Ghostbusting in Detroit: Evidence on nonfilers from a controlled field experiment[*]

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Abstract

Many people who owe income tax fail to file a timely tax return. In communication with these "ghosts," what messages from the tax authority are effective for eliciting a return? This is the first study to address message content in communication with income tax nonfilers. I assess the efficacy of messages related to penalty salience, punishment probability, compliance cost, and civic pride by evaluating the response to experimental mailings distributed by Detroit to 7,142 suspected resident nonfilers. The penalty salience message was the most effective. Relative to a basic mailing that requested a return, penalty salience mailings that stated the statutory penalty for failing to file a return tripled response rates from 3% to 10%, increased the number of back-year returns filed per response from 0.08 to 0.27, and raised the fraction of filed returns that admitted tax due from 39% to 52%. Compliance cost mailings that enclosed a blank tax return and punishment probability mailings that stated the recipient's federal income also raised response rates relative to the basic mailing, but civic pride mailings did not. Mailings were more effective in eliciting returns from older, higher-income, and first-time nonfilers. I investigate the impact of treatment mailings on the behavior of untreated neighbors and find no evidence of geographic network effects.

Keywords: Nonfiler, Tax Evasion, Income Tax
JEL Codes: H24, H26

1 Introduction

Tax authorities want to know what messages induce compliance from noncompliant taxpayers. Relative to other enforcement mechanisms like audits or site visits, the marginal cost of written communication is low. Even better, the marginal cost of making communication more effective is zero; the postage cost of mailing a letter that gets filed in the dustbin is the same as the postage cost of mailing a letter that induces additional timely compliance. Tax authorities want to send a message that works.

One common form of noncompliance is failure to file a tax return. For the U.S. federal individual income tax, Erard et al. (2014) estimate that 6.1% of required tax year 2012 returns were not filed on time. Nonfiling is a much bigger problem for Detroit's individual income tax, for which I estimate that 48% of required tax year 2014 returns were not filed on time. Controlled experiments are becoming more common in the literature on the determinants of tax compliance, most of which examines underreporting or underpayment. Several papers have examined corporate tax and profits tax nonfiling (Kettle et al. 2016; Brockmeyer et al. 2016), but individual income tax nonfilers have been the focus of only one such empirical paper, which examined the effect of repetition and reminders on filing rates (Guyton et al. 2016).

This paper provides the first evidence from a controlled experiment about message content in communication with income tax nonfilers. The experiment was designed and conducted by the author in collaboration with the City of Detroit. Detroit's income tax division sent mailings in April through June 2016 to 7,142 suspected "ghosts"—people who owed tax but did not file a tax year 2014 return. Each mailing contained one of several experimental messages, related variously to penalty salience, punishment probability, compliance cost, or civic pride. From the population of suspected ghosts with at least $350 in estimated tax liability, nonfilers were randomly selected into experimental treatments and sent the same

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message in two mailings: a postcard, and then a certified letter one week later.

I compare the effectiveness of the various experimental messages for inducing taxpayer compliance. The main outcome of interest is the response rate, the rate at which mailings elicited a tax return from suspected resident nonfilers in the sample. I also evaluate response quality, including the amount of remittances, the likelihood of claiming a refund rather than admitting tax due, and the number of back-year returns accompanying the tax year 2014 return. I examine whether taxpayer behavior differed across treatments in ways that can be attributed only to messages on the postcard, such as the rate at which taxpayers accepted the letters, which required a signature for delivery. I identify taxpayer characteristics, including age and income, that were associated with higher response rates to the experimental messages. I investigate geographic network effects—the response rates of untreated neighbors to experimental mailings.

In communication with nonfilers, the penalty salience message was the most effective at inducing compliance. Mailings that stated the statutory penalty for failing to file elicited a tax return from 10.1% of intended recipients, more than triple the response rate to the contact-only control mailings and more than any other treatment mailings. Taxpayers in the penalty salience treatment were most likely to file back-year returns, most likely to admit tax due, and most likely to remit payment. Taxpayers responded more promptly to the penalty salience message, sometimes after receiving just the postcard, before the letter was even delivered.

The compliance cost mailings were also effective at raising response rates relative to a contact-only control, but the response quality was lower than the penalty salience mailings. Whereas all other treatment mailings differed only by one or two sentences in a prominent box on the postcard or letter, the compliance cost treatment letter also enclosed a blank tax form and return envelope. The response rate to the compliance cost mailings was 6.2%, double the response rate to the contact-only control mailings. However, the returns that

were filed in response to the compliance cost mailings were more likely to claim refunds and less likely to admit tax due than the returns filed in response to the penalty salience mailings. Taxpayers also filed fewer back-year returns in response to compliance cost mailings.

Adding to the penalty salience message a punishment probability message that informed nonfilers that the city tax authority knew their 2014 federal income dampened response rates relative to the penalty salience message by itself. The idea behind the punishment probability message is that revealing the nonfiler's federal income demonstrates that the tax authority has the ability to monitor taxpayer behavior and therefore raises the perceived probability of punishment. On its own, the punishment probability message raised response rates relative to the contact-only control. If the punishment probability and penalty salience messages both operated exclusively through their intended channels, we would expect that including both messages would raise response rates relative to one or the other by itself (Erard and Ho 2001). However, when mailings included both the punishment probability message and the penalty salience message, the response rate was lower than the response rate to mailings with just the penalty salience message. This surprising result may be a consequence of limited taxpayer attention, supporting the conclusions from prior literature that simplicity is important in communication with taxpayers (Bhargava and Manoli 2015).

This is the first controlled experiment to test the effectiveness of a civic pride message on city taxpayers, and the response rate was statistically indistinguishable from the contact-only control. The civic pride message reminded taxpayers that the collection of taxes is essential to the successful resurgence of the City of Detroit. Kettle et al. (2016) found no impact of a "national pride" message on payment rates among Guatemala corporations. Prior tax experiments have tested the efficacy of other moral appeals: public service, fairness, and compliant majority messages. Consistent with the results of this experiment, most prior literature finds that moral appeals are not as effective as messages about the probability of being caught and the penalty if caught (Slemrod 2015).

I find no evidence of geographic network effects. Network effects can be important even when per-neighbor effects are very small because treated individuals can have many neighbors. To investigate geographic network effects, I compute the distance between every treated nonfiler and every untreated taxpayer who filed a return within 90 days of the first postcard in the experiment. The effect of treatment mailings on filing rates of taxpayers within 100 meters of treated nonfilers was not statistically significant, and this finding was robust to alternative distances. If there are network effects from treatment, they are likely through family or coworkers rather than geographic neighbors.

I assess the revenue and welfare effects of the experimental mailings. I estimate that the penalty salience treatment raised marginal revenue net of administrative costs by \$8 per letter. A back-of-the-envelope application of marginal net revenue to the population of 42,754 nonfilers who fit the sample selection criteria implies that the penalty salience mailings could have generated net revenue of \$342,000. Accounting for the private costs to taxpayers of foregone consumption and compliance costs, the baseline estimate finds that even the most effective treatment had a negative effect on social welfare. However, the welfare estimate is sensitive to assumptions about the social value of public spending and the cost of compliance.

If collecting revenue is valued highly relative to private compliance costs, then net welfare can be improved relative to the penalty salience treatment by refining the sample selection criteria. Taxpayers with higher income, older taxpayers, and taxpayers who were identified as nonfilers for the first time in tax year 2014 were more responsive to all treatments including penalty salience. The effects of age, income, filing history, and treatment status appear to be positive even when they are all at play. Higher income taxpayers are also likely to have larger tax liability net of compliance costs. Relative to applying the penalty salience treatment to the entire population of interest, net welfare could be improved by focusing on a smaller population with higher response rates and higher expected liability net of compliance costs.

Section 2 gives background on the income tax system, the decision to file, and the estimated number of nonfilers in Detroit. Section 3 presents the design of a controlled field experiment. Section 4 presents the results of the field experiment. Section 5 conducts a normative analysis. Section 6 discusses the results in the context of prior literature. Section 7 concludes.

2   Background

2.1   Tax system

The City of Detroit levies an income tax on local residents and local workers. Regardless of where they work, residents owe 2.4% of income, with an exemption of $600 per filer, spouse, or dependent. People who work in Detroit but reside elsewhere owe 1.2% of income earned in Detroit with the same exemption levels. Detroit imposes other taxes such as property tax, but my focus here is on the income tax.[1]

Whether the worker or the firm remits income tax to Detroit depends on worker classification and firm location. A firm must classify workers as either employees or contractors.[2] A firm located in the city must withhold from employees and remit income tax to Detroit. However, a firm located outside the city is not required to withhold Detroit income tax from employees, even if the employees owe Detroit income tax because they are Detroit residents.[3] A firm never remits income tax on behalf of contractors, regardless of the firm's location. City tax administrators believe one reason remittances by firms have fallen is that an increasing share of the workforce is classified as contractors.[4]

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[1]Many localities levy income tax. Appendix Table A.1 reports a count of localities by state.

[2]Generally, workers who receive benefits and over whom the firm has control are employees. The IRS has guidelines for distinguishing employees from contrators: https://www.irs.gov/businesses/small-businesses-self-employed/independent-contractor-self-employed-or-employee.

[3]State legislation may soon require firms outside the city to withhold and remit income tax on behalf of Detroit residents. See House Bill 4829 of 2015: http://legislature.mi.gov/doc.aspx?2015-HB-4829.

[4]"Detroit Chief Financial Officer John Hill blamed the [revenue] shortfall on a reduction in income tax withholding by employers in the city. In February, he told the Financial Review Commission, the state

Reporting requirements also depend on worker classification and firm location. Firms issue forms that summarize annual income to all workers—a Form W2 for employees and a Form 1099 for contractors. A taxpayer must include a copy of W2s and 1099s she received when she files a tax return with the city. A firm located in Detroit must report to the city the income and withholding information from any W2 or 1099 forms it issues. A firm located outside Detroit is not required to report income earned by Detroit residents.

Tax enforcement in Detroit is severely limited by administrative capacity. Detroit struggles just to process returns submitted on time by compliant taxpayers.[5] Around the time of Detroit's bankruptcy in July 2013, lawyers for the city who wanted to sue taxpayers with known tax due were limited by the court, which had insufficient staff to process more than five such cases per week. Prior to tax year 2015, Detroit did not accept electronic returns; taxpayers were required to mail a paper return to a post office box or deliver a paper return in person to the municipal center.[6]

Within these limits, Detroit does audit tax returns, but not the same way as the IRS. For tax year 2014, Detroit contracted with Chase Bank to scan and manually key tax returns into a data file, which was then loaded into proprietary software called CityTax. City auditors can check information from returns in CityTax against information on federal income tax returns that are shared with Detroit by the IRS.[7] Whereas IRS audits often independently verify information supplied by a taxpayer, the vast majority of Detroit audits currently go no

board overseeing Detroit's fiscal affairs post-bankruptcy, that he believes a fair number of the new workers downtown are contract workers." *Detroit Free Press*, March 7, 2015.

[5]"Taxpayers often wait months or even years before their refund checks arrive." *Detroit Free Press*, March 7, 2015.

[6]Detroit's tax administration is changing. In recognition of capacity constraints, Detroit turned over primary responsibility for processing city returns to the state beginning with tax year 2015. Even as Detroit ceded some responsibility to Michigan, the city maintained its own compliance and enforcement apparatus. The sample in this paper is for tax year 2014, for which the city retained full responsibility.

[7]The IRS shares federal tax information with state and local governments for the purpose of tax enforcement. Third party information reporting is an important mechanism of tax enforcement, as noted by, for example, Erard and Ho (2004) and Pomeranz (2015). This context is somewhat unusual because the "third party" is another level of government.

further than comparing the information in the city return to the information in the federal return. Information on the federal return is treated as verification.

Michigan gives cities legal tools for income tax enforcement. A city tax authority is permitted to examine records that will help it to assess tax liability, including the tax liability of individuals who did not file a return but are believed to owe income tax. The city does not have automatic subpoena power over records, but it can sue noncompliant individuals in court to compel documents. Willful failure to file a return, remit tax owed, or permit the tax authority to examine records is a misdemeanor.[8]

Detroit has two available pathways for pursuing identified individuals who have not filed a tax return. The first pathway is to send a "proposed assessment" to the taxpayer based on the city's belief of what the taxpayer owes. If the taxpayer receives and does not dispute the proposed assessment, the tax debt becomes official. If the taxpayer then does not remit the tax debt, Detroit sends the debt to a collection agency. The second pathway is a criminal procedure. The city can charge an individual who fails to file a tax return with a misdemeanor. For many years, Detroit has used the first pathway exclusively—issuing proposed assessments and forwarding unpaid tax debt to a collection agency.

As part of the proposed assessment pathway, the city must be able to prove that the taxpayer received the proposed assessment in order for the tax debt to become official. There is no such notification requirement for the city to charge taxpayers with a misdemeanor. To be courteous and reduce enforcement costs, city administrators prefer to communicate with taxpayers prior to charging them with a misdemeanor, but Detroit is under no legal obligation to do so. The city's burden of ensuring the taxpayer is notified when it pursues the proposed assessment pathway may have led taxpayers to believe that they could avoid getting in trouble by refusing to accept the treatment letter, which was sent via certified

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[8]City Income Tax Act of 1964, Act 284 at 141.673 and 141.699: https://legislature.mi.gov/documents/mcl/archive/2014/May/mcl-Act-284-of-1964.pdf.

mail and therefore required a signature for delivery.

2.2 Filing decision

The logic of the standard model of income reporting can be naturally extended to the decision whether to file a return. In the standard model of Allingham and Sandmo (1972), taxpayer reports depend on the probability of audit and the penalty for a false report. In an extension by Erard and Ho (2001), taxpayer choice of whether to file a return depends on the probability of detection and the penalty for nonfiling. One suspects that Detroit residents and workers correctly perceive that the probability of punishing nonfilers is low. However, the statutory penalty for failing to file an income tax return is substantial: a fine of up to $500 and up to 90 days in jail.

The extended model of filing a return includes compliance costs, which appear to be important in Detroit. Many workers who are owed a refund from the city, because they have income tax withheld from their paychecks exceeding tax liability, still fail to file a return. The standard model cannot explain this behavior. It is possible that some of these workers decide not to claim a refund as a form of "donation" to the city, but it seems likely that compliance costs are more important. Compliance costs should be at least as large for taxpayers with tax due as it is for taxpayers who are owed a refund. So taxpayers with tax due are discouraged from filing a return both by the prospect of remitting tax and by the compliance costs.

There may also be nontax reasons to avoid truthfully reporting residence. For instance, car insurance rates are particularly high in Detroit, higher than in districts immediately adjacent to the city.[9] A resident of downtown Detroit would save money on car insurance

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[9]According to carinsurance.com, the average annual auto insurance rate was $1,400 higher in central Detroit than in selected suburbs adjacent to Detroit. Reported auto insurance rates are averages by zip code for a 2014 Honda Accord for a single 40-year-old male with a clean record and good credit. The average rates in central Detroit were $4,846 in Downtown (zip code 48226), $5,025 in Midtown (48201), $4,945 in New Center / North End (48202), $4,827 in Downtown (48207), and $4,636 in Corktown / Woodbridge (48216).

by claiming residence at a suburban address. Workers may believe their true residence is more likely to be detected by the car insurance company if it is truthfully reported on an income tax return. To the extent that truthfully reporting residence is necessary for renters or homeowners insurance, desire for those insurance services could act in the opposite direction. So the decision not to file a return may be jointly determined by considerations of the probability of detection by the tax authority, the penalty for detection, compliance costs, and nontax reasons for claiming residence in a particular location.

