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How Do Taxpayers Respond to Tax Subsidy for Long-Term Savings? Evidence from Thailand's Tax Return Data

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Abstract

This paper uses a panel of personal income tax return data for the population of Thai tax filers to examine how individuals respond to tax subsidy for long-term savings. We utilize the 2013 tax reform that lowered the price subsidy for long-term savings in order to obtain causal identification. Our difference-in-difference analysis illustrates that there is a considerable heterogeneity in the individual responses to the subsidy cut—with middle-income taxpayers responding much greater than their high-income counterparts. Among the middle-income group, we also find that the subsidy reduction has larger effects on decisions of smaller contributors. Our findings shed light on the heterogeneity of individual responses which are crucial for policymakers who consider an incremental change in the existing tax incentive scheme.

JEL Codes: H240, H310.

Keywords: personal income tax, tax subsidy, long-term savings, retirement savings, developing countries.

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1. Introduction

Many countries employ tax subsidies to promote long-term savings and investment in their individual income tax systems. Their main objective is to ensure that individuals have adequate wealth for retirement by either raising total savings or shifting portfolio composition towards long-term savings (Ayuso et al. 2019). One of the key parameters to understand the efficacy of these tax incentives is the extent to which individuals respond to changes in the subsidies especially those most likely to have inadequate savings (Friedman 2017). Such understanding is critical due to the high costs associated with these subsidies (Joint Committee on Taxation 2019; Tanzi and Zee 2000) and the rising share of elder population in many countries.

Recently, increasing availability of high-quality administrative data have allowed researchers to extend progress in the literature related to tax-based saving incentives. Chetty et al. (2014) makes a seminal contribution by demonstrating that tax subsidy for long-term savings have strong effects on portfolio allocation with little impact on total savings. In particular, it illustrates that cutting the tax subsidy for retirement saving contributions of Danish high-income taxpayers significantly lowered contributions to the savings account that was affected. The cut, however, also brought about offsetting increases in other tax-favored accounts that were not affected by the subsidy reduction.

Still, it remains unclear how widely these findings can be applicable to other individuals especially those with lower income (Gale et al. 2020). Previous studies have emphasized the wide heterogeneity of individual responses to subsidy for savings (see,

for example, Duflo et al. 2006; Ayuso et al. 2019).¹ Moreover, findings in advanced economies are unlikely to apply directly to developing countries. Institutional factors may influence how individuals decide to contribute to their retirement or long-term savings. Specifically, needs for retirement or long-term savings are likely to be more emphasized in developing countries where public welfare provision and social security programs are more limited and capital market is less developed.

This paper uses a panel of tax return data for the population of Thai taxpayers to address a first-order policy question: how do taxpayers respond to a change in tax subsidy for long-term savings in developing countries? We design our analyses to shed light on the impacts of the tax subsidy on saving contributions, illustrate potential heterogeneity, and examine tax expenditure implications. Our identification strategy is based on a difference-in-difference approach around the income cutoffs associated with Thailand's 2013 personal income tax reform. By introducing several new tax brackets, the 2013 reform has lowered the subsidies associated with tax deductions for long-term savings across the income distribution.² We focus on individuals' contributions to tax-deductible Long-term Equity Fund (LTF), which represents long-term investment in domestic equity mutual funds and constitutes the largest tax expenditure associated with all tax breaks for long-term savings.³

¹ Duflo et al. (2006) conduct an experiment at H&R Block offering randomly chosen match rates to taxpayers for their contributions to a retirement account. It illustrates an increase in take-up among low-income taxpayers when incentives are salient.

² We provide additional details on Thailand's 2013 personal income tax reform as well as the institutional background in Section 2 and 3.

³ We provide estimate of Thailand's tax expenditure for major tax deductions for long-term savings in Section 2.

A common and important limitation of using the administrative tax return data is that we do not have information on wealth and savings outside tax-favored accounts. While we are not able to demonstrate if the reduction in taxpayers' savings reflect a cut in total savings or a shift to non-tax-incentivized savings, the reduction in either case represents the drop in savings that are legally mandated for a long-term/retirement use.

We document two key empirical findings. First, there is a considerable heterogeneity in the individual responses to the tax subsidy change along the income distribution. Middle-income taxpayers respond strongly to the subsidy change. We find that the marginal propensity to save (MPS) for the middle-income group declines by 22.6% following the 2013 tax reform. Such response is much more limited for high-income taxpayers—their MPS declines by 5.4% following the 2013 tax reform. The response is not significantly different from zero for low-income group. We also perform a litany of robustness tests to mitigate a concern that another factor was confounding our result.

Based on these estimates, we illustrate that each baht of the tax revenue gain from the subsidy cut is associated with a reduction of 0.8 baht in long-term savings for middle-income taxpayers and 0.3 baht for high-income taxpayers. This measure is helpful for policymakers since it facilitates comparison with marginal cost or benefit of other policy.

Second, we find that the tax responses are concentrated among those with small contributions. Among the middle-income group, the 2013 price subsidy change lowers the probability to make any LTF contribution by 6.8%. The size of the reduction declines to 5.2%, 2.2% and less than 0.3% for the probability of making LTF contributions of at least 2.5%, 5% and 7.5% of income, respectively. These patterns are qualitatively consistent among high-income taxpayers.

Our study is closely related to the public economics literature that study how individuals respond to tax subsidy for retirement and long-term savings (for literature review, see Hubbard and Skinner 1996; Hawksworth 2006; Friedman 2017). It complements this literature in two different ways. First, it demonstrates a clear income heterogeneity of individual responses to an incremental change in the tax subsidy. While Chetty et al. (2014) provides powerful insights on the effects of price subsidies among high-income individuals, a more comprehensive understanding of individual responses especially of middle- and low-income groups is needed to guide policy. Understanding responses to an incremental change in the existing subsidy scheme is also central to policy debate since such tax subsidies have already been operative for some time in many countries.

Second, we present micro-based evidence of the effects of tax subsidy for retirement and long-term savings in a developing-country context. Studies that examine individuals' responses to tax subsidies for retirement savings tend to focus on developed economies. US examples include Poterba et al. (1995, 1996); Attanasio et al. (2005), Gelber (2011). Other examples include Chetty et al. (2014) and Kreiner et al. (2017) for Denmark, Veall (2001) and Milligan (2002) for Canada, Blundell et al. (2006), Chung et al. (2006) and Disney et al. (2010) for the UK, Japelli and Pistaferri (2002) for Italy, and Ayuso et al. (2019) for Spain. There is very limited micro-based empirical evidence on this issue for developing countries. Our paper provides one the first analyses of taxpayers' responses to price subsidy for long-term savings using tax returns from a middle-income developing country. Its findings have broad implications for policymaking in countries at similar development stages.

The remainder of this paper is organized as follows. In the next section, we briefly discuss the institutional background. Section 3 describes the empirical design and the tax

return data. Section 4 presents the empirical results and robustness tests. Section 5 concludes the study.

2. Institutional background: The Thai personal income tax system

The Thai personal income tax system represents a tax on individual income and is implemented using a progressive schedule. Similar to many countries, the Thai government provides tax deductions for retirement and long-term savings/investment in the system. Major deductions are long-term equity fund contribution (LTF), retirement mutual fund contribution (RMF), and provident fund contribution (PVD). Since these contributions are deductible from individuals' taxable income, associated tax subsidies can be viewed as price subsidy—the tax benefit drives down the after-tax price of saving contributions.

