An Experimental Evaluation of Strategies to Increase Property Tax Compliance: Free-riding in the City of Brotherly Love

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Abstract

This study evaluates a set of notification strategies intended to increase property tax collection. We develop a field experiment in collaboration with the Philadelphia Department of Revenue to test three of the most commonly suggested hypotheses of tax compliance: deterrence, moral appeal, and peer conformity. Our preliminary findings provide evidence that both moral appeal and peer conformity modestly improve tax compliance, while deterrence notifications are no different from standard notifications.

KEYWORDS: Tax Compliance, Property Taxation, Field Experiment, Deterrence, Moral Appeal, Peer Conformity.

1 Introduction

The purpose of this study is to evaluate a set of strategies intended to increase property tax revenue collection. We designed different notification treatments that are motivated by the theoretical literature on tax compliance. Extrinsic motivations are emphasized by the deterrence model (Becker, 1968) which explains tax compliance as a combination of penalties and costly monitoring. Intrinsic motivations are captured in models that rely either on social norms or social contracts. We develop and implement a field experiment to test three of the most commonly suggested hypotheses: deterrence, moral appeal, and peer conformity. The basic strategy behind our controlled randomized experiment is to vary the informational content of real estate tax notification letters sent to property owners.[1]

While most of the previous literature has focused on income tax collection, we focus on property tax collection. There are compelling reasons to focus on property taxes. First, property taxes should be, in principle easier to collect than income taxes. The property tax base, which is the assessed value of the house, is easily observed and verified. Establishing the tax base for an income is much more difficult. Moreover, the property tax base is established in a separate assessment process in most cities in the U.S. While there are frequent disagreements about correct property tax assessments, tax enforcement is dictated by the assessed value of the property. Second, property taxes play an integral role in financing local municipalities and their school districts. The local autonomy of the U.S. tax system compared to other developed countries, means that property taxes play a large role in the provision of public services in the U.S.

[1]The empirical literature on tax compliance is discuss in detail in Hallsworth, List, Metcalfe and Vlaev (2014). Other notable papers that use field experiments to study tax compliance are Blumenthal et al (2001), Kleven et al. (2011), Ariel (2012), and Pomeranz (2013).

Property tax compliance is a significant problem in the many large U.S. cities. Philadelphia is a leading example. A recent study by the Pew Charitable Trust (2013) focused on a sample of 36 cities and found that Philadelphia had the fifth highest delinquency rate in 2011, the last year for which common statistics were available. Nine percent of property taxes went uncollected in Philadelphia. This compares to a median delinquency rate of 4.1 percent in 36 large U.S. cites. As of April 2014, the city and school district were owed $595 million in delinquent taxes on 134,888 properties.

We implemented our field experiment in collaboration with the the Philadelphia Department of Revenue (DoR) to provide new insights into strategies for increasing property tax collection. Our intervention focuses on three treatments that are motivated by the recent literature on tax compliance.

The first treatment is based on the deterrence model of tax compliance, which emphasizes the external motivations of behavior (Becker, 1968, Allingham and Sandmo, 1972). Key elements of deterrence are the certainty of detection (the monitoring probability) and the seriousness of the penalty or fine that is levied on tax evaders who are caught. Given the uncertainty of tax enforcement, tax compliance is primarily a function of subjective perceptions of the probability of detection and the seriousness of the penalties for being caught evading taxes. The basic idea behind the our first treatment condition is to change these subjective perceptions of the certainty of detection and the seriousness of being caught failing to pay property taxes. Our experiment does not explicitly involve tax amnesties. Neither do we change the fiscal incentives to pay taxes in our proposed experiment. Instead, we attempt to alter subjective perceptions of the probability of detection and consequences of tax delinquency by informing agents that the DoR will go after them for failure to pay property taxes, and that this evading property taxes has serious repercussions.

The second treatment is based on a more recent theory that emphasizes the internal moral appeal for paying taxes (Alm, McClelland and Schulze, 1992). There is an implicit social contract in that a local municipality agrees to deliver public goods and services in exchange for more-or-less voluntary tax payments. Loyalties and emotional ties to the social contract play a large role in creating high tax moral. Parallels are drawn between the problem of raising taxes and the fund-raising problem faced by non-for-profit organizations (Andreoni, Erard and Feinstein, 1998).[2] The basic idea behind the second experiment is then to design an informational treatment that reinforces this social contract. The treatment takes the form of a moral appeal to the delinquent tax payer and emphasizes the *quid pro quo* of tax compliance in the city–public goods and services (namely, education and safety provision) funded by compliant taxpayers.

Finally, the third treatment is based on the recent literature on social norms which emphasizes concepts of social fairness and reciprocity (Fehr and Gachter, 1998). The idea behind the third treatment is to appeal to potential tax delinquents' proclivities to conform to their peers.

To implement our experiment we needed to integrate our three treatment conditions into the standard operating procedures of the billing system of the DoR. Fortunately, DoR assigns properties to billing cycles using a pseudo-randomized mechanism, in which assignments are primarily based on the last two digits of social security or employer identification numbers. We then assigned our three treatments (deterrence, social contract, peer conformity) and the usual condition of payment notification to days in the billing cycles using randomly drawn four-day sequences.

