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

Ben Meiselman†
Johns Hopkins University

January 12, 2018

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%. 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. 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

*The data in this paper pertaining to the field experiment is subject to a non-disclosure agreement and was provided to the author from the City of Detroit. The content of the manuscript is also subject to disclosure approval from the City of Detroit.

†I am grateful for guidance from Joel Slemrod. I thank Odell Bailey, Will Boning, Charlie Brown, Donna Brown, Brian Erard, Enda Hargaden, Jim Hines, Chris House, Ryan Kellogg, Jason Kerwin, Gaurav Khanna, Margaret Lay, Dayanand Manoli, Nimit Modi, Stefan Nagel, Carol O'Cleireacain, Debra Pospiech, Daniel Reck, Ajay Shenoy, David Szymanski, Ugo Troiano, Michelle Weston, and Eleanor Wilking. I gratefully acknowledge funding from the Office of Tax Policy Research, the Michigan Institute for Teaching and Research in Economics, and Rackham Graduate School at the University of Michigan. The views expressed here are my own and do not necessarily reflect the views of the City of Detroit.

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

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. An interaction treatment that included both the penalty salience message and the punishment probability message was no more effective than the penalty salience message by itself. The punishment probability message on its own and the compliance cost message with an enclosed blank tax form also raised response rates relative to the contact-only control, but the response rate to the civic pride message was not statistically different from the contact-only control.

I find no evidence of geographic network effects. Network effects can be important even when effects per neighbor 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 50 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 suggests 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.

Section 2 gives background on the income tax system, decision to file, and estimated number of nonfilers in Detroit. Section 3 describes the design of a controlled field experiment. Section 4 presents the results of the field experiment. Section 5 estimates the welfare impact of nonfiler mailings. 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 wages, salaries, business income, and capital income, with an exemption of $600 per filer, spouse, or dependent.[1] 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, but I focus on the income tax.

Reporting and remittance procedures depend 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. A firm never remits income tax on behalf of contractors, regardless of the firm's location. A firm located in Detroit must report the income and withholding information for both employees and

[1] More details on what income sources are taxable are available at http://www.detroitmi.gov/incometax.

[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.

contractors. 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 simply to process returns submitted on time by compliant taxpayers.[3] 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. In recognition of capacity constraints, Detroit turned over primary responsibility for processing city returns to the state beginning with tax year 2015.[4]

Within these limits, Detroit does audit tax returns, but not the same way the IRS does. City auditors can check information from city income tax returns against information from federal income tax returns that is shared with Detroit by the IRS.[5] The vast majority of Detroit audits simply compare the information in the city return to the information in the federal return.

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

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

[4]The experimental mailings described in this paper were sent to a sample of tax year 2014 suspected resident nonfilers, for which the city retained full responsibility. Localities that levy income tax rely on state governments to different extents. For example, county income tax in Maryland is collected by the state, whereas cities in Ohio are more autonomous.

[5]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). In this context, the "third party" is another level of government.

permit the tax authority to examine records is a misdemeanor.[6]

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 records 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 used the first pathway exclusively—issuing proposed assessments and forwarding unpaid tax debt to a collection agency.

2.2 Filing decision

The logic of the standard model of income reporting can be naturally extended to the decision of 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

[6] 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.

that compliance costs are more important. Compliance costs should be at least as large for taxpayers with tax due as they are 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.

Filing a return could be influenced by nontax considerations, or it might not be the result of optimizing behavior. Desire for renters or homeowners insurance may motivate truthful reporting of residence on tax forms.[7] 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. Lastly, some Detroit residents and workers, especially those new to the area, may honestly be unaware that Detroit has an income tax.[8]

2.3 Nonfiler population size

In designing a tax enforcement approach to nonfilers, it would be helpful to know how many nonfilers there are. The identity of filers is known, but the identity and size of the tax base is unknown. 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. Applying LEHD shares to the CES workforce, Table 1 shows the estimated income tax base of Detroit was 387,000 people for tax year 2014.

For a given tax year, the population of nonfilers shrinks over time because many individ-

[7] The author has also heard anecdotes of the reverse—concealing residence in order to avoid higher car insurance rates inside the city than in nearby suburban neighborhoods.

[8] 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.

Table 1: Estimated Detroit tax base and nonfiler population as of April 2016

Tax year	Estimated tax base				Filed returns			Estimated nonfiling	
	Resident workers	Residents who work elsewhere	Nonresident workers	Total	All	Joint	Two earners	Individual nonfilers	Missing returns
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
2012	69	192	122	382	205	82	32	145	135
2013	66	191	123	381	193	77	31	156	145
2014	68	194	125	387	179	73	29	179	167

Note: All units are thousands. Estimates of Detroit resident workers, residents who work elsewhere, and nonresident workers are obtained by applying Detroit shares of Wayne County workers and employed residents (LEHD) to the workforce of Wayne County (CES). A return is considered to have two earners if there was a W2 associated with the "secondary" social security number. The estimate of missing returns assumes 17% of nonfilers would file joint returns, and 40% of those joint returns would have two earners. Individual nonfilers are estimated as [8] = [4] - [5] - [7], and missing returns are estimated as [9] = [8] * (1 - 0.17 * 0.40).

uals 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 have been 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 1, and that 17% of nonfilers would file joint returns, there were 167,000 missing returns, equal to 48% of required returns.[9]

[9]Erard et al. (2014) estimate there were 7.6 million federal individual income tax nonfilers in 2012 (6.1% of required returns). Among suspected resident nonfilers identified from federal income tax returns, 17% filed joint federal returns.