Although all of those three tax deductions are provided to encourage saving and investment, there are important differences with respect to investment types and holding requirements. The LTF represents an investment in mutual funds of which domestic equity accounts for at least 60% of their portfolio. During the study period, taxpayers are required to hold the purchased units for at least 5 calendar years. The RMF represents an investment in general mutual funds. Taxpayers are required to hold the purchased units until they are at least 55 years old, or if over that age, must hold for at least five calendar years. After their first investment, they are also required to contribute at least the minimum of 3% of gross income and 5,000 baht every year until reaching age 55.⁴ Note

⁴ Taxpayers who violate the requirements of LTF and RMF are subject to strict penalty. They will have to 1) return the tax benefit associated with deduction, 2) pay the fine at the rate of

that both LTF and RMF represent active investment on mutual fund but, for working-age taxpayers, the LTF has much less strict holding requirements than the RMF. This makes the LTF investment much more widespread than the RMF.

The PVD includes both registered-employers provident funds and government pension fund. Eligible employees are able to contribute 2-15% of gross income to their provident funds. They are also generally required to hold the PVD investment until retirement which must be after the age of 55. While both LTF and the RMF involve active investment decisions every year, the PVD contribution is made passively via automatic salary deduction. Taxpayers are generally permitted to adjust their monthly contributions in a narrow window (typically a two-week period in December) before the start of a calendar year.

The LTF contribution is subject to a limit that is more generous than that of RMF and PVD and does not depend on those two deductions. During the study period, the deduction for LTF contribution is capped at the minimum of 15% of gross income or 500,000 baht (approximately 2.5 times of Thailand's GDP per capita in 2020). The deductions for RMF and providence fund contributions, on the other hand, are each capped at the minimum of 15% of gross income and their combined amount cannot exceed 500,000 baht.

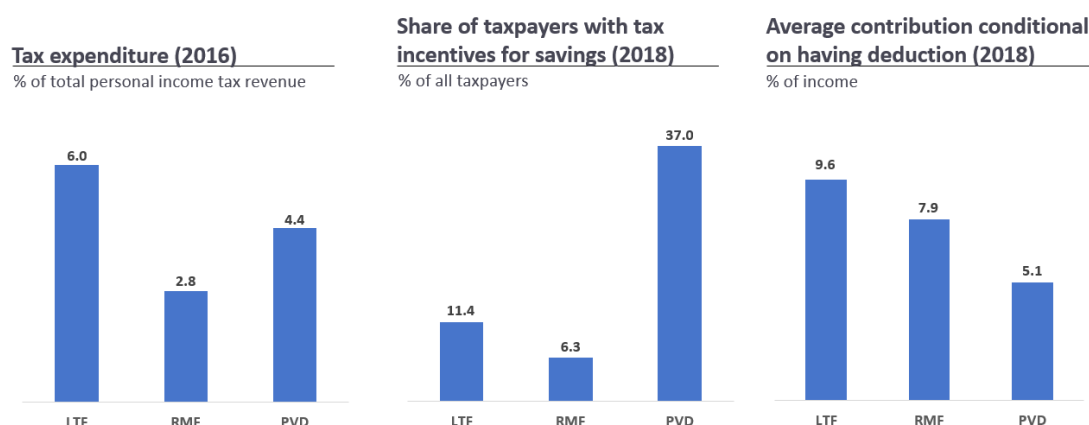
Figure 1 illustrates tax expenditure, participation and average conditional contribution associated with each type of the tax deductions.⁵ LTF, which is the focus of

1.5% per month associated with the tax benefit, and 3) pay the income tax on any capital gains associated with the sale of LTF/RMF units.

⁵ We compute the tax expenditure as the difference between the tax liability without benefit of the tax deduction and the tax liability under the 2016 law.

our study, accounts for the largest tax expenditure (6.0% of total personal income tax revenue). RMF and the PVD account for 2.8% and 4.4% of total personal income tax revenue, respectively.

Figure 1: Tax expenditure, participation and average conditional contribution associated with tax deductions for long-term and retirement savings



Notes: This figure shows tax expenditure, participation and average conditional contribution associated with tax deductions for long-term and retirement savings. LTF refers to long-term equity fund, RMF refers to retirement mutual fund, and PVD refers to provident fund. We define the tax expenditure as the difference between the tax liability without benefit of the tax deduction and the tax liability under the 2016 law. It is computed using the universe of tax returns described in Section 3 and include all taxpayers.

Source: Authors' estimate

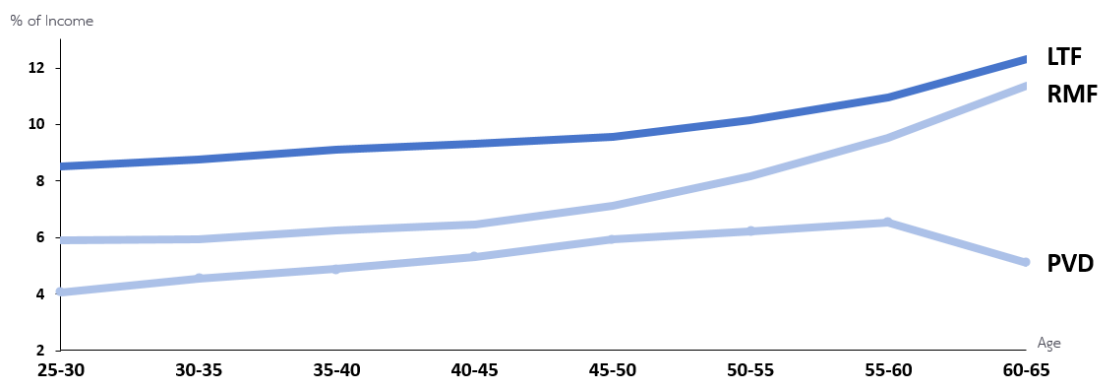
In term of participation, 11.4% of all taxpayers report LTF contributions in 2018. The share of taxpayers with RMF contributions is 6.3%, while that with provident fund contribution is 37.0%. Taxpayers with LTF tend to rely heavily on it. Conditional on having the deduction, average LTF contribution is 9.6% of income in 2018. This is noticeably greater than the conditional averages for RMF and PVD (7.9% and 5.1% of income, respectively).