It is also possible that failure to file a return is not the result of a conscious decision or optimizing behavior. Some taxpayers may mistakenly believe that they filed a city return electronically. Many taxpayers file federal and state returns electronically, but Detroit did not accept city tax returns electronically prior to tax year 2015. If taxpayers use tax preparation software, they may think they are done with all of their federal, state, and local returns when they click the submit button, but that is not true if they owe Detroit income tax. Detroit only processes income tax returns that are mailed to a post office box or hand delivered. Furthermore, some Detroit residents and workers, especially those new to the area, may honestly be unaware that Detroit has an income tax.[10]

2.3 Nonfiler population size

In designing a tax enforcement approach to nonfilers, it would be helpful to know how many nonfilers there are. That would be easy for a tax administrator to calculate if she knew who is in the tax base and who filed tax returns. The identity of filers is known, but the identity and size of the tax base is unknown. Detroit's income tax base consists of residents and

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The average rates in selected suburbs were $3,491 in Southfield (48075), $3,489 in Oak Park (48237), $2,621 in Ferndale (48220), $3,139 in Grosse Pointe (48230), and $4,256 in Dearborn (48126).

[10]Awareness of Detroit's income tax seems comparable to awareness of city income tax in Ohio cities Cincinnati and Columbus, judging by an index of search interest from Google Trends. See Appendix Figure A.1. Hoopes, Reck, and Slemrod (2015) discuss tax enforcement with uninformed taxpayers.

workers whose income exceeds the exemption amount.[11]

I estimate the number of people who owed Detroit income tax for tax year 2014 to be approximately 387,000. To calculate this figure, I use the Current Employment Statistics (CES) program of the Bureau of Labor Statistics to estimate the number of people who work in Wayne County and the number of employed Wayne County residents. I then utilize Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics from the Census Bureau to estimate Detroit's share of workers in Wayne County and Detroit's share of employed residents of Wayne County. Table 1 shows that the estimated income tax base of Detroit was 387,000 people when these shares from LEHD are applied to the workforce of Wayne County from CES.

For a given tax year, the population of nonfilers shrinks over time because many individuals file city tax returns months or years late. The population of nonfilers for a given tax year is thus a moving target. For example, Detroit received 155,000 tax year 2011 returns on time by April 2012, 42,000 additional tax year 2011 returns over the next 12 months by April 2013, 12,000 additional tax year 2011 returns by April 2014, and 3,000 additional tax year 2011 returns by April 2015. Filing patterns are similar for other tax years. For the purpose of cross-year comparisons, it is therefore important to specify the date on which the population is being measured.

As of April 2016, when the field experiment began, I estimate the number of people who were Detroit nonfilers for tax year 2014 to be 179,000. The estimate comes from subtracting the actual number of people in the tax base who filed returns from the estimated total number of people in the tax base. That estimate implies that 46% of individuals who were required to file Detroit tax returns failed to file a return. Assuming 40% of joint returns have two earners, as in Table 2, and that 17.3% of nonfilers would file joint returns, there were 167,000 missing returns, equal to 48% of required returns.[12]

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[11]The exemption amount is $600 per filer, spouse, and dependent.

[12]Erard et al. (2014) estimate there were 7.6 million federal individual income tax nonfilers in 2012 (6.1%

Table 1: Estimated Detroit Tax Base

Year	Detroit residents who work in Detroit	Detroit residents who work elsewhere	Nonresidents who work in Detroit	Total
2012	68,970	191,878	121,542	382,389
2013	66,468	191,176	123,256	380,901
2014	67,562	194,144	125,398	387,103

Note: Estimates of Detroit resident-workers, nonresident workers, and worker nonresidents are obtained by applying Detroit shares of Wayne County workers and employed residents to the workforce of Wayne County. Detroit shares of Wayne County workers and employed residents are from the Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics from the Census Bureau. Wayne County workforce is from the Current Employment Statistics (CES) program of the Bureau of Labor Statistics.

A notable source of uncertainty is the number of joint filers who earned income. When all income is reported by third parties to the tax authority on Form W2 for employees and Form 1099 for contractors, then the tax authority knows whether one or both individuals in a couple filing jointly are among the 387,000 individuals in the tax base. However, for income with no third-party reporting, there is no way to know whether each individual is in the tax base. Table 2 shows the computation of nonfilers by subtracting the number of people in the tax base who filed returns from the number of people in the tax base.

This section provided context for the controlled field experiment by describing the income tax system in Detroit, identifying factors that influence the failure of a taxpayer to file a return, and estimating the size of Detroit's nonfiler population. The next section explains the design of the experiment.

3 Design of a controlled field experiment

3.1 Sample

A sample of 9,523 individuals for the field experiment was randomly selected from the population of 42,754 suspected nonfilers who met the following sample selection criteria: (1)

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of required returns). Among suspected resident nonfilers identified from federal income tax returns, 17.3% filed joint federal returns.

Table 2: Estimated Detroit Nonfilers

Year	Individuals in Detroit tax base	Returns filed	Joint returns	Joint returns with two earners	Nonfilers
2012	382,389	205,275	82,046	32,135	144,979
2013	380,901	193,455	77,084	31,133	156,313
2014	387,103	178,859	72,843	28,847	179,397

Note: Individuals in Detroit tax base (column 2) is author's estimate explained in the text and Table 1. Returns filed (column 3) includes resident, non-resident, and partial-year returns. A return is considered to be a joint return (column 4) if it was marked as such by the taxpayer. A return is considered to be a joint return with two earners (column 5) if there was a W2 associated with the "secondary" social security number. Nonfilers (column 6) is equal to the size of the tax base (column 2) less the number of returns (columns 3) and the number of joint returns with two earners (column 5).

The IRS identified the individual as a federal taxpayer with a Detroit residence and income taxable to Detroit in tax year 2014. (2) Detroit had no record of the individual filing a 2014 city income tax return as of April 2016. (3) Detroit estimated the individual had 2014 tax due to the city of at least $350. (4) Detroit had no record of the individual passing away or filing for bankruptcy. (5) The individual's address appeared to be valid.[13] Of the 185,137 taxpayers who met the first two criteria, approximately 135,000 were eliminated from consideration by the third criterion because Detroit estimated the individual had 2014 tax due to the city of less than $350.

Detroit estimates tax due from nonfilers using an algorithm that includes federal income information from the IRS and local withholding information from city employers. The city's algorithm for estimating tax due is correct within $15 of reported tax due for 70% of taxpayers who file both local and federal returns. Incomplete withholding information from employers causes discrepancies between Detroit's estimation of tax due and actual tax due. Detroit's estimation of tax due is too high for nonfilers with employers who did not submit W2s to the city electronically.[14] Two sources of income—active duty military pay and pension

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[13]To avoid pursuing individuals who were not actually Detroit residents, addresses were excluded if they had a zip code that is shared between Detroit and another city (e.g. Highland Park). To reduce the nondelivery rate, addresses were excluded if they had a street name that was not shared by other federal taxpayers, on the grounds that it was likely to be an erroneous address.

[14]Detroit accepts W2s from employers in electronic (online or CD) and paper format. Around 4% of

income—also cause discrepancies between Detroit's estimation of tax due and actual tax due. Detroit's estimation of tax due is too high for nonfilers with these types of income.[15]

Detroit excluded taxpayers with addresses that were likely to be invalid. For prior tax years, Detroit sent tens of thousands of letters to nonfilers, thousands of which were returned as undeliverable. For tax year 2014, Detroit used a filter on addresses that marked about 7% of IRS addresses as likely to be invalid prior to sample selection. The United States Postal Service contracts with private vendors to offer paid address verification services, but Detroit does does not pay for those services.

Table 3 reports summary statistics for individuals who filed a federal return in tax year 2014 with a Detroit address by local filing status, sample eligibility, and sample selection. Among federal filers, individuals who failed to file a city return were younger on average and more likely to file as a head of household. Local nonfilers had lower income, and they were much more likely to have been identified by Detroit as a nonfiler for a tax year prior to 2014. Around 84% of nonfilers in the sample were also identified as a nonfiler for a prior year.

3.2 Experimental treatments

Taxpayers in the sample were sent two separate mailings in sequence, one week apart. The first mailing was a postcard, and the second mailing was a letter.[16] The postcard listed

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the 12,700 employers who file an annual report with individual income tax withholding do so electronically. If an employer submitted a W2 electronically, then Detroit used the withholding amount for the nonfiler to estimate tax due. W2s that were submitted in paper form only were not digitized or used to estimate individual income tax due. By dollar value, around 20% of tax prepayments reported on city returns, including employer withholding and estimated payments from business income, are visible to the tax division and able to be connected to the taxpayer before receiving the city return.

[15]Active duty military pay appears as wage (W2) income on a federal 1040. It is taxable income to the federal government, but it is not taxable income to Detroit. Detroit cannot systematically distinguish between active duty military pay and other wage income, although it can request that information for individual taxpayers. Similarly, pension income appears as other (1099-MISC) income on a federal 1040. It is taxable income to the federal government, but it is not taxable income to Detroit. As with military pay, Detroit cannot systematically distinguish between pension income and other income from a 1099-MISC, although it can request that information for individual taxpayers.

[16]To track delivery, the letters were sent via United States Postal Service certified mail. Certified mail requires a signature for delivery, either in person or on a card left by the letter carrier.

Table 3: Summary Statistics (TY 2014)

	Filer		Nonfiler		Population		Sample	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Age	50.2	15.4	44.8	17.5	39.6	12.0	39.6	12.0
FS = single (%)	46.4	49.9	43.4	49.6	39.4	48.9	39.2	48.8
FS = married filing jointly (%)	26.9	44.3	17.3	37.8	10.6	30.8	10.8	31.0
FS = head of household (%)	24.3	42.9	37.9	48.5	48.6	50.0	48.6	50.0
Years identified as nonfiler	3.5	2.2	4.1	2.4	4.3	2.5	4.3	2.5
Filed in 2012 or 2013 (%)	82.4	38.1	15.2	35.9	23.3	42.2	22.4	41.7
Total income ($ 000s)	57.0	91.6	40.1	175.3	33.9	42.6	33.4	24.7
Wage income ($ 000s)	44.4	61.3	27.5	80.2	31.4	23.3	31.3	23.7
Log total income	10.3	0.7	10.0	0.5	10.3	0.5	10.3	0.5
Nonzero nonwage income (%)	36.4	48.2	42.9	49.5	29.5	45.6	29.5	45.6
Observations	61,632		185,342		42,754		9,523	

Note: This table reports means and standard deviations of taxpayer characteristics from administrative tax data. "Filers" are taxpayers identified by the IRS as Detroit residents who filed both a federal return and a city return for tax year 2014. "Nonfilers" are taxpayers identified by the IRS as Detroit residents who filed a federal return but not a city return for tax year 2014. "Population" is the subset of Nonfilers who met all five sample selection criteria, including estimated tax due of at least $350. "Sample" is the subset of Population that was randomly selected for the experiment.

the types of income that are taxable by Detroit and directed taxpayers where to find tax forms and filing instructions. The letter informed the nonfiler that Detroit believes they had taxable income and failed to file a city tax return for tax year 2014. Taxpayers were randomly assigned to a treatment status, which varied the content of a prominent box in both the postcard and the letter. Table 4 reports the message associated with each treatment status. Examples of postcards and letters are in Appendix Figure A.2.[17]

Penalty salience. One treatment status tested whether penalty salience affects tax compliance. The boxed message stated that failure to file a tax return is a misdemeanor, and the statutory penalty for the misdemeanor is a fine of up to $500 and 90 days in jail. Absent this treatment, the statutory penalty was almost certainly unknown by the vast majority of Detroit residents. The city had not prosecuted anyone under the misdemeanor provision for many years. The message in this treatment status was not phrased as a threat, but it is comparable to other field experiments that test "threats" of various sorts.[18]

Punishment probability. Another treatment status was intended to affect the perceived

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[17]This study was submitted for approval to the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board. The IRB determined that this study had a status of "Not Regulated".

[18]The "threat" treatment in Chirico et al. (2015) actually uses threatening language. Most other threat treatments are based on the threat of auditing a return, rather than the threat of punishment if no further action is taken.

Table 4: Experimental treatments

Treatment	Intervention	Message in prominent box on letter[a]
Penalty salience	Postcard and letter	Failure to file a tax return is a misdemeanor punishable by a fine of $500 and 90 days in jail.
Punishment probability	Postcard and letter	Our records indicate you had federal total income of $X for tax year 2014.[a]
Compliance cost	Postcard and letter, form and return envelope enclosed with letter	For your convenience, City Income Tax Form D-1040(R) is enclosed with this letter.[a]
Civic pride	Postcard and letter	Detroit's rising is at hand. The collection of taxes is essential to our success.
Penalty salience × Punishment probability	Postcard and letter	Our records indicate you had federal total income of $X for tax year 2014. Failure to file a tax return is a misdemeanor punishable by a fine of $500 and 90 days in jail.[a]
Contact-only (control)	Postcard and letter	None
No-contact (control)	None	N/A

Note: This table describes the experimental treatments. 1,200 taxpayers were assigned to each experimental treatment other than the no-contact control, to which 2,400 taxpayers were assigned.
[a] The boxed message was exactly the same on the postcard and the letter within each treatment other than the punishment probability treatments and the compliance cost treatment. In the punishment probability treatments, the boxed message on the postcard was, "The letter you receive will indicate how much taxable income you had in tax year 2014." In the compliance cost treatment, the boxed message on the postcard was, "For your convenience, City Income Tax Form D-1040(R) will be enclosed with the letter."

probability of punishment. The boxed message revealed that Detroit knew the recipient's total federal income, which is among the information provided by the IRS to Detroit. The rationale for this treatment is that a taxpayer will feel punishment is more likely if the tax authority reveals that it has relevant information. Revealing this information is intended to raise the perceived probability of punishment, relative to the letters that do not reveal that Detroit has information about the taxpayer other than name and address.

Compliance cost. The cost to the taxpayer of filing a return was reduced by a treatment status that enclosed a blank tax form and a return envelope. The enclosed return was for

Detroit residents for tax year 2014, Form D-1040(R).[19] The boxed message referred to the tax form as being provided for the convenience of the recipient. Although the monetary cost of the form and envelope is small, the nonmonetary cost could be substantial, including the time and effort to find the form online or retrieve it from the Coleman A. Young Municipal Center in downtown Detroit.

Civic pride. One set of mailings tested the effect of an appeal to civic pride. The boxed message proclaimed the importance of tax collection to the resurgence of Detroit. This is the first moral appeal of its kind, but it is not the only type of moral appeal that is potentially relevant in communication with taxpayers. In similar tax enforcement field experiments, moral appeals to taxpayers have (1) reminded taxpayers of services provided by tax dollars, (2) informed taxpayers about the compliance rate of their neighbors, and (3) referred to a general principle of equity or fairness.

Penalty salience × punishment probability. The messages in the penalty salience treatment status and the punishment probability treatment status were combined in a separate treatment group. The boxed message stated the taxpayer's income first, then the penalty. Standard theory about the decision to file suggests that the interaction between penalty salience and punishment probability should be important. If the other treatments are effective and operate through the intended channel of raising the perceived penalty and probability of punishment, then we would expect the interaction treatment to elicit a higher response than either by itself.