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) 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.[10] 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 portion of the city's algorithm that estimates tax liability is correct within $15 of reported tax liability for 70% of taxpayers who file both local and federal returns. However, incomplete withholding information often 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.[11] Two sources of income—active duty

[10] 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.

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

military pay and pension income—occasionally lead Detroit to overestimate tax due.[12]

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.

Table 2 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.

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 sent via United States Postal Service certified mail. The postcard listed 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 3 reports the message associated with each treatment status. Examples of postcards and letters are in Appendix Figure A.2.[13]

Penalty salience. One treatment status tested whether penalty salience affects tax com-

[12]Active duty military pay and pension income are taxable income to the federal government but not to Detroit. Using data from the IRS, Detroit cannot systematically distinguish between active duty military pay and other wage income, although it can request that information for individual taxpayers. Similarly, Detroit cannot systematically distinguish between pension income and other nonwage income, but it can request that information for individual taxpayers.

[13]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".

Table 2: Summary statistics, tax year 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.

pliance. 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, such as Chirico et al. (2016).

Punishment probability. Another treatment status was intended to affect the perceived 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).[14] The boxed message referred to the

[14]The individual income tax form for nonresidents, Form D-1040(NR), was sent to some nonfilers in the

Table 3: 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."

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 municipal center downtown.

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. 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

experiment in place of the tax form for residents.

neighbors, and (3) referred to a general principle of equity or fairness. The author is aware of just one other "pride" message previously tested (Kettle et al. 2016).

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 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 messages in the other treatment groups.

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.[15] Each batch had an approximately equal number of nonfilers from each treatment group. There were 119, 581, 2,160, 2,160, and 2,160 individuals in batches one through five, respectively.[16]

[15]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.

[16]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.

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.

It is possible that the State of Michigan taking responsibility for processing individual City of Detroit income tax returns beginning with tax year 2015 influenced response rates to the experimental mailings for tax year 2014 suspected resident nonfilers, but there is no reason to think that nonfilers in one treatment status had a different level of exposure to the change than nonfilers with a different treatment status.

4 Results

Table 4 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.[17] Inclusion in the sample was conditional on the city estimating tax due above $350, but 34% of returns nevertheless claimed a refund.[18] 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 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.

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

[18] 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 4: 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

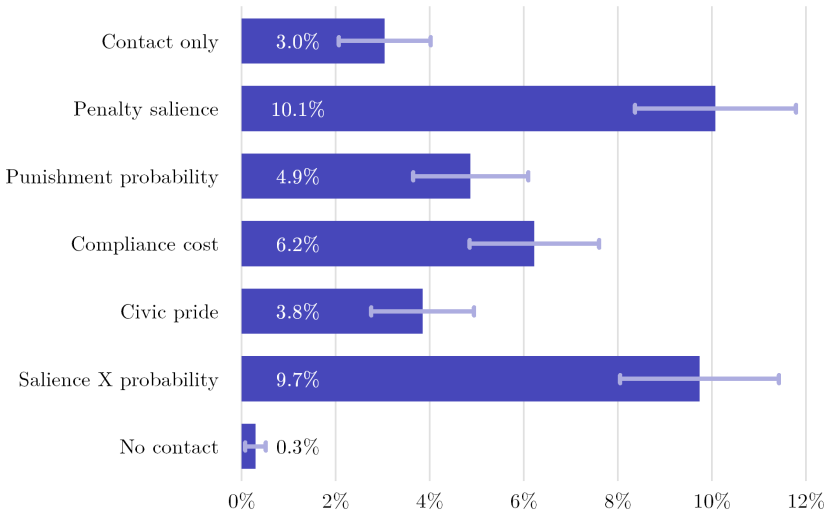
Note: This table reports summary statistics for responses within 75 days of sending the postcard.

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 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 mailings, 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 5 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

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.

straightforward because suspected resident nonfilers were randomly selected into treatments. Column 1 thus regresses the response indicator on treatment indicators only. As a test of balance, column 2 reports results from a regression with other observable characteristics included as controls 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 5, the dependent variable is scaled by a factor of 100 so that coefficients can be read in percentage points. The estimated treatment effects are robust to the inclusion of controls.