We conducted our experiment in November 2014 spanning a period consisting of 9 treatment days. We assessed the fidelity of our experiment by analyzing letters

[2]For example, publicly funded radio stations typically need to raise funds from their listeners.

that were returned to the DoR by the U.S. Postal Service. Based on our analysis of the returned letters we concluded that our treatment had been correctly assigned on these days. Our final sample consists of 5,151 properties. Based on a variety of balance tests, we conclude that treatments were randomly assigned within our sample. The DoR started to share data on property tax payments immediately after the experiment. Our current sample is based on all payments up to January, 2015. We plan to expand our sample until the March 2015.

Our empirical analysis focuses on two sets of outcome measures. First, we follow the recent literature and analyze discrete outcomes. We would like to know whether the property owner paid their property taxes during the follow-up observation period. Second, we examine the size of actual payments received by DoR. We normalize the received property tax payments by the assessed value of the property. Our preliminary findings show some evidence that both moral appeal and peer conformity help to improve tax compliance. We find that the deterrence notification performs no different than the standard billing notification.[3]

The rest of the paper is organized as follows. Section 2 discusses the institutional background focusing on property tax collection in Philadelphia. Section 3 provides a detailed discussion of our three treatments and the control. Section 4 discusses the experimental design and the fidelity of its implementation. Section 5 details the statistical approach to measuring treatment response. Section 6 presents our current empirical findings. Section 7 offers some preliminary conclusions.

[3]Other empirical studies have failed to provide support for the deterrence model are Alm (1999) and Togler (2002).

2 Institutional Background

Real estate taxes in Philadelphia are levied annually on a property-level basis. The Office of Property Assessment evaluates the market value of each property, 1.34 % of which must be paid to the Philadelphia Department of Revenue. The city then splits property tax revenue with the School District of Philadelphia, with the former getting approximately 45% revenues. Tax bills are mailed by DoR in batches throughout December and early January each year; the owners have until March 31st to remit their balance to the City, after which time their bill begins to accrue penalties and interest.

The DoR actively begins pursuing non-paying properties in the September following nonpayment. First, the city delegates roughly $\frac{2}{3}$ of the debts to the authority of two designated external law firms which have contracts with the city for delinquent property tax collection.[4] These law firms are free to pursue the collection of the debt as they see fit, and are rewarded with a portion of any debts recovered for the City.

For those debts that remain targeted by DoR itself, the city traditionally leverages one of several legal options as threat and punishment for nonpayment. Beginning on March 31st, the city regularly sends plain bills to properties still in hock–roughly once every 10 weeks.[5] More substantive enforcement strategies begin when when the properties become officially delinquent on December 31.

Philadelphia operates with relatively wide latitude under the Pennsylvania Municipal Claims and Tax Lien Law (MCTLL), enacted in 1923. The city can place a lien on any property that not yet paid real estate taxes 9 months past the March

[4]Currently, these law firms are Linebarger, Goggan, Blair & Sampson and Goehring, Rutter & Boehm.

[5]See the section on implementation below for exact details.

31st deadline. A tax lien may be imposed for delinquent taxes owed on real property as a result of failure to pay taxes. A tax lien takes precedence over all other claims and gives the holder of the lien basis for legal action, including foreclosure. Tax liens typically includes the principal tax amount, plus any interest and penalties.

Having obtained a lien the city can technically start a foreclosure process. This is the legal process of seizing title of a property (or the deed) and forcing its sale for the purpose of paying off a debt, such as a tax lien. In a tax foreclosure, the local jurisdiction petitions a court to award it the title based on an unpaid lien. The jurisdiction may then sell the property in a tax-deed sale or auction, hoping at least to recover the amount of the tax lien. The original owner usually has the right to regain the property if she pays the back taxes within a set time period after the sale, called the redemption period. If nobody buys the deed, the tax lien remains unpaid, and the jurisdiction keeps the title and responsibility for the property. A Sheriff's Sale is basically a public auction of the property, whereby all ownership rights to the property are stripped from the former owner upon successful bid.[6]

For commercial properties, the city may also sequester income from the business, become the property manager, or even shut down the business. City employees may see their taxes deducted from their salaries, and applicants for municipal jobs are vetted for eligibility– new employees must either be fully repaid or have started a payment plan. Philadelphia has recently begun to explore several alternative enforcement options for property tax delinquents, including levying liens on owners' home addresses outside Philadelphia (targeting delinquent nonresident landlords) and impounding cars.

A recent study by the PCT (2013) concluded that "compared to laws governing

[6]A list of properties currently up for Sheriff's Sale by the City of Philadelphia can be found at *http://www.officeofphiladelphiasheriff.com/en/real-estate/foreclosure-listings*

delinquency collection in some other states and other Pennsylvania counties, the state statutes governing Philadelphia give city government a lot of discretion in setting policies on when to initiate foreclosures or what kind of catch-up payment plans to offer. In the past, Philadelphia has tended to use this discretion to delay taking action, put up fewer properties for sale, or let delinquents enroll and default on payment plans many times, all of which has caused delinquencies to accumulate over the years." As a consequence, currently threats of enforcement of property tax collection may lack sufficient deterrence in Philadelphia.

