the region where the booklets were sent in April (black line), payment rate increased from 59% in March to 62% in April, while the payment rate changed from 50% in April to 54% in May in the region where the booklets were sent in May (gray line). This effect seems to be transient. In the month following the beginning of intervention, we already observe a significant decrease in payment rates in both regions. Further, payment rates return to pre-intervention levels by the end of 2014<sup>2</sup>.

Our regression estimates (Table 2, full sample column) confirm these findings. There is a significant effect ( $b = 3.87\%$ ,  $p < .001$ ) in the month of the intervention that becomes nonsignificant after six months and negative in the seventh month ( $b = -0.48\%$ ,  $p < .001$ ).

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Insert Table 2 Here  
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More critically, separate regression models for each group indicate heterogeneous effects. In the month of the intervention, the effect has an inverted U-shape when related to pre-

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<sup>2</sup> We should notice that the difference in payment between the end of 2013 and 2014 observed in Figure 1 seems to signal a strong downward trend compared to 2013. This difference, though, is inflated due to our sample, as it includes only microentrepreneurs who formalized as MEIs before 2014 and newly formalized MEIs have the highest payment rates on average. Thus, average payment rate is reduced after the intervention, as we do not observe payment rates of recently formalized MEIs in that period. In the regressions, we account for this effect by controlling for time since formalization and thus have more reliable estimates of the intervention effects.

intervention payment rate, with higher effects for irregular-payers than for non-payers or regular-payers.

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Insert Figure 2 Here  
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For the regular-payers group, the effects of the intervention on payment were small in the month of the intervention (2.5%, Figure 2), disappear two months later and become negative in the sixth (-0.50%) and seventh months (-1.14%). This suggests that the intervention backfired for the regular-payers, reducing their likelihood of payment. The impact of the intervention was largest for the irregular-payers (7.28% in the month of the intervention), and this effect remained positive and significant until the seventh month after (4.42%). Finally, non-payers also had a positive effect in the intervention month (5.37%); this stayed positive and significant until the last observed month (2.4%).

## **5. Discussion and Conclusion**

Our results indicate that a behavioral intervention based on convenience, information and reminder may be a valuable tool to augment social security contributions of the self-employed. Furthermore, in the light of increasing public policy intervention that try to “nudge” (Thaler & Sunstein, 2008) individuals into higher savings for retirement, the main contribution of this paper is its emphasis on accounting for heterogeneity in a behavioral intervention (Vivalt, 2015). Our results indicate a positive and significant average treatment effect in the month of the intervention and heterogeneous effects across MEIs with distinct previous payment histories. This suggests that behavior interventions

should be fitted to performance trends of the targeted audience in the variable of interest in order to achieve the best results. This is important, as our results show that interventions may take the wind out of an entrepreneur's sail in his pursuit of payment of taxes and social security, if there is an established habit of payment prior to a behavioral intervention. On the other hand, an intervention might be particularly helpful to those entrepreneurs who are characterized by an inconsistent payment history. This may indicate that entrepreneurs with inconsistent retirement contribution histories face stronger behavioral biases and are, therefore, also more sensitive to behavioral interventions.

The highest effects of the intervention were observed among those who paid only some or none of the contributions in the first six months. In contrast to Bosch et al. (2015), we do not observe a full backslide of the intervention effect for them. These groups, which represent 34% of the sample, also had long-term effects, with an increase in payments that lasted until the end of 2014.

For regular-payers, we identify a significant and negative effect after six months, with payment rates below the pre-intervention level; this is even more concerning than the backsliding effect to previous payment levels observed by Bosch et al. (2015). Our finding may be due to the disruption of the MEIs' previous habits that allowed them to keep track of payment over time, especially those who paid on time. In the first moment, the reminder effect may have increased the probability of payment, but once the new bill is not as salient any more, it may be less efficient than the old habit of printing and paying the bills.

A warning may derive from this finding, as it highlights the possibility of backfiring for those who already performed the actions the intervention tried to incentive. Although this type of backfiring is discussed in the literature in descriptive social norms interventions

(for those who perform above the social norm and reduce the intended behavior, as they think they are overperforming) and in the crowd-out effect of financial incentives (as they may substitute intrinsic for extrinsic motivations (e.g. Deci, Koestner, & Ryan, 1999)), the substitution of old good habits for new good habits has received less empirical attention.