The most interesting theoretical object in this context might be the effect of *receiving*

Table 5: Response by experimental intervention, linear probability model

	Dependent variable:		p-value of F-test:
	Filed return	Filed return	coeff. = contact-only
	(1)	(2)	(3)
Penalty salience	9.78***	9.94***	$p < 0.01$
	(0.88)	(0.86)	
Punishment probability	4.58***	4.66***	$p = 0.02$
	(0.63)	(0.63)	
Compliance cost	5.93***	5.86***	$p < 0.01$
	(0.71)	(0.70)	
Civic pride	3.56***	3.43***	$p = 0.28$
	(0.57)	(0.56)	
Penalty X punishment	9.45***	9.49***	$p < 0.01$
	(0.87)	(0.85)	
Contact only	2.74***	2.84***	N/A
	(0.51)	(0.51)	
Mean of dependent variable	4.80	4.81	
Observations	9,523	9,508	
R^2	0.027	0.072	
Controls		X	

Note: This table estimates the treatment effect of experimental mailings on nonfiler response rate 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. Column 1 reports estimated treatment effects where the regressors are six dummy indicators for treatment status and the omitted treatment status is the no-contact control group. Column 2 reports estimated treatment effects with controls for age, filing status, filing history, log income, the presence of nonwage income, and batch. Column 3 tests the hypothesis that the coefficent of the specified treatment is equal to the coefficient of the contact-only treatment based on estimates from column 1. 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.

a treatment message, but I nevertheless focus on the intent to treat with a message, or (equivalently in this case) the effect of *sending* mailings. According to the USPS tracking website, the letter was delivered to approximately 55% of intended recipients. One might be tempted to restrict attention to intended recipients for whom the letter was reported as delivered, but the delivery rate varied by treatment status. Treated taxpayers had an opportunity to decline to authorize delivery of the letter after viewing the postcard, which also had a treatment message.[19] Furthermore, some of the intended recipients for whom the USPS tracking website reported no letter delivery filed a return anyway, and the tax division reported receiving phone calls from some treated taxpayers who had received the

[19]The F-statistic for equal delivery rates is 2.24, rejecting the null of equal delivery rates at the 5% level.

postcard but not the letter. The postcard should be understood as a treatment even though we cannot confirm whether it was received. Restricting attention to taxpayers for whom we can confirm receipt of the letter would therefore be inappropriate.

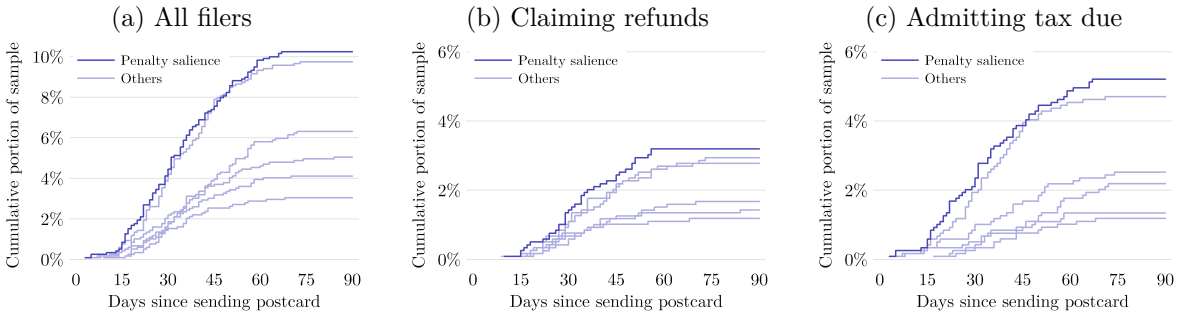
4.2 Response quality

The penalty salience mailings outperformed the other treatments in most dimensions relevant to tax enforcement. They elicited more returns admitting tax due, more returns per filer, and more remitted dollars than other treatments. Table 4 shows that 44 of the 153 returns elicited by the penalty salience mailing remitted payment (29%), a higher portion remitting payment than any other treatment. 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 was likely 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.

Across the entire sample including intended recipients who did not file a return, 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. Taxpayers also claimed refunds of $2.60 on average in response to the penalty salience mailings and $0.64 to $3.18 in response to the other mailings. Reported tax due net of refunds claimed ($25.45) and remittances net of refunds claimed ($11.87) were also highest in response to the penalty salience mailings. Section 5 elaborates on the net revenue and net welfare impact of the treatment mailings.

Promptness is a consideration in tax compliance, and the timing of responses did not differ substantially by treatment. Most responses were received between 15 and 60 days

Figure 2: Cumulative response to penalty salience treatment by net tax due



These graphs show the cumulative response rate to the treatment mailings. Panel (a) shows the cumulative percent of taxpayers who filed returns, Panel (b) shows the cumulative percent of taxpayers who filed returns claiming a refund, and Panel (c) shows the cumulative percent of taxpayers who filed returns admitting tax due.