3 Treatments

To explore softer avenues for revenue take augmentation, we determined that the most logistically feasible approach was to include a "message" in the bills regularly mailed to non-payers, the language of which was carefully chosen to target one of three enforcement strategies: deterrence (the "Threat" treatment), social normality (the "Moral" treatment), and conformity (the "Peer" treatment). To properly isolate the treatment effects of receiving a specific message from the effects of receiving *any* message given the status quo of plain bills, we also randomly sent properties a plain message (the "Control" treatment).

The letters were designed carefully to differ only in the wording of their second paragraph; for clarity, the idiosyncratic wording is reiterated here. We also took care to minimize communication issues for those with limited literacy by simplifying the language of the three different messages–shunning uncommon words and syntactic complexity by churning the text through the latest linguistic tools for complexity analysis software.

Further, in accordance with the DoR's general desire to reach out to its substantial

immigrant populations, we agreed to include Spanish translations of each treatment's text on the reverse of the messages.[7]

3.1 Treatment 1: Deterrence

The goal of the Deterrence treatment is to emphasize the repercussions of not-complying with property tax payments with the city, highlighting the policy tools available to the city. This message was intended to educate owners who may have poorly-formed notions of the extent of action the city may be willing to take to recover taxes from each property. The message contained the following sentences:

Not paying your Real Estate Taxes is breaking the law. Failure to pay your Real Estate Taxes may result in seizure or sale of your property by the City. Do not make the mistake of assuming we are too busy to pursue your case.

3.2 Treatment 2: Moral Appeal

The goal of the Moral treatment is to emphasize the social contract between tax payers and the city–that, the city can only provide public goods if property taxes are paid timely. In particular, we chose to highlight the correspondence between Real Estate Tax compliance and the City's provision of public education and safety services. The message contained the following sentences:

We understand that paying your taxes can feel like a burden. We want to remind you of all the great services that you pay for with your Real Estate Tax Dollars. Your tax dollars pay for schools to teach our children. They also pay for the police and

[7]Puerto Ricans make up the plurality of Philadelphia's non-English-speaking population. See Appendix for the exact style and full wording of each treatment, including the Spanish translations we ultimately chose with input from several native speakers

firefighters who help keep our city safe. Please pay your taxes as soon as you can to help us pay for these essential services.

3.3 Treatment 3: Social Pressure & Conformity

The goal of the Peer treatment is to socially shame delinquents by underlining their nonconformity compared to their neighbors. The message contained the following sentences:

You have not paid your Real Estate Taxes. Almost all of your neighbors pay their fair share– 9 out of 10 Philadelphians do so. Paying your taxes is your duty to the city you live in. By failing to pay, you are abusing the good will of your Philadelphia neighbors.

3.4 Control

The Control message was designed to be as plain and unpersuasive as possible, with the goal of the informational content being orthogonal to each of the three treatment messages. The control condition contained the standard billing notification:

The enclosed bill details your outstanding Real Estate Taxes due to the City of Philadelphia.

4 Experimental Design

4.1 Randomization

Our approach to randomization was constrained by the logistics of DoR's enforcement faculties. We concluded after several discussions with our collaborators at DoR that it would be logistically impossible to assign properties at random to different treatments. Instead, we chose to exploit the pseudo-random assignment of properties to billing cycles and randomized treatments across the cycles. To understand this decision it is useful to discuss the current practice of sending out letters by DoR.

Mailing of delinquent real estate tax bills by DoR works roughly as follows. Every property in the city is assigned to one of 50 mailing cycles; since it is cheaper and simpler to send at once all bills to those owners owing taxes on multiple properties, assignment to cycles is done at the owner level, so that each mailing cycle has roughly the same number of owners. Every morning, a printer at DoR taps the in-house accounting system to find all properties that a) owe taxes to the City and b) are in the current day's mailing cycle, which increases by one each day. After identifying the bills to be printed for the day, the printer merges several other pieces of information stored with the delinquent balance such as the mailing address and an in-house ID associated with the property. The 1200 or so bills that are printed each day are then brought to the City's mailing room, wherein they are stuffed into envelopes and delivered to the property owners.

Given the volume of bills printed each day and the existing infrastructure for processing them, especially the machine-automated process of envelope stuffing, we determined the most practical solution would be to randomize treatment at the mailing cycle level, so that every bill printed on the same day would be paired with the

same message. Randomization of mailing days was handled by the authors. We elected to randomize 4-day cycles–for each 4-day period, we picked at random among the $4! = 24$ possible arrangements of treatments over the subsequent 4 days. Our experiment was conducted during 9 days in November 2014, from the 4^{th} through the 25^{th}.

While we are certain of the sanctity of our mailing cycle-level randomization process, one may be concerned about the assignment of properties to mailing cycles by the city. Fortunately, however, the city uses a pseudo-random mechanism to assign owners to billing cycles, which means that we achieve proper full-scale two-stage randomization of the properties through our process of day-level randomization.

