Deterring Property Tax Delinquency in Philadelphia: An Experimental Evaluation of Nudge Strategies

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Abstract

Municipal governments commonly confront the problem of tardy or delinquent property tax payments. We implement an experiment in property tax collection for tardy taxpayers in the City of Philadelphia for the calendar year, 2015. The experiment sent one of seven reminder letters to the tardy taxpayers, testing the efficacy of a simple reminder, two alternative reminders stressing economic sanctions, and four alternative reminders emphasizing either that taxpayers receive neighborhood services or city-wide services for their tax payments, that most of their neighbors pay their taxes on time, or that as a citizen in a democracy it is a civic duty to pay taxes on time. Compliance behaviors were compared to a holdout sample that received no reminder letter. The most effective letters were those that threatened an economic sanction for continued non-compliance. These letters were particularly cost-effective in raising additional city revenues. There was no evidence that those receiving a reminder for calendar year 2015 improved their tax compliance behavior in calendar year 2016.

KEYWORDS: Tax Compliance, Property Taxation, Field Experiment, Deterrence, Public Service Appeal, Appeal to Civic Duty.
JEL: H2, H7

I Introduction

Property taxation is the primary tax for most U.S. cities. In fiscal year 2016, 47 percent of all local government revenues and over 72 percent of local taxes came from the property tax (Census of Governments, 2018). Yet collection of the tax has, in many cities, been problematic. While some U.S. cities do an excellent job in collecting the tax and receive over 95 percent of assessed revenues the year the tax is due, other cities have over the last ten years done significantly worse – notably Flint (78%), Cleveland (84%), Pittsburgh (86%), Milwaukee (87%), Philadelphia (88%), Detroit (89%), and St. Louis (89%).[1] In this paper, we explore some low-cost strategies that may help cities improve the compliance of taxpayers.

This failure to collect the property tax on time creates budget uncertainty at best and budget deficits at worst. Late payments are costly to the city. If not enforced, delinquent taxpayers may become permanent tax evaders. Furthermore, significant rates of delinquency today may become a signal to other taxpayers that avoidance is possible, encouraging further delinquency.[2] Yet collecting the property tax should be straightforward. In contrast to collecting self-reported taxes on income, profits, and sales, property tax obligations equal the city's assigned assessed value of the property times the city chosen tax rate, and are known by both the city and the taxpayer.[3] There is no uncertainty as to what is due, or when. Property tax payment is a matter of enforcement.

The most common property tax enforcement strategy is the economic stick: fines and penalties. When a delinquent taxpayer does not respond to penalties and fines, the city can issue a tax lien on the property equal to the value of the taxes owed and accrued interest and penalties. Alternatively, the city may appeal to an intrinsic motive for tax payments, perhaps to encourage a sense of

[1]For more details, see Chirico, Inman, Loeffler, MacDonald, and Sieg (2016).

[2]Besley, Jensen, and Persson (2015) study local property taxation in England following the imposition of a local head tax as a replacement for the local property tax. In response to widespread citizen resistance, the poll tax was removed two years later and the property tax restored. However, compliance rates for the reinstated property tax fell by 14 percent. Though efforts to improve compliance emphasized high penalties it has taken nearly eighteen years to return to the original levels of tax compliance.

[3]Modern tax systems make widespread use of third-party reporting from firms and the financial sector which makes income tax evasion more difficult than in the past. Hallsworth (2014), Slemrod (2019), and Alm (2019) provide reviews of tax compliance behavior.

community or to foster a more positive view of elected officials responsible for collecting taxes and providing city services. Intrinsic motives for paying taxes may include a desire to contribute when others contribute, to pay a fair share of the cost of services received, or to fulfill one's civic obligation as a citizen of the community.

To explore each of these motivations, we implemented an experiment in property tax collection from tardy taxpayers in the City of Philadelphia for the fiscal year 2016. In addition, we test for a possibly simpler explanation. Perhaps tardy taxpayers are just forgetful (Akerlof, 1991) or procrastinators (O'Donoghue & Rabin, 1999)? If so, a simple reminder letter may suffice. Our experiment sent one of seven different reminder letters to the tardy taxpayers. Compliance behaviors of those receiving a reminder letter were compared to a holdout sample that received no reminder letter. One letter was a simple reminder. Two letters stressed that continued non-payment leads to fines and penalties and may lead to a lien on their home with the possibility of a sheriff's sale of the property. The final four letters explored the possibility of an intrinsic, or tax morale, motive for tax payment: that others are contributing, taxes pay for neighborhood services, taxes pay for city-wide services, and finally, that citizens bear a civic duty to contribute to the costs of democratic government.

Each letter cost one dollar to send and over all seven letters, returned on average $37 in increased city tax revenues. The two letters stressing economic sanctions were the most effective, returning $65 in extra revenues for each letter sent. In contrast, adding an intrinsic message to the reminder did not increase compliance over receiving only the simple reminder. We do not find any evidence that those receiving a reminder for fiscal year 2016 improved their tax compliance behavior in fiscal year 2017.

Our experimental design closely follows that used by Hallsworth, List, Metcalfe, and Vlaev (2017) in their analysis of reminder letters to UK citizens to encourage timely payment of income taxes already declared. Their objective, like ours, is to improve both the speed and rate of compliance. Like us, they find reminders that stress financial penalties encourage greater compliance, but unlike our results, stressing to the tardy taxpayer they are now one of a minority of all taxpayers also improves compliance.

Beyond providing assistance to Philadelphia's Department of Revenue, our study contributes to the growing literature on the use of "nudges" to encourage taxpayer compliance. Reminders as nudges are typically inexpensive to implement and, if successful, provide a valuable additional tool for tax administration (Keen & Slemrod, 2017). Recent empirical research on the use of nudges to improve tax collections have shown targeted reminders can be effective motivators for increased compliance. But success depends upon the action being nudged and the exact wording of the reminder.[4] Most successful nudges have been applied to truthful reporting of the taxpayer's tax base, with the reminders stressing the likelihood of a taxpayer audit and associated economic fines on unreported income or sales; see Kleven, Knudsen, Kreiner, Pedersen, and Saez (2011) and Pomeranz (2015) specifically. Less successful have been reminders that stress an intrinsic or "tax morale" motive for tax reporting or payment. An exception is Dwenger, Kleven, Rasul, and Rincke (2016) who study local church tax compliance in Bavaria. They report that a significant fraction of individuals comply in the zero deterrence baseline where compliance should be zero absent intrinsic motivations. Around 20 percent of individuals pay the true taxes owed, while the remaining 80 percent of individuals evade taxes and most of them fully evade.

Four published studies have directly evaluated the impact of nudges on taxpayer compliance for the paying of local government taxes. Torgler (2004) finds no increased compliance associated with tax morale messages for the payment of income taxes to Swiss local governments. Meiselman (2018) finds improved compliance to Detroit's local income tax for reminders that stress economic penalties but no improved compliance for reminders that stress taxes are essential for Detroit's economic future. Miller and Nikaj (2016) examine the impact of tax lien sales on collected city tax revenues in Ohio. The lien sales generated direct revenue to cover past taxes owed and also encouraged additional tax payments by other taxpayers. They estimate that tax lien sales increase property tax collection by 5.6 percent above what had been generated by the sales alone, a result strikingly similar to what we find for our reminder letter threatening lien sales. Finally, in the

[4] See Slemrod, Blumenthal, and Christian (2001) and Luttmer and Singhal (2014) for reviews.

study closest to ours, Castro and Scartascini (2015) examine the payment of local property taxes to Argentine municipalities and find, as do we, there is significantly greater compliance for those receiving reminders stressing economic sanctions. There were mixed results for those receiving a tax morale message, however. On average, the messages stressing peer behaviors or the public service benefits of paying taxes had no impact on payment. But there was significant heterogeneity in responses. However, taxpayers living inside the city and who had previously paid their taxes reduced their rate of payments after being reminded that 30 percent of other city taxpayers do not pay their taxes. Taxpayers living outside the city and who as a group have a low rate of compliance increased their rates of payment in response to both reminders stressing peer rates of payment and the value of city public services.

These mixed results for the impact of nudges on taxpayer compliance provide an important reminder that context matters. Nudges that work for one tax and for one government may not work in other settings. There is no general lesson beyond the one that nudges, in some form and in some settings, can improve compliance. Nudges can be a useful policy tool for efficient tax administration, but each nudge must be evaluated and compared in a specific setting of tax compliance.