Control. Two groups of nonfilers were assigned to "control" groups. One group received no contact at all, and the other group was sent mailings with the prominent box omitted from both the postcard and the letter. There is considerable evidence that taxpayers respond to any kind of contact from the tax authority, probably because it alerts the taxpayer that

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[19]The individual income tax form for nonresidents, Form D-1040(NR), was sent to some nonfilers in the experiment in place of the tax form for residents.

the tax authority can monitor their behavior, so it is important to isolate the effect of the contact-only mailings from the effect of the particular messages in the other treatment groups.[20]

From the population of 42,754 nonfilers that met the sample selection criteria, 1,200 individuals were randomly selected for each of the 6 treatment groups that received letters (including the contact-only control group), and 2,400 individuals were randomly selected to be in a no-contact control group. To stay within the limits of the Detroit tax division's administrative capacity, the postcards and letters were sent in staggered batches.[21] Each batch had an approximately equal number of nonfilers from each treatment group. Individuals in the no-contact group were assigned to batches as if they were being sent postcards and letters. There were 119, 581, 2,160, 2,160, and 2,160 individuals in batches one through five, respectively.[22] The treatment groups are not exactly the same size because the city's address filter was refined shortly before sending the second batch. Also, individuals were removed from the sample if they filed a city tax return between the time the sample was selected and the time the postcards were mailed. Individuals removed from the sample were replaced with other individuals randomly selected from the population of nonfilers whenever possible. Appendix Table A.2 reports summary statistics by treatment status.

This field experiment was accompanied by another change that may have affected response rates. The State of Michigan took responsibility for processing individual City of Detroit income tax returns for tax year 2015. The state did not take any responsibility for past returns, so there is no direct impact on tax year 2014 returns. The shift to processing

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[20]Chirico et al. (2015) and Fellner, Sausgruber, and Traxler (2013) describe field experiments that used similar contact-only letters to isolate the response to particular messages from the response to contact from the tax authority.

[21]The tax division reports that it was unable to handle the phone calls that resulted from large batches (tens of thousands) of similar letters to nonfilers in past years. That likely dampened response rates and the effectiveness of contact. Therefore, in this field experiment, postcards and letters were dispersed in batches.

[22]Postcards were sent on April 18, May 2, May 16, June 1, and June 13-15. Letters were sent on April 25, May 9, May 24-26, June 9, and June 23.

tax returns by the state was not directly related to this experiment, although both were motivated by a desire by city administrators to improve the efficiency of tax enforcement. There is no reason to think that nonfilers in one treatment status had a different level of exposure to this change than nonfilers with a different treatment status.

4   Results

Table 5 summarizes the response of nonfilers to mailings in the field experiment. Of the 7,142 taxpayers in the sample to whom mailings were sent, 450 taxpayers (6.3%) responded by filing a return within 75 days of the initial mailing. Even though the mailings only mentioned tax year 2014 specifically, many taxpayers filed returns for multiple years, such that the number of returns per filer was 1.16.[23]

Inclusion in the sample was conditional on the city estimating tax due above $350, but 34% of returns nevertheless claimed a refund.[24] Of returns claiming refunds, the average refund size was $75. About half of the returns that were filed admitted tax due, and on returns that admitted tax due the average due was $379. Taxpayers are instructed to remit payment along with the return, but only 56% of returns that admitted tax due were accompanied by a remittance. The average remittance was $316. The sum of refunds claimed by taxpayers who received mailings was $13,109, the sum of tax due admitted was $91,642, and the sum of payments remitted was $42,712.

4.1   Response to mailings

Figure 1 shows the fraction of sampled suspected resident nonfilers who filed a return within 75 days of the initial mailing. The penalty salience mailing elicited the highest response

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[23]When a taxpayer calls or visits the tax division, staff instruct the taxpayer to file returns for all missing years.

[24]The most common discrepancy between estimated and actual tax due is withholding that Detroit did not connect with an individual taxpayer. However, many individuals claimed a refund without enclosing a W2 to prove withholding, and without a W2 the city does not issue a refund.

Table 5: Summary of response

	Contact only	Penalty salience	Punishment probability	Compliance cost	Civic pride	Salience x Probability	All letters	No contact
Sample size	1,185	1,191	1,191	1,189	1,195	1,191	7,142	2,381
Filers	36	120	58	74	46	116	450	7
Returns filed	39	153	69	83	50	129	523	7
Claiming refund	16	44	19	34	21	41	175	5
Admitting tax due	15	80	37	30	18	62	242	2
Remitting payment	10	44	19	16	10	36	135	1
Total claimed ($)	758	3,092	834	3,367	1,276	3,782	13,109	297
Total admitted ($)	6,183	33,413	11,494	9,388	11,804	19,360	91,642	1,720
Total remitted ($)	5,046	17,237	4,353	2,157	4,278	9,641	42,712	1,690
Filed % of sample	3.0	10.1	4.9	6.2	3.8	9.7	6.3	0.3
Returns per filer	1.08	1.27	1.19	1.12	1.09	1.11	1.16	1.00
Refund % of returns	41.0	28.8	27.5	41.0	42.0	31.8	33.5	71.4
Tax due % of returns	38.5	52.3	53.6	36.1	36.0	48.1	46.3	28.6
Payment % of returns	25.6	28.8	27.5	19.3	20.0	27.9	25.8	14.3
Avg refund claimed ($)	47.38	70.27	43.89	99.03	60.76	92.24	74.91	59.40
Avg due ($)	412.20	417.66	310.65	312.92	655.78	312.26	378.68	860.00
Avg remittance ($)	504.60	391.75	229.11	134.81	427.80	267.81	316.39	1690.00
Claim per letter ($)	0.64	2.60	0.70	2.83	1.07	3.18	1.84	0.12
Due per letter ($)	5.22	28.05	9.65	7.90	9.88	16.26	12.83	0.72
Remit per letter ($)	4.26	14.47	3.65	1.81	3.58	8.09	5.98	0.71

Note: This table reports summary statistics for responses within 75 days of sending the postcard. It includes information from returns received through the income tax division's post office box and returns processed by Chase Bank. Initially, 1,200 taxpayers were selected to be sent each of the treatment mailings. A few taxpayers were removed without being replaced because the city refined its address validity criteria, and a few taxpayers were removed without being replaced because they filed a tax return shortly before the postcard would have been sent.

rate (10.1%), followed by penalty salience × punishment probability (9.7%), compliance cost (6.2%), punishment probability (4.9%), civic pride (3.8%), and contact-only (3.0%) mailings. The individuals in the no-contact control group, of course, did not receive a letter, and the "response" rate of filers as a percent of the no-contact sample was 0.3%. Each individual in the no-contact control was assigned to a batch of outgoing postcards, so a return from a no-contact individual is considered to be a response if it is received within 75 days of the date the postcards were sent to that batch, just as if the individual had been sent a postcard.

Table 6 reports the estimated effects of sending experimental mailings on response rates. In this experiment, estimating the effect of sending experimental mailings on filing behavior is straightforward because suspected resident nonfilers were randomly selected into treatments.

Figure 1: Response rate by treatment status
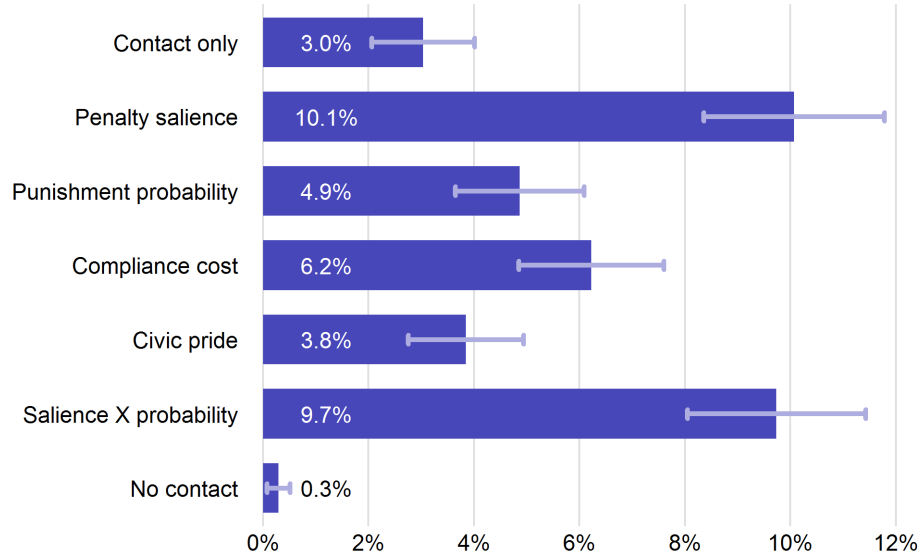
Note: This figure shows response rates by treatment status, where a response is filing a return within 75 days of the initial mailing. Standard error bars show 95% confidence intervals. Appendix Table A.2 reports summary statistics by treatment status.

To control for other characteristics that may impact response rates, treatment effects are estimated using the linear probability model

$$\mathbb{P}[response_i = 1] = \alpha + \sum \beta^j treatment_i^j + \gamma X_i, \tag{1}$$

where indicator variables denoting treatment status j ($treatment_i^j$) predict the probability that taxpayer i filed a return, with $response_i$ equal to one if the taxpayer filed a return and zero otherwise. A vector of taxpayer characteristics X_i includes age, filing status, filing history, log income, and a dummy indicator for the presence of nonwage income. Treatment effects are estimated relative to the excluded no-contact control condition, in which taxpayers were not sent any mailings. In Table 6, the dependent variable is scaled by a factor of 100 so that coefficients can be read in percentage points.

Column 5 of Table 6 reports the response rate to treatment mailings with the full set of controls. A mailed penalty salience letter raised response rates by 9.9 percentage points relative to the no-contact control, about 3.5 times the effect of the contact-only letter, which

Table 6: Response by experimental intervention, linear probability model

	(1) Filed	(2) Filed	(3) Filed	(4) Filed	(5) Filed
Treatments					
Penalty salience	9.78***	9.78***	9.96***	9.76***	9.94***
	(0.88)	(0.87)	(0.86)	(0.87)	(0.86)
Punishment probability	4.58***	4.70***	4.55***	4.57***	4.66***
	(0.63)	(0.63)	(0.63)	(0.63)	(0.63)
Compliance cost	5.93***	5.92***	5.83***	5.97***	5.86***
	(0.71)	(0.70)	(0.70)	(0.71)	(0.70)
Civic pride	3.56***	3.64***	3.34***	3.60***	3.43***
	(0.57)	(0.57)	(0.56)	(0.56)	(0.56)
Penalty X punishment	9.45***	9.46***	9.46***	9.52***	9.49***
	(0.87)	(0.86)	(0.85)	(0.86)	(0.85)
Contact only	2.74***	2.80***	2.81***	2.79***	2.84***
	(0.51)	(0.51)	(0.51)	(0.51)	(0.51)
Other variables					
Age		0.20***			0.16***
		(0.02)			(0.02)
FS = single		2.59***			1.47***
		(0.45)			(0.47)
FS = married filing jointly		4.75***			2.60***
		(0.92)			(0.97)
Years nonfiler			-0.38***		-0.52***
			(0.08)		(0.09)
Filer in 2012 or 2013			7.98***		6.35***
			(0.70)		(0.69)
Log income				4.32***	1.65***
				(0.55)	(0.58)
Nonwage income dummy				1.64***	0.93*
				(0.50)	(0.50)
Mean of dependent variable	4.80	4.81	4.80	4.80	4.81
Observations	9,523	9,508	9,523	9,523	9,508
R^2	0.027	0.048	0.056	0.040	0.072
Batch fixed effects		X	X	X	X
p-value of F-test on:					
Civic pride = Contact only	0.28	0.26	0.47	0.27	0.42
Penalty salience = Sal x Prob	0.78	0.79	0.67	0.84	0.70
Fixed effects joint significance		0.16	0.09	0.14	0.08

Note: This table estimates the response of nonfilers to experimental treatments using ordinary least squares regressions. The dependent variable is a dummy indicator (scaled by 100) for whether the suspected resident nonfiler filed a city income tax return within 75 days of the initial mailing. Mailings were sent in five batches in April–June 2016. Age is not observed for 0.2% of taxpayers in the sample. Heteroskedasticity robust standard errors in parentheses. Coefficients are significantly different from zero at the *10%, **5%, or ***1% significance level.

raised response rates by 2.8 percentage points. A mailed penalty salience × punishment probability letter raised response rates by 9.5 percentage points, the compliance cost letter by 5.8 percentage points, the punishment probability letter by 4.6 percentage points, and the civic pride letter by 3.4 percentage points.

Filing history was a significant determinant of response rates. Taxpayers who had filed a tax year 2012 or 2013 return were 6.5 percentage points more likely to respond to treatment mailings by filing a return. However, taxpayers who had previously been identified as suspected resident nonfilers were less likely to respond to treatment mailings. For each additional year of identification as a suspected resident nonfiler, the conditional expectation of the response rate was 0.5 percentage points lower.

Income was positively associated with response rates. For each point of log income, taxpayers were 1.6 percentage points more likely to respond. Taxpayers with nonzero nonwage income were 0.9 percentage points more likely to respond. Because a large portion of tax liability attributable to wage income had withholding, taxpayers with nonwage income are more likely to have net liability substantially different from zero. Taxpayers with negative nonwage income are likely to be owed a refund, and taxpayers with positive nonwage income are likely to have tax due. A higher response rate of taxpayers with nonzero nonwage income is consistent with an attitude that filing taxes is more important when there is a substantial net obligation.

4.2   Letter delivery and response to postcard

Many intended recipients never received the treatment letter. Table 7 reports the delivery status according to the USPS tracking website six months after the letters were sent. Across all treatments, 55.3% of letters had a status of delivered, 25.8% were listed as unclaimed, 11.5% were listed as undeliverable, and 7.3% were listed as in transit. The volume of letters that were still listed in some stage of transit six months after the letters were sent is an

Table 7: Nonfiler letter delivery rates

| Treatment status	Delivered		Unclaimed		Delivery status Undeliverable		In transit		Total	
Contact only	662	55.9%	285	24.1%	149	12.6%	89	7.5%	1,185	100.0%
Penalty salience	670	56.3%	294	24.7%	136	11.4%	91	7.6%	1,191	100.0%
Punishment probability	658	55.2%	334	28.0%	132	11.1%	67	5.6%	1,191	100.0%
Compliance cost	621	52.2%	311	26.2%	168	14.1%	89	7.5%	1,189	100.0%
Civic pride	643	53.8%	343	28.7%	128	10.7%	81	6.8%	1,195	100.0%
Salience X probability	697	58.5%	279	23.4%	110	9.2%	105	8.8%	1,191	100.0%
Total	3,951	55.3%	1,846	25.8%	823	11.5%	522	7.3%	7,142	100.0%

Note: This table reports the delivery status of certified letters according to the USPS tracking website. The F-statistic for equality of delivery rates (delivered % of sample) is 2.24, which is significant at the 5% level. Appendix Table A.3 reports summary statistics by delivery status.

indication of reporting error. Letters with a status of delivered or unclaimed had valid addresses or active forwarding addresses and were capable of being delivered. Letters with a status of undeliverable had invalid addresses or inactive forwarding addresses.

A potentially interesting treatment effect is the impact of *receiving* a treatment message, but estimation of this effect is not straightforward. Because the letter was sent via certified mail, we know the subsample of taxpayers to whom the letter was reported on the USPS tracking website as delivered. However, treated taxpayers were first sent a postcard and then a letter via certified mail, so they had an opportunity to decline to authorize delivery of the letter after viewing the postcard, which also had the treatment message and may have induced selection into the delivered subsample. The F-statistic for equality of delivery rates is 2.24, rejecting the null of equal delivery rates at the 5% level. In consideration of possible selection into receipt of the treatment letter, I focus on the effect of an intent to treat, meaning the response rate among the entire sample of suspected resident nonfilers. This can be interpreted as a lower bound on the effect of receiving a treatment message.