Panel A of Figure 2 shows the reliance on LTF, RMF and provident fund by age. The reliance on LTF is rising with age and greater than the other two deductions during the overall working age. Panel B of Figure 2 further illustrates the importance of LTF relative to RMF and PVD. While only 11% of taxpayers reports LTF contributions in

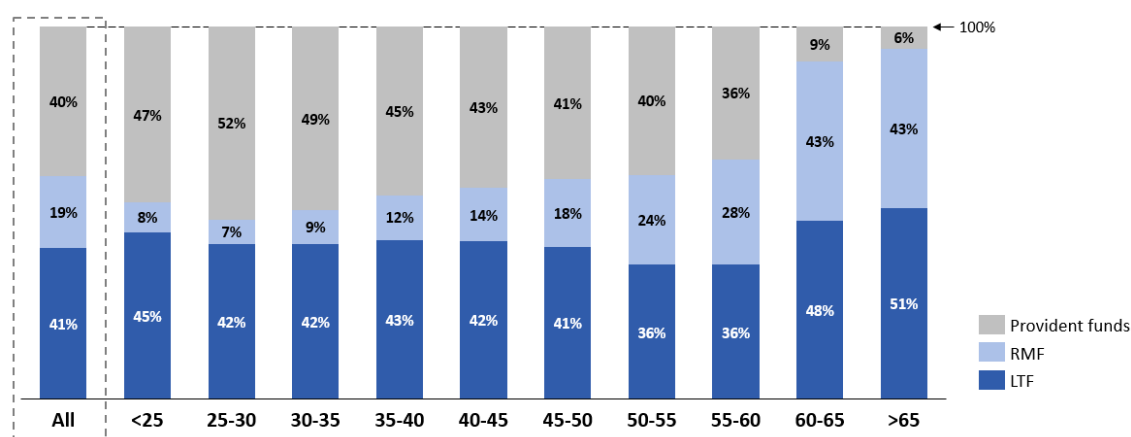
2018, total LTF contributions constitute roughly the same share as total PVD contributions in the portfolio of long-term saving contributions.

Figure 2: Uses of tax deduction for long-term saving/investment by age (2018)

A) Average deduction in % of income conditional on having each deduction



B) Portfolio share of LTF, RMF and provident fund



Notes: Panel A shows the average deduction in % of income among respective contributors by age in 2018. Panel B shows portfolio share of LTF, RMF and provident fund. LTF is Long-term equity fund, and RMF = Retirement mutual fund.

Source: Authors' estimate

At the end of 2012, the Thai government has enacted the legislation that increases the number of tax brackets in the personal income tax schedule starting from 2013.⁶ The

⁶ The tax change was officially temporary (lasting two years) in order to avoid requiring lengthy parliamentary approval. However, the government claimed (and the public perceived) that the tax cut was permanent with the legislation process being completed in the near future.

main objective was to lower tax burden in order to increase the country's tax competitiveness. As described in detail in Section 3, our empirical design takes advantage of a quasi-experiment brought about by this change.

There are at least two primary benefits associated with using the Thai tax data and studying their tax environment. First, the 2013 tax schedule change lowers marginal tax rates and, therefore, price subsidies for all types of tax-incentivized savings. With no incentive to switch to another tax-incentivized saving account, the response likely reflects a change in saving that is mandated for long-term/retirement use.

Second, tax-favored pension system around the world typically yields tax benefit at the time of contribution with earned income taxed when withdrawn. In those countries, an incentive to contribute may depend on expectation of future tax rates, which can be influenced by major tax reforms. For Thailand, however, contributions to tax-incentivized savings are deductible from taxable income at the time of contributions with both earned and capital gains income being tax exempt when withdrawn. The saving incentives, therefore, are less likely to be influenced by expectation of future tax rates.

3. Empirical Design and Data

3.1 Empirical design

Our primary objective is to analyze the extent to which contributions to tax-deductible long-term savings respond to changes in the price subsidy. Our identification strategy is based on the difference-in-difference approach exploiting a quasi-experiment resulting from the change in the personal income tax schedule in 2013. Starting in 2013, several tax brackets were added to the progressive tax schedule—resulting in lower marginal tax rates (and hence price subsidy) for some individuals.

We select income cutoffs around which taxpayers are subject to the same marginal tax rate before 2013 but face different marginal tax rates from 2013 onward. There are six associated income cutoffs: 300,000, 500,000, 750,000, 1 million, 2 million, and 4 million baht. Figure 3 illustrates the income cutoffs used in our analysis. Specifically, we compare contributions of taxpayers with income 15% around these six cutoffs before and after the 2013 change.⁷ In each cutoff, taxpayers in the treatment group are those who experience the reduction in marginal tax rate, while taxpayers in the control groups are those who face the same marginal tax rate. Under the identification assumption that unobserved determinants of contributions do not distinctively change on average between treatment and control groups around the 2013 tax schedule change, this approach allows us to capture the causal effects of the price subsidy cut on taxpayers' contributions.

We divide taxpayers into three income groups. Given that the 40th percentile of adjusted taxable income is around 500,000 in 2013, we classify taxpayers in the 300,000, 500,000 baht cutoffs as low-income group. Middle-income group are those in the 750,000-baht cutoff (65th percentile in 2013). Taxpayers in the top three cutoffs are classified as high-income taxpayers.⁸

⁷ We narrow to the bands to 10% around the income cutoffs in one of the robustness tests.

⁸ The 90th percentile of adjusted taxable income is around 1 million baht in 2013.

Figure 3: Income cutoffs used in the baseline analysis

Annual net income	2009-2012	2013-2016	
0-150,000	Exempt (0%)	Exempt (0%)	
150,001-300,000	10%	5%	} Low income Below 40 th percentile
300,001-500,000	10%	10%	
500,001-750,000	20%	15%	} Middle income Around 65 th percentile
750,001-1,000,000	20%	20%	
1,000,001-2,000,000	30%	25%	} High income Above 90 th percentile
2,000,001-4,000,000	30%	30%	
Above 4,000,000	37%	35%	

Notes: This figure shows income cutoffs and tax rates before and after the 2013 change. Taxable income is income net of expense and deductions.

Source: Authors' estimate

Our focus is on the LTF contribution since the LTF contribution decision is likely to be much more flexible than that of RMF and PVD.⁹ Taxpayers can freely decide whether or not to invest in LTF and what amount to invest each year. On the other hand, the rule requires the minimum PVD investment of 2% of gross income and opting out is generally not possible. Also, taxpayers can modify their PVD contributions only in a narrow window before the start of each calendar year. For RMF, once invested, taxpayers are required to continue making at least the minimum amount of RMF contribution every year until age 55. This complicates the decision to lower contribution or opt out of the RMF.

⁹ We also present the effects on the sum of all long-term saving (LTF, RMF and PVD contributions) in one of the sensitivity tests.

Following Chetty et al. (2014), we examine the effects of the price subsidy reduction using marginal propensity to save (MPS).¹⁰ To quantify the effect on the MPS, we estimate the following equation for each income group:

$$\begin{aligned} Sav_{i,t} = & \beta_0 + \beta_1 Treat_{i,t} + \beta_2 Post_{i,t} + \beta_3 Treat_{i,t} * Post_{i,t} + \beta_4 Y_{i,t} + \\ & \beta_5 Treat_{i,t} * Y_{i,t} + \beta_6 Post_{i,t} * Y_{i,t} + \beta_7 Treat_{i,t} * Post_{i,t} * Y_{i,t} + \beta_8 X_{i,t} + yearFE + \\ & coffFE + yearFE * coffFE + \varepsilon_{it}, \end{aligned} \quad (1)$$

where $Sav_{i,t}$ = savings contribution, $Treat_{i,t} = 1$ for treatment group (0 for control group), $Post_{i,t} = 1$ for years 2013-2016 (0 for 2009-2012), $Y_{i,t}$ = adjusted taxable income, $X_{i,t}$ = a vector of control variables, and ε_{it} = error term. The control variables include age (level and squared), number of children, and indicator variables for gender, having mortgage interest deduction. We also control for year fixed effects ($yearFE$), income-cutoff fixed effects ($coffFE$), and year-income-cutoff fixed effects ($coffFE$). The coefficient β_7 represents the causal effect of the reduction in the tax subsidy on the MPS. Note that, because of income fluctuations, the set of individuals in the treatment and control groups varies across years.