With this conclusion in mind, we report the results for our evaluation of a policy experiment to increase tax compliance in Philadelphia for the payment of fiscal year 2016 property taxes. The initial sample included all taxpayers who were tardy in their tax payments for that fiscal year. After eliminating multiple-property owners, we obtained a sample of 19,039 single property owners. We assigned 2,088 of these taxpayers to the holdout sample receiving no reminder. The remaining 16,951 tardy taxpayers received one of our seven treatment messages: a simple reminder, either of two reminders stressing either a "gentle" or a "strong" economic sanction, and one of four reminders stressing the payment behavior of their neighbors, the role of local taxes in paying for neighborhood or city-wide services, and that with citizenship comes a civic duty to pay their taxes.

Overall, we find that that all reminder letters are more effective than doing nothing. Moreover, the two letters that stress economic sanctions are more effective than the other five reminder letters.

The simple reminder letter did encourage significantly greater tax compliance, but our four letters stressing tax morale messages were, on average, no more effective than the simple reminder. We cannot reject the possibility that the simple reminder may have implicitly triggered its own "personal" tax morale response, however.

There are three competing explanations for tardiness in property tax payments: procrastination or forgetfulness, lack of enforcement, and liquidity constraints. We find that 70 percent of all tardy taxpayers fully comply with the tax laws by the end of the fiscal year. The remaining 30 percent may be liquidity constrained. If so, access to a tax payment plan that smooths out payments over the fiscal year may be helpful. The city offers such a plan. We find, however, that no more than 3 to 4 percent of those potentially credit constrained taxpayers actually use the tax payment program. We conclude that liquidity constraints may bind, but the main barrier to payment is the taxpayer's inclination to do so.

The paper is organized as follows. Section 2 discusses details of our field experiment including a description of the treatments. Section 3 discusses our randomization procedure. Section 4 reports the main empirical findings. Section 5 compares our results here to those from our pilot study for this experiment which did find a role for a civic duty, tax morale nudge. Section 6 discusses the urban fiscal policy implications of our experiment. Section 7 discusses the effectiveness of nudges. Section 8 offers conclusions.

II A Field Experiment

The research setting for the experiment is the City of Philadelphia for calendar year, 2015, for the payment of property taxes to be spent in fiscal year 2015-2016. Notices of property tax payments are sent on January 1, and the full balance of taxes are due by March 31. If payment has not been received by that date, or the taxpayer has not entered into a tax payment plan with the City, then taxes are considered tardy and interest and penalties begin to accrue. On April 1, the City's Department of Revenue (DoR) begins contacting all taxpayers with unpaid accounts, informing them of taxes due and accumulated interest and penalties for late payment. At this time, the City will normally send two-thirds of the tardy accounts to outside collection agencies acting as co-counsel for the City. The outside collection agencies are reimbursed at the rate of six percent of all their tardy revenues collected by December 31. The remaining one-third of the tardy accounts remain with the DoR for collection. All accounts still tardy on December 31 are designated as "delinquent" and then assigned to new outside collection agencies. For the purposes of our experiment the City of Philadelphia agreed to delay sending any of the tardy accounts to the collection agencies until August 15, 2015.

Our sample for the experiment began with all taxpayers tardy as of April 1, 2015, equal to approximately 17 percent of all taxpayers who received tax bills for the fiscal year. From the list of all tardy taxpayers, we first eliminated chronically delinquent taxpayers from our sample and those who owed less than $10 in taxes. This reduced the sample to 21,468 taxpayers. Of these 21,468 tardy taxpayers, 2,429 taxpayers owned more than one property.[5] There is much heterogeneity within the subsample of multiple property owners by the amount of taxes owed making it difficult to achieve balance with a handful of debtors owing substantial and substantially different amounts. We chose, therefore, to exclude multiple property owners from the analysis reported here. Our final sample consists of 19,039 taxpayers who owned only one property. As owners of only one property, this sample is less affluent than the overall sample of all property holders in Philadelphia.

Our intervention sent reminder letters to seven randomly assigned groups of tardy taxpayers: one letter that is a simple reminder, one sanction reminder that stresses tax liens at the time of home sale and a second sanction reminder that threatens a sheriff's sale to pay back taxes, and four tax morale reminders that note first, taxes pay for neighborhood services, second, that taxes pay for city-wide services, third, that nine of ten Philadelphians pay their taxes on time, and fourth, that citizens have a civic duty to pay their taxes. Reminders are low cost interventions and take

[5]Tax compliance is by taxpayers, not properties. It is, therefore, necessary to assign an owner to each property. Lacking an objective identifier of the owner of each property such as a social security or taxpayer identification number, we used the owner names attached to properties. We found no instances in which property owners had the same legal name.

as given taxpayer preferences and information regarding the benefits and costs of compliance. Each reminder is meant to trigger an immediate awareness, called saliency, of those benefits and costs.[6] More expensive experimental treatments to educate taxpayers as to the possible long-run private and wider public benefits of payment can also be imagined and have been effective in other settings.[7] Our interventions were more modest.

Our experiment began with the mailing of our experimental reminder letters in mid-June, 2015 and continued to December 31, 2015. Of the tardy taxpayers with a single property, 16,951 received a reminder letter and 2,088 taxpayers did not receive a reminder. This sample of 2,088 taxpayers became our "holdout" sample and the basis for identifying the importance of reminders in taxpaying behavior. To ensure that our experiment was not contaminated by other treatments not under our control, the DoR agreed to postpone all other enforcement activities until August 15. In particular, the outside collection agencies were not allowed to begin their collection efforts until after that date. The likely earliest date that those efforts led to any contact with a taxpayer was September 15.

Each reminder letter was approved by the City's DoR to ensure that it could be easily understood by all taxpayers. Each letter also provided contact information for assistance for non-English speaking taxpayers. Translations were available for a number of different languages.[8]

Each reminder letter in our experiment was drafted to identify a potential channel that may affect taxpayers compliance. For brevity we present here the important distinguishing feature of each letter.

Reminder-only: **Our records indicate that you have a balance due of *balance.*** If you have

[6]See Akerlof (1991) and O'Donoghue and Rabin (1999).

[7]Effectiveness often depends crucially upon a preexisting social or cultural environment, in particular a community with homogenous values and a prior trust in government; see Alm (2019) for a review. For example, the long-standing tradition in poorer communities in South Africa of not paying utility bills as a protest against the apartheid regime continues to today, despite an extensive public message campaign featuring leading entertainers, sports figures, and respected public officials stressing this is now "our South Africa" and that all citizens have an obligation to pay for public services. Distrust of government in poor neighborhoods remains a significant barrier to the payment of fees and taxes; see Reuters News Service, November 19, 2014, "South Africa's Latest Power Struggle: Unpaid Bills."

[8]Templates of the "reminder only" and "lien" letters are attached in the appendix. The full template for the other letters are available as an online appendix.

already paid, thank you. If not, please pay now or contact us to arrange a payment plan. The fastest and easiest way to pay is online at www.phila.gov/pay. Paying by E-check only costs 35 cent – less than the cost of a stamp!