In addition to its influence on the rate at which taxpayers authorized delivery of the treatment letter, the postcard also influenced taxpayer behavior directly. The cumulative response rate over time in Figure 2 shows that some taxpayers responded to the postcard by filing a return almost immediately, even before the letter was sent a week later. Most returns were filed between 15 and 60 days after the postcard was sent, and very few returns

Figure 2: Cumulative response by treatment status
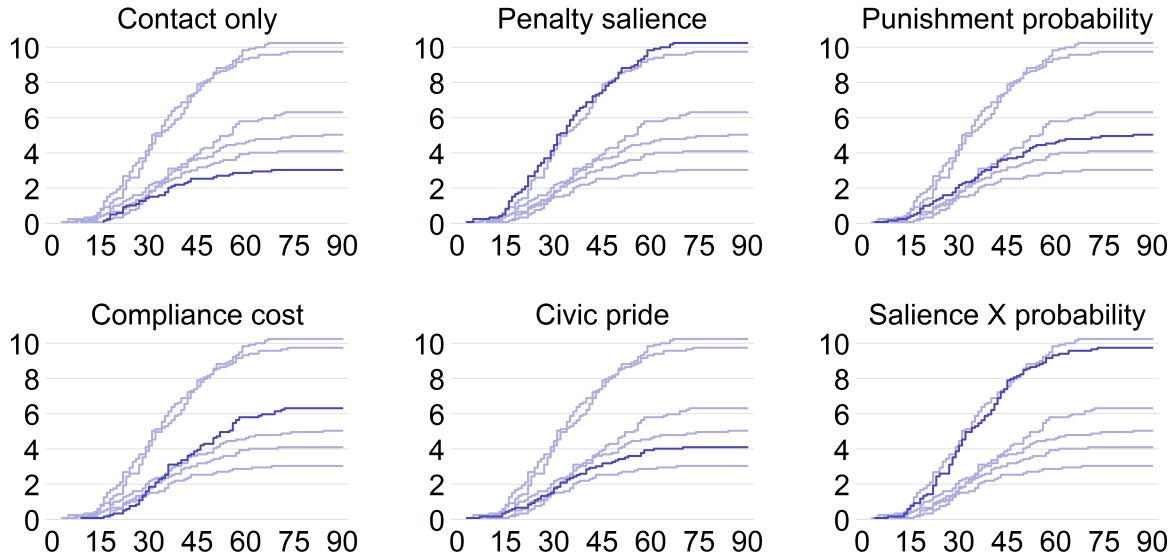
Note: These graphs show the cumulative percent of taxpayers who filed returns. The vertical axis is percent of sample, and the horizontal axis is days elapsed since the date on which the postcard was sent.

were filed after 75 days. The time pattern of responses was similar across treatment groups, except for the returns filed in response to the compliance cost mailings. The cumulative response rate to the compliance cost mailings was the lowest of all treatment mailings until about 30 days after the postcard was sent, then it rose over the following 15 days to be the third highest response rate. This is likely because the compliance cost postcard announced that the letter would enclose a blank tax form, and some taxpayers waited for the blank tax form to be delivered before taking action to respond. The contact-only response rate was zero until a full two weeks after the postcard was sent. This suggests people may not have read or seen the postcard, because the only responses were after the letter arrived. That was the only treatment without a boxed message on the postcard and letter, so it is possible that the box itself, regardless of the content, attracted attention.

4.3 Response quality

Some types of responses are better than others from an enforcement perspective. For example, a filed return accompanied by a remittance is better for net revenue from enforcement efforts than a filed return that claims a refund. This section reports treatment effects along several dimensions of response quality: the propensity of a filed return to claim a refund or admit tax due, the number of returns per filer, and the dollar amount of net tax due.

Figure 3 decomposes cumulative response rates by treatment according to whether the taxpayer had negative or positive net tax due. For the subgroup with positive net tax due, there is a large gap between the two treatments that included the penalty salience message and the four treatments that did not. However, for the subgroup that claimed a refund, the compliance cost treatment elicited nearly the same response rate as the penalty salience treatments. This was likely a composition effect: The compliance cost treatment was as effective as the penalty salience treatment among taxpayers who were owed a refund, but the compliance cost treatment was no more effective than the punishment probability treatment among taxpayers who had tax due.

The penalty salience mailings elicited more returns per filer and more remitted dollars than other treatments. Table 5 shows that the penalty salience mailing elicited 1.27 returns per filer, whereas the other mailings elicited just 1.08 to 1.19 returns per filer. The number of returns per filer may have been mediated by direct contact with the tax authority. Taxpayers in the penalty salience treatment group were relatively more likely to call or visit the tax division, and taxpayers who called or visited the tax division were instructed by staff to file all delinquent returns including for tax years other than 2014.

Table 5 also shows that taxpayers admitted tax due of $28.05 on average in response to the penalty salience mailings but just $5.22 to $16.26 in response to the other mailings. Similarly, taxpayers remitted $14.47 on average in response to the penalty salience mailings but just $1.81 to $8.09 in response to the other mailings. The difference in remittances and

Figure 3: Cumulative response by treatment status and net tax due

(a) Claiming refunds

(b) Admitting tax due
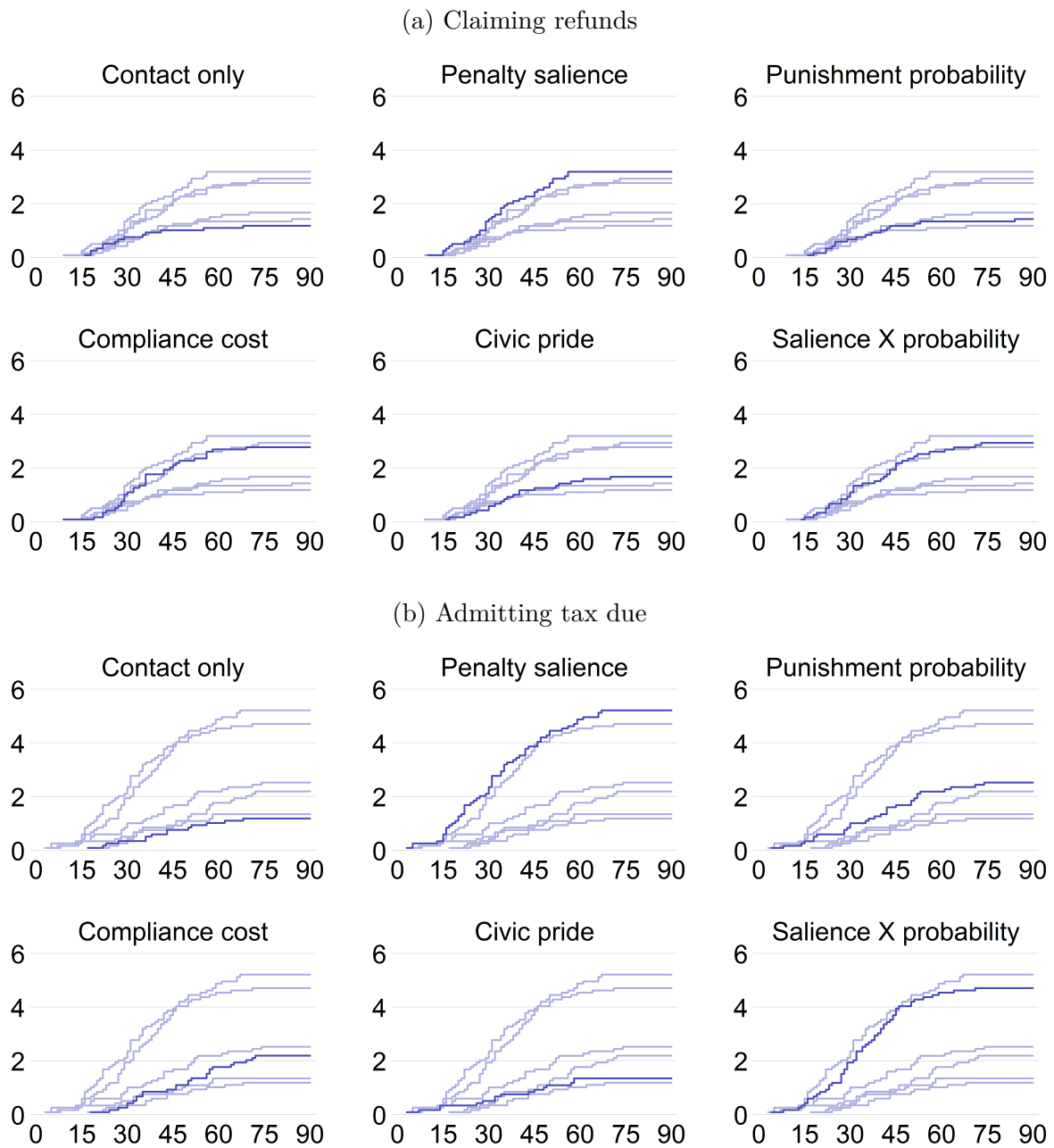
These graphs show the cumulative response rate. The vertical axis is percent of sample, and the horizontal axis is days elapsed since the date on which the postcard was sent. Panel (a) shows the cumulative percent of taxpayers who filed returns claiming a refund. Panel (b) shows the cumulative percent of taxpayers who filed returns admitting tax due.

admitted tax due is largely attributable to the difference in response rates. However, the penalty salience × punishment probability mailings elicited nearly the same response rate as the penalty salience mailings but still had substantially lower remittances. The average dollar figures are sensitive to outliers, so the response rates are measured more precisely.

4.4 Heterogeneity of response

A particular treatment message could be effective for eliciting a return from some taxpayers and not others. Similarly, nonfiler letters overall could be well-suited as an enforcement tool for some taxpayers and poorly-suited for others. To inform the welfare and policy discussion, this section examines heterogeneous response to treatment with respect to filing history, age, and income.[25]

Taxpayers who were identified as nonfilers from federal returns in more years were less likely to respond to experimental mailings. Figure 4 shows that this pattern holds across treatments, and it is more pronounced in the treatments that elicited higher response rates.

Older taxpayers responded to experimental mailings at higher rates than younger taxpayers. This was true across all treatments, and the gap was larger for the more effective mailings. To examine the heterogeneity by age, Figure 5a plots a fractional polynomial regression of response rate on age within each treatment.[26] Taxpayers under age 40 had a response rate below 10% for the penalty and penalty salience × punishment probability treatments and below 5% for the other treatments. Response rates appear to be convex in age, such that response rates increase from age 40 to 50 and increase by even more from age 50 to age 60. By age 70, more than 20% of mailings elicit a return.[27]

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[25]Appendix Table A.4 reports response rates by history, age, income, filing status, and treatment batch.

[26]Fractional polynomial regressions find the best fitting polynomial from a predefined set of powers that includes noninteger powers (Royston and Altman 1994). I use the predefined set of powers {-2, -1, -.5, 0, .5, 1, 2, 3}.

[27]Pension income is not taxable for Detroit city income tax. Some taxpayers over age 65 are pensioners, but others are among the highest active earners.

Figure 4: Response rate by filing history and treatment
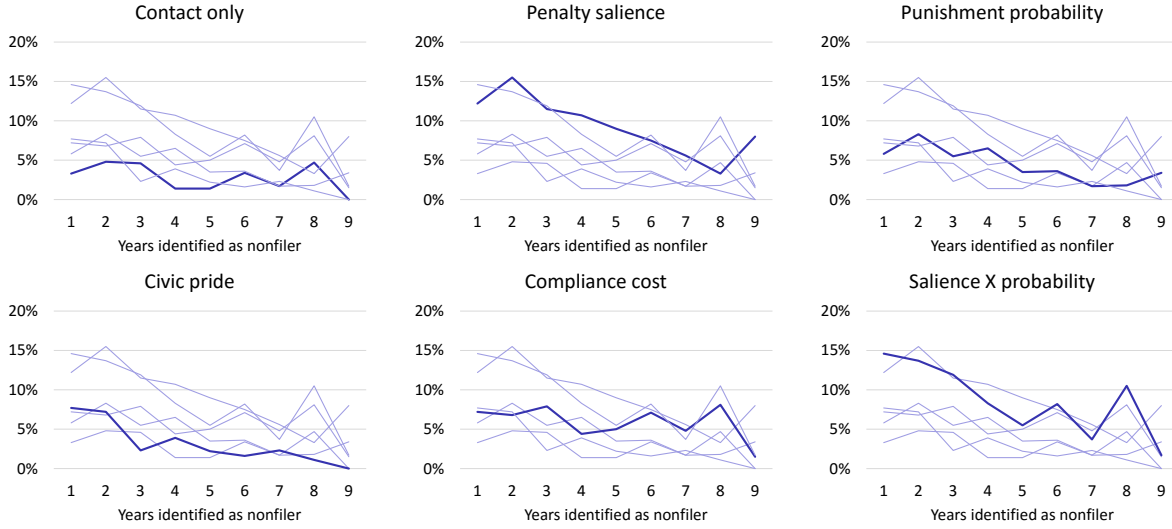
Note: This figure estimates response rate by income using a fractional polynomial regression of response on income.

Income is highly correlated with age, so it is not surprising that response rates are higher for taxpayers with higher incomes. This is again true across treatment groups but more pronounced in the more effective treatments. Figure 5b plots response rates by income for each of the mailing treatments. The penalty and penalty salience × punishment probability treatments elicited higher response rates even from taxpayers earning less than $30K, whereas most of the gains from the compliance cost and punishment treatments came among taxpayers earning more than $40K, and the civic pride treatment only raised response rates considerably above $50K. The contact-only letter was not much more effective with higher-income taxpayers than with lower-income taxpayers.