Overall, heterogeneity in the payment trend prior to the intervention was extremely relevant for the magnitude of the intervention effect, which implies the need to customize interventions beyond a “one size fits all” approach. Our results suggest that unobservable characteristics might be properly captured by the pre-intervention’s trend and may account for a series of behavioral characteristics that usually stay hidden and which are useful predictors of treatment effects.

Finally, past behavior related to the outcomes of interest of retirement policy interventions may be often free and readily available from registry data. Our results show that by using this information, policy-makers may predict more precisely treatment effects for subpopulations of interest and thus tailor the interventions to target them more adequately and increase their cost efficiency.

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Table 1 – Variable definitions

Variables	Definition
<b>Dependent variable</b>	
Payment	Indicates if the contribution of month due was paid (1 = paid, 0 not paid)
<b>Independent and control variables</b>	
Post	Indicates time (in months) from bill sent by mail (zero in the month of the intervention)
Month due	Calendar month of the year in which the payment is due
Year due	Calendar year in which the payment is due
Time formal	Time after formalization (in months) of MEI
CNPJ	Business ID of the MEI ( <i>Cadastro Nacional de Pessoa Jurídica</i> )
Gender	Gender of the MEI (1= female, 0 = male)
Age	Age of the entrepreneur (in years)
Score	Credit score of the entrepreneur one month before the intervention

Figure 1: Payment rates over month due by region

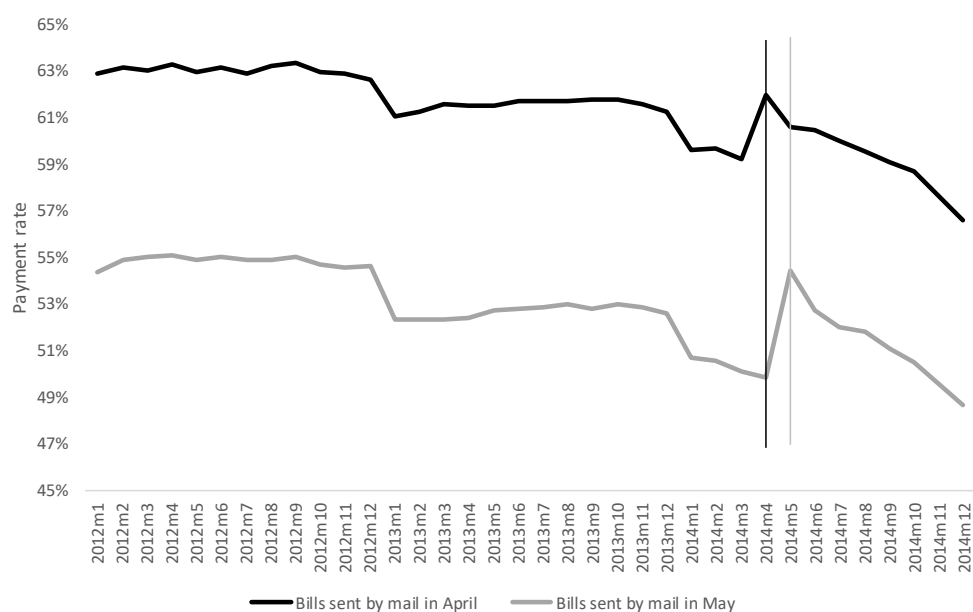


Table 2 – Effects of intervention on payment by time after intervention and previous payment history

<i>Post</i> (months after interv.)	Full sample	Previous payment history subsample		
		Regular-payers	Irregular-payers	Non-payers
0	0.0387***	0.0252***	0.0728***	0.0537***
1	0.0295***	0.0180***	0.0606***	0.0438***
2	0.0238***	0.0150***	0.0465***	0.0388***
3	0.0186***	0.0116***	0.0378***	0.0357***
4	0.0117***	0.0055**	0.0312***	0.0308***
5	0.0065***	0.0005	0.0251***	0.0289***
6	0.00161	-0.0052**	0.0205***	0.0279***
7	-0.0048**	-0.0114***	0.0142***	0.0243***
N. MEIs	66,734	42,373	11,112	13,249
N. obs.	2,145,952	1,275,984	364,661	432,541

\* p < .05, \*\* p < .01, \*\*\* p < .001

Standard errors between parentheses.

Figure 2: Effect of intervention in the first month on payment by previous payment behavior

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