The reminder-only letter allows us to identify the potential importance of tax saliency to taxpayer compliance.[9]

Reminder plus Tax Lien: Failure to pay your Real Estate Taxes may result in a tax lien on your property in an amount equal to your back taxes plus all penalties and interest. When your property is sold, those delinquent tax payments will be deducted from the sale price. By paying your taxes now, you can avoid these penalties and interest. Properties near you in your neighborhood that have liens placed on them include: < List Three Properties with liens and Sale Dates > **Pay your taxes now to avoid a lien being placed on your property. Our records indicate that you have a balance due of *balance*.**

Reminder plus Lien and Sheriff's Sale: Failure to pay your Real Estate Taxes may result in the sale of your property by the City in order to collect back taxes. In the past year we have sold *N* properties in your neighborhood at a Sheriff's Sale. Included in these *N* properties are the following properties near you: <List Three Properties and Sheriff Sale Dates> **Pay your taxes now to prevent the sale of your property. Our records indicate that you have a balance due of *balance*.**

The reminder letter coupled with the threat of a lien, or a lien plus a sheriff's sale of the taxpayer's home, increase the recognized interest and penalties from delay. A taxpayer lien for all interest and penalties is collected at the future date of home sale, which may be a very large obligation if the home is sold significantly in the future. A lien coupled with a sheriff's sale may occur sooner and thus have lower accumulated interest and penalties, but the forced sale of one's home

[9]Our experimental design identifies the effect of saliency alone as a trigger for tax compliance by estimating the difference in the rate of compliance for our holdout sample receiving no letter compared to the sample receiving the simple reminder letter only. Our reminders were mailed six months after the initial notification of taxes due, and thus could estimate the loss of saliency for this period only. Staggered mailings of the simple reminder letter could identify the rate of decline in saliency, but this was not possible in our experiment because of time constraints imposed by DoR.

is likely to have very high psychic costs. Which of the two added penalties is seen as larger, and, therefore, likely to have a stronger impact on compliance, will depend upon the circumstances of the individual tardy taxpayer. To make clear these sanctions are not empty threats, both letters list three neighborhood properties where these added enforcement measures have been implemented. If penalties are perceived as significant and likely to be enforced then both letters should increase compliance over that observed for the simple reminder.[10]

Our final four reminder letters test for the potential role of "tax morale" motives for compliance. An appeal to a tax morale is meant to cue a possible benefit from having paid one's taxes. In contrast to user fees, property tax payments are not tied to the citizen's receipt of particular services during our experimental period. In effect, each delinquent taxpayer is a potential free rider, and the appeal to a tax morale for payment is meant to overcome such self-interest.

We test for the importance of four such motives: 1) the value of knowing one is a contributor to the immediate services of one's neighborhood; 2) the value of knowing one is a contributor to the wider services that benefit the city as a whole; 3) the value of knowing one is part of a collective effort with other taxpayers or "peers" in paying for city services; and 4) the value of knowing one has meet one's obligations as a citizen in a democracy. Each of these benefits may motivate taxpayer compliance, and our reminder letters are meant to trigger a direct recognition of the importance to the taxpayer of each motive. Some tardy taxpayers may respond to one motive, some to another, and perhaps others to none at all if the free-rider motive is decisive. The four tax morale reminder letters are:

Reminder Plus Appeal to Neighborhood Services: We want to remind you that your taxes pay for essential public services in *neighborhood name*, such as <List Two Local Amenities such as a Park or a Library>, your local police officer, snow removal, street repairs, and trash collection. **Please**

[10]The point of listing neighborhood properties was to make clear from locally available evidence that City sanctions will be enforced. A referee suggested, however, that taxpayers may interpret the three listed properties as the only sanctioned properties and thus, while there is enforcement, it is only rarely used. We cannot rule out this possibility. In addition, our letters did not communicate when the enforcement will happen which may create uncertainty about enforcement strategies. See Alm, Jackson, and McKee (1992) for an experimental study for how institutional uncertainty may affect taxpayers compliance.

pay your taxes to help the city provide these services in your neighborhood. Our records indicate that you have a balance due of *balance*.

Reminder Plus Appeal to City-Wide Services: Your taxes pay for important services that make a city great. Your tax dollars are essential for ensuring all Philadelphia's children receive a quality education and all Philadelphians feel safe in their neighborhoods. **Please pay your taxes as soon as you can to help us pay for these important services. Our records indicate that you have a balance due of *balance*.**

Reminder Plus Appeal to Peer Behavior: You have not paid your Real Estate Taxes. Almost all of your neighbors pay their fair share: 9 out of 10 Philadelphians do so. **By failing to pay, you are abusing the good will of your Philadelphia neighbors. Our records indicate that you have a balance due of *balance*.**

Reminder Plus Appeal to Civic Duty: For democracy to work, all citizens need to pay their fair share of taxes for community services. **By failing to do so, you are not meeting your duty as a citizen of Philadelphia. Our records indicate that you have a balance due of *balance*.**

We take as evidence that a tax morale message increases the likelihood of tax compliance when the tax morale reminder increases the rate of compliance above that of the reminder-only letter.

III Randomization Procedure

We begin our analysis with 19,039 first-time tardy taxpayers owning only a single property in Philadelphia, 16,951 taxpayers in the seven randomly assigned treatment groups and 2,088 taxpayers in the holdout or control group. Given the high correlation between the propensity to pay taxes and total debt owed, randomization blocks were defined according to owner-level total debt to assure uniformity of samples along the dimension of debt owed. Each owner assigned to receive a reminder letter was equally likely to receive each of the seven treatments.

Table 1 checks whether the treatment and holdout groups are balanced based on the two most important variables, taxes due and assessed property value. Table 1 shows that randomization was successful in the single property owner sample. The average debt owed by each owner is $1,287 in the seven treatment groups and $1,233 in the holdout sample. The average assessed property value is $144,145 in the treatment group and $142,630 in the holdout group. The average tenure for property ownership was 15 years across all groups. As a further test of our randomization procedure, we also checked to see whether randomization achieved spatial uniformity throughout the geographic expanse of the city. As reported in Table 1 geographic balance was achieved. Overall, we find no evidence that would suggest any problems with randomization.

IV Empirical Results

Table 2 presents our core results for the one-month and three-months period of our experiment. Our experiment started on June 15, 2015. The one-month and three-months results are compelling since they are not "contaminated" by the activities of outside collection agencies. For our experiment the City delayed their collection efforts until mid-September, 2015. The difference between our one-month and three-month results will illustrate the revenue benefits of low cost reminders and of patience when collecting revenues from first-time, tardy taxpayers. Importantly, we find a significant revenue benefit to waiting before using costly outside collection agencies

We consider three distinct outcome measures for tax compliance behavior. First, did the taxpayer make any contribution at all towards their tax bill; this is the *ever-paid* response. Second, did the taxpayer make a full payment of their tax bill; this is the *paid-in-full* response. Third, what was the total amount paid by the taxpayer; this is the *total-paid*. For ease of interpretation, Table 2 presents OLS estimates for the linear probability model.[11]

The top line of Table 2 reports the mean rates of compliance for our holdout sample measured by the fraction of tardy taxpayers by *ever-paid* or *paid-in-full* and their mean payments. We report these rates one month from the starting date of the experiment (July 15) and three months from the starting date of the experiment (September 15). The rate of *ever-paid* compliance for taxpayers in

[11] Logit estimates are identical in significance and interpretation to the OLS results reported here.

the holdout sample rises from 30.5 percent after one month to 51.4 percent after three months; the rate of *paid-in-full* compliance for the holdout sample rises from 23.5 percent after one month to 40.8 percent after three months.

The next seven rows report the additional impact on rates of compliance and mean payments from our seven treatment letters: Reminder-only, Reminder & Lien, Reminder & Sheriff, Reminder & Neighborhood, Reminder & Community, Reminder & Peer, and Reminder & Duty. Receiving the reminder-only letter increases the rate of compliance after one month for an *ever-paid* tax payment by 3.7 percent above the holdout's rate of compliance and by 3.9 percent after three months. Both effects are statistically significant at the 99 percent level of confidence. These estimates for the reminder-only letter indicate the relative importance of salience and the benefit of simple notification strategies to taxpayer compliance behavior.[12]

The simple reminder letter is particularly effective early in our experiment, where the pure effect of a reminder increases the rate of *ever-paid* compliance after one month by approximately 12 percent (= 3.7/30.5). While receipt of the reminder letter is still effective after three months, its overall impact on compliance behavior is relatively less, adding an additional 8 percent (= 3.9/51.4) to the rate of *ever-paid*. The same statistical significance and declining rate of overall impact of reminder-only on compliance is also observed for the outcome, *paid-in-full*. Here the reminder-only letter increases the one-month rate of compliance over the holdout sample by 2.2 percent on a mean rate of holdout compliance of 23.5 percent (9.4 percent relative improvement) and the three-months rate of compliance over the holdout sample by 3.0 percent on a mean rate of 40.8 percent (7.4 percent relative improvement). While most of the new taxpayers paid in full – 3 percent compared to the 3.9 percent of all taxpayers after three months – the additional revenues raised by the reminder letters over that paid by those with no letter is never significant and is quantitatively very small, on average only $15.20 more than the amount paid by the holdout sample after three

[12]For evidence from other settings that saliency matters and reminders have significant impacts in inducing appropriate behaviors, see Thaler and Sunstein (2003), Karlan, Morton, and Zinman (2016), and Kessler and Zhang (2015). For evidence that simple reminders matter for the payment of local taxes, see Del Carpio (2013) and for the payment of local fines see Heffetz, O'Donoghue, and Schneider (2016).

months.