The penalty salience message was the most effective overall, and it was also the most effective within most identifiable subgroups. Figure 6 compares the response rates to the penalty salience mailings with the response rates to the penalty salience × punishment probability mailings within age-income-filing history bins. The penalty salience message tended to elicit higher response rates in the same bins as the penalty salience × punishment

Figure 5: Heterogeneity of response

(a) Age
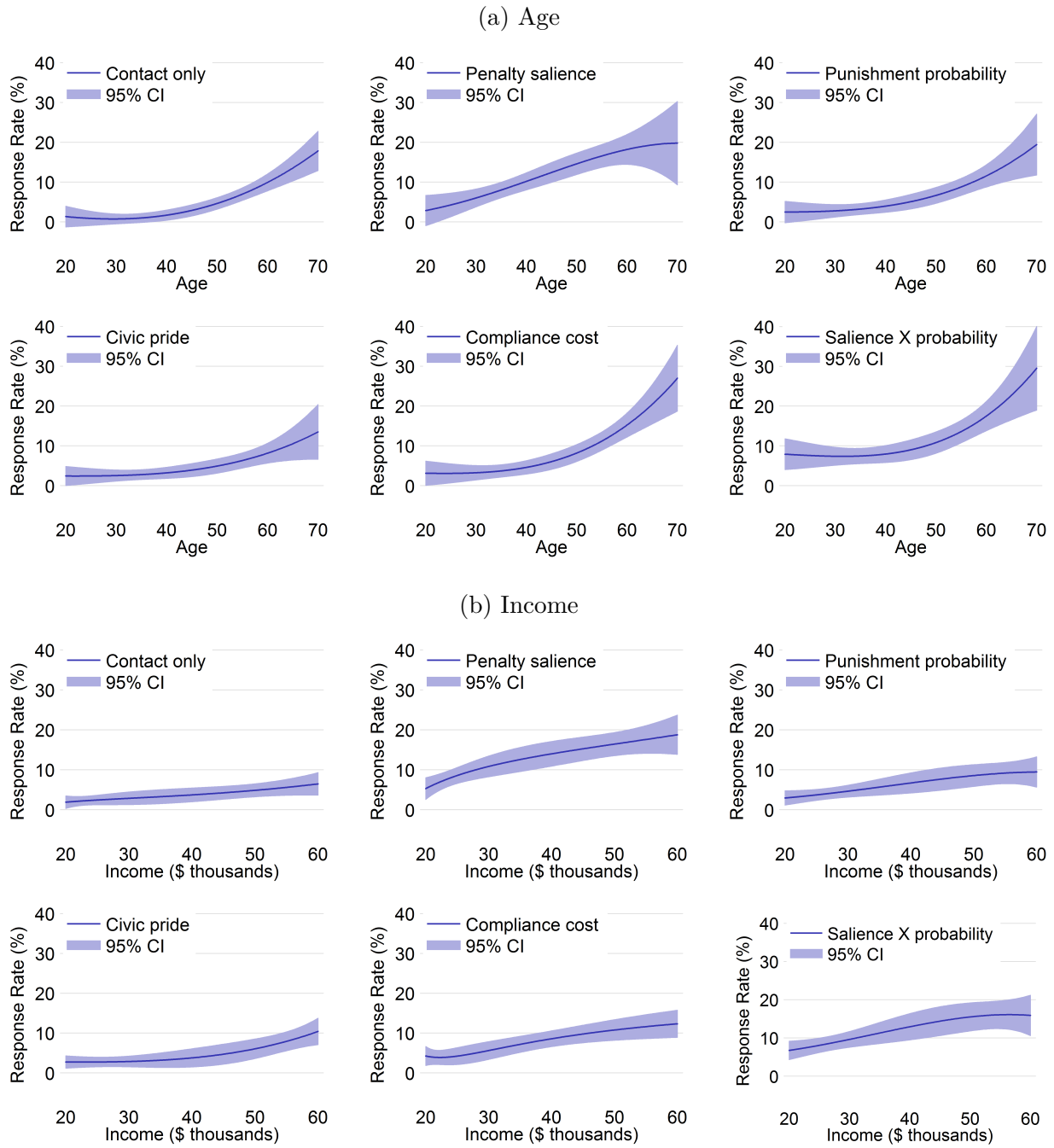
(b) Income

This figure shows heterogeneity of response rates with respect to age and income. Panel (a) plots a fractional polynomial regression of response rate on age within each treatment. Panel (b) plots a fractional polynomial regression of response rate on income within each treatment. The fractional polynomial regressions find the best fitting polynomial from the predefined set of powers {-2, -1, -.5, 0, .5, 1, 2, 3}.

Figure 6: Response rate by age-income-filing history bin
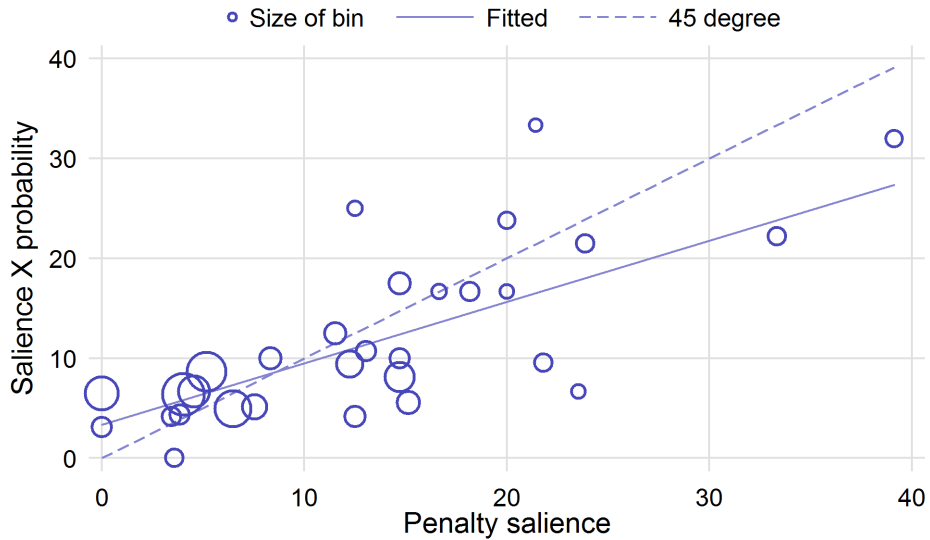
Note: This figure compares response rates to the penalty salience mailings with response rates to the penalty salience × punishment probability mailings within age-income-filing history bins. Appendix Figure A.4 shows the analogous comparison with other treatments. Appendix Table A.5 reports response rates by treatment and age-income-filing history bin. For defining bins, the three age categories are below 30, 30–50, and above 50. The four income categories are below \$25K, \$25K–\$35K, \$35K–\$50K, and above \$50K. The three filing history categories are 1–2 years, 3–5 years, and 6–9 years identified as a suspected resident nonfiler.

probability message. A bubble above the 45 degree line indicates a bin for which the penalty salience × punishment probability message was more effective than the penalty salience message. Those bins are candidates for message targeting by demographics. However, the bins for which the response rate is substantially above the 45 degree line are small and thus less precisely measured. The large bins above the 45 degree line are still pretty close to the 45 degree line, so there is not a strong case for using the interaction message with some bins rather than the penalty salience message. The analogous comparisons in Appendix Figure A.4 lead to the same conclusion, that the penalty salience message is better with most bins and never substantially worse than any of the other treatment messages.

The effects of age, income, filing history, and treatment status appear to be positive even when they are all at play. The response rates by age-income-filing history bin reported in

Appendix Table A.5 are higher for older taxpayers, higher-income taxpayers, and taxpayers with less history of nonfiling. The highest response rate by a bin to a treatment, 39% to the penalty salience treatment, was by the bin of taxpayers with all three of those characteristics: over age 50 with more than $50K income who had been identified as a suspected resident nonfiler fewer than three times. The tax authority could thus raise response rates above what was achieved in the sample for any experimental treatment by refining the criteria it uses to contact nonfilers.

4.5   Network effects

This section investigates behavioral responses of untreated taxpayers to the experimental mailings. The mailings could have influenced the behavior of untreated taxpayers if, for example, recipients of experimental mailings told their neighbors, relatives, or coworkers that they had been contacted by Detroit's income tax division. Even a small effect per neighbor can add up to a substantial impact if treated taxpayers have many network connections. In other enforcement contexts, network effects like this appear to be important.[28]

I find weak evidence of a negative geographic spillover effect from penalty salience and punishment probability mailings. For each treated nonfiler, including the no-contact control group, I calculate the number of untreated neighbors within 50 meters who filed a return between May 2 and August 27, from 15 days after the first experimental postcard was sent until 75 days after the final experimental postcard was sent. I geocoded the addresses of all treated taxpayers and all untreated taxpayers who filed a return during the relevant time period, then computed the distance between every treated nonfiler-untreated taxpayer pair. I then regress the count of untreated taxpayers who filed during the relevant time period on

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[28]Drago, Mengel, and Traxler (2015) find that, when a sample of potential evaders of TV license fees were sent a letter, their untreated neighbors who did not receive a letter were more likely to comply with the fee. Boning et al. (2016) examine network effects of enforcement letters and site visits among firms, where the networks are defined by geography or common tax preparers.

Table 8: Untreated neighbor responses to treatment

	(1) <25m	(2) <50m	(3) <100m
Contact only	0.036	0.021	0.041
	(0.154)	(0.120)	(0.083)
Penalty salience	-0.097	-0.122	-0.025
	(0.158)	(0.123)	(0.085)
Punishment probability	-0.124	-0.117	0.074
	(0.163)	(0.126)	(0.084)
Compliance cost	0.060	0.017	0.009
	(0.153)	(0.120)	(0.084)
Civic pride	0.076	0.049	-0.027
	(0.157)	(0.121)	(0.086)
Salience × probability	-0.302*	-0.221*	-0.129
	(0.165)	(0.127)	(0.087)
Pseudo-R^2	0.0015	0.0010	0.0005
Observations	9,274	9,274	9,274

Note: This table reports results from a negative binomial regression of the number of untreated neighbors who filed a return from an address within x meters of an individual in the sample on the treatment dummies. Heteroskedasticity robust standard errors in parentheses. Coefficients are significantly different from zero at the *10%, **5%, or ***1% significance level.

treatment dummies, where an observation is a treated nonfiler. Table 8 shows that most of the estimated coefficients on treatment dummies were not statistically different from zero. The penalty salience × punishment probability treatment is significant at the 10% level, but significance is not robust to alternative distances. I repeated the procedure for a variety of distances, including 25, 50, and 100 meters. If taxpayers told their neighbors that they received mailings from the tax division, neighbors may have interpreted that as a sign that they would be warned by mail prior to receiving any sort of punishment.

5   Normative analysis

Would it be worthwhile for Detroit to send mailings to one additional suspected resident nonfiler? In this section I estimate that the direct expected welfare effect of nonfiler mailings is negative for all treatments, conditional on the exact selection criteria in the experiment. I then discuss the sensitivity of the direct welfare estimate to parameter assumptions and

identify modifications to the selection criteria that would make mailings welfare-enhancing.

A tax authority that aims to maximize welfare should consider the effect of enforcement actions on the private well-being of individual taxpayers. Tax revenue is assumed to be spent on public goods that are valued by individual taxpayers. However, when the tax authority collects tax from an individual taxpayer, that taxpayer faces private compliance costs and also loses the ability to use the collected tax for private consumption. The tax authority should compare the expected marginal benefit of public goods to taxpayers with the expected marginal private costs to individual taxpayers. This welfare analysis therefore combines three components: expected marginal revenue net of administrative costs, expected marginal private cost, and the marginal social value of public spending.

Adapting the optimal enforcement condition from Keen and Slemrod (2016) to the present context, a tax authority should send mailings to a nonfiler if the expected change in welfare is positive:

$$\phi\Big[\Delta\text{Revenue} - \Delta\text{Administrative cost}\Big] - \Delta\text{Private cost} > 0 \tag{2}$$

The expression inside the brackets is expected marginal revenue net of administrative costs. The marginal social value of public spending, expressed by the parameter ϕ, converts tax-authority dollars to privately-held dollars. If collecting tax is ever worthwhile, then one dollar held by the tax authority has more social value than one dollar held by an individual taxpayer, so $\phi > 1$. The expression for net welfare therefore weights administrative costs more heavily than private costs. Note that foregone consumption appears twice—once as revenue and once as a component of private cost.

One assumption in this framework is that the individual marginal utility per dollar is constant across individual taxpayers. It would be natural to consider an alternative model with heterogeneous individual marginal utility per dollar, for example with high marginal

utility per dollar for low income taxpayers and low marginal utility per dollar for high income taxpayers. However, such a model would require additional assumptions to map income onto marginal utility. Furthermore, if the tax base and rates were chosen optimally, then they would already incorporate considerations of heterogeneous marginal utility. For transparency and simplicity this welfare analysis equates marginal utility per dollar across taxpayers.

A second assumption is that the marginal social value of public spending is constant. The social value of spending is the sum of the valuations of individual taxpayers. Again, there is a natural alternative assumption, that there are diminishing marginal returns to public spending, i.e. that the social value of spending is concave. Constant marginal social value of public spending is a reasonable local approximation that simplifies the analysis.

Expected net welfare per mailing is estimated in Table 9 separately for each experimental treatment. Remittances are a large and important part of marginal revenue, but not the only part. They are offset by refunds, which are issued when withholding exceeds tax liability. Also, some tax debt which is not remitted with a tax return will eventually be recovered as a result of these mailings. Overall, marginal revenue is equal to remittance plus recovered tax debt minus refunds issued.

Marginal administrative costs include (1) the cost of mailings and (2) the cost of processing responses. The marginal cost of mailings per nonfiler is estimated to be \$4.70. Appendix Table A.6 shows the components of the marginal cost of mailings, including materials, time, and postage. The administrative cost of processing returns is assumed to be one hour per taxpayer who files a return, with time valued at \$23.95 per hour, the hourly equivalent of the top annual salary of a Detroit tax examiner.[29] The postage and staff time required for sending the letters via certified mail was about 80% of the marginal cost of mailings per

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[29]The amount of processing time per taxpayer is based on conversations between the author and tax division staff. The salary of a Detroit tax examiner is from the following publication: *White Book, 2016-2017 Salary and Wage Adjustments*, March 2016, page 63, available at http://www.detroitmi.gov/how-do-i/view-city-of-detroit-reports.

Table 9: Net welfare

		Contact-only	Penalty salience	Punishment probability	Compliance cost	Civic pride	Salience × probability
Remit per letter	[1]	4.26	14.47	3.65	1.81	3.58	8.09
Tax debt recovered	[2]	0.19	2.72	1.20	1.22	1.26	1.63
Refund issued	[3]	0.51	2.08	0.56	2.27	0.85	2.54
Marginal revenue	[4] = [1] + [2] - [3]	3.94	15.11	4.29	0.76	3.99	7.19
Cost of mailings	[5]	4.70	4.70	4.70	4.70	4.70	4.70
Processing responses	[6]	0.73	2.41	1.17	1.49	0.92	2.33
Net revenue	[7] = [4] - [5] - [6]	-1.49	8.00	-1.57	-5.43	-1.64	0.15
Social value	[8] = $\phi \times$ [7]	-2.23	12.00	-2.36	-8.14	-2.45	0.23
Private cost	[9]	7.74	27.71	10.38	8.54	8.80	19.36
Net welfare	[10] = [8] - [9]	-9.97	-15.71	-12.74	-16.68	-11.25	-19.13

Note: All units are dollars per mailing. Refunds that are claimed are not always paid, e.g. if the taxpayer does not submit a W2, so refund issued is assumed to be 80% of claimed refund per letter. Similarly, admitted tax debt is not always collected, so tax debt recovered is assumed to be 20% of admitted due per letter that is not remitted with the return. Marginal revenue is equal to remit per letter plus tax debt recovered minus refund issued. Net revenue is equal to marginal revenue minus the cost of mailings per nonfiler ($4.70, details in Appendix Table A.6) and the cost of processing responses (one hour per taxpayer valued at $23.95 per hour). Social value of spending is equal to the marginal value of public spending (ϕ) times net revenue, with $\phi = 1.5$ in the baseline estimate. Private cost is calculated as foregone private consumption (equal to marginal revenue) plus compliance costs of $125 per filer. Net welfare is social value minus private cost.

nonfiler.

Marginal net revenue per nonfiler is positive in the penalty salience treatment and the penalty salience × punishment probability treatment. The row of Table 9 labeled net revenue subtracts the marginal cost of mailings per nonfiler from collections net of administrative costs. Net revenue is $8.00 per nonfiler in the penalty salience treatment, $0.15 per nonfiler in the penalty salience × punishment probability treatment, and negative for the other treatments.

The marginal social value of public spending ϕ is the economic return to public spending, excluding administrative and compliance costs. Cellini, Ferreira, and Rothstein (2010) estimate this parameter is 1.5 for infrastructure spending in public school districts in California, arguing that school infrastructure is a local public good that ought to be reflected in home prices. In a jurisdiction with limited fiscal capacity such as Detroit, the marginal social value of public spending could be much higher if budget constraints force the city to forego projects that would be highly valued by constituents. I use 1.5 in my baseline estimate of welfare and perform alternative calculations with 1.1 and 4.5.