The key threat to this study's empirical design is that other time-varying shocks may coincide with the 2013 tax schedule change and confound our result. We work to mitigate these concerns throughout my study. First, we control for year-fixed effects in the model estimation. This allows us to account for changes in macroeconomic conditions

¹⁰ Heterogeneity in the response to income changes can have significant impact on the effectiveness of fiscal policies and redistributive programs (see, for example, Krueger et al. 2018; Fisher et al. 2020). We also estimate the effect on the level of LTF contribution in section 4.

that may influence individuals' saving contributions. Second, we estimate the baseline model separately for each of the six income cutoffs in order to investigate sensitivity to the income grouping. Third, we narrow the income band around each of the six cutoffs from 15% to 10%. This tests how sensitive our results are to the size of bands around cutoffs. Forth, we conduct a placebo experiment using an income cutoff around which there is no change in the marginal tax rate. Finally, we conduct an estimation where we limit the sample to taxpayers who filed tax returns throughout 2009-2016. This allows us to see if our results are driven by potential bias resulting from old or young taxpayers.

3.2 Data

We use a de-identified panel of personal income tax return data for the population of Thai tax filers from 2009-2016. We focus on tax filers with salaried income only because other types of income, such as self-employment income, are likely to make it difficult for individuals to precisely pinpoint their tax bracket. These filers accounts for approximately 75% of all tax filers. We also exclude observations with age below 20 and over 60. Given these restrictions, our dataset consists of approximately 8.1 million observations.

The dataset is rich in information related to income, demographics and saving/investment behavior since the tax system allows a few deductions related to various characteristics of taxpayers. For salaried workers, their income and savings contributions are generally based on third-party reporting. This ensures data quality and minimizes misreporting due to tax avoidance purpose. To avoid potential endogeneity,

we define adjusted taxable income (ATI) as gross income net of expense and only deductions related to personal characteristics (e.g. children and elderly parents).¹¹

Table 1 provides summary statistics on contributions and other characteristics of taxpayers in our baseline analysis.

¹¹ We provide an estimation with an alternative measure of ATI in one of the robustness tests.

Table 1: Summary Statistics of the baseline analysis dataset

Variables	Low-income taxpayers				Middle-income taxpayers				High-income taxpayers			
	N	Mean	Median	SD	N	Mean	Median	SD	N	Mean	Median	SD
Fraction with LTF contribution	5,905,976	3.6%			1,329,179	15.5%			877,120	37.4%		
LTF contribution	5,905,976	1,271	0.0	8,186	1,329,179	10,230	0	28,339	877,120	56,435	0	103,209
Adjusted taxable income	5,905,976	377,167	328,849	102,305	1,329,179	728,763	718,431	63,322	877,120	1,311,968	1,025,523	706,706
Female	5,905,976	44.7%			1,329,179	40.9%			877,120	33.5%		
Age	5,905,976	41.7	42.0	9.7	1,329,179	45.5	46.0	9.5	877,120	44.6	45.0	8.3
Number of children	5,596,899	0.7	0.0	0.9	1,248,546	0.7	0.0	0.9	834,125	0.8	0.0	0.9
Fraction married	5,905,976	51.2%			1,329,179	57.4%			877,120	56.8%		
Fraction having mortgage	5,905,976	33.1%			1,329,179	44.6%			877,120	52.2%		

Notes: This table provides summary statistics on contributions and other characteristics of low-, middle-, and high-income taxpayers in our baseline analysis.

Source: Authors' estimate

4. Results

We begin this section by providing a visualization of change in the marginal propensity to save for all three income groups. We then perform a formal quantification of the responses, compute the impacts of tax expenditure change on tax-deductible savings, and investigate the potential heterogeneity.

4.1 Baseline response

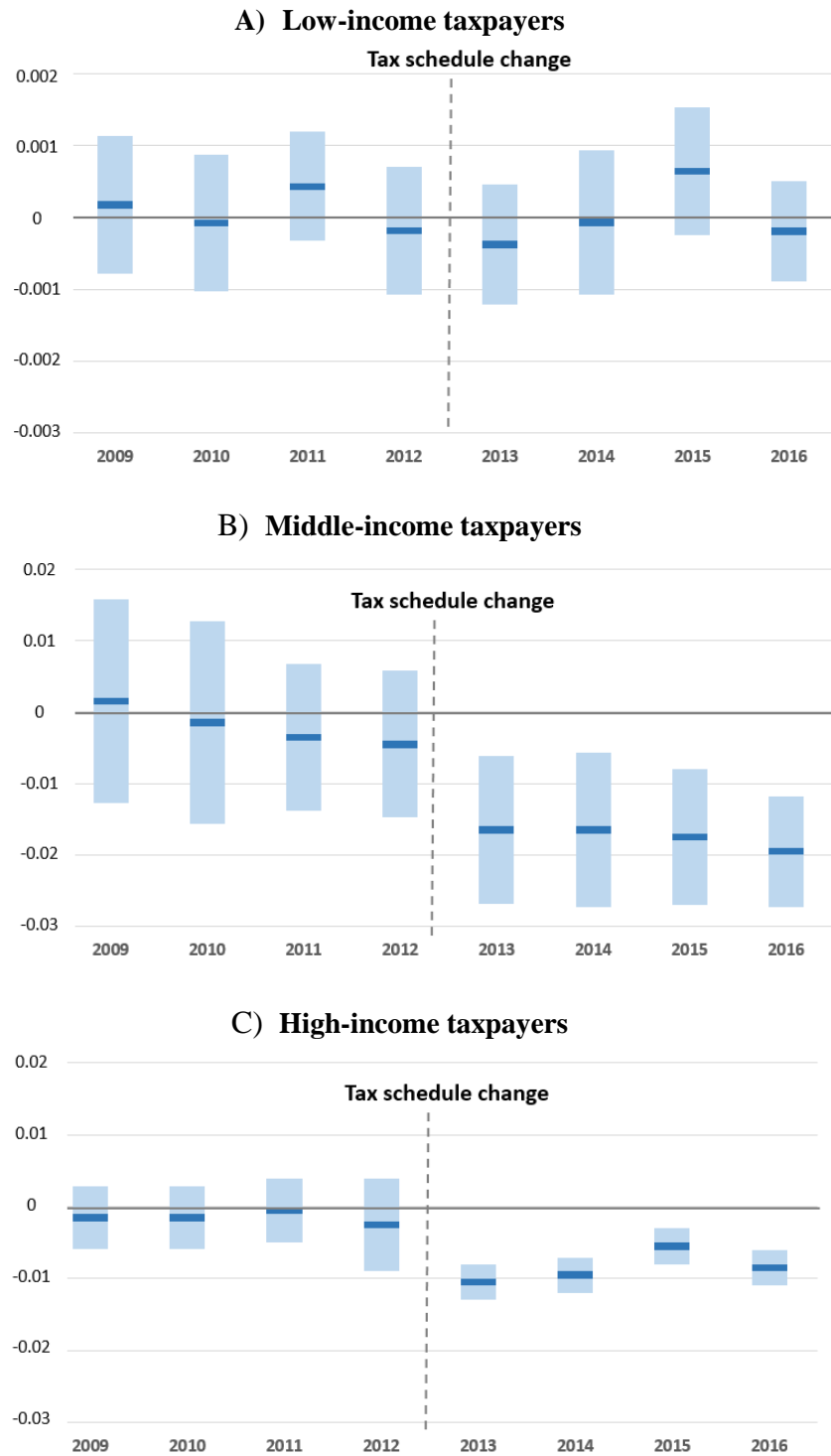
Figure 4 illustrates the impact of the 2013 tax change on marginal propensity to save (MPS) in LTF. It plots the difference in the MPS between treatment and control groups before and after the tax change. To construct this figure, we estimate the following equation separately for each year and each income group from 2009 to 2016