Similar to results from other tax compliance studies, the impact of adding a more substantive message to the reminder letter depends on the content of the message. After one month, the sample receiving the reminder/lien letter had an additional 9.0 percent rate of *ever-paid* compliance over the hold-out sample's rate of compliance of 30.5 percent (30 percent relative improvement) and after three months an additional 9.2 percent rate of *ever-paid* compliance over the hold-out sample's compliance rate of 51.4 percent (18 percent relative improvement). The impacts are statistically significant at the 99 percent level of confidence. The results for *paid-in-full* compliance for the reminder/lien letter are also statistically significant and add 5.7 to the rate of compliance over the holdout sample after one month and 7.3 percent to the rate of compliance after three months. Importantly, the impact of the reminder/lien letter on total taxes paid over that for the holdout sample is statistically significant and shows increased payments of from \$117 per letter (36 percent relative improvement) to \$122.7 per letter (19 percent relative improvement) after one month and three months, respectively. Though with slightly smaller impacts on compliance and taxes paid, the reminder/sheriff letter also yields significantly higher compliance rates and tax payments above the holdout sample.[13] The four tax morale letters stressing the payment's benefits for the neighborhood (*neighbor*) and city (*community*) services, compliance behavior by other Philadelphians (*peer*), or civic duty (*duty*) to pay ones taxes have the same effect as a reminder-only on compliance behaviors. There is no statistically significant added compliance to the tax morale reminders, on average, above that obtained from just the simple reminder letter.[14] Overall, results are similar in statistical significance and impact to those in Castro and Scartascini's (2015) study of property tax payments in Junan, Argentina, the other major field experiment seeking to

[13]Left unanswered by these results is the question of why taxpayers respond to extrinsic messages that communicate pre-existing penalty information. One possible explanation is that taxpayers interpret the threat of enforcement as new information rather than a reiteration of existing information. Bérgolo, Ceni, Cruces, Giaccobasso, and Perez-Truglia (2017) report evidence consistent with the idea that this new threat information is used to update the recipients perceived risk of enforcement and punishment.

[14]Formal statistical tests cannot reject the null hypothesis of equality for the impact of the tax morale reminders and the simple reminders on the rates of tax payer compliance or amount paid. We do reject equality of impact for the Lien and Sheriff's letters compared to the simple reminder, however.

improve property tax collection.

Table 3 estimates the longer run impacts of our seven nudge interventions on compliance. The first three columns of Table 3 show the estimated effects of each nudge on compliance six months after the start of the experiment (December 31), again compared to compliance behavior in our holdout sample. The six-months responses for those in the holdout sample and in our seven treatment groups now include the possible influence of the outside collection agencies on still delinquent taxpayers. We do not know their "treatment" strategies, although we conjecture that they primarily rely on enforcement threats. The effects observed for the six-months window, therefore, predict the impact of our treatments from our June letters interacted with the treatments of the outside agencies.

Since all tardy taxpayers including our holdout sample are now likely to have received some form of an enforcement reminder, it is not surprising that our original reminder letter no longer has a differential impact on payment behavior.[15] What does continue to impact behavior, however, is our original reminders that stressed the risk of liens and sheriff's sales. The effects of our lien and sheriff reminders are now slightly smaller in percentage terms, though not significantly so. Again, none of the tax morale intrinsic nudges show a statistically significant impact on compliance behaviors. These taxpayers are now receiving sanction reminders for the first time, just like those in the holdout sample. They appear to respond identically. This provides further evidence that extrinsic or penalty messages are effective for converting non-payers into payers. Total amount paid above that paid by the holdout sample is, with the exception of the civic duty reminder, unaffected. Sanctions work on the extensive margin by increasing the number of taxpayers. Tax morale messages, particularly the peer and civic duty letters, appear to have a positive effect on the intensive margin by inducing greater payments from those planning to already pay.

The last three columns of Table 3 carry our sample into the next tax year, beginning with the receipt of a new property tax bill in early January, 2016. We now study if having received a

[15]It is our understanding from DoR that their treatments are a combination of simple reminders and reminders coupled with extrinsic messages stressing penalties, liens, and perhaps sheriff sales.

reminder letter in June, 2015 improves compliance behavior for the payment of the 2016 taxes by June of 2016. Consistent with the importance of saliency, none of the 2015 reminder letters appear to have "staying power" into the next tax year. Tardy Philadelphians need constant reminders.[16]

We have also analyzed the compliance behavior of tardy taxpayers by the size of their tax bills. Tardy taxpayers were divided into four quartiles by taxes owed: Quartile 1 (mean owed = $149); Quartile 2 (mean owed = $597), Quartile 3 (mean owed = $1,133), and Quartile 4 (mean owed = $3,885). Figure 1 plots the fraction of tardy taxpayers that paid paid a positive amount within the first three-months after receiving their reminder letters.

Figure 1 shows that tardy taxpayers in Quartile 1 owing the least in taxes are the most likely to make a tax payment, whether they receive a reminder letter or not; note particularly the significant lower rate of compliance in Quartiles 2-4 of the holdout sample. Receiving a Lien and Sheriff letter significantly improves *ever-paid* compliance for all four Quartiles, but the effects are greatest for those in the lowest two Quartiles.[17]

Finally, our results shed light on the possible importance of liquidity constraints as a motivation for tardy tax payments. If liquidity constraints are important, then nudges may be insufficient unless accompanied by a way to smooth payments of the original tax obligation. Taxpayer agreements that spread payments over several months without penalty is one policy. Each reminder letter included a sentence stressing the availability of taxpayer agreements to help with payments. The results in Table 2 suggest, however, that liquidity constraints are not binding for most of our tardy taxpayers.

If a tardy taxpayer pays, they most often will *pay-in-full*. This is true both for our tardy taxpayers in the holdout sample and for those receiving a reminder; see Tables 2 and 3 comparing the percent who *pay-in-full* to the percent who *ever-paid*. For example, for the holdout sample, 30.5 percent of the tardy taxpayers made some payment (*ever-paid*) after one month, 51.4 percent made some

[16]The new property tax bill, which is sent out at the beginning of the new year, may also serve as a reminder for tardy taxpayers to pay the bill for the previous year.

[17]More detailed results for all three outcomes are available upon request from the authors.

payment after three months, and 73.3 percent made some payment after 6 months (by December). Of these taxpayers making some payment (*ever-paid*), always more than sixty percent have made their payment in full (*paid-in-full*). For example, in the holdout sample after one month, 30.5 percent made some payment while 23.5 percent paid in full; thus, 77 percent (= 23.5/30.5) of those who paid any amount, paid in full. These high rates of full payment, conditional on any payment, are true for the holdout sample and for all our reminder letters as well, and at the one month, three month, and six month payment intervals.

All that said, there are still 25 to 30 percent of tardy taxpayers who have not made any payment by the end of the tax collection year, even with reminders; see Table 3, six month, *ever-paid* column. Offering these tardy taxpayers a tax payment plan to smooth their payments may be valuable. The City does offer such a program. Table 4 shows what fraction of tardy taxpayers have agreed to enroll in the program by end of our experiment. The share of the holdout sample that uses the tax payment option is less than 1 percent. Use by the recipients of the reminder letters is never greater than an additional 1.6 percent (reminder/sheriff). On average, tax payer agreements are only being used by about 1 percent of the original 19,039 tardy taxpayers or 200 taxpayers and only about 3 to 4 percent of all tardy taxpayers who have not yet made a full tax payment. Liquidity constraints may bind, but the main barrier to payment is an inclination to do so.