In particular, the city assigned properties to cycles based on the last two digits of an in-house ID number; those with final two digits 01 and 02 are mapped to cycle 1, those with final digits 03 and 04 are mapped to cycle 2, and so on. The in-house ID itself is motley in nature. For many properties, DoR has on file the owner's Social Security Number (SSN); for many others, mainly commercial properties, the DoR stores their Employer Identification Number (EIN); and for the remainder of properties, DoR assigns its own in-house ID number. This last is a 9-digit code which is assigned sequentially to property owners who cannot be matched to either of the federal ID numbers. While this assignment based on SSN or EIN is not purely random, it is a pseudo-random assignment. It is hard to believe that there would be any significant sorting or self-selection based on the last two digits of SSN or EIN.

4.2 Implementation Fidelity

To assess the fidelity of the experimental design, we leveraged a unique feature of the environment. The Department of Revenue regularly posts envelopes destined for

addresses that are either unattended (vacant) or do not exist in the first place due to typos. Either before or after an attempted delivery to such an address, the postal service flags down these bills and returns the missives to DoR, which then process them and attempts, if they can identify a suitable alternative address, to re-deliver the tax bill. We took advantage of the fact that a subset of bills made their way back to DoR to check firsthand the extent of treatment fidelity. Our final sample consists of the nine treatment days for which greater than 90% fidelity was achieved.

4.3 Sample Size

Starting with the original sample of 134,888 delinquent properties, we obtained our final sample by using the following screening devices:

1. Payment agreement (23%=31456)
2. Any tax abatement (5% = 4706)
3. Not handled by DoR (62%=61170)
4. Sheriff's Sale (11%=4098)
5. Bankruptcy (3%=948)
6. Sequestration (3%=1130)
7. Returned mail flag (5%=1429)
8. Not mailed during treatment period (83%=24800)

Our final sample thus consisted of 5151 properties.

4.4 Sample Balance on Observables

To confirm whether or not we indeed achieved randomization, we performed a series of balance-on-observables tests. The null hypotheses of these tests are that a given observable data moment is identical across mailing cycles. We turn now to the results of those tests.

Analysis of balance on observables is complicated by the random assignment at the owner level. Because there are some large holders of property – thousands of properties owned by public entities like the City of Philadelphia, the Philadelphia Housing Authority, and the Redevelopment Authority of Philadelphia, hundreds owned by many others such as the University of Pennsylvania and Drexel University – a simple analysis of balance at the property level is potentially skewed by these outliers. In addition, it is not clear how to aggregate many of the property-level characteristics to the owner level meaningfully, especially geographic variables. Our approach to solve this issue was to examine sample balance on the subset of properties for which a) the owner is unique, and b) any tax exemption claimed by the property is related to abatements for new construction.[8]

As can be seen in Table 1, randomization appears to have been successful. The properties are strongly randomly distributed by location (their political ward, of which there are 66 in Philadelphia), category (type of property usage), property size (as measured by the number of rooms or by the size of the tract), and case assignment (this variable captures, if applicable, to which outside law firm a property is assigned, whether the property is in sequestration, or has entered a payment agreement with

[8]We ran several other similar specifications, with the qualitative results remaining unchanged. We also ran tests on the subsample of properties for which we could obtain the secure ID used by the City, for which the putative mapping was violated; again, the results are qualitatively identical. See the Appendix for details.

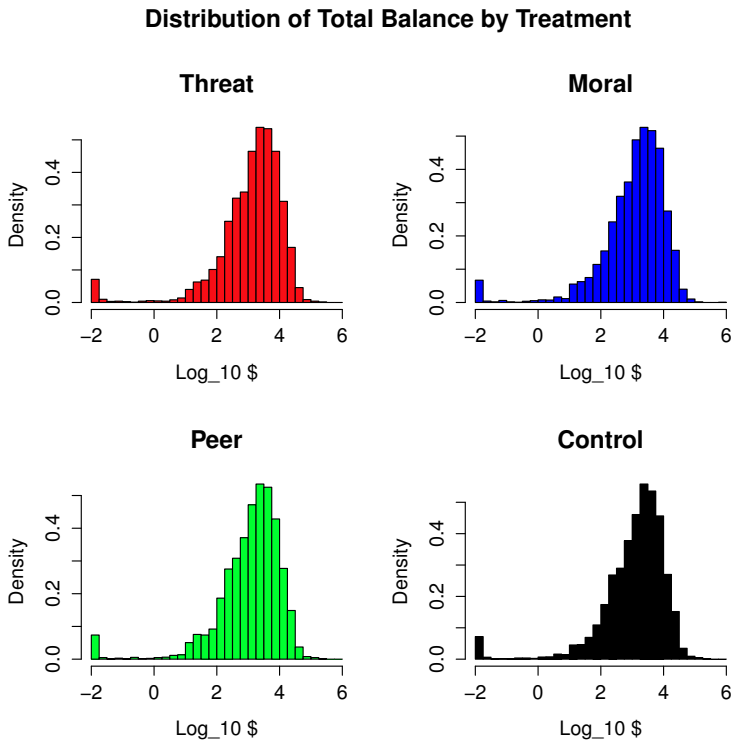
Table 1: Tests of Sample Balance on Observables