$$Sav_{i,t} = \beta_0 + \beta_1 Treat_{i,t} + \beta_2 Y_{i,t} + \beta_3 Treat_{i,t} * Y_{i,t} + coeffFE + \varepsilon_{it}, \quad (2),$$

where all variables are defined in equation (1). The coefficient β_3 represents the difference in the marginal propensity to contribute to LTF for taxpayers in the treatment group and the control group in each year.

Figure 4 plots the coefficient β_3 of equation (2) and its 95% confidence interval from 2009 to 2016 for each income group. While not statistically significant for the low-income taxpayers, the MPS difference for the middle-income group is negative and significantly different from zero in all years after the subsidy reduction. The same pattern holds for the high-income group but the MPS difference is smaller in magnitude than that for the middle-income group.

Figure 4: Difference in MPS in LTF for taxpayers in the treatment and the control group by year



Notes: This figure shows the impact of the 2013 tax change on MPS in LTF for low-, middle- and high-income taxpayers. It plots the difference in the MPS in LTF between taxpayers in the treatment and the control group in each year. The MPS difference is estimated using equation (2). Shaded bar represents the 95% confidence interval. Full estimation tables are in the supplementary appendix which is available upon request.

Source: Authors' estimate

Next, we formally quantify the magnitude of this change in the MPS. Specifically, we estimate the effects of the 2013 tax subsidy reduction on the marginal propensity to save (MPS) in LTF (Equation 1). Table 2 present the empirical results of Equation 1 for low-, middle- and high-income taxpayers. All columns use LTF contributions as a dependent variable. The results are shown without and with control variables.

For middle-income taxpayers, the null hypothesis that the 2013 change has no effect on the MPS in LTF is strongly rejected (Column 4 of Table 2). The coefficient of -0.012 implies that, when the previous tax schedule was in place before 2013, a 10,000-baht increase in income leads to 120 baht of additional saving in LTF. With the MPS in the treatment group before 2013 being 0.053 ($\beta_4 + \beta_5 = 0.059 - 0.006$), this represent the reduction in the MPS in LTF by 22.6%. The estimate is also similar without control variables (Column 3 of Table 2). Given that the 2013 tax change raises the after-tax price of LTF for the middle income group by 6.3%, the implied price elasticity of MPS is -3.6. That is, an increase in the price of LTF by 1% leads to a reduction in the MPS by -3.6%.

We also find significant effect on the MPS for high-income taxpayers but its magnitude is considerably lower than that of the middle-income group. The 2013 tax change lowers the MPS in LTF by 5.4% for the high-income group. Given that the 2013 change raises the after-price of LTF by 7.0%, the implied price elasticity of MPS is -0.8.¹² For low-income taxpayers, however, we are not able to reject the null hypothesis that the 2013 change had no effect on their MPS (Columns 1-2 of Table 2).

¹² The 2013 tax change raises the after-tax price of LTF by 7.1% for the treatment groups in the 1 million and 2 million baht cut offs, and by 3.2% for those in the 4 million baht cut off. Using the number of taxpayers in each cut off as weight, the weighted change is -7.0%.

Table 2: Baseline effect of 2013 tax change on marginal propensity to save in LTF
(Dep var: LTF contributions)

	(1)	(2)	(3)	(4)	(5)	(6)
	Low-income taxpayers		Middle-income taxpayers		High-income taxpayers	
Treatment x Post x Income	-0.000 (0.000)	-0.000 (0.000)	-0.012*** (0.004)	-0.012*** (0.004)	-0.004*** (0.001)	-0.004*** (0.001)
Observations	5,905,976	5,596,899	1,329,179	1,248,546	877,120	834,125
MPS (Treatment/Pre)	0.010	0.011	0.053	0.053	0.072	0.074
Year FE	YES	YES	YES	YES	YES	YES
Control	NO	YES	NO	YES	NO	YES

Notes: This table presents the estimated impacts of the 2013 reduction in price subsidy on MPS in LTF. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for taxpayers in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. MPS (Treatment/Pre) is the estimated marginal propensity to save for treatment group during the pre-change period and equals the sum of β_4 and β_5 in Equation 1. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively. Full estimation table is in the appendix.

Source: Authors' estimate

Our elasticity estimate for high-income taxpayers is much smaller in magnitude than the elasticity of -2.5 reported by Chetty et al. (2014) for taxpayers at the 80th percentile of the income distribution.¹³ The difference in the results between Chetty et al. (2014) and ours may arise from the fact that Denmark's tax reform only lowered the subsidy for capital pension—leaving the tax treatment unchanged for annuity pension. Chetty et al. (2014) show that the response mostly reflects the allocation to another tax-favored saving account with unchanged tax treatment. On the other hand, Thailand's 2013 tax change lowered the price subsidy in the tax system across the board. This does not provide a reallocation of incentive to another tax-favored account and the response here therefore likely reflects the cut in saving legally mandated for long-term use.

Our main analysis focuses on the impact on marginal propensity to save in LTF which reflects the fraction of additional income that is allocated to long-term investment. It is, however, important to note that the impact of the subsidy cut on the contribution level will also depend on the Treatment-x-Post interaction coefficient which is positive and significant for both middle- and large- income groups (Table 6 in the appendix). The positive coefficient on Treatment-x-Post can be viewed as an increase in the intercept term for the treatment group after the subsidy cut and will somewhat mitigate the negative impact on MPS documented above.

¹³ Chetty et al. (2014) investigates how Danish taxpayers at the 80th percentile of the income distribution changed their capital pension contributions following the subsidy reduction. Given that the change increased the after-tax price of capital pension contribution by 34.1%, the price elasticity of MPS is $-84\%/34.1\% = -2.46$.

To understand the impact on the overall level, we estimate the effects of the reduction in the price subsidy on the level of LTF contribution. Specifically, we estimate the following equation:

$$Sav_{i,t} = \beta_0 + \beta_1 Treat_{i,t} + \beta_2 Post_{i,t} + \beta_3 Treat_{i,t} * Post_{i,t} + \beta_4 X_{i,t} + yearFE + coeffFE + yearFE * coeffFE + \varepsilon_{it}, \quad (3)$$

where variables are defined as in equation (1). The coefficient β_3 represents the causal effect of the reduction in the tax subsidy on the level of savings contribution. Table 3 presents the empirical results of Equation 3 for low-, middle- and high-income taxpayers. All columns use LTF contributions as a dependent variable.