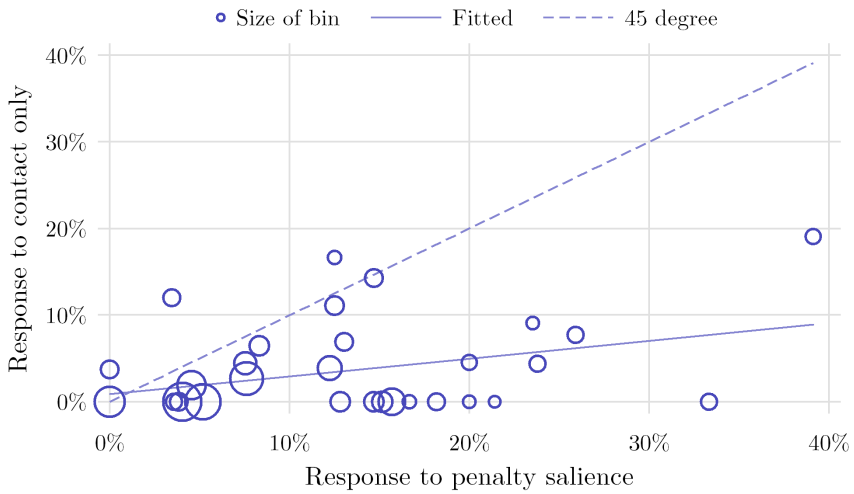
after the postcard was sent. Figure 2 presents cumulative response rates by treatment for all taxpayers and according to whether the taxpayer had negative or positive net tax due.

4.3 Heterogeneity of response

The penalty salience message was the most effective message overall, but tax administrators may want to tailor messaging by demographic subgroup if a subgroup responds particularly well to some other treatment message. I find no evidence that any of the other treatment messages would be more effective with any subgroup. Figure 3 shows that the response rates within age-income-filing history bins were higher for the penalty salience mailings than for the contact-only control mailings. Other pairwise comparisons between the penalty salience message and other messages within age-income-filing history bins are similar—the only subgroups with higher response rates for the other messages had very small samples, and I attribute those differences to sampling variability.

Similarly, tax administrators may want to tailor communication strategies to subgroups if demographic subgroups respond particularly well or poorly to various channels of communication. Response rates to all treatments were higher among higher income taxpayers, older taxpayers, and taxpayers with a recent history of filing a return. Figure 4 plots a fractional

Figure 3: Response rate by age-income-filing history bin



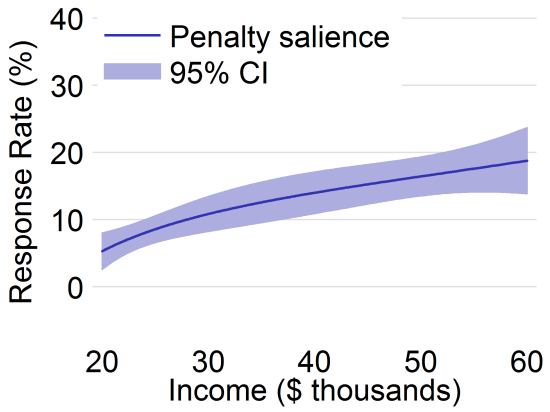
Note: This figure compares response rates to the penalty salience mailings with response rates to the contact-only control mailings within age-income-filing history bins. For defining bins, the three age categories are below 30, 30–50, and above 50. The four income categories are below $25K, $25K–$35K, $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.

polynomial regression of response rate on income, showing that higher income taxpayers responded at higher rates.[20]

The effects of age, income, filing history, and treatment status appear to be positive even when they are all at play. 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 by refining the criteria it uses to contact nonfilers.

[20]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}.

Figure 4: Response rate as a function of income



This figure plots a fractional polynomial regression of response rate on income within the penalty salience treatment group. The fractional polynomial regression finds the best fitting polynomial from the predefined set of powers {-2, -1, -.5, 0, .5, 1, 2, 3}.

4.4 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.[21]

I fail to find evidence of geographic spillover effects. 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

[21] 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 6: 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.

taxpayer pair. I then regress the count of untreated taxpayers who filed during the relevant time period on treatment dummies, where an observation is a treated nonfiler. Table 6 shows that most of the estimated coefficients on treatment dummies were not statistically different from zero. I repeated the procedure for a variety of distances, including 25, 50, and 100 meters. The penalty salience and punishment probability point estimates are negative, and the penalty salience × punishment probability treatment is significant at the 10% level, but significance is not robust to alternative distances. 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

This section estimates that the direct expected welfare effect of nonfiler mailings is negative for all treatments, conditional on the exact selection criteria in the experiment. It then

discusses the sensitivity of the direct welfare estimate to parameter assumptions and identifies 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. Adapting the optimal enforcement condition from Keen and Slemrod (2017) 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 marginal social value of public spending, expressed by the parameter ϕ, multiplies marginal revenue net of administrative costs in order to compare tax-authority dollars with privately-held dollars. If collecting tax is ever worthwhile, then one tax-authority dollar has more social value than one privately-held dollar, so $\phi > 1$. Note that foregone consumption appears twice—once as revenue and once as a component of private cost. For simplicity, this framework assumes that marginal utility per dollar is constant across individual taxpayers and that the marginal social value of public spending is constant.