V Comparison to Our Pilot Results

Our results here show a significant impact on taxpayer compliance from reminders that stress sanctions, and little effect on compliance of those that stress tax morale messages. These results are in sharp contrast to those that we obtained in our 2014 pilot experiment for this study completed on a sample of 3,888 tardy taxpayers owning a single property; see Chirico, et. al. (2016). That study began on November 15, 2014 and included only those taxpayers who had not paid by that date. These taxpayers had received repeated reminders from the City and had been exposed to the collection messages of the outside collection agencies – most likely sanctions. Our intervention at the November date consisted of one of three reminders mailed to randomly selected, still tardy taxpayers: one threatening sanctions, a second stressing the importance of taxes for public services, and a third stressing civic duty and that others pay their taxes. Their responses were compared to tardy taxpayers in a holdout sample. In contrast to our results here, the letter threatening sanctions had no effect on the rate of compliance or on the level of payment, but the letter stressing that taxes provide public services increased both the rate of compliance and the level of payments (above holdout) for those who did comply. As here, the civic duty letter had no effect on the rate of compliance, but did increase payments for those who did comply. The biggest effect was from the public service reminder and the effect was largest for those with the smallest level of taxes owed. Compared to the pilot's holdout sample, these letters induced an additional 16 percent of these very tardy taxpayers (about 620) to make payments. But again in contrast to our results here, payments were small relative to total taxes owed. On average, payments were only \$238 towards the average liability of \$4,021.

These contrasting results from our full experiment and from our pilot study are another reminder as to the importance of heterogeneity in taxpayers responses to nudges for compliance.[18] Taxpayers who were in our pilot study were the "very tardy" taxpayers and close to becoming delinquent in their 2014 payments. They had received repeated reminders and had likely been threatened by sanctions by the outside collection agencies. Our additional threat had no effect on their compliance. Whether from a sense of guilt or a positive desire to make at least small contribution towards City services, the tax morale letters did elicit payments but only from a small subset and the payments were very modest. These very tardy taxpayers would likely benefit from tax payment plans, but may need a more personal "nudge" to initiate compliance.

[18]As suggested by one of the editors, the source of the heterogeneity may be less behavioral and have more to do with the underlying political and economic environments at the time of the pilot and our full experiment. The city's economy in 2014 was only just beginning to recover from 2009/2010 recession. The city's unemployment rate fell from 8.9 percent in July, 2014 to 6.1 percent by December, 2015. High unemployment rates during 2014 may have increased the likelihood that tardy taxpayers were liquidity constrained and thus less able to make full tax payments when threatened with economic sanctions. The year of the full sample study (2015) was an election year, perhaps leading taxpayers to look directly at the benefits of their tax dollars and to conclude, by our estimates, that the returns were not there.

VI Tax Revenue Implications

While of interest as a specification and test of a behavioral theory of tax compliance, our results are also directly relevant for city tax collection policies. As a strategy for improving collection from tardy taxpayers, our analysis informs two important policy issues. First, cities need revenues: Do reminders improve collection, and then do reminders with a message raise more money than a simple reminder? Second, citizen commitment is essential for efficient and effective local governance: Do reminders with a message, and then which message, improve tax collection as a "nudge" to citizen engagement? Table 5 provides answers to these two questions.

Listed in Table 5 are our seven treatments, the sample size to which each treatment applied and total taxes owed, and then estimates of the impact of each treatment on the number of new payers three months after receipt of the treatment letter, the average additional revenue received per letter sent, total additional revenues collected from each treatment letter above that paid by the holdout sample, and finally, the percent of owed taxes paid because of each treatment. The upper panel of Table 5 is based on the three-months estimates, while the lower panel of Table 5 is based on the six-months results.[19]

Since the three-months estimates are not affected by the activities of the collection agencies we start the analysis here. For single property owners, the total number of additional taxpayers above the holdout sample from all reminder letters is 834, an average increase in the overall rate of compliance from receiving one our treatment letters of 4.9 percent (834/16,951). Table 5 also provides an estimate of additional revenues raised by each of our treatment letters and then the total revenue raised from each treatment group. Our experiment was a good investment of resources. Each letter cost about \$1 to process and send and raised on average over all letters \$36.27. The estimated revenue to cost ratios for the seven treatments ranged from a low of \$19.19 (the Neighborhood

[19] Note that we base our results in Table 5 on the median estimated additional revenues per letter. These estimates of median revenues are significantly lower than the estimates reported in Table 2, which are estimates of mean additional revenues per letter. In that sense, we view our analysis as providing conservative estimates of the revenue implications of the different reminder letters.

letter) to a high of $67.90 (the Lien letter). The approximately $17,000 spent on our experiment to mail the 16,951 treatment letters raised $615,222 in additional city revenues: an average revenue to cost ratio of 36.2.

Among our seven treatments, our experimental results clearly show the power of the Lien and Sheriff letters compared to a simple reminder or the tax morale nudges. The number of taxpayers above the holdout sample is three to four times larger and the revenue per letter is two to three times larger with the letters stressing sanctions. As a consequence, total additional revenues above the holdout sample from the sanction letters and new revenues as a share of all taxes owed are three to four times larger as well. If we had sent only the Lien or Sheriff's letter to the 16,951 taxpayers in our treatment groups we would have raised $1.15 million in additional revenues rather than $615,222 – nearly twice as much. The paid percent of taxes owed would have risen from our experiment's average of 2.5 percent to that of the Lien letter only of 4.9 percent.

The lower panel in Table 5 repeats this exercise using the six-months estimates as reported in Table 3. We find qualitatively similar effects of the reminder letters after six months, though the number of new taxpayers is smaller after six months than after 3 months – 310 new payers after six months vs. 834 new payers after three months. While the 310 new payers after six months are truly new payers for the fiscal year (i.e., delinquent had they not paid by December 31), the 834 "new" payers after three months may include both truly new (i.e., otherwise delinquent) taxpayers as well as "early" taxpayers who were nudged by our reminders to move their payments from December to August. Estimates of the net revenue benefits for the City will need to know the division of the new payers after 3 months into those who are early and those who are truly new (otherwise, delinquent) taxpayers. We do not know this split.

However, we can provide upper and lower bounds to the net revenue benefits of our reminder letters. Assuming all 834 new three month taxpayers are truly new (no longer delinquent) taxpayers, we then raise $615,222 in new revenues after three months. The 310 (truly) truly new taxpayers who pay in December pays $227,856 in new revenues. The upper bound estimate of new revenues from our experiment is then $834,078, or an average of $49.73 (= $36.29 + $13.44) per reminder letter. Alternatively, if we assume all 834 new taxpayers at the three month interval are only early taxpayers, then the City only gains the four months of interest earned on those early payments, perhaps $12,300 (= .02 x $615,222). In this case total new revenues from our experiment will equal $12,300 in interest revenues plus $227,856 in new payments or $240,160. This lower bound benefit of the experiment then equals $14.17 per letter sent. Even at this lower bound, the experiment is cost effective. Were the City to have only sent the Lien and Sheriff's letters, it would have earned an overall average return for those two letters of $66.42 per letter after three months and $27.29 per letter after six months. In this case the upper bound to new revenues would equal $93.71 per letter (= $66.42 + $27.29) for a total of $1.589 million in new revenues. The lower bound revenue estimate for using only the Lien and Sheriff letters would be $28.62 per letter (= .02 x $66.42 + $27.29) yielding a total new revenue estimate of $485,111. Inducing early tax payments will still add revenues, but it is clear from the analysis here that the significant revenue benefits of the nudge strategy come not from early payments but from new payments by initially delinquent taxpayers.

Though not possible to quantify from our results, tax nudges have a potentially important additional benefit, particularly in taxing jurisdictions with relatively low rates of taxpayer compliance. Besley, Jensen, and Persson (2015) provide evidence from local taxpayers in Britain that once in a low participation equilibrium it will be very difficult, even with penalties and sanctions, to escape that equilibrium. Castro and Scartascini (2015) provide evidence from Argentina that previously paying taxpayers reduce their rate of compliance when the rate of participation by their peers falls to near 70 percent. Even if nudges do not bring in new money they are valuable if they succeed in holding a taxpaying community in the high compliance equilibrium against pressures to free ride; see Wenzel (2005).

VII Discussion: What Role for Nudges?