Marginal private cost includes foregone private consumption and compliance costs. Foregone private consumption is equal to net revenue, which is positive for a taxpayer who remits tax, negative for a taxpayer who receives a refund, and positive on average for all treatments. Compliance costs are not directly observed. The city income tax form for Detroit residents, Form D-1040(R), is comparable in length and complexity to federal Form 1040EZ, which the IRS estimates imposes an average burden of 5 hours and $40 per taxpayer.[30] The baseline estimate of welfare assumes the compliance costs for the city income tax form are equal to that IRS estimate of compliance costs for Form 1040EZ: $125 per taxpayer who files a return, equal to 5 hours at $17 per hour—the hourly equivalent of the average annual income in the sample—plus $40.

The baseline estimate of $125 per taxpayer could overstate or understate true compliance costs. The $125 estimate would overstate compliance costs if income is earned at a lower wage rate by working more hours, or if the marginal compliance burden is lower because there is a fixed cost of tax preparation that was already paid in order to file a federal return. The $125 estimate would understate compliance costs if income is earned by a part-time worker or if preparing tax forms is more unpleasant and psychologically costly than typical work, as argued by Benzarti (2015) in the context of itemizing federal deductions. In addition to the $125 per taxpayer baseline, I perform alternative welfare calculations with $25 and $250 as the compliance cost per taxpayer who files a return.

Net welfare is estimated to be negative for all treatments under the baseline assumptions. The net effect was between minus $10 and minus $20 per letter. The social value of net revenue is not large enough to offset foregone private consumption and compliance costs. If compliance costs are truly as large as in the baseline estimate, then even for an average taxpayer who responds by filing a return, the net effect on welfare is negative. The welfare

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[30]The IRS burden estimate is in *1040a Instructions 2015*, available at https://www.irs.gov/pub/irs-pdf/i1040a.pdf.

effect estimated here is direct in the sense that it considers mailings in isolation rather than simultaneously with other enforcement tools and in the sense that it does not consider specific or general deterrence effects.

The effect of mailings on net welfare is sensitive to assumptions about certification, the marginal social value of public spending, and compliance costs. Certification may have raised response rates if recipients took the letter more seriously, but certification may have reduced response rates if fewer intended recipients received the letter. It is therefore informative to consider a scenario in which certification was neutral and the same response rates could be obtained at lower cost without certification. Table 10 reports welfare calculations per letter for each treatment excluding the cost of certification and using alternative assumptions about the marginal social value of public spending ($\phi = 1.1, 1.5, 4.5$) and compliance costs ($25, $125, $250). In the most optimistic scenario, with $\phi = 4.5$ and compliance costs of just $25, each penalty salience mailing raised welfare by $35.20.

This analysis omits two potentially important channels by which nonfiler mailings could affect welfare. First, sampled taxpayers may comply at a higher rate in the future (specific deterrence). Second, other taxpayers may comply at a higher rate if they infer that Detroit is increasing its enforcement capability (general deterrence). If the mailings have a specific or general deterrence effect, then the estimates of marginal revenue and marginal compliance cost are too low.

If the most effective treatment, the penalty salience treatment, had been applied to the entire population of nonfilers that fit the sample selection criteria, then the city would have collected net revenue of $342,000. This is inferred from a simple back-of-the-envelope calculation multiplying the number of taxpayers who fit the sample selection criteria (42,754) by the net revenue per letter ($8.00). If the marginal social value of public spending is sufficiently high, then mailings sent to nonfilers who fit the selection criteria also improve welfare. Under the baseline assumptions, nonfiler mailings using the selection criteria from

Table 10: Net welfare under alternative assumptions

Parameters		Treatments					
Marginal social value	Compliance cost	Contact only	Penalty salience	Punishment probability	Compliance cost	Civic pride	Salience × probability
$\phi = 1.1$	$25	-2.23	-4.71	-3.13	-4.18	-2.63	-5.34
$\phi = 1.1$	$125	-5.27	-14.79	-8.00	-10.40	-6.47	-15.08
$\phi = 1.1$	$250	-9.07	-27.37	-14.09	-18.19	-11.28	-27.26
$\phi = 1.5$	$25	-1.33	-0.02	-2.27	-4.85	-1.79	-3.78
$\phi = 1.5$	$125	-4.37	-10.09	-7.14	-11.08	-5.63	-13.52
$\phi = 1.5$	$250	-8.17	-22.68	-13.23	-18.87	-10.43	-25.70
$\phi = 4.5$	$25	5.42	35.20	4.21	-9.92	4.54	7.89
$\phi = 4.5$	$125	2.38	25.13	-0.66	-16.15	0.70	-1.85
$\phi = 4.5$	$250	-1.42	12.54	-6.75	-23.94	-4.10	-14.03

Note: This table reports welfare estimates in units of dollars per mailing using the procedure from Table 9 with alternative parameter assumptions. Three assumptions are changed. First, the cost of certification is removed from the cost of mailings, so that the cost of mailings is $0.96. Second, the marginal social value of spending is assumed to be 1.1, 1.5, or 4.5, as indicated in column 1. Third, the compliance cost per taxpayer is assumed to be $25, $125, or $250, as indicated in column 2.

this experiment did not improve welfare. However, the income threshold can be refined such that mailings would generate expected marginal revenue that is high enough to outweigh administrative and compliance costs and thereby to improve welfare.

Large administrative and compliance costs set a high bar for the expected marginal revenue required for a worthwhile intervention. Suppose that all suspected resident nonfilers respond to nonfiler mailings by filing a return. Rearranging Equation 2 and substituting the baseline assumptions, a welfare-improving enforcement action must collect tax of $\Delta\text{Revenue} > \left(\frac{\phi}{\phi-1}\right)\Delta\text{Administrative cost} + \left(\frac{1}{\phi-1}\right)\Delta\text{Compliance costs} = (3)(4.70 + 23.95) + (2)(125) = 335.95$. This condition provides a benchmark *expected marginal revenue threshold* for welfare-improving nonfiler mailings. Adjusting the benchmark for a 10% response rate, so that the administrative cost also includes the cost of mailings that do not elicit responses, the expected marginal revenue threshold is $462.85.

Under these assumptions, nonfiler mailings sent to taxpayers with sufficiently high income improve welfare. The income level that corresponds to the expected marginal revenue threshold is higher to the extent that taxpayers remit only a fraction of net liability and to the extent that withholding is imperfectly observed. For most taxpayers, Gross liability $= t(Y - 600 \cdot \text{Exemptions})$, where Y is income and t is a tax rate of 2.4% for

residents. If withholding is zero, then net liability is equal to gross liability, and net liability of $463 corresponds to an income level of $20,492 for a taxpayer with two exemptions. Among taxpayers who filed a return in response to treatment mailings, marginal revenue was 64% of net liability, so income of $32,019 would be required to generate expected marginal revenue of $463. For welfare-improving mailings, this would be a reasonable income threshold for taxpayers with only nonwage income and no withholding.

However, taxpayers with wage income are likely to have withholding, so a larger income threshold is required to generate the same level of expected marginal revenue. Among taxpayers who filed a return in response to treatment mailings and had only wage income, net liability was 22% of gross liability. For suspected resident nonfilers with only wage income, an income level of $145,540 would therefore correspond to expected marginal revenue of $463. The decomposition here, Expected marginal revenue$_i$ = $\frac{\overline{\text{Marginal revenue}}}{\text{Net liability}} \cdot \frac{\overline{\text{Net liability}}}{\text{Gross liability}} \cdot t(Y_i - 600 \cdot \text{Exemptions}_i)$, highlights the difference between net and gross liability for taxpayers who earned wage income and were likely to have unobserved withholding.

Response rates are an important component of administrative costs with additional potential for refining selection criteria. As noted earlier in the discussion of the expected marginal revenue threshold, the administrative cost of sending letters is effectively higher if many letters go unanswered. When letters elicit a 10% response rate, eliciting one response requires postage for sending 10 letters. The population examined by the field experiment included taxpayers who the city estimated owed at least $350, without regard to age, income level, income composition, or filing history. My analysis suggests that the city could reduce administrative costs by focusing on higher-yield demographics. Older taxpayers, higher-income taxpayers, and taxpayers who had been identified fewer times as nonfilers had higher response rates. These effects appear to operate even when they are all present, such that taxpayers with all of the higher-response characteristics have particularly high response rates.

6   Discussion

This paper is part of a rapidly expanding literature that uses controlled field experiments to improve tax compliance.[31] These experiments are motivated by the twin recognitions that (1) rationality is limited in its ability to describe actual human behavior (DellaVigna 2009; McCaffery and Slemrod 2006) and (2) controlled field experiments are the best available method for understanding tax compliance behavior (Angrist and Pischke 2010; Slemrod and Weber 2012; Hallsworth 2014).

Deterrence parameters. Traditional deterrence parameters are the basis for many tax experiment treatments, yet even those treatments are behavioral. In the canonical model of Allingham and Sandmo (1972), taking the tax rate as given, the tax authority needs only to set a penalty and a probability. However, in addition to those deterrence parameters, actual taxpayer behavior is mediated by the salience of the tax (Finkelstein 2009; Chetty, Looney, and Kroft 2009), the salience of the penalty, and beliefs about the probability of being caught (Alm 2012). Furthermore, nonfinanicial penalties like shaming are clearly grounded in the traditional deterrence parameters but rely on social preferences that are outside the scope of strict rationality (Perez-Truglia and Troiano 2015).

The response to the penalty salience message in this experiment suggests that compliance can be induced by a threat even if that threat is merely implicit. Based on evidence that taxpayers in other contexts—filers, delinquents, corporations—respond to threats, it would have been reasonable to guess that income tax nonfilers would respond to a message about the penalty for failing to file a tax return. The penalty salience message in this experiment is typically understood as an implicit threat: If you do not file a return, you will be fined or sent to jail. However, the message itself did not actually promise any action; it stated a fact about a legal statute that had not been enforced in many years. That contrasts with

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[31]Mascagni (2016) reviews tax experiments and develops a taxonomy of tax treatments which I adopt.

"threat" treatments in other recent experiments that explicitly promise action against the taxpayer (Fellner, Sausgruber, and Traxler 2013; Castro and Scartascini 2015; Chirico et al. 2015). Tax administrators might prefer the somewhat more "courteous" frame of information salience if the two messages are equally effective, although the potency of the message may depend on whether the information is perceived as a threat.

Information reporting. The second deterrence parameter, the probability of being caught, is closely linked with third-party information reporting. In Detroit, the "third party" that enabled the tax authority to tailor the punishment probability message with information about the individual nonfiler's federal income was the Internal Revenue Service. Information reporting has been linked to the ability of taxpayers to evade and the effectiveness of enforcement (Kleven et al. 2011; Naritomi 2013; Pomeranz 2015).

This experiment is one of a handful that attempts to influence the perceived probability of punishment by referring to information the tax authority has about the taxpayer. Brockmeyer et al. (2016) and Bott et al. (2014) both found that informing taxpayers—nonfiling firms or individuals with misreported foreign income, respectively—that the tax authority uses third-party information to identify sources of income had a positive effect on compliance even when the information itself was not revealed. It is possible that the punishment probability message in this experiment could have been even more effective by referencing the existence and source of information—the taxpayer's federal income according to the IRS—rather than revealing the information. Haynes et al. (2013) found that text messages to a fine-owing delinquent were more effective with an amount than just a reminder, but that including the delinquent's name in the text message was even better than the name and amount together. This is in some ways parallel to the results from this experiment in Detroit, where the penalty salience message elicited a response rate that was above but not statistically different from the penalty salience and punishment probability messages combined.

Compliance costs. Compliance costs are almost certainly large (Benzarti 2015; Guyton et al. 2003) and just as closely related to traditional economic incentives as deterrence parameters (Erard and Ho 2001), but they have not received much experimental attention. Hasseldine et al. (2007) found no effect of offering assistance to sole proprietors, which they attribute to the fact that most sole proprietors use paid tax preparers. The finding in Detroit that providing a blank tax form and return envelope raises response rates of nonfilers, but with lower quality responses than other treatments, is the first of its kind. However, several tax experiments have attempted to reduce compliance costs in other ways. Guyton et al. (2016) found that reminders raise compliance rates. Bhargava and Manoli (2015) found that reducing the complexity of informational mailings improved takeup of the Earned Income Tax Credit, but attempts to reduce program stigma failed to improve takeup.

Moral appeals. This experiment adds to the bulk of the evidence against the effectiveness of moral appeals. I include in this category messages about a "compliant majority" of other taxpayers, messages about the "public services" that taxes fund, and messages that refer to general principles of equity or fairness. Most of these messages do not appear to be as effective as messages related to deterrence parameters. The only similar message to the civic pride message in this experiment was a "national pride" message tested by Kettle et al. (2016) on corporate and profits nonfilers in Guatemala. They also found no impact on the rate of payment. Perhaps people with whom a message about civic pride would succeed had already filed their tax returns. Against accumulating evidence to the contrary, Hallsworth et al. (2014) find that certain moral appeals *do* enhance tax compliance. With the benefit of a very large sample, they tested many fairly similar messages. I interpret their findings as strong evidence that small changes in wording—seemingly insignificant, with no relationship to traditional economic incentives—can have a surprisingly large impact on behavior, probably through framing or reference effects. For instance, Hallsworth et al. (2014) found that, all else equal, replacing "nine out of ten" with "88%" raised a response

rate to a compliant majority message by two percentage points.

Social learning. The social learning literature has provided ample theoretical and empirical grounds for expecting diffusion of technology and allocation of jobs (Glaeser 1999; Conley and Udry 2010; Mobius and Rosenblat 2014), but there is relatively little evidence of social learning about tax. Drago, Mengel, and Traxler (2015) found that letters about television license fees to households in rural Austria improved compliance behavior of geographically proximate untreated households. Failure to find spillover effects in Detroit could be attributed to differences in rural and urban communication norms; people in an urban setting like Detroit might learn from coworkers, friends and family rather than geographic neighbors. Or Detroit residents might not be discussing tax at all. Social workers and journalists seem to think it is self-evident that people are reluctant to discuss money (Trachtman 1999; Taylor 2014; Kadlec 2016), although Duflo and Saez (2003) do find social learning through coworkers in the context of retirement saving. There could be stigma associated with failure to pay income tax that is not present for retirement saving.

Fiscal capacity. The success of targeted messaging for improving tax compliance would be particularly helpful for tax authorities like Detroit with constrained fiscal capacity. Constrained fiscal capacity is particularly common in developing economies (Besley and Persson 2013). Finding effective, low-cost enforcement tools, like the penalty salience message in this experiment, could be a boon to tax administration with constrained fiscal capacity. However, it is possible that the lessons learned in Detroit might not be generalizable to all taxpayers or all fiscally constrained tax authorities. The City of Detroit has unusual challenges of tax administration, including with income tax and also property tax (Hodge et al. 2016). The fact that higher-income taxpayers in Detroit had higher response rates in the experiment suggests that the lessons learned here may be more applicable to taxpayers in higher-income jurisdictions than in fiscally-constrained jurisdictions with lower-income taxpayers.