The effects on the contribution level are qualitatively similar to those on the MPS, although their magnitudes are smaller. For middle-income taxpayers, we estimate that the 2013 tax change lowers LTF contributions by 339 baht relative to a pre-2013 mean of 8,320 baht for taxpayers in the treatment group (Table 3). The estimate is significant at the 1% level. This represents the reduction of 4.1% in the LTF contribution level. On the other hand, the 2013 change lowers the LTF contribution by 1.6% for the high-income group.

Table 3: Effects on level of LTF contributions (Dep var: LTF contributions)

	(1)	(2)	(3)
	Low- income taxpayers	Middle- income taxpayers	Middle- income taxpayers
Treatment x Post	-12.1 (14.7)	-338.8*** (122.0)	-954.5** (399.7)
Observations	5,596,899	1,248,546	834,125
Mean of LTF contributions (Treatment/Pre)	1,029	8,320	59,338
Year FE	YES	YES	YES
Control	YES	YES	YES

Notes: This table presents the estimated impacts of the 2013 reduction in price subsidy on LTF contribution levels. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively. Full estimation table is in the supplementary appendix which is available upon request.

4.2 Robustness tests

In addition to testing the sensitivity with respect to the inclusion of control variables, we perform six groups of tests to examine the robustness of our results.

Table 4: Robustness tests**A) Separate estimation for each income cutoff (Dep var: LTF contributions)**

	(1)	(2)	(3)	(4)	(5)	(6)
	Low-income		Middle-income	High-income		
	Cutoff 1: 300,000	Cutoff 2: 500,000	Cutoff 3: 750,000	Cutoff 4: 1 million	Cutoff 5: 2 million	Cutoff 6: 4 million
Treatment x Post x Income	-0.001 (0.001)	-0.000 (0.000)	-0.012*** (0.004)	-0.004*** (0.001)	0.001 (0.016)	-0.001 (0.001)
Observations	3,308,840	2,288,059	1,248,546	636,834	158,150	39,141
MPS (Treatment/Pre)	0.005	0.013	0.053	0.077	0.111	0.096
Year FE	YES	YES	YES	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES

B) Placebo and narrower bands around income cutoffs (Dep var: LTF contributions)

	Placebo	Narrower bands around income cutoffs		
	(1)	(2)	(3)	(4)
		Low	Middle	High
Treatment x Post x Income	0.002 (0.009)	-0.000 (0.000)	-0.018*** (0.003)	-0.005** (0.002)
Observations	555,902	3,699,958	800,600	559,353
MPS (Treatment/Pre)	0.054	0.011	0.057	0.086
Year FE	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes

C) Requiring filing throughout the study period and alternative assumption of adjusted taxable income (Dep var: LTF contributions)

	Requiring filing throughout the study period			Alternative ATI		
	(1)	(2)	(3)	(4)	(5)	(6)
	Low	Middle	High	Low	Middle	High
Treatment x Post x Income	-0.000 (0.000)	-0.013*** (0.004)	-0.001 (0.001)	-0.000 (0.000)	-0.018*** (0.005)	-0.004*** (0.002)
Observations	3,342,535	908,428	630,784	5,596,899	1,248,546	834,125
MPS	0.012	0.055	0.076	0.009	0.055	0.079
(Treatment/Pre)						
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes	Yes	Yes

D) Effect of 2013 tax change on marginal propensity to save in other long-term savings (Dep var: All long-term saving)

	All long-term saving		
	(1)	(2)	(3)
	Low	Middle	High
Treatment x Post x Income	-0.000 (0.000)	-0.017*** (0.006)	-0.008*** (0.002)
Observations	5,596,899	1,248,546	834,125
MPS (Treatment/Pre)	0.045	0.111	0.141
Year FE	YES	YES	YES
Control	YES	YES	YES

Notes: Panel A presents the estimated impacts of the 2013 reduction in price subsidy on MPS in LTF for each income cutoff. Panel B presents two robustness tests: 1) Placebo and 2) Narrower income bands. Panel C presents two robustness tests: 1) Limiting the sample to taxpayers who filed tax returns throughout 2009-2016 and 2) Adopting an alternative assumption of adjusted taxable income. Panel D presents the estimated impacts of the 2013 reduction in price subsidy on MPS in all long-term saving (LTF, RMF and PVD contributions). Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively. Full estimation tables are in the supplementary appendix which is available upon request.

We first re-estimate equation 1 separately for each of the six income cutoffs. The results are provided in Panel A of Table 4. They are consistent with our baseline estimate. We are not able to reject the null hypothesis that the 2013 price subsidy change had no effect on the MPS for the low-income group (Columns 1-2 of Panel A of Table 4). The tax responsiveness of the high-income group also appears to be driven by those around the income cutoff of 1 million baht (Columns 4 of Panel A of Table 4).

We also perform a placebo experiment where we replicate the baseline analysis but using an alternative income cutoff (875,000 baht). The treatment (control) group includes those with taxable income 10% below (above) the cutoff.¹⁴ These two groups are subject to the same marginal tax rates before and after the 2013 tax change. The estimation result is shown in Column 1 of Panel B of Table 4. We do not find any significant effect on the MPS. This null result helps mitigate a concern that another factor was confounding our baseline result.

In addition, we narrow the income range around each of the six cutoffs from 15% to 10%. This allows us to test how sensitive our results are to the size of bands around cutoffs. The findings reported in Columns 2-4 of Panel B of Table 4 are quantitatively consistent with our baseline results. The middle-income group responds strongly to the price subsidy change, while the response of the high-income group is relatively moderate.

Further, we perform a test where we limit the sample to taxpayers who filed tax returns throughout 2009-2016 in order to avoid potential bias resulting from old taxpayers retiring or young taxpayers entering the workforce. The findings are generally consistent with our baseline results for all income groups (Columns 1-3 of Panel C of Table 4).

¹⁴ We use narrower cutoff than that employed in the baseline analysis in order to avoid overlapping with the range of taxable income that is affected by the 2013 tax change.

As mentioned earlier, we define ATI as gross income net of expense and deductions related to personal characteristics. It is possible that there is measurement error with some taxpayers being incorrectly positioned near the cutoffs used for the identification. To check if this potential measurement error significantly affects our results, we employ an alternative assumption where ATI is defined as gross income net of expense and all deductions except LTF. The results are consistent with our baseline findings—suggesting that the potential measurement error here is not likely to be a major issue (Columns 4-6 of Panel C of Table 4).

Finally, we estimate the effects of the subsidy reduction on the MPS all long-term saving (the sum of LTF, RMF and PVD contributions). Our findings are again consistent with the baseline estimate. The subsidy reduction lowers the MPS in all long-term saving by 15.3% for middle-income taxpayers and 5.7% for high-income taxpayers (Panel D of Table 4).

4.3 Impacts of tax expenditure on long-run savings

We calculate the revenue gain associated with the cut in price subsidy based on the estimate provided in Table 3A. For each middle-income taxpayer in the treatment group, the 2013 tax schedule change lowers the subsidy by 0.05 baht per each baht of LTF contribution. The mechanical revenue gain ignoring any behavioural response is thus $7,581 \times 0.05 = 379$ baht per middle-income taxpayer in the treatment group.