Expected net welfare per mailing is estimated in Table 7 separately for each experimental treatment. Net welfare is estimated to be negative for all treatments under the baseline assumptions, 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.

Note that negative net welfare is not equivalent to negative net revenue. Indeed, if 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 estimated net revenue of \$342,000. This is inferred from a simple back-of-the-envelope calculation multiplying the

Table 7: 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. Claimed refunds are not paid if the taxpayer fails to 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. Appendix Table A.2 breaks down the components of the $4.70 estimated cost of mailings per nonfiler. The cost of processing responses is assumed to be one hour per filer valued at $23.95, the hourly equivalent of the top annual salary of a Detroit tax examiner in the *White Book, 2016-2017 Salary and Wage Adjustments*, March 2016. The marginal value of public spending is assumed to be $\phi = 1.5$ in the baseline estimate. Private cost is calculated as foregone private consumption (equal to marginal revenue) plus compliance costs of $125 per filer.

number of taxpayers who fit the sample selection criteria (42,754) by the revenue per penalty salience letter net of refunds claimed and administrative costs ($8.00).

The effect of mailings on net welfare is sensitive to assumptions about the marginal social value of public spending, compliance costs, and the impact of certification. 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. I use $\phi = 1.5$ in my baseline estimate and perform alternative calculations with 1.1 and 4.5.

The city income tax form for Detroit residents 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.[22] The baseline welfare estimate assumes compliance costs of $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 could overstate compliance costs if the

[22]See *1040a Instructions 2015*, available at https://www.irs.gov/pub/irs-pdf/i1040a.pdf.

marginal burden of a city return is low when a taxpayer has already filed a federal return. It could understate compliance costs if preparing tax forms is more psychologically costly than typical work, as argued by Benzarti (2017) in the context of itemizing federal deductions. I perform alternative calculations with compliance costs of \$25 and \$250.

Certification was a large component of administrative costs, but there is no evidence that it dramatically influenced response rates. Table 8 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 positive deterrence effect, then the estimates of marginal revenue are too low.

It may be possible to find an income threshold such that mailings improve expected welfare. Suppose momentarily that all intended recipients 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 \$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. Generally, Gross liability =

Table 8: 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 7 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.

$t(Y - 600 \cdot \text{Exemptions})$, 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 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.

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 correspond to expected marginal revenue of \$463.

6 Discussion

This paper is part of a rapidly expanding literature that uses controlled field experiments to learn about human behavior and improve tax compliance.[23] 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 ex-

[23]Mascagni (2017) reviews tax experiments and develops a taxonomy of tax treatments which I adopt.

periments 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) 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).

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 "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. 2016). 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.

The experiment in Detroit suggests that penalty salience deserves a place on the list of factors mediating taxpayer behavior. 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). However, Cranor et al. (2017) report on a mailing experiment with ninety thousand delinquent Colorado taxpayers in which a treatment message that described the legal penalty for continued noncompliance in detail was effective for raising payment rates. The effectiveness of a message similar to the penalty salience message but in a different context—delinquents in Colorado—strengthens the case that the importance of penalty salience may be generalizable in tax enforcement.

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 in a text message to a fine-owing delinquent, naming the recipient and stating the delinquent amount was no more effective than naming alone, which parallels the result from Detroit. Even though both penalty salience and punishment probability were individually effective relative to the contact-only mailings, the salience $\times$ probability treatment was no more effective than the penalty salience message by itself. 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.

Compliance costs. Compliance costs are just as closely related to traditional economic incentives as deterrence parameters (Erard and Ho 2001), but they have not received much experimental attention even though they are almost certainly large (Benzarti 2017; Guyton et al. 2003). Hasseldine et al. (2007) found no effect of offering assistance to sole proprietors, perhaps because many sole proprietors use paid tax preparers. Guyton et al. (2016) found that reminders raise compliance rates, and Bhargava and Manoli (2015) found that reducing the complexity of informational mailings improved takeup of the Earned Income Tax Credit. The finding in Detroit that providing a blank tax form and return envelope raises compliance is the first of its kind.

Moral appeals. This experiment adds to the body of evidence that moral appeals are typically not as effective for improving tax compliance as messages related to deterrence parameters. Within moral appeals, I include 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. The civic pride message in Detroit was novel in the sense that the only "pride" message in the literature 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. Hallsworth et al. (2017) present evidence from several large controlled field experiments in the United Kingdom that moral appeals *can* improve tax compliance, although the moral appeals are not contrasted with messages based on deterrence parameters.

Social learning. The social learning literature has provided ample theoretical and empiri-

cal 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.

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, who have received relatively little attention in the literature. The penalty salience message was the most effective. 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 building 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.

References

Allingham, Michael G and Agnar Sandmo. 1972. "Income tax evasion: A theoretical analysis." *Journal of Public Economics* 1 (3):323–338.