7 Conclusion

This paper tested the efficacy of messages related to penalty salience, punishment probability, compliance cost, and civic pride for improving tax compliance among income tax nonfilers. Informing taxpayers of a statutory penalty for failing to file a return elicited higher filing rates, more returns per filer, more admitted tax due, and more remittances than any other message. Even though both penalty salience and punishment probability were individually effective relative to the contact-only mailings, interacting these two treatments was no more effective, indeed less effective, than the penalty salience message by itself. This is inconsistent with the theoretical prediction that penalty salience and punishment probability should have a positive interaction. The interaction may have exhibited no improvement over penalty salience by itself because (1) the effectiveness of the penalty salience message depended on its simplicity, or (2) the penalty salience message had already exhausted the channel of affecting taxpayer behavior through perceived probability of punishment. Enclosing a blank tax form and return envelope was effective in eliciting higher response rates, but the quality of responses to the compliance cost treatment was lower in the sense that taxpayers were more likely to claim a refund and less likely to admit tax due. The response rate to the civic pride treatment was not statistically different from the contact-only control group.

Controlled experiments are the best available method for evaluating behavioral responses to tax enforcement. Many tax experiments have attempted to influence the perception of standard deterrence parameters: penalty and probability. The controlled experiment described in this paper tested the response to similar deterrence parameter treatments by income tax nonfilers, who have received relatively little attention in the literature. This experiment provides the first evidence about civic pride among city taxpayers, and it tests a novel approach to addressing compliance costs—providing a blank tax form.

I find that a single sentence, strategically placed in mailings to attract attention, can

have an economically meaningful impact on tax filing behavior. Tax experiments like this one are helping to build an understanding of compliance behavior. However, even subtle treatment differences can affect taxpayer responses, and techniques that are individually effective can interact in surprising ways. Building experimental variation into tax enforcement is a valuable way of exploring compliance behavior and making enforcement more efficient, which should be particularly helpful for tax authorities with limited fiscal capacity.

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A   Appendix

Figure A.1: Google Trends search index for Detroit, Columbus, and Cincinnati income tax
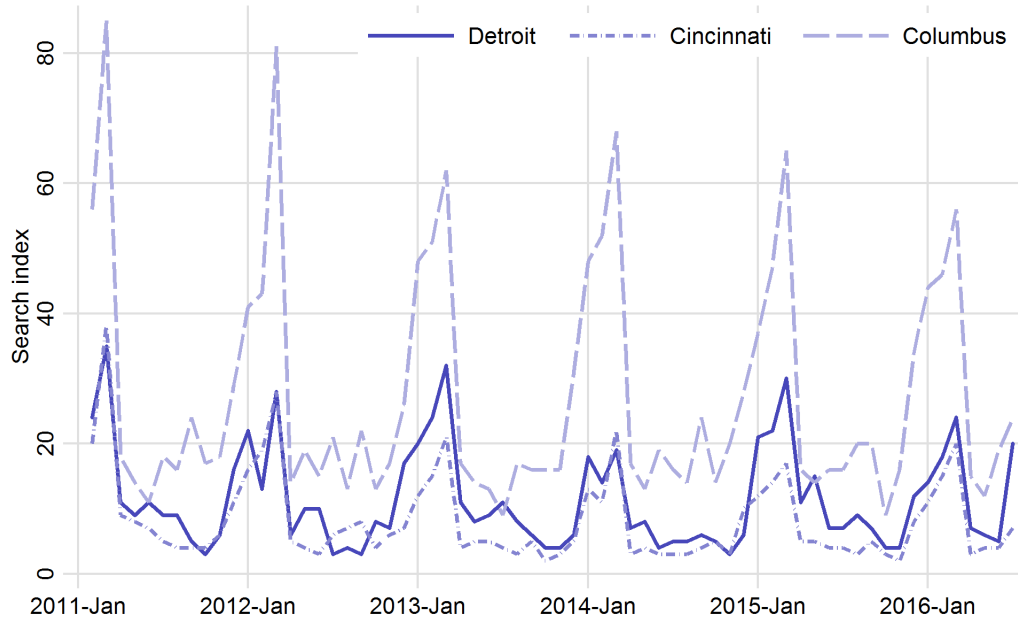
Source: Google Trends.
Note: This figure compares search interest in "Detroit income tax" to corresponding search terms for Columbus and Cincinnati. Columbus has approximately the same population as Detroit but a much smaller metropolitan area. Cincinnati has a larger population in the city proper and about half of the population in the metropolitan area.
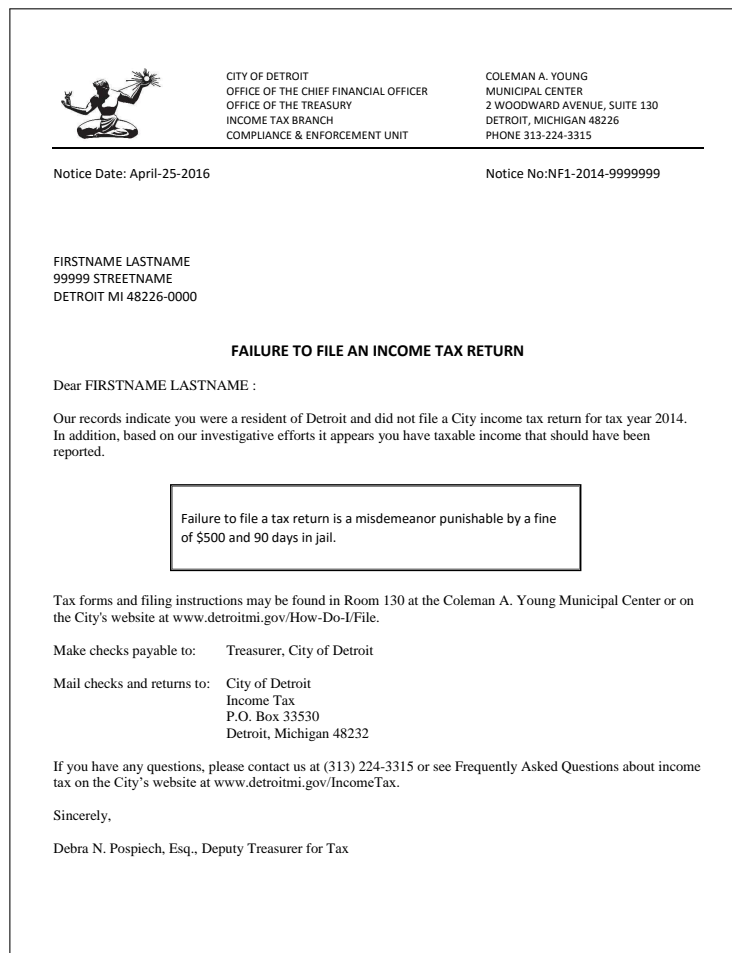
Figure A.2: Example postcard and letter

CITY OF DETROIT
OFFICE OF THE CFO
OFFICE OF THE TREASURY
INCOME TAX BRANCH
COMPLIANCE UNIT
2 WOODWARD AVE
SUITE 130
DETROIT, MI 48226

PRSRT STD
U.S. POSTAGE
PAID
DETROIT MI
PERMIT NO. XXXX

FIRSTNAME LASTNAME
99999 STREETNAME
DETROIT MI 48226-0000

In a few days, you will receive a letter about filing a tax return with the City of Detroit. The following income is taxable by the City: wages, salaries, business income, capital income.

Failure to file a tax return is a misdemeanor punishable by a fine of $500 and 90 days in jail.

Tax forms and filing instructions may be found in Room 130 at the Coleman A. Young Municipal Center or on the City's website at www.detroitmi.gov/How-Do-I-File.

CITY OF DETROIT
OFFICE OF THE CHIEF FINANCIAL OFFICER
OFFICE OF THE TREASURY
INCOME TAX BRANCH
COMPLIANCE & ENFORCEMENT UNIT

COLEMAN A. YOUNG
MUNICIPAL CENTER
2 WOODWARD AVENUE, SUITE 130
DETROIT, MICHIGAN 48226
PHONE 313-224-3315

Notice Date: April-25-2016   Notice No:NF1-2014-9999999

FIRSTNAME LASTNAME
99999 STREETNAME
DETROIT MI 48226-0000

FAILURE TO FILE AN INCOME TAX RETURN

Dear FIRSTNAME LASTNAME :

Our records indicate you were a resident of Detroit and did not file a City income tax return for tax year 2014. In addition, based on our investigative efforts it appears you have taxable income that should have been reported.

Failure to file a tax return is a misdemeanor punishable by a fine of $500 and 90 days in jail.

Tax forms and filing instructions may be found in Room 130 at the Coleman A. Young Municipal Center or on the City's website at www.detroitmi.gov/How-Do-I-File.

Make checks payable to: Treasurer, City of Detroit

Mail checks and returns to: City of Detroit
                               Income Tax
                               P.O. Box 33530
                               Detroit, Michigan 48232

If you have any questions, please contact us at (313) 224-3315 or see Frequently Asked Questions about income tax on the City's website at www.detroitmi.gov/IncomeTax.

Sincerely,

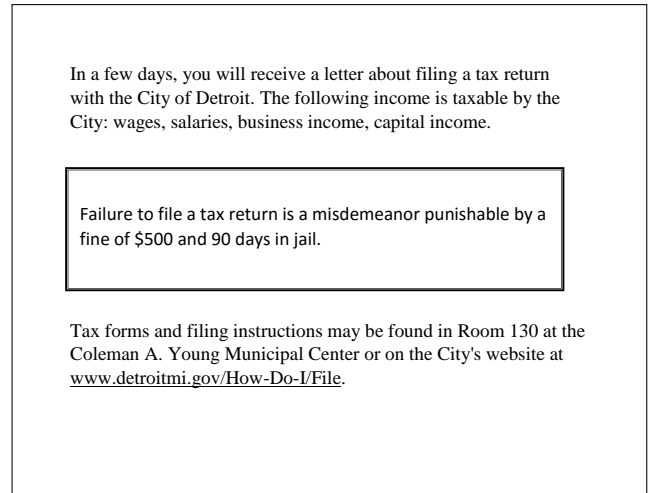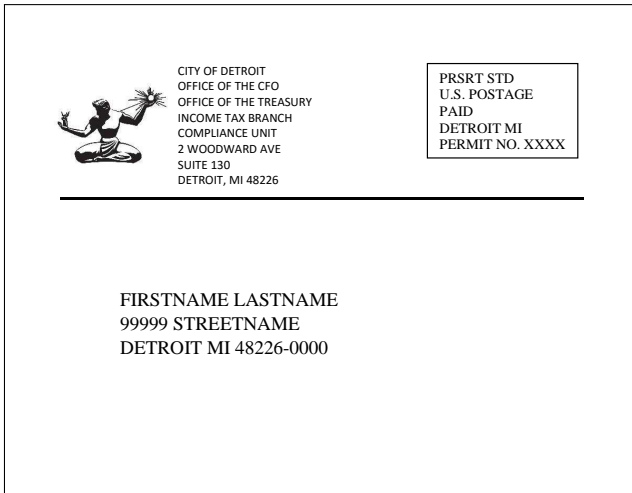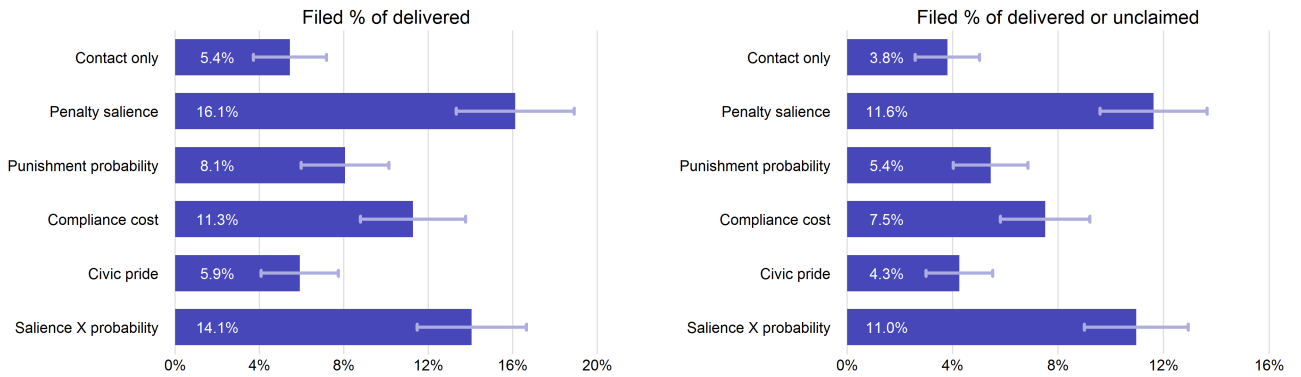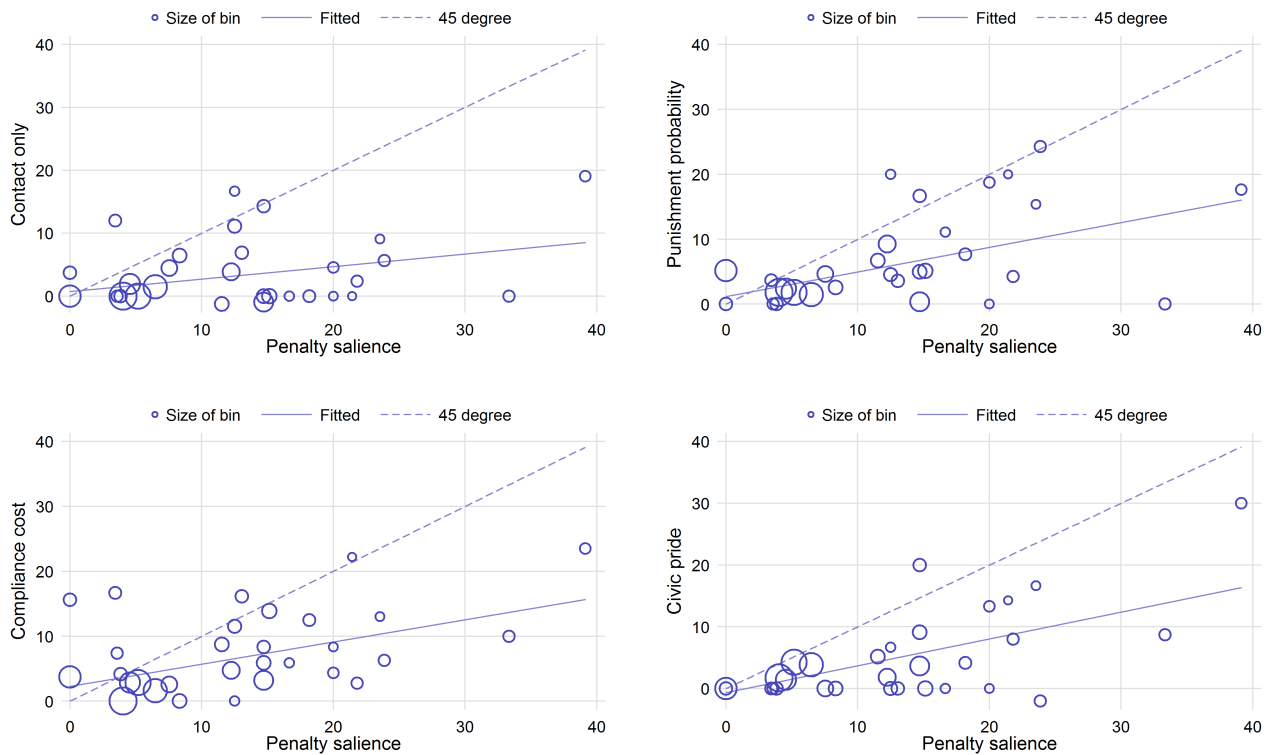Debra N. Pospiech, Esq., Deputy Treasurer for Tax

Figure A.3: Response rates by treatment status

Note: This figure shows response rates by treatment status. The left panel restricts attention to taxpayers for whom the treatment letter was listed as delivered on the USPS tracking website. The right panel restricts attention to taxpayers for whom the treatment letter was listed as delivered or unclaimed on the USPS tracking website. Standard errors show 95% confidence intervals.