	Threat	Moral	Peer	Control	Test	p-value
Positive balance due	3332.12	3745.42	3532.9	3277.44	ANOVA	0.08
Market value ('000)*	192	170	188	294	χ^2	0.20
Land Area (ft^2)*	3949.91	3475.54	3408.11	3732.49	χ^2	0.64
# Rooms:						
0-5	0.23	0.43	0.23	0.11	χ^2	0.18
6	0.20	0.47	0.24	0.10		
7+	0.22	0.43	0.24	0.11		
Years Owed:						
1 Year	0.21	0.44	0.24	0.11	χ^2	0.18
2 Years	0.24	0.42	0.24	0.10		
3-5 Years	0.21	0.46	0.23	0.10		
6+ Years	0.20	0.48	0.21	0.12		
City Council District**					χ^2	0.56
Category:						
Residential	0.15	0.48	0.25	0.12	χ^2	0.47
Hotels&Apts	0.21	0.46	0.21	0.13		
Store w. Dwell.	0.25	0.42	0.21	0.12		
Commercial	0.21	0.45	0.24	0.10		
Industrial	0.21	0.47	0.23	0.09		
Vacant Land	0.25	0.40	0.22	0.13		
Distribution of Properties	0.21	0.45	0.23	0.11	χ^2	0.22
Expected Distribution	0.22	0.44	0.22	0.11		

*Tested as a two-way χ^2 test of quartile vs. treatment, due to outliers.

**See Appendix for full two-way table of this variable.

Figure 1:



the city). The number of properties assigned to each treatment is further exactly as expected, given the unequal number of mailing days in our treatment.

Evidence of randomization is only slightly weaker for randomization on delinquent balance and randomization on market value, though tests of both are far from rejecting the null hypothesis of equal group means. We suspect this is largely due to the influence of outliers– as seen in Figure 1, the distributions are highly similar visually.

5 Methods

To analyze the causal effects of our treatments, we consider two types of outcomes. First, we examine the effect of treatment on two binary outcomes–namely, one indicator for whether a given account submitted some payment to DoR in the sample period and another for whether the account at a property was cleared completely. Second, we attempt to detect if treatment causally impacted the dollar value of payments submitted to the city or the relative value of payments submitted to the city.

5.1 Logistic Regressions

To analyze discrete outcomes we use logistic regressions. Let $y_i = \mathbb{1}[x_i > 0]$, where $\mathbb{1}[\cdot]$ is an indicator taking the value one when its argument inside the brackets is true and 0 otherwise. x_i is the cumulative remittance to the city at the conclusion of the sample period by property i. Given the random assignment of treatments we can obtain a consistent estimator of the causal impact of treatment on y_I by using the following logistic regression model:

$$y_i = X_i^T \beta + D_{T,i}\gamma_T + D_{M,i}\gamma_M + D_{P,i}\gamma_P + \epsilon_i, \quad \epsilon \text{ logistic} \tag{1}$$

The $D_{k,i}$ are indicators for the three treatments, i.e. $D_{k,i} = \mathbb{1}[treatment_i = k]$, $k \in T, M, P$ for Threat, Moral, and Peer, respectively. The coefficients γ_k, then, measure the causal impacts of the treatments on the likelihood of some degree of remittance to the city, relative to the control treatment of a plain message.

To improve efficiency we also include some controls such as (log) land area, maturity of debt (more or less than 5 years), geographic location (as proxied by City Council District), usage category, property exterior condition (whether or not the property was categorized as sealed/compromised by the city), whether the property

took a homestead exemption, (log) balance at mailing, and (log) market value.[9]

Similarly, we examine a more restrictive yes-no participation outcome–namely, whether or not the property offered not just token repayment in our sample period, but whether its debts were paid back in full.[10] To this end, let $y_i = \mathbb{1}[x_i = m_i]$ be an indicator for full repayment of debt in the sample timeframe where m_i is the amount owed by property i at the start of treatment.

5.2 Tobit Regressions

Next, we turn our attention to measuring effects of treatment on the magnitude of debt drawdown–that is, instead of answering questions to the effect of "Did our treatment(s) significantly induce repayment?", we address the intermediate question of "Did our treatment(s) induce significantly more repayment?". In particular, we try to isolate the relative magnitude of repayment by essentially normalizing the dollar amount repaid by the "size" of the property, so that bigger payments by "bigger" properties in some group don't mechanically skew our results in favor of that group.

In our first Tobit Model, our notion of "size" is the market value of the property. The estimates of this model will highlight any significant differences in the amount repaid relative to market value.

[9]Philadelphia offers a tax discount of $30,000 off the taxable value of the property for those residents who are verifiably owner-occupants of a property–thus not taking a homestead exemption is a signal that a property is operated by a remote landlord.

[10]Due to some measurement issues, it is not possible to track on a day-to-day basis exactly the balance due for each property– accrual of interest and other charges is hard to pinpoint exactly. In the main results below, we actually measure full repayment as submission of at least 95% of the balance due.

Specifically, we estimate the following Tobit model:

$$\begin{aligned} \log x_i^* &= X_i^T \beta + \delta \log v_i + \sum_{k \in \{T,M,P\}} D_{k,i} \left(\gamma_k + \log v_i \eta_k\right) + u_i \\ x_i &= \mathbb{1}\left[x_i^* >= 0\right] x_i^* \end{aligned} \tag{2}$$

where x_i^* is the latent repayment amount, whose observed counterpart x_i only takes nonzero value when x_i^* is strictly positive. By controlling for (log) market value v_i, the η_k represent the group-specific additional repayment for each (log) market value. Thus a positive coefficient on $D_{k,i} \times \log v_i$ has the interpretation that higher-value properties were more likely to pay their taxes.