Alm, James. 2012. "Measuring, explaining, and controlling tax evasion: Lessons from theory, experiments, and field studies." *International Tax and Public Finance* 19 (1):54–77.

Angrist, Joshua D and Jörn-Steffen Pischke. 2010. "The credibility revolution in empirical economics: How better research design is taking the con out of econometrics." *Journal of Economic Perspectives* 24 (2):3–30.

Benzarti, Youssef. 2017. "How taxing is tax filing? Using revealed preferences to estimate compliance costs." Working Paper 23903. National Bureau of Economic Research.

Besley, Timothy and Torsten Persson. 2013. "Taxation and development." *Handbook of Public Economics* 5:51–111.

Bhargava, Saurabh and Dayanand Manoli. 2015. "Psychological frictions and the incomplete take-up of social benefits: Evidence from an IRS field experiment." *American Economic Review* 105 (11):3489–3529.

Boning, Will, John Guyton, Ron Hodge, Joel Slemrod, and Ugo Troiano. 2016. "Direct and network effects of alternative collection enforcement treatments: Evidence from a randomized control experiment." Working Paper. University of Michigan.

Bott, Kristina, Alexander W Cappelen, Erik Ø Sørensen, and Bertil Tungodden. 2014. "You've got mail: A randomised field experiment on tax evasion." Discussion Paper. NHH Norwegian School of Economics.

Brockmeyer, Anne, Marco Hernandez, Stewart Kettle, and Spencer Douglas Smith. 2016. "Casting the tax net wider: Experimental evidence from Costa Rica." Working Paper 7850. World Bank Policy Research.

Castro, Lucio and Carlos Scartascini. 2015. "Tax compliance and enforcement in the Pampas evidence from a field experiment." *Journal of Economic Behavior & Organization* 116:65–82.

Cellini, Stephanie Riegg, Fernando Ferreira, and Jesse Rothstein. 2010. "The value of school facility investments: Evidence from a dynamic regression discontinuity design." *Quarterly Journal of Economics* 125 (1):215–261.

Chetty, Raj, Adam Looney, and Kory Kroft. 2009. "Salience and taxation: Theory and evidence." *American Economic Review* 99 (4):1145–1177.

Chirico, Michael, Robert P Inman, Charles Loeffler, John MacDonald, and Holger Sieg. 2016. "An experimental evaluation of notification strategies to increase property tax compliance: Free-riding in the city of brotherly love." *Tax Policy and the Economy* 30 (1):129–161.

Conley, Timothy G and Christopher R Udry. 2010. "Learning about a new technology: Pineapple in Ghana." *American Economic Review* 100 (1):35–69.

Cranor, Taylor, Jacob Goldin, Tatiana Homonoff, and Lindsay Moore. 2017. "Communicating tax penalties to delinquent taxpayers: Evidence from a field experiment." Working Paper.

DellaVigna, Stefano. 2009. "Psychology and economics: Evidence from the field." *Journal of Economic Literature* 47 (2):315–372.

Drago, Francesco, Friederike Mengel, and Christian Traxler. 2015. "Compliance behavior in networks: Evidence from a field experiment." Discussion Paper 9443. IZA.

Duflo, Esther and Emmanuel Saez. 2003. "The role of information and social interactions in retirement plan decisions: Evidence from a randomized experiment." *Quarterly Journal of Economics* 118 (3):815–842.

Erard, Brian and Chih-Chin Ho. 2001. "Searching for ghosts: Who are the nonfilers and how much tax do they owe?" *Journal of Public Economics* 81 (1):25–50.

— 2004. "Mapping the U.S. tax compliance continuum." *Contributions to Economic Analysis* 268:167–186.

Erard, Brian, Pat Langetieg, Mark Payne, and Alan Plumley. 2014. "Missing returns vs. missing income: Estimating the extent of individual income tax filing noncompliance from IRS and Census data." Working Paper. B. Erard & Associates.

Fellner, Gerlinde, Rupert Sausgruber, and Christian Traxler. 2013. "Testing enforcement strategies in the field: Threat, moral appeal and social information." *Journal of the European Economic Association* 11 (3):634–660.

Finkelstein, Amy. 2009. "E-ZTax: Tax salience and tax rates." *Quarterly Journal of Economics* 124 (3):969–1010.

Glaeser, Edward L. 1999. "Learning in cities." *Journal of Urban Economics* 46 (2):254–277.

Guyton, John L, John F O'Hare, Michael P Stavrianos, and Eric J Toder. 2003. "Estimating the compliance cost of the U.S. individual income tax." *National Tax Journal* 56 (3):673–688.

Guyton, John, Dayanand S Manoli, Brenda Schafer, and Michael Sebastiani. 2016. "Reminders and recidivism: Evidence from tax filing and EITC participation among low-income nonfilers." Working Paper 21904. National Bureau of Economic Research.

Hallsworth, Michael. 2014. "The use of field experiments to increase tax compliance." *Oxford Review of Economic Policy* 30 (4):658–679.