The 2013 change induces middle-income taxpayers to reduce their LTF contributions by 339 baht. This reduction further increases government revenue since the LTF is tax-deductible. The revenue gain due to such behavioural response is $339 \times 0.15 = 51$ baht. The total revenue gain is then 430 baht per treated middle-income taxpayer. Each baht of revenue gain following the 2013 subsidy change is, therefore, associated with $339/430 = 0.8$ baht of reduction in the long-term savings for middle-income

taxpayers. Repeating this exercise for high-income taxpayers, we find that each baht of revenue gain is associated with $955/3,334 = 0.3$ baht of reduction in the long-term savings.

4.4 Distributional analysis of the tax responsiveness

In this subsection, we study the distributional effects associated with the price subsidy reduction. Using the linear probability model, we examine the effects on the likelihood that LTF contributions exceed zero, 2.5%, 5% and 7.5% of income. This allows us to understand how the change in price subsidy impacts decisions to contribute different LTF levels.

For middle-income taxpayers, we find that the reduction in tax subsidy significantly lowers the probability to make LTF contribution by 0.9 percentage point (Column 1 of Table 5). This represents the reduction of 6.8% relative to the pre-2013 mean probability of contributions for middle-income taxpayers in the treatment group. The size of the effect is monotonically declining for the probability of making larger LTF contributions (Columns 2-4 of Table 5). These findings suggest that, for the middle-income group, the price subsidy change has large effect on decisions of taxpayers with small LTF contributions. For high-income taxpayers, we also find qualitatively consistent results—significantly negative effects for the decisions to contribute at least zero and 2.5% of income but insignificant effect for the decisions to contribute higher levels (Columns 5-8 of Table 5).

Table 5: Distributional effects across the LTF contribution
(Dep var: Indicator variables for LTF contribution at various levels)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Middle-income taxpayers				High-income taxpayers			
	Having LTF contribution	Contribute at least 2.5% of income	Contribute at least 5% of income	Contribute at least 7.5% of income	Having LTF contribution	Contribute at least 2.5% of income	Contribute at least 5% of income	Contribute at least 7.5% of income
Treatment x Post	-0.009*** (0.001)	-0.006*** (0.001)	-0.002 (0.001)	-0.000 (0.001)	-0.004* (0.002)	-0.005*** (0.002)	-0.000 (0.002)	-0.003 (0.002)
Observations	1,248,546	1,248,546	1,248,546	1,248,546	834,125	834,125	834,125	834,125
Mean of Dep. Var (Treatment/Pre)	0.133	0.116	0.093	0.062	0.390	0.358	0.296	0.253
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This table presents the distributional effects for middle and high-income taxpayers. Dependent variables are indicator variables which equal 1 if LTF contribution exceeds a specified level and zero otherwise. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively. Full estimation table is in the supplementary appendix which is available upon request.

Source: Authors' estimate

5. Conclusion

Understanding how individuals respond to tax subsidies for retirement and long-term savings is key to creating a tax system that maintains fiscal sustainability while addressing the needs to prepare for aging society in many countries. This study employs a quasi-experimental research design to estimate the effects of price subsidy reduction on contributions to tax-deductible long-term savings. Our findings highlight the heterogeneous response of taxpayers to the tax subsidy. While middle-income taxpayers respond strongly to the subsidy cut, the response of high-income taxpayers is much more limited. We also illustrate that each baht of the tax expenditure gain from the subsidy cut is associated with a reduction of 0.8 baht in long-term savings for middle-income taxpayers and 0.3 baht for high-income taxpayers. Given that most of the associated tax expenditure accrue to high-income taxpayers, this raises an important question about the merit of providing a subsidy for savings in the form of tax deductions, which grant larger subsidy for those in the higher tax bracket and are often used in developing countries. This also underlies the importance of taking into account individual responses when designing the tax subsidy.

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Appendix

In the appendix we provide 1) full estimation of the baseline result (Table 2) and 2) Heterogeneity analysis of the tax responsiveness with respect to age.

Table 6: Full estimation of the baseline result (Dep var: LTF contributions)

	(1)	(2)	(3)	(4)	(5)	(6)
	Low-income taxpayers		Middle-income taxpayers		High-income taxpayers	
Post	-1,129.148*** (253.144)	-1,310.750*** (258.981)	-12,574.001*** (2,575.733)	-8,773.996*** (2,565.916)	-54,925.509*** (12,032.656)	-40,894.343*** (12,164.982)
Treatment	206.195*** (76.069)	123.751 (76.764)	2,605.131 (2,228.933)	4,138.262* (2,205.401)	3,136.045** (1,270.957)	4,545.709*** (1,276.308)
Treatment x Post	97.574 (105.679)	154.121 (108.165)	8,751.305*** (2,858.409)	8,794.684*** (2,848.022)	5,505.499*** (1,566.905)	4,847.339*** (1,592.502)
Income	0.010*** (0.000)	0.011*** (0.000)	0.057*** (0.003)	0.059*** (0.002)	0.077*** (0.002)	0.079*** (0.002)
Post x Income	0.003*** (0.001)	0.003*** (0.001)	0.012*** (0.003)	0.009*** (0.003)	-0.000 (0.003)	0.001 (0.003)
Treatment x Income	-0.000 (0.000)	0.000 (0.000)	-0.004 (0.003)	-0.006** (0.003)	-0.005*** (0.001)	-0.005*** (0.001)
Treatment x Post x Income	-0.000 (0.000)	-0.000 (0.000)	-0.012*** (0.004)	-0.012*** (0.004)	-0.004*** (0.001)	-0.004*** (0.001)
Female		709.115*** (10.210)		5,896.273*** (77.737)		20,632.038*** (293.582)
Age		-88.811*** (5.020)		-1,050.633*** (44.649)		-692.377*** (156.744)
Age-squared		0.063 (0.058)		5.304*** (0.493)		-3.070* (1.804)

Number of Kids		-165.217*** (6.009)		-451.458*** (48.004)		-1,499.667*** (188.544)
Married		-255.712*** (11.216)		-1,424.786*** (86.386)		-2,183.872*** (343.142)
Having mortgage		-461.582*** (9.444)		-4,857.354*** (70.497)		-13,049.050*** (264.826)
Constant	-2,898.463*** (182.121)	185.663 (210.377)	-30,752.803*** (2,004.481)	3,920.735* (2,197.240)	-12,129.506 (9,470.226)	23,665.311** (10,059.953)
Observations	5,905,976	5,596,899	1,329,179	1,248,546	877,120	834,125
R-squared	0.017	0.032	0.022	0.076	0.363	0.393
Year FE	YES	YES	YES	YES	YES	YES
Control	NO	YES	NO	YES	NO	YES

Notes: This table presents the full estimation of the baseline estimation in Table 2. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for taxpayers in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimate

We investigate heterogeneity of the responses to price subsidy reduction by age for middle- and high-income taxpayers. (Table 7). We divide taxpayers into two groups using age of 40 years old as the cutoff. We find that the subsidy reduction has significant impacts on both groups but its impact is much larger for taxpayers younger than 40. The results are consistent for both middle- and high-income taxpayers. This suggests that younger taxpayers exhibit higher responsiveness to the change in price subsidy.

Table 7: Heterogeneity of the tax responsiveness by age (Dep var: LTF contributions)

	(1)	(2)	(3)	(4)
	Middle-income		High-income	
	<=40	>40	<=40	>40
Treatment x Post x Income	-0.018** (0.007)	-0.006 (0.004)	-0.008*** (0.007)	-0.003** (0.001)
Observations	429,701	818,845	278,702	555,423
MPS (Treatment/Pre)	0.043	0.068	0.069	0.075
Year FE	YES	YES	YES	YES
Control	YES	YES	YES	YES

Notes: This table presents the heterogeneity analysis by age for middle-and high-income taxpayers. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively. Full estimation table is in the supplementary appendix which is available upon request.