Our second pair of Tobit regressions entails a different (but correlated) measure of the "size" of a property–namely, the amount owed by the property at the onset of treatment[11]. Here, we are primarily concerned with whether those properties that owed more to begin with ended up remitting more to DoR in our sample timeframe.

6 Empirical Results (Preliminary)

We present some preliminary empirical results as the outcomes of estimation of the aforementioned models. We also report some plots of time series demonstrating the evolution of key outcomes by treatment throughout the sample period.

Table 2 reports the results from logit regressions using ever paid as the outcome variable. As can be seen from Table 2, the moral and the threat treatments had a

[11] Though, on each year's initial tax bill, the market value is exactly proportional to the property's tax debt (modulo any exemptions claimed, but these properties are excluded from our analysis), the history of payments in general stands to create a wedge in this proportional relationship–low-value properties that have a long history of nonpayment or high value properties that have already partially repaid their debts drive dissonance in either direction.

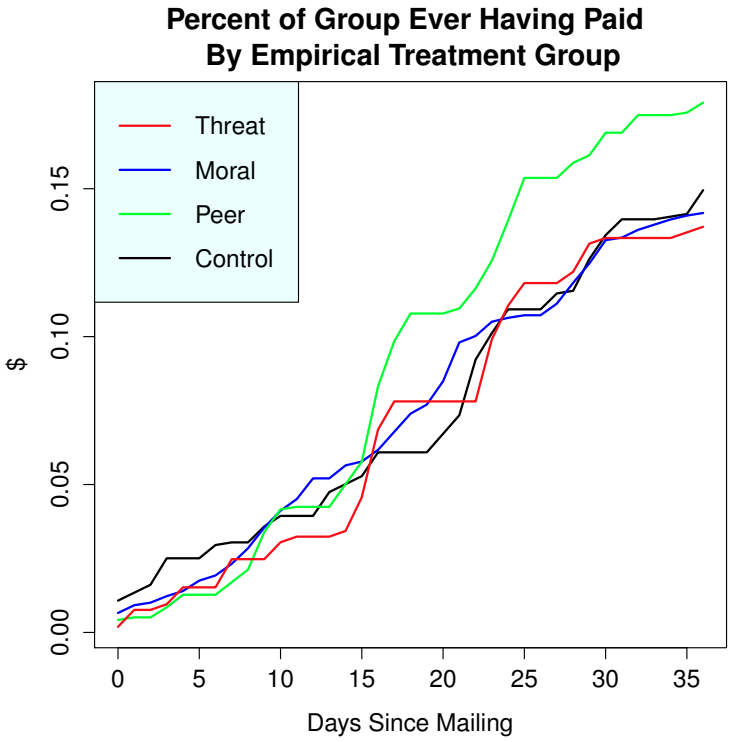
Table 2: Model I: Logistic Regressions – Ever Paid

	Ever Paid	Ever Paid (with Controls)
Intercept	-1.74^{***}	-3.35^{***}
	(0.08)	(0.74)
Treatment Group		
Moral	-0.06	-0.07
	(0.10)	(0.10)
Peer	0.22^{*}	0.18
	(0.11)	(0.12)
Threat	-0.10	-0.07
	(0.15)	(0.15)
Log Balance at Mailing		-0.00
		(0.01)
Log Market Value		0.09
		(0.06)
Log Likelihood	-2167.55	-2088.77
Num. obs.	5105	5105

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$, . Control coefficients omitted for brevity; see Appendix

strongly significant effect at the conclusion of the sample period. The Peer treatment is significant ($p = .056$) in the baseline model, but this significance disappears upon inclusion of control variables ($p = .124$).

Figure 2:



The end-of-sample insignificance contrasts with a sustained outpacing of the rise in repayment participation since about two weeks subsequent to mailing. This can be seen in Figure 2.

Table 3 presents the results of the second model, which examined the likelihood of full repayment of debts by treatment group. As with Model I, the Peer treatment shows signs from about two weeks past treatment onset of outpacing the control group; as seen in Figure 3, the trajectory of full repayment tracks that of partial