The seven treatments are effective on the margin in increasing compliance and in raising revenues, and the letters stressing economic sanctions particularly so. That said, the final column of Table 5 makes clear that, at least in Philadelphia, our treatments will not solve the larger problem of unpaid City property taxes. The contributions of each reminder letter towards total taxes owed range from a low of 1.0 percent for the Neighborhood letter to a maximum of 4.9 percent for the Lien letter after the three months of our experiment. The reminders together raised a maximum of $615,222 in property tax revenues from the total of $22.143 million owed in tardy payments, or 2.5 percent. Estimates provided by the six-months results in Table 5 show that an additional $227,850 can be considered additional revenues for the tax year. Importantly, since our sample was close to the full sample of all tardy taxpayers, these revenue estimates are close to the most the City might expect in new revenues were our experiment to become annual policy.

Should we, therefore, conclude from these modest revenue gains that a nudge strategy should not become part of Philadelphia's fiscal policy? We think not. First, our work here was an experiment looking for an effective collection strategy, not an evaluation of an established policy. The Lien and Sheriff letters were significantly more effective than the average reminder letter. If those letters were to be adopted as part of the City's collection strategy for tardy taxpayers and applied alone to the entire sample of 19,039 taxpayers, the city could expect to collect no less than $545,000 (= $28.62 x 19039) to perhaps as much as $1.784 million (= $93.71 x 19,039) in additional City revenues.

Second, no single policy is likely to be the best and only means for collecting revenues. Any collection policy will involve a range of collection strategies, ranging from voluntary compliance on each annual 'tax day,' to mailed reminders as here, to detailed in person audits, to policing, trial, and impoundment of assets. Each strategy will have its own costs and benefits. All strategies that provide revenue benefits greater than collection costs should be included as part of the final collection policy (Keen and Slemrod, 2017). Our Lien and Sheriff letters raising over $65 in new revenues for each $1 of administrative costs seem to have earned their place in Philadelphia's collection strategy.

Third, and perhaps most importantly for designing a cost-effective strategy to collect tardy taxes, our experiment revealed the revenue benefits for the City's tax administration to be patient. After three months of our experiment, the holdout sample of tardy taxpayers receiving no letter increased their tax compliance by 51.4 percent in making at least some payment and by 40.8 percent in making their full payment. The average payment received after three months was $637 per taxpayer; see Table 2. These are revenues the City received without any expenditure of City administrative resources, just waiting for taxpayers to recognize on their own that their property tax payments are due. Had the City adopted this 'wait-and-see' strategy applied to all 19,039 of the tardy, single property owner taxpayers, then after three months 9,786 tardy taxpayers would have made some payment. With an average payment of $637 per taxpayer, City revenues would have increased by $6.234 million, or approximately 28 percent of revenues owed by all tardy taxpayers. Other than a small opportunity cost of waiting, this is "free" money and clearly the most efficient beginning strategy for the City for collecting tardy property taxes.

We conclude that the efficient administrative package would combine the waiting policy followed by the most efficient reminder letter stressing economic sanctions, mailed to all tardy taxpayers. Assuming those who pay without a nudge will not be annoyed by receiving the reminder letter and thus less likely to pay, the City would receive payments of $6.234 million from those who pay without the nudge and $1.288 million from those who pay in response to the nudge with economic sanctions. This administrative package raises a total $7.522 million, or 34 percent of all tardy revenues owed. The cost of the combined policy will be just a dollar per letter or $19,039 for all of the reminder letters.

The revenues and costs of this "wait-and-see" strategy followed by reminders with sanctions for those still tardy should be compared to the City's current strategy of assigning the tardy taxpayers to collection agencies who are now paid 6 percent of all revenues collected. Prior to our study, the City assigned 2/3's of its tardy taxpayers to law firms for collection of revenues, or from our study

12,700 of 2015's 19,039 single owner tardy taxpayers. The holdout sample in our study reveals that by doing nothing approximately 51 percent or 6,530 of these taxpayers would have made an average payment of $637 after three months. Their total payment would equal $4.158 million, all without effort by the collecting law firms. These collected revenues will then earn a payment of $249,950 from the City. If the law firms were to then adopt our sanction strategy with the $66 revenue to cost ratio for the remaining 6,530 tardy taxpayers, an additional $430,980 in revenues could be collected, earning an additional $25,900 in commissions. Total commissions paid would equal $275,400. Keeping our nudge strategy for tardy taxpayers in-house for the first three months would save the City these commissions. Collection agencies might still be used for the nearly delinquent taxpayers as the tax year nears December.

VIII Conclusion

With the cooperation of the Department of Revenue of the City of Philadelphia, we developed and implemented a new tax policy experiment. We used written nudges designed to improve the collection of property tax revenues from citizens who had not paid their fiscal year 2016 taxes by the due date of March 31, 2015. The results reported here are for the 19,039 taxpayers who own a single property, excluding those who own multiple properties. The experiment reached six substantive conclusions: First, a simple reminder letter had a statistically significant effect on compliance when compared to our control group who received no reminder. Second, the content of the reminder letter matters. The two letters that stress the likely economic sanctions of continued tardy payment led to faster and higher levels compliance than the simple reminder. Third, adding a tax morale message to the reminder, one that stressed the value of public services, neighbors' compliance, or civic duty did not increase compliance over receiving only the simple reminder. Fourth, most of the taxpayers who did respond with payments, paid their full tax obligation. Fifth, reminders were very cost effective on the margin. Each letter cost one dollar to send and returned on average $37 in increased city tax revenues after three months. The two letters stressing economic sanctions were the most effective, returning $65 to $68 in extra revenues for each letter sent. Sixth, reminders had no staying power. Having received a 2015 reminder letter had no effect on the taxpayer's likelihood of paying their 2016 property taxes on time.

The results of our experiment suggested three policy conclusions for the design of an efficient tax collection strategy for Philadelphia. First, appropriately designed reminder letters as nudges contribute positively to revenue collection and should be part of the City's collection strategy. Our nudge strategy raised a minimum of $240,160 in new revenues for an average return of $14,17 for each letter (costing $1) sent, and perhaps as much as $834,078 in new revenues for an average of $49.73 per letter sent. If only the most cost-effective letters stressing economic sanctions had been sent, the minimum revenue raised would have been $485,111 or $28.62 per letter while maximal revenues might equal $1.589 million for an average of $93.71 per letter sent. But second, our nudge strategies, even the most effective Lien and Sheriff letters, will not solve the problem of tardy tax collections in Philadelphia. The total amount of tardy taxes owed in 2015 was $24,866 million; maximal "nudge revenues" of $1.589 million will contribute at most 6 percent to covering this shortfall.

Third, and perhaps most interestingly, just being patient had high returns. Our study included a sample of holdout taxpayers who received no reminder. That group increased their rate of compliance by 51.4 percent from the start of our study to its three month conclusion date. The average payment from this sample receiving no reminder was $637 per taxpayer. Total new City revenues from this group equaled $6.234 million dollars, all raised at no cost to the City other than the small opportunity cost from delay. Relying upon tardy taxpayers to recognize and pay their taxes on their own and then using the sanction reminder to leverage those who continue to forget or need a nudge would together raise $7.522 million of the $24.866 owed by all tardy taxpayers, or 34 percent. The total cost to the City of this collection strategy would be $19,039 for the reminder letters. After three months, a more aggressive but also more expensive collection strategy might be tried.

There are limitation to our study, however. First, the large empirical literature on nudges and tax collection makes clear that successful strategies are context specific. Collection strategies that work well for one tax and for one government may fail to do so for another tax and in another fiscal setting. Our results are for Philadelphia taxpayers alone. What we think does generalize, however, is the value of repeating studies such as ours for the design of tax administration strategies. We feel that our seven reminder letters and the importance of having a holdout sample provide an effective methodology for use by other cities for understanding how best to collect their own tardy and delinquent property taxes. Further, at an average cost of $1 per reminder letter including mailing and office expenses, there is no reason not to implement a study such as ours on the full sample of tardy or delinquent taxpayers.

Second, that said the effectiveness of each letter is likely to depend on the exact wording of the message and the additional information that is provided in the letter. For example, in our pilot study we found that a simple deterrence message that did not provide any specific or detailed information about enforcement was not effective in increasing compliance. In contrast, in this version of our experiment reminder letters stressing sanctions did provide such information, and these reminders were our most effective intervention.