Hallsworth, Michael, John A List, Robert D Metcalfe, and Ivo Vlaev. 2017. "The behavioralist as tax collector: using natural field experiments to enhance tax compliance." *Journal of Public Economics* 148:14–31.

Hasseldine, John, Peggy Hite, Simon James, and Marika Toumi. 2007. "Persuasive communications: Tax compliance enforcement strategies for sole proprietors." *Contemporary Accounting Research* 24 (1):171–194.

Haynes, Laura C, Donald P Green, Rory Gallagher, Peter John, and David J Torgerson. 2013. "Collection of delinquent fines: An adaptive randomized trial to assess the effectiveness of alternative text messages." *Journal of Policy Analysis and Management* 32 (4):718–730.

Hodge, Timothy R, Daniel P McMillen, Gary Sands, and Mark Skidmore. 2016. "Assessment inequity in a declining housing market: The case of Detroit." *Real Estate Economics*.

Hoopes, Jeffrey L, Daniel H Reck, and Joel Slemrod. 2015. "Taxpayer search for information: Implications for rational attention." *American Economic Journal: Economic Policy* 7 (3):177–208.

Kadlec, Dan. 2016. "Is it rude to talk about money? Millennials don't think so." *Time*. URL: http://time.com/money/4187855/millennials-money-manners/.

Keen, Michael and Joel Slemrod. 2017. "Optimal tax administration." *Journal of Public Economics* 152:133–142.

Kettle, Stewart, Marco Hernandez, Simon Ruda, and Michael Sanders. 2016. "Behavioral interventions in tax compliance: Evidence from Guatemala." Working Paper 7690. The World Bank.

Kleven, Henrik Jacobsen, Martin B Knudsen, Claus Thustrup Kreiner, Søren Pedersen, and Emmanuel Saez. 2011. "Unwilling or unable to cheat? Evidence from a tax audit experiment in Denmark." *Econometrica* 79 (3):651–692.

Mascagni, Giulia. 2017. "From the lab to the field: A review of tax experiments." *Journal of Economic Surveys*.

McCaffery, Edward J and Joel Slemrod. 2006. "Toward an agenda for behavioral public finance." In: *Behavioral public finance*. Ed. by Edward J. McCaffery and Joel Slemrod. Russell Sage Foundation. Chap. 1pp. 3–31.

Mobius, Markus and Tanya Rosenblat. 2014. "Social learning in economics." *Annual Review of Economics* 6 (1):827–847.

Naritomi, Joana. 2013. "Consumers as tax auditors." Working Paper. Harvard University.

Perez-Truglia, Ricardo and Ugo Troiano. 2015. "Shaming tax delinquents: Theory and evidence from a field experiment in the United States." Working Paper 21264. National Bureau of Economic Research.

Pomeranz, Dina. 2015. "No taxation without information: Deterrence and self-enforcement in the value added tax." *American Economic Review* 105 (8):2539–2569.

Royston, Patrick and Douglas G Altman. 1994. "Regression using fractional polynomials of continuous covariates: Parsimonious parametric modelling." *Applied Statistics* 43 (3):429–467.

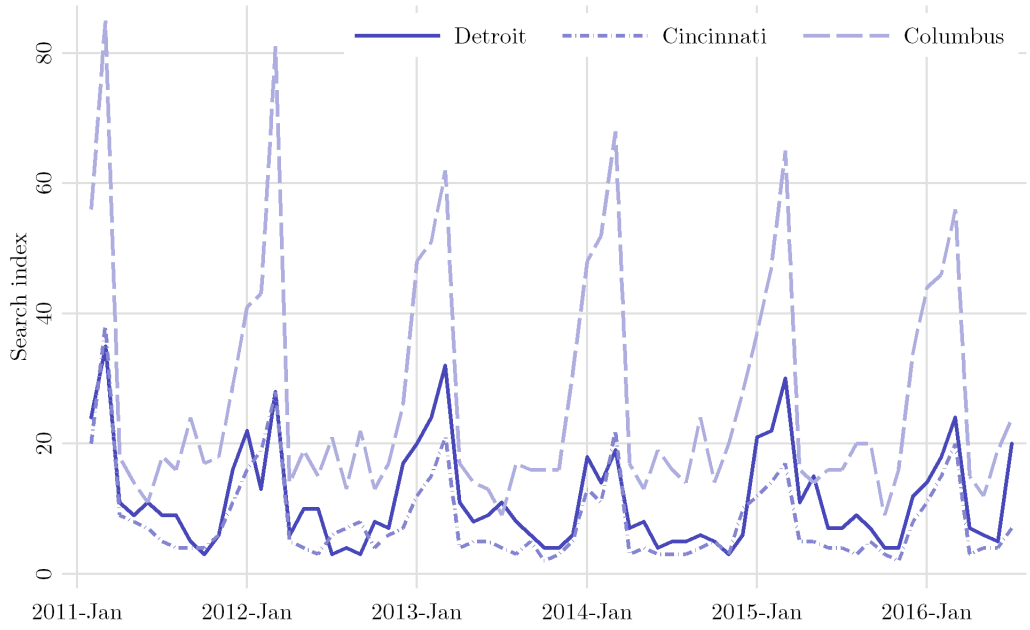
Slemrod, Joel and Caroline Weber. 2012. "Evidence of the invisible: Toward a credibility revolution in the empirical analysis of tax evasion and the informal economy." *International Tax and Public Finance* 19 (1):25–53.