Figure A.4: Response rates by age-income-filing history bin

Note: This figure compares response rates to the penalty salience mailings (horizontal axis) with response rates to other treatments (vertical axis) within age-income-filing history bins. Appendix Table A.5 reports the raw response rates by treatment and age-income-filing history bin.

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Table A.1: States with local income tax

State	Localities	State	Localities
Alabama	4	Michigan	22
California	1	Missouri	2
Colorado	3	New Jersey	1
Delaware	1	New York	4
Indiana	91	Ohio	774
Iowa	297	Oregon	2
Kansas	535	Pennsylvania	2,961
Kentucky	218	West Virginia	3
Maryland	24		

Source: Tax Foundation
Note: The types of localities that levy income tax vary widely. In Michigan the localities that levy income tax are cities. In Maryland all 23 counties and one city, Baltimore, levy income tax. In Pennsylvania 2,492 municipalities and 469 school districts levy income tax.

Table A.2: Summary Statistics (TY 2014) by treatment status

	Contact only		Penalty salience		Punishment probability		Compliance cost		Civic pride		Salience × Probability		No contact	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Age	39.7	12.2	39.8	11.9	39.5	12.0	39.7	12.0	39.6	12.1	39.7	12.0	39.5	11.9
FS = single (%)	40.6	49.1	38.8	48.7	40.1	49.0	41.1	49.2	38.9	48.8	38.7	48.7	38.5	48.7
FS = joint (%)	10.3	30.4	10.9	31.2	10.4	30.5	10.0	30.0	10.9	31.2	10.5	30.7	10.9	31.2
FS = Head of household (%)	47.6	49.9	49.1	50.0	48.1	50.0	47.2	49.9	48.8	50.0	49.5	50.0	49.1	50.0
Years identified as nonfiler	4.3	2.5	4.3	2.4	4.2	2.4	4.2	2.5	4.2	2.4	4.3	2.5	4.3	2.5
Filed in 2012 or 2013 (%)	22.8	42.0	23.2	42.2	23.4	42.4	23.6	42.5	23.7	42.5	23.0	42.1	23.2	42.2
Total income ($ 000s)	33.7	28.8	33.5	22.6	33.7	23.6	33.7	24.8	34.1	42.8	33.6	25.3	34.3	69.1
Wage income ($ 000s)	31.3	26.9	31.4	21.6	31.4	22.0	31.1	21.6	31.2	23.8	31.4	22.8	31.6	23.5
Log total income	10.3	0.5	10.3	0.5	10.3	0.5	10.3	0.5	10.3	0.5	10.3	0.5	10.3	0.5
Nonzero nonwage income (%)	29.5	45.6	29.2	45.5	30.3	46.0	29.9	45.8	29.3	45.5	29.7	45.7	29.1	45.4
Observations	5,399		5,274		5,350		5,313		5,476		5,342		10,617	

Note: This table reports means and standard deviations of taxpayer characteristics from administrative tax data.

Table A.3: Summary Statistics (TY 2014) by delivery status

	Delivered		Unclaimed		Undeliverable		Transit	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Age	40.3	12.2	38.7	11.4	37.4	11.2	39.8	11.7
FS = single (%)	39.7	48.9	41.6	49.3	36.5	48.2	39.3	48.9
FS = married filing jointly (%)	12.8	33.4	8.4	27.7	6.2	24.1	11.6	32.1
FS = head of household (%)	46.3	49.9	48.4	50.0	56.3	49.6	47.1	50.0
Years identified as nonfiler	4.2	2.5	4.3	2.4	4.3	2.5	4.2	2.4
Filed in 2012 or 2013 (%)	25.0	43.3	20.8	40.6	14.6	35.3	24.2	42.9
Total Income ($ 000s)	34.3	27.4	32.9	20.3	28.9	16.1	35.2	24.6
Wage Income ($ 000s)	31.8	24.5	31.4	19.6	27.1	16.7	33.0	22.7
Log total income	3.4	0.5	3.4	0.5	3.3	0.4	3.4	0.5
Nonzero nonwage income (%)	31.9	46.6	27.6	44.7	24.8	43.2	29.6	45.7
Observations	3,980		1,852		824		524	

Note: This table reports means and standard deviations of taxpayer characteristics from administrative tax data.

Table A.4: Heterogeneity of response

	Contact only	Penalty salience	Punishment probability	Compliance cost	Civic pride	Salience × Probability	All letters	N
Age								
Age <= 30	0.9%	4.8%	2.1%	3.8%	1.8%	6.9%	3.3%	1,919
30 < Age <= 40	0.9%	8.3%	3.9%	2.7%	3.5%	8.3%	4.6%	2,042
40 < Age <= 50	3.5%	10.0%	4.8%	7.9%	4.0%	8.2%	6.5%	1,704
50 < Age <= 60	5.1%	20.4%	8.6%	8.2%	6.9%	14.3%	10.7%	1,061
60 < Age	15.9%	16.7%	15.2%	23.3%	7.8%	23.1%	17.1%	403
Filing status								
Single	4.5%	9.6%	5.0%	6.6%	5.4%	13.3%	7.3%	2,846
Joint	4.4%	23.1%	13.8%	11.1%	3.7%	15.6%	12.3%	765
Head of Household	1.4%	7.5%	2.5%	4.8%	2.7%	5.7%	4.1%	3,434
Other	7.7%	0.0%	11.1%	8.7%	0.0%	13.3%	7.2%	97
Years nonfiler								
1 year	3.3%	12.2%	5.8%	7.2%	7.7%	14.6%	8.3%	1,115
2 years	4.8%	15.5%	8.3%	6.8%	7.2%	13.7%	9.5%	1,116
3 years	4.6%	11.5%	5.5%	7.9%	2.3%	11.9%	7.2%	937
4 years	1.4%	10.7%	6.5%	4.4%	3.9%	8.3%	6.0%	873
5 years	1.4%	9.0%	3.5%	5.0%	2.2%	5.5%	4.2%	756
6 years	3.4%	7.5%	3.6%	7.1%	1.6%	8.2%	5.4%	747
7 years	1.7%	5.6%	1.7%	4.8%	2.3%	3.7%	3.3%	646
8 years	4.7%	3.3%	1.8%	8.1%	1.1%	10.5%	5.0%	581
9 years	0.0%	8.0%	3.4%	1.5%	0.0%	1.7%	2.7%	371
City returns filed								
Filed 2012	2.0%	18.3%	6.5%	4.7%	7.8%	14.9%	8.8%	605
Filed 2013	6.7%	29.9%	6.5%	10.2%	8.6%	11.7%	12.3%	446
Both	14.3%	35.7%	16.8%	22.3%	16.1%	36.2%	23.2%	547
Neither	1.9%	5.8%	3.3%	4.2%	1.7%	6.4%	3.9%	5,544
Income ($ 000s)								
Income <= 20	2.2%	4.3%	1.7%	5.2%	1.9%	5.9%	3.5%	1,846
20 < Income <= 30	1.9%	8.5%	5.2%	3.3%	3.6%	8.6%	5.2%	2,557
30 < Income <= 40	4.2%	13.6%	2.9%	8.5%	2.4%	9.7%	6.8%	1,157
40 < Income <= 50	2.6%	14.9%	9.4%	8.6%	4.2%	15.0%	9.2%	612
50 < Income <= 60	6.3%	11.8%	10.7%	11.5%	10.0%	16.4%	11.0%	353
60 < Income	6.7%	21.7%	8.8%	11.5%	10.4%	16.5%	12.6%	617
Treatment batch								
Batch 1	0.0%	15.0%	0.0%	15.0%	0.0%	10.0%	6.7%	119
Batch 2	2.1%	16.5%	11.2%	7.1%	3.1%	11.6%	8.6%	580
Batch 3	2.8%	9.5%	6.7%	7.0%	4.2%	8.4%	6.4%	2,151
Batch 4	3.6%	11.5%	3.4%	5.0%	3.9%	10.3%	6.3%	2,149
Batch 5	3.1%	7.3%	3.1%	5.9%	3.9%	10.1%	5.6%	2,143
Total	3.0%	10.1%	4.9%	6.2%	3.8%	9.7%	6.3%	7,142

Note: This table shows heterogeneity in response.

Table A.5: Response rate by age-income-filing history bins

Years nonfiler	Contact only	Penalty salience	Punishment probability	Compliance cost	Civic pride	Salience × Probability	All letters
			age <= 30, inc <= 25K				
1-2 years (N = 867)	0.0%	5.2%	1.8%	2.9%	4.3%	8.7%	3.8%
3-5 years (N = 618)	0.0%	0.0%	5.2%	3.8%	0.0%	6.5%	2.6%
6-9 years (N = 186)	0.0%	3.6%	0.0%	7.4%	0.0%	0.0%	2.0%
Total	0.0%	3.2%	2.8%	3.8%	2.3%	6.8%	3.1%
			age <= 30, 25K < inc <= 35K				
1-2 years (N = 273)	6.5%	8.3%	2.6%	0.0%	0.0%	10.0%	4.0%
3-5 years (N = 218)	0.0%	3.8%	0.0%	4.2%	0.0%	4.3%	1.9%
Total	3.4%	6.0%	1.5%	1.5%	0.0%	7.5%	3.1%
			age <= 30, 35K < inc <= 50K				
1-2 years (N = 110)	0.0%	20.0%	0.0%	8.3%	0.0%	16.7%	6.9%
Total	0.0%	20.0%	0.0%	8.3%	0.0%	16.7%	6.9%
			30 < age <= 50, inc <= 25K				
1-2 years (N = 401)	3.8%	12.2%	9.3%	4.8%	1.8%	9.4%	6.9%
3-5 years (N = 730)	2.6%	7.6%	2.6%	2.7%	5.0%	6.1%	4.5%
6-9 years (N = 973)	0.0%	4.0%	1.8%	0.0%	1.7%	6.4%	2.3%
Total	1.7%	6.8%	3.7%	1.7%	3.0%	6.9%	4.0%
			30 < age <= 50, 25K < inc <= 35K				
1-2 years (N = 273)	0.0%	14.7%	5.0%	5.9%	9.1%	17.5%	9.0%
3-5 years (N = 470)	0.0%	15.7%	1.4%	4.2%	4.6%	9.1%	5.4%
6-9 years (N = 564)	1.9%	4.5%	2.4%	2.9%	1.4%	6.7%	3.4%
Total	0.8%	10.6%	2.5%	4.0%	4.2%	10.0%	5.3%
			30 < age <= 50, 35K < inc <= 50K				
1-2 years (N = 208)	0.0%	18.2%	7.7%	12.5%	4.2%	16.7%	10.3%
3-5 years (N = 290)	0.0%	15.2%	5.1%	13.9%	0.0%	5.6%	6.2%
6-9 years (N = 349)	4.4%	7.5%	4.7%	2.6%	0.0%	5.1%	4.4%
Total	1.9%	12.0%	5.6%	9.3%	1.0%	8.6%	6.5%
			30 < age <= 50, 50K < inc				
1-2 years (N = 221)	14.3%	14.7%	16.7%	8.3%	20.0%	10.0%	13.9%
3-5 years (N = 264)	0.0%	12.8%	8.0%	10.0%	6.5%	13.8%	8.6%
6-9 years (N = 221)	3.7%	0.0%	0.0%	15.6%	0.0%	3.1%	4.1%
Total	5.7%	9.8%	8.4%	11.2%	9.1%	8.6%	8.9%
			50 < age, inc <= 25K				
1-2 years (N = 158)	4.5%	20.0%	18.8%	4.3%	13.3%	23.8%	13.4%
3-5 years (N = 229)	6.9%	13.0%	3.6%	16.1%	0.0%	10.7%	8.0%
6-9 years (N = 240)	11.1%	12.5%	4.5%	11.5%	0.0%	4.2%	7.5%
Total	7.7%	14.3%	7.6%	11.3%	2.5%	12.3%	9.2%
			50 < age, 25K < inc <= 35K				
1-2 years (N = 117)	9.1%	23.5%	15.4%	13.0%	16.7%	6.7%	14.3%
3-5 years (N = 177)	4.3%	23.8%	6.3%	4.8%	10.0%	11.5%	10.2%
6-9 years (N = 201)	12.0%	3.4%	3.7%	16.7%	0.0%	4.2%	7.1%
Total	8.5%	14.9%	7.1%	12.2%	7.7%	7.7%	9.9%
			50 < age, 35K < inc <= 50K				
1-2 years (N = 101)	0.0%	21.4%	20.0%	22.2%	14.3%	33.3%	19.7%
3-5 years (N = 132)	16.7%	12.5%	20.0%	0.0%	6.7%	25.0%	13.5%
6-9 years (N = 128)	0.0%	16.7%	11.1%	5.9%	0.0%	16.7%	9.7%
Total	7.9%	16.7%	16.3%	9.8%	7.7%	23.9%	14.0%
			50 < age, 50K < inc				
1-2 years (N = 165)	19.0%	39.1%	17.6%	23.5%	30.0%	32.0%	27.6%
3-5 years (N = 174)	7.7%	25.9%	26.3%	8.3%	0.0%	23.5%	15.2%
6-9 years (N = 179)	0.0%	33.3%	0.0%	10.0%	8.7%	22.2%	10.7%
Total	8.7%	32.3%	12.7%	14.3%	11.9%	26.1%	17.7%

Note: This table shows response rate by age, income, and filing history. Only age-income-history bins with at least 100 observations are shown. The three age categories are below 30, 30–50, and above 50. The four income categories are below $25K, $25K–$35K, $35K–$50K, and above $50K. The three filing history categories are 1–2 years, 3–5 years, and 6–9 years identified as a suspected resident nonfiler.

Table A.6: Marginal cost of mailings per nonfiler

	Dollars	Source / Description
Materials		
Card stock	0.017	$\frac{\$17}{250 \text{ sheets}} \times \frac{1 \text{ sheet}}{4 \text{ postcards}}$
Envelopes	0.044	$\frac{\$22}{500 \text{ envelopes}}$
Ink	0.040	pcworld.com estimate
Paper	0.014	$\frac{\$7}{500 \text{ sheets}}$
Time		
Printing	0.033	$\frac{3 \text{ hours}}{2,160 \text{ letters}} \times \frac{\$23.95}{\text{hour}}$
Stuffing	0.033	$\frac{3 \text{ hours}}{2,160 \text{ letters}} \times \frac{\$23.95}{\text{hour}}$
Certifying	0.444	$\frac{40 \text{ hours}}{2,160 \text{ letters}} \times \frac{\$23.95}{\text{hour}}$
Applying postage	0.033	$\frac{3 \text{ hours}}{2,160 \text{ letters}} \times \frac{\$23.95}{\text{hour}}$
Postage		
Postcard	0.270	USPS permit imprint
Letter	0.465	USPS metered postage
Certification	3.300	USPS metered postage
Total	4.698	

Note: Staff time is valued at $23.95 per hour, the hourly equivalent of the top annual salary of a Detroit tax examiner. *White Book, 2016-2017 Salary and Wage Adjustments*, March 2016, page 63, available at `http://www.detroitmi.gov/how-do-i/view-city-of-detroit-reports`. Marginal cost of mailings per nonfiler was a bit higher for the compliance cost group because the compliance cost letters enclosed a blank tax form and a return envelope. Also, the stuffing machine was less likely to stuff the outgoing envelope successfully, which required staff time to correct.