Third, our experiment only allowed us to estimate the impact of reminder letters conditional upon taxpayers' information and preferences and cannot be used to evaluate the impact of more extensive interventions. While our sanction reminder letters did refer to existing sanctions now in place and illustrated those sanctions for real properties in the taxpayer's neighborhood, our tax morale messages were less specific as to the benefits of paying taxes and thus may suffer by comparison. For example, the tax morale messages did not follow a city-wide intervention advertising the value of neighborhood or city services, have a personal plea to "join me" in paying city taxes, or stress the civic obligation we all have as citizens to pay our "fair share." These more extensive, but costly, tax morale interventions may be very effective.

Fourth, our experiment does not allow us to determine with any precision why approximately 1/3 of tardy taxpayers in our sample did not pay their taxes by the end of the tax year. They are now delinquent. A liquidity constraint may be the problem, but the option to use the City's tax payment program to smooth payments was available and mentioned in our reminder letters, yet no more than 3 to 4 percent of those who did pay used the plan. Interviewing these newly delinquent families would be valuable.

Finally, it is useful to speculate as to who pays the final burden for our effective interventions. General taxpayers pay for the initial cost of our reminders. When enforcement is successful, the burden falls primarily on those tardy taxpayers who pay the fines and penalties. Those fines and penalties presumably cover their enforcement costs and the costs associated with the delay in payment. If enforcement is not successful then the burden of enforcement falls on the taxpayers who do comply. A final benefit-cost analysis will need to consider the distributive consequences of any enforcement strategy.

Motivated by the results of our work here, Philadelphia's Department of Revenue now uses a reminder letter stressing the risk of a tax lien and subsequent sheriff's sale and has delayed by three months (to mid-July) the use of outside firms for the collection of tardy of taxes.

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Table 1: Balance on Observables

Variable	1	2	3	4	5	6	7	8	p-value
Amount Due	$1,233	$1,383	$1,389	$1,613	$1,950	$1,290	$1,338	$1,316	0.32
	($1,840)	($6,510)	($4,130)	($13,118)	($25,290)	($2,021)	($3,413)	($2,158)	
Prop. Value	$142	$163	$147	$155	$206	$130	$130	$166	0.29
	($509)	($1,316)	($699)	($966)	($2,035)	($181)	($181)	($1,336)	
Years Tenure	18.7	18.7	19.0	18.6	18.5	18.8	18.9	18.9	0.96
	(15.6)	(15.2)	(15.7)	(15.5)	(15.7)	(15.6)	(15.6)	(16.0)	
Center City	5%	5%	5%	5%	5%	4%	5%	5%	0.66
Northeast Philly	17%	18%	16%	15%	17%	16%	18%	16%	
North Philly	22%	21%	22%	22%	21%	20%	22%	22%	
Northwest Philly	26%	25%	27%	28%	26%	27%	25%	25%	
South Philly	10%	9%	10%	10%	10%	10%	10%	10%	
West Philly	21%	23%	21%	21%	22%	23%	20%	22%	
# Owners	2,088	2,420	2,432	2,419	2,389	2,441	2,417	2,433	

p-values in rows 1-2 are F-test p-values from regressing each variable on treatment dummies. A χ^2 test was used for the geographic distribution.

Standard deviations in parentheses. Property values are reported in $1000.

1: Holdout, 2 : Reminder, 3: Lien, 4: Sheriff, 5: Neighborhood, 6: Community, 7: Peer, 8: Duty

Table 2: Short-Term Gains in Compliance and Payments: Linear Probability Model Estimates

	Ever Paid		Paid in Full		Total Paid	
	One Month	Three Months	One Month	Three Months	One Month	Three Months
Holdout	30.5	51.4	23.5	40.8	\$324.0	\$636.6
Reminder	3.7^{***}	3.9^{***}	2.2^{*}	3.0^{**}	36.6	15.2
	(1.4)	(1.5)	(1.3)	(1.5)	(31.6)	(43.1)
Lien	9.0^{***}	9.2^{***}	5.7^{***}	7.3^{***}	117.0^{***}	122.7^{**}
	(1.4)	(1.5)	(1.3)	(1.5)	(43.9)	(54.9)
Sheriff	7.3^{***}	8.8^{***}	4.5^{***}	6.7^{***}	68.4^{**}	96.8^{*}
	(1.4)	(1.5)	(1.3)	(1.5)	(34.1)	(49.5)
Neighbor.	1.7	2.6^{*}	-0.2	1.6	51.0	40.1
	(1.4)	(1.5)	(1.3)	(1.5)	(37.6)	(48.8)
Community	3.8^{***}	2.8^{*}	1.3	2.5^{*}	41.1	18.3
	(1.4)	(1.5)	(1.3)	(1.5)	(32.6)	(45.1)
Peer	3.9^{***}	3.5^{**}	1.8	3.4^{**}	59.0	119.6
	(1.4)	(1.5)	(1.3)	(1.5)	(36.6)	(76.1)
Duty	2.4^{*}	3.6^{**}	0.7	2.3	35.8	70.7
	(1.4)	(1.5)	(1.3)	(1.5)	(35.6)	(49.2)
Num. obs.	19039	19039	19039	19039	19039	19039

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Robust standard errors.

Holdout values in levels; remaining figures relative to this.

Table 3: Long-Term Gains in Compliance and Payments: Linear Model Estimates

	Six Months			Next Tax Year (2016)		
	Ever Paid	Paid in Full	Total Paid	Ever Paid	Paid in Full	Total Paid
Holdout	73.3	63.2	937.9	65.5	52.5	1043.9
Reminder	1.3	1.5	21.2	-1.4	-0.7	-24.7
	(1.3)	(1.4)	(50.0)	(1.4)	(1.5)	(69.1)
Lien	3.7^{***}	4.8^{***}	87.5	-0.9	-0.7	38.9
	(1.3)	(1.4)	(58.8)	(1.4)	(1.5)	(96.9)
Sheriff	3.7^{***}	2.9^{**}	74.5	-0.6	-1.1	245.8
	(1.3)	(1.4)	(55.9)	(1.4)	(1.5)	(260.6)
Neighborhood	-0.2	-0.0	47.6	-3.1^{**}	-2.1	181.3
	(1.3)	(1.4)	(55.3)	(1.4)	(1.5)	(189.6)
Community	0.9	1.1	55.0	-1.8	-2.0	-52.9
	(1.3)	(1.4)	(53.6)	(1.4)	(1.5)	(66.8)
Peer	1.4	2.3	130.0	-1.9	-1.1	-69.0
	(1.3)	(1.4)	(79.5)	(1.4)	(1.5)	(65.9)
Duty	2.1	1.0	120.3^{**}	-1.6	-1.9	37.1
	(1.3)	(1.4)	(57.6)	(1.4)	(1.5)	(70.2)
Num. obs.	19039	19039	19039	19036	19036	19036

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Robust standard errors. Holdout values in levels; remaining figures relative to this.

Change in sample size between long-term and subsequent year results reflects property dissolution for three properties.

Table 4: Adoption of Payment Agreements

Holdout	0.9
Reminder	0.4
	(0.4)
Lien	1.0^{***}
	(0.4)
Sheriff	1.6^{***}
	(0.4)
Neighborhood	0.6
	(0.4)
Community	0.4
	(0.4)
Peer	0.8^{**}
	(0.4)
Duty	0.8^{**}
	(0.4)
Num. obs.	19039

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.
Holdout values in levels; remaining figures relative to this

Table 5: Revenue Estimates

Treatment	Sample Size	Total Taxes Owed	New Payers	Revenue/ Letters	New Revenues	New % of Taxes Paid
Based on 3 Months Estimates						
Reminder	2,420	$3.346 M	94	$28.78	$69,647	2.1
Lien	2,432	$3.378 M	224	$67.90	$165,132	4.9
Sheriff	2,419	$3.902 M	213	$64.94	$157,089	4.0
Neighborhood	2,389	$4.658 M	62	$19.19	$45,844	1.0
Community	2,441	$3.148 M	68	$20.66	$50,431	1.6
Peer	2,417	$3.233 M	85	$25.83	$62,431	1.9
Duty	2,433	$3.201 M	88	$26.57	$64,644	2.0
Totals	16,951	$24.866 M	834	$36.29	$615,222	2.5
Based on 6 Months Estimates						
Treatment	Sample Size	Total Taxes Owed	New Payers	Revenue/ Letters	New Revenues	New % of Taxes Paid
Reminder	2,420	$3.346 M	31	$9.29	$22,474	0.7
Lien	2,432	$3.378 M	91	$27.44	$66,739	2.0
Sheriff	2,419	$3.902 M	89	$27.14	$65,659	1.7
Neighborhood	2,389	$4.658 M	-6	-$1.76	-$4,194	-0.1
Community	2,441	$3.148 M	21	$6.38	$15,564	0.5
Peer	2,417	$3.233 M	33	$9.97	$24,091	0.7
Duty	2,433	$3.201 M	51	$15.42	$37,524	1.2
Totals	16,951	$24.866 M	310	$13.44	$227,856	0.9