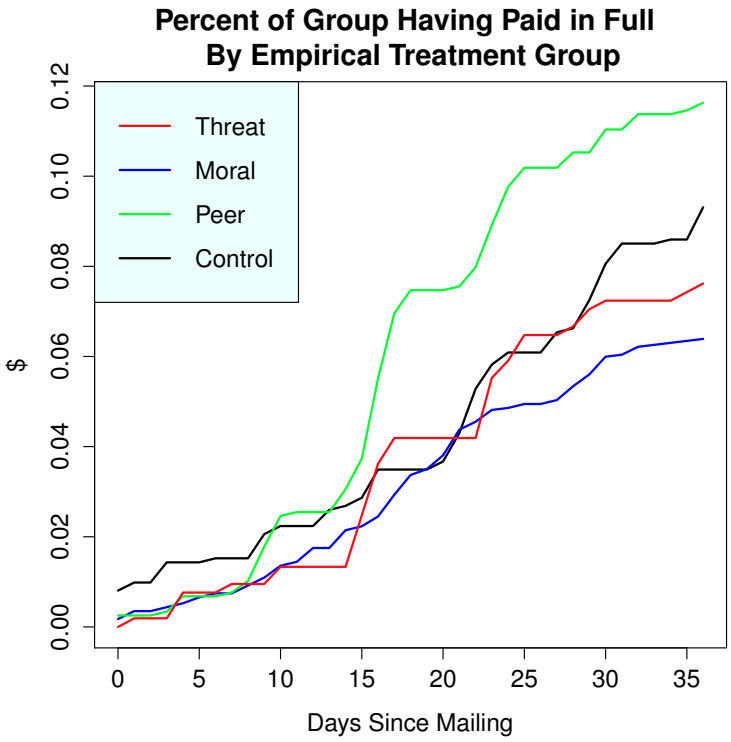
Table 3: Model II: Logistic Regressions – Paid Full

	Paid in Full	Paid in Full (with Controls)
Intercept	-2.28^{***}	-3.04^{***}
	(0.10)	(1.03)
Treatment Group		
Moral	-0.41^{***}	-0.40^{***}
	(0.13)	(0.14)
Peer	0.25^{*}	0.21
	(0.14)	(0.14)
Threat	-0.22	-0.19
	(0.19)	(0.20)
Log Balance at Mailing		-0.11^{***}
		(0.02)
Log Market Value		-0.02
		(0.08)
Log Likelihood	-1453.60	-1350.17
Num. obs.	5105	5105

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Control coefficients omitted for brevity; see Appendix

repayment for the Peer group quite well.

Figure 3:



Further, the Moral treatment caused a significant reduction in full repayment. Figure 3 suggests full repayment started flagging about three weeks after treatment after tracking the control group quite well thereto. The Threat treatment is all but indistinguishable from the control.

The results of the first Tobit model are displayed in Table 4. Only about 15% of observations were uncensored. Results of Model III suggest that those owing the most in the Moral treatment were significantly more likely to pay more than their control counterparts. This is confirmed in Figure 4, which depicts the trajectories of (normalized) repayments by each group.

Table 4: Model III: Tobit of Repayment vs. Market Value

	Paid vs. Market Value	Paid vs. Market Value (with Controls)
Intercept	-12348.07^{***}	-11096.96^{***}
	(2318.61)	(2883.17)
Treatment Group		
Moral	-7128.53^{**}	-7441.16^{**}
	(2893.30)	(2985.93)
Peer	1398.56	806.87
	(3150.31)	(3223.92)
Threat	−1364.18	−1456.06
	(3998.04)	(4110.60)
Log Market Value	563.40^{***}	404.39
	(200.81)	(253.71)
Moral*MV	624.16^{**}	653.08^{**}
	(251.37)	(259.30)
Peer*MV	−79.53	−32.17
	(274.75)	(281.09)
Threat*MV	106.23	114.47
	(348.01)	(357.51)
Log Balance at Mailing		61.90
		(45.97)
Log Likelihood	-8864.14	-8836.89
Left-censored	4331	4331
Uncensored	774	774

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Control coefficients omitted for brevity

Figure 4:

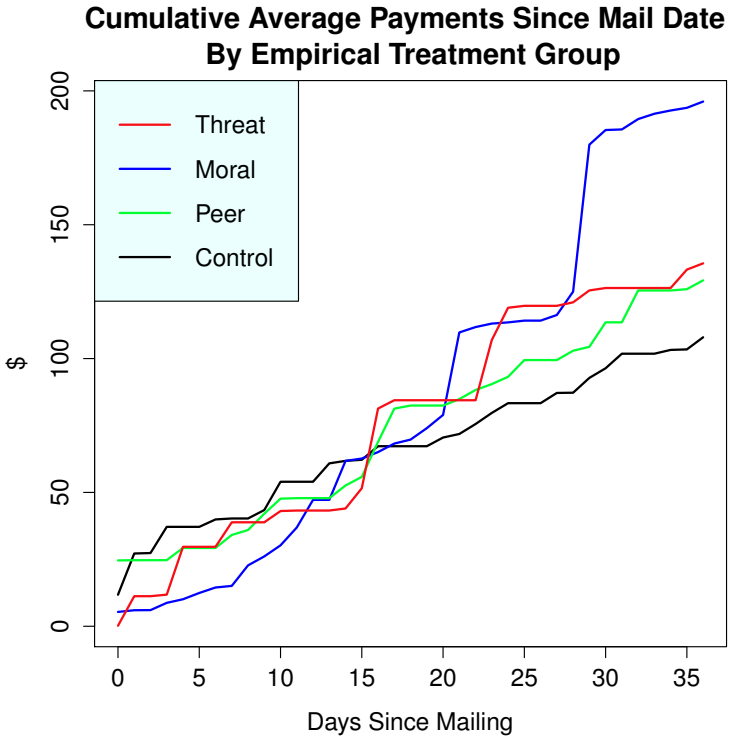

Cumulative Average Payments Since Mail Date
By Empirical Treatment Group
Threat
Moral
Peer
Control
$
0
50
100
150
200
0
5
10
15
20
25
30
35
Days Since Mailing