Taylor, Chris. 2014. "The last taboo: Why nobody talks about money." URL: http://www.reuters.com/article/us-money-conversation-idUSBREA2Q1UN20140327.

Trachtman, Richard. 1999. "The money taboo: Its effects in everyday life and in the practice of psychotherapy." *Clinical Social Work Journal* 27 (3):275–288.

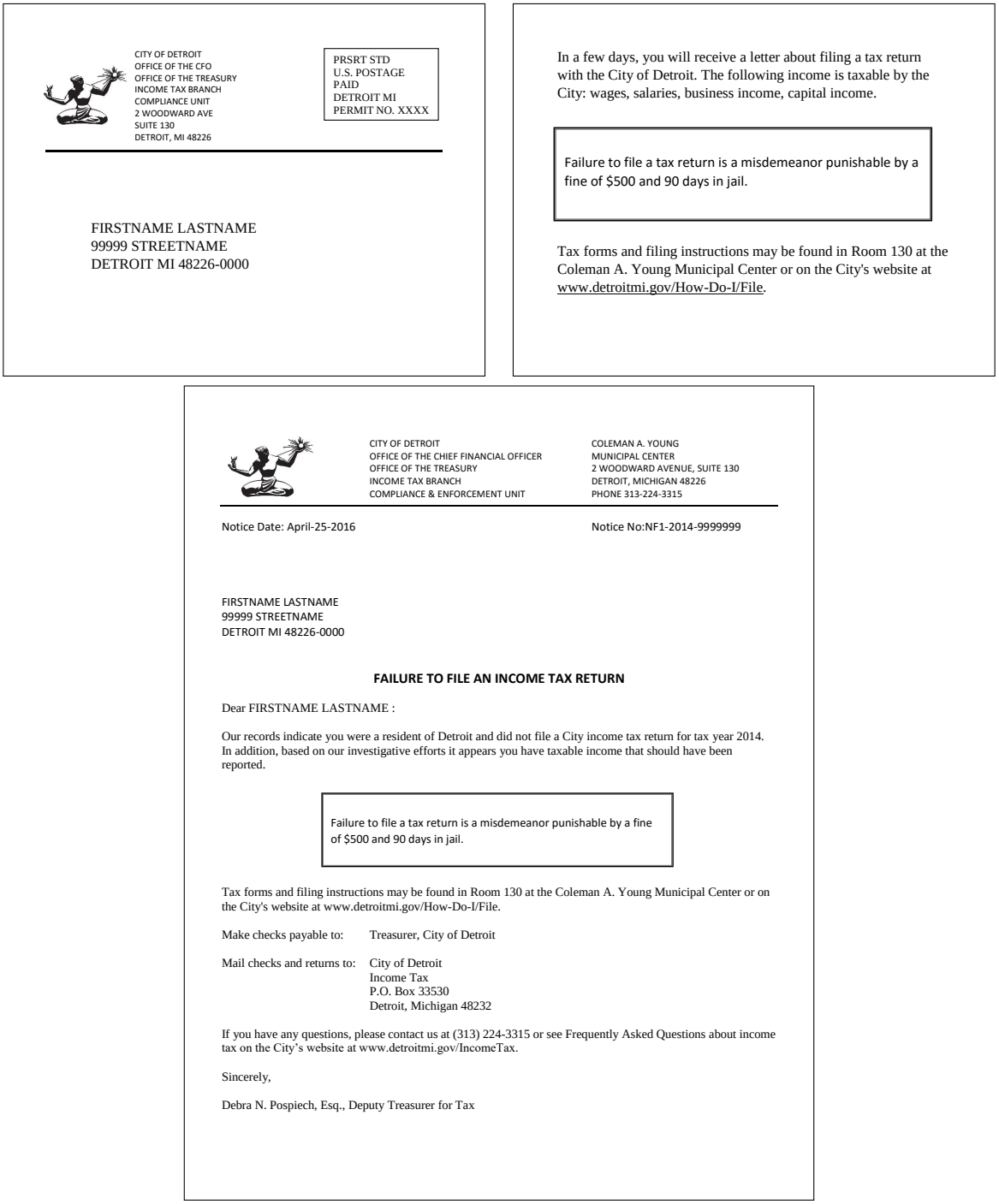
A Appendix

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

Table A.1: Heterogeneity of response

	Treatment status							
	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.2: 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. The mailings did not include postage for the return envelope. Also, the stuffing machine was less likely to stuff the outgoing envelope successfully, which required staff time to correct.