* Sample Size is the number of single property tax payers in the treatment group. Total Taxes Owed is the total taxes owed by single property tax payers in the treatment group. New Payers equals the new payers after three months computed as the estimated increase in rate of compliance of those receiving the letter over those in the holdout sample as reported in upper panel of Table 2; for example, for the reminder letter the number of new payers equals 94 = 0.039 x 2,420. Revenue per letter for each treatment equals the median new revenue collected from those who received a treatment letter and made some payment (=$738/letter) times the three month increase in compliance from each treatment letter; for example for the reminder letter the median estimated revenue per letter equals $28.78 = 0.039 x $738. New revenues for each treatment equals the revenue/letter times the number of single owner properties receiving a treatment letter: for example, for the reminder letter the estimated total new revenues equals $69,647 = $28.78 x 2,420. New % of Taxes Paid equals New Revenues divided by Total Taxes Owed; for example, for the reminder letter 2.1 = $69,647 / $3,345,846. The six-months estimates are computed similarly based upon results reported in Table 3.

Figure 1:

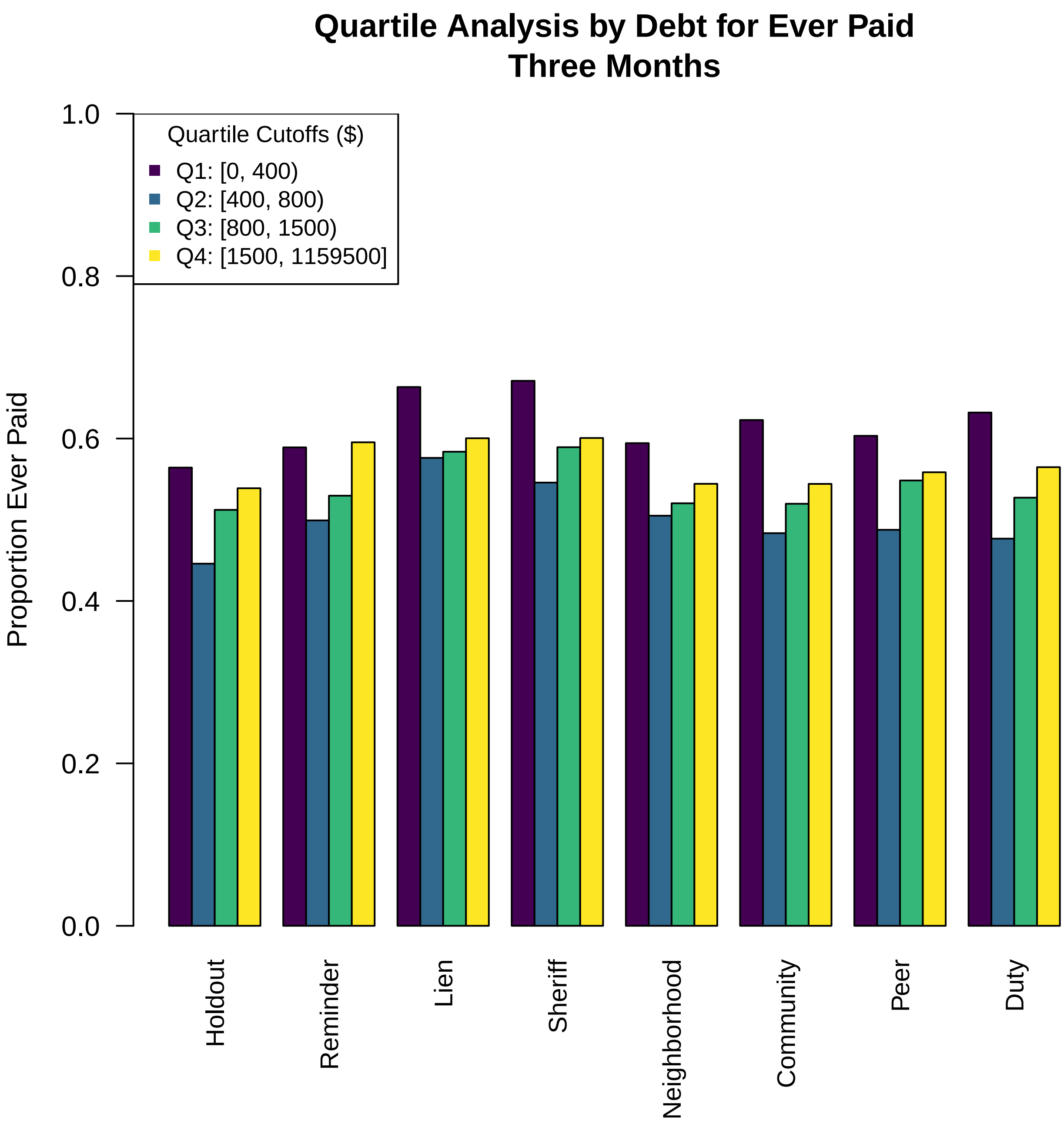
Quartile Analysis by Debt for Ever Paid
Three Months
Quartile Cutoffs ($)
Q1: [0, 400)
Q2: [400, 800)
Q3: [800, 1500)
Q4: [1500, 1159500]
Proportion Ever Paid
1.0
0.8
0.6
0.4
0.2
0.0
Holdout
Reminder
Lien
Sheriff
Neighborhood
Community
Peer
Duty

Figure 2:

CITY OF PHILADELPHIA
DEPARTMENT OF REVENUE
TAX | WATER | LAW

Real Estate Tax Delinquency Notice

January 27, 2017

RICHARD ROE
706 CRESHEIM RD
PHILADELPHIA, PA 19119

Owner(s):	RICHARD ROE
Property Address:	706 CRESHEIM RD
Account Number:	124578340
Balance Due:	$2,087.37

Se brindan servicios de interpretación.
خدمات الترجمة الشفهية متوفرة لدينا.
提供口译服务.
Services d'interprétation disponibles.
통역이 제공됩니다.
Предоставляются услуги устного переводчика.
[illegible]

Dear Richard Roe,

Our records indicate that you have a balance due of $2,187.27.

If you have already paid, thank you. If not, please pay now or contact us for to arrange a payment plan. The fastest and easiest way to pay is online at www.phila.gov/pay. Paying by E-check only costs 35¢—less than the cost of a stamp!

Sincerely,

Deputy Commissioner Marisa Waxman
Department of Revenue
City of Philadelphia

Revenues for Schools & Services
Have questions or need help? Visit www.phila.gov/revenue or call 215-686-6442

Figure 3:

CITY OF PHILADELPHIA
DEPARTMENT OF REVENUE
TAX | WATER | LAW

Real Estate Tax Delinquency Notice

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អាចផ្តល់ជូនសេវាកម្មអ្នកបកប្រែភាសា ។

Dear Richard Roe,

Failure to pay your Real Estate Taxes will result in a tax lien on your property in an amount equal to your back taxes plus all penalties and interest. When your property is sold, those delinquent tax payments will be deducted from the sale price. By paying your taxes now, you can avoid these penalties and interest.

Properties near you in Upper Kensington that have had liens placed on them include:

- 117 EAST WISHART STREET — Sold November 19, 2014
- 401-11 E ALLEGHENY AVE — Sold April 15, 2015
- 3419 F ST — Sold April 15, 2015

Pay your taxes now to avoid a lien being placed on your property. Our records indicate that you have a balance due of $2,187.27.

If you have already paid, thank you. If not, please pay now or contact us for to arrange a payment plan. The fastest and easiest way to pay is online at www.phila.gov/pay. Paying by E-check only costs 35₵—less than the cost of a stamp!

Sincerely,

Deputy Commissioner Marisa Waxman
Department of Revenue
City of Philadelphia

Revenues for Schools & Services
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