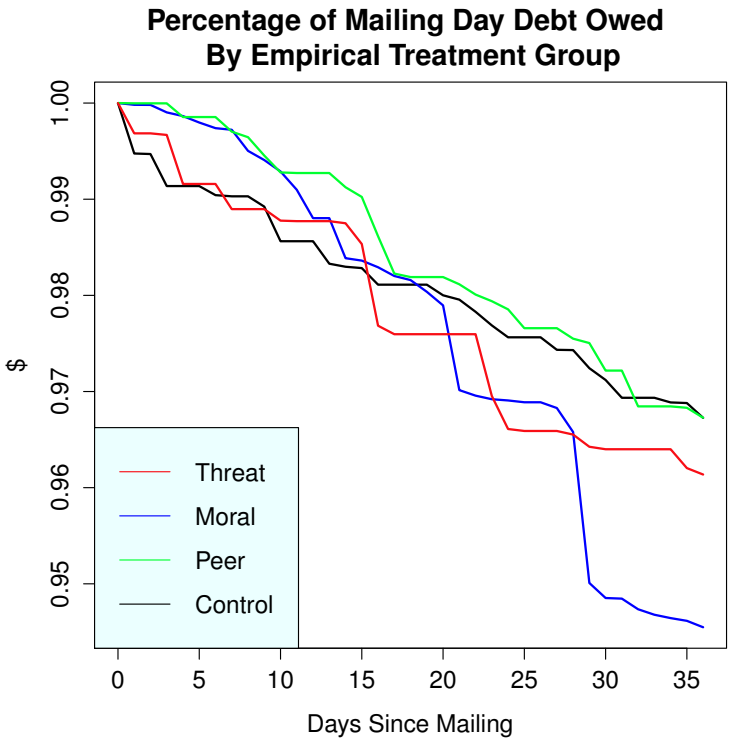
Table 5: Model IV: Tobit of Repayment vs. Total Debt

	Paid vs. Total Debt	Paid vs. Total Debt (with Controls)
Intercept	-5478.88^{***}	-13650.77^{***}
	(598.31)	(2074.35)
Treatment Group		
Moral	-1505.26^{**}	-1669.69^{**}
	(752.51)	(748.86)
Peer	779.26	773.16
	(785.66)	(778.14)
Threat	−629.38	−579.61
	(1031.67)	(1029.50)
Log Balance at Mailing	−107.27	−37.85
	(87.24)	(87.50)
Moral*Balance	249.08^{**}	272.72^{**}
	(110.60)	(110.23)
Peer*Balance	−44.45	−58.25
	(119.07)	(118.16)
Threat*Balance	79.00	70.76
	(151.02)	(151.20)
Log Market Value		687.78^{***}
		(175.00)
Log Likelihood	-8901.02	-8836.25
Left-censored	4331	4331
Uncensored	774	774

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$. Control coefficients omitted for brevity; see Appendix

We move finally to the results from the final model, which focuses not on payments relative to property value, but instead on payments relative to the balanced owed by each account at mailing day. The results of this model are qualitatively identical to those of Model III, which is further mirrored in the time series results of Figure 5.

Figure 5:



7 Conclusions

This field experiment evaluated a set of different notification strategies intended to increase property tax compliance. We tested three of the most commonly suggested models of tax compliance: deterrence, moral appeal, and peer conformity. We have implemented the experiment in collaboration with the Philadelphia Department of Revenue (DoR). Our preliminary findings provide some evidence that both moral appeal and peer conformity may improve tax compliance. We find little evidence that supports the standard deterrence model compared to a traditional simple bill notification.

Our study provides ample scope for future research. Unlike several recent papers (Kleven et al. 2011; Slemrod, Blumenthal, and Christian 2001), which have found large increases in compliance after providing information about the threat of auditing, we find no evidence of a deterrent effect. It is probably not surprising that our deterrence treatment was not effective. Philadelphia is city with a history of high property tax delinquency. it is hard to belief that one could significantly alter perceptions of beliefs of punishment by sending one letter in a city with already high property tax delinquency. Any threats may be considered to be empty given previous attempts at collection and the lack of enforcement penalties. It would be more interesting to design an intervention that is based on a more credible threat. The peer conformity treatment is also subject to the same potential criticism. It my be more effective to randomly print a number of delinquent tax payers in the local news paper or to send mail informing the neighbors. Of course, these type of intervention face much larger legal hurdles and, therefore, much harder to implement. It also may backfire and increase tax noncompliance by encouraging defiance of the law (Sherman 1993).

Consistent with other recent tax compliance experiments (Fellner, Sausgruber, and

Traxler 2013), we also find that the largest effect is observed in the subset of taxpayers at the margin of compliance. Beyond this traditional perspective on achieving higher rates of legal compliance through modifications to legal threats, others have examined how non-external factors contribute to tax compliance. Similar to other studies we find that providing social information about tax compliance provides some marginal increase in collection (Wenzel and Taylor 2004; Wenzel 2005; Hallsworth et al. 2014). While this finding is by no means universal (Fellner, Sausgruber, and Traxler 2013), our results suggest that providing social norm information is noticeable more effective than either deterrent or moral persuasion messages

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