Source: Authors' estimate

Supplementary Online Appendix

Table A1: Full estimation for Table 3 (Dep var: LTF contributions)

	(1) Low-income taxpayers	(2) Middle-income taxpayers	(3) High-income taxpayers
Post	68.383** (30.616)	-1,654.372*** (151.324)	-1,260.713*** (301.218)
Treatment	159.069*** (10.041)	-6,483.686*** (94.468)	4,026.524*** (305.057)
Treatment x Post	-12.072 (14.711)	-338.793*** (122.041)	-954.459** (399.745)
Female	705.144*** (10.216)	5,818.493*** (77.751)	20,504.764*** (294.946)
Age	-92.799*** (5.024)	-992.412*** (44.714)	-267.193* (157.625)
Age-squared	0.149** (0.058)	4.583*** (0.493)	-7.923*** (1.814)
Number of Kids	-173.753*** (6.012)	-429.417*** (48.056)	-1,442.811*** (189.412)
Married	-253.705*** (11.223)	-1,470.212*** (86.499)	-2,305.856*** (344.573)
Having mortgage	-430.735*** (9.419)	-4,784.893*** (70.493)	-13,085.551*** (265.921)
Constant	5,703.134*** (106.356)	50,210.774*** (978.657)	52,133.402*** (3,286.691)
Observations	5,596,899	1,248,546	834,125
R-squared	0.029	0.072	0.384
Year FE	YES	YES	YES
Control	YES	YES	YES

Notes: This table presents the estimated impacts of the 2013 reduction in price subsidy on LTF contribution levels. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively. *Source:* Authors' estimate

Table A2: Full estimation for Table 4A (Dep var: LTF contributions)

	(1) Cutoff 1: 300,000	(2) Cutoff 2: 500,000	(3) Cutoff 3: 750,000	(4) Cutoff 4: 1 million	(5) Cutoff 5: 2 million	(6) Cutoff 6: 4 million
Post	-858.629*** (205.859)	-2,324.564*** (377.148)	-8,773.996*** (2,565.916)	-2,746.122 (3,538.440)	-25,863.205 (28,588.771)	-141,845.470** (61,771.487)
Treatment	310.932* (162.756)	-3,351.368*** (554.766)	4,138.262* (2,205.401)	14,485.976*** (4,873.042)	-43,135.482* (25,856.835)	-84,326.581 (89,781.293)
Treatment x Post	335.643 (234.516)	1,951.460*** (757.063)	8,794.684*** (2,848.022)	-18,806.538*** (6,375.441)	-1,205.345 (32,826.886)	348,776.594*** (110,247.657)
Income	0.006*** (0.000)	0.013*** (0.001)	0.059*** (0.002)	0.080*** (0.003)	0.089*** (0.011)	0.093*** (0.013)
Post x Income	0.003*** (0.001)	0.002*** (0.000)	0.009*** (0.003)	0.003*** (0.001)	0.007 (0.013)	0.003 (0.002)
Treatment x Income	-0.001** (0.001)	-0.000 (0.000)	-0.006** (0.003)	0.003*** (0.001)	0.022* (0.013)	0.003 (0.002)
Treatment x Post x Income	-0.001 (0.001)	-0.000 (0.000)	-0.012*** (0.004)	-0.004*** (0.001)	0.001 (0.016)	-0.001 (0.001)
Female	304.455*** (6.393)	1,506.188*** (22.506)	5,896.273*** (77.737)	14,421.176*** (203.363)	34,210.963*** (993.890)	74,483.419*** (3,435.622)
Age	-108.432*** (3.228)	-446.478*** (13.016)	-1,050.633*** (44.649)	-1,959.354*** (111.451)	2,852.506*** (586.280)	10,457.822*** (2,329.095)
Age-squared	0.982*** (0.037)	3.185*** (0.146)	5.304*** (0.493)	11.638*** (1.260)	-47.210*** (6.501)	-106.617*** (25.500)
Number of Kids	-65.567*** (3.578)	-206.786*** (12.854)	-451.458*** (48.004)	-1,271.547*** (118.207)	-2,124.617*** (577.816)	-2,300.958 (1,955.930)
Married	-94.663*** (6.702)	-450.375*** (24.394)	-1,424.786*** (86.386)	-2,298.295*** (224.973)	-1,594.915 (1,105.033)	514.091 (3,834.207)
Having mortgage	-159.421*** (5.505)	-961.527*** (19.848)	-4,857.354*** (70.497)	-10,521.689*** (177.127)	-24,682.655*** (864.488)	-10,036.784*** (3,015.005)
Constant	1,315.588***	8,963.429***	3,920.735*	11,829.982***	-85,043.657***	-97,654.343

	(155.907)	(386.790)	(2,197.240)	(3,582.726)	(25,911.747)	(72,038.697)
Observations	3,308,840	2,288,059	1,248,546	636,834	158,150	39,141
R-squared	0.010	0.033	0.076	0.078	0.066	0.051
Year FE	YES	YES	YES	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES

Notes: This table presents the estimated impacts of the 2013 reduction in price subsidy on MPS in LTF for each income cutoff. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimate

Table A3: Full estimation for Table 4B (Dep var: LTF contributions)

	Placebo	Narrower bands around income cutoffs		
	(1)	(2) Low	(3) Middle	(4) High
Post	-15,310.436** (6,547.647)	-1,421.712*** (474.591)	-1,421.832 (4,203.394)	-11,111.701 (25,073.215)
Treatment	13,129.298** (5,997.397)	135.158 (98.813)	4,994.680 (3,864.618)	-1,037.121 (1,861.193)
Treatment x Post	-1,437.985 (7,792.407)	108.123 (139.322)	-942.004 (4,896.149)	5,347.901** (2,320.635)
Income	0.070*** (0.006)	0.011*** (0.001)	0.065*** (0.004)	0.086*** (0.004)
Post x Income	0.015** (0.007)	0.003*** (0.001)	0.010*** (0.003)	-0.004 (0.005)
Treatment x Income	-0.016** (0.007)	-0.000 (0.000)	-0.008*** (0.002)	-0.000 (0.001)
Treatment x Post x Income	0.002 (0.009)	-0.000 (0.000)	-0.018*** (0.003)	-0.005** (0.002)
Female	10,840.932*** (162.427)	721.451*** (11.768)	6,114.791*** (93.455)	19,562.058*** (310.631)
Age	-1,728.261*** (88.054)	-108.305*** (5.821)	-1,021.721*** (53.349)	-920.481*** (169.758)
Age-squared	11.154*** (0.992)	0.305*** (0.067)	4.757*** (0.589)	-0.571 (1.949)
Number of Kids	-881.955*** (94.792)	-173.178*** (6.960)	-448.329*** (57.497)	-1,640.570*** (197.017)
Married	-1,868.067*** (178.831)	-250.109*** (12.939)	-1,518.030*** (104.056)	-2,042.256*** (360.946)
Having mortgage	-7,990.385*** (141.831)	-460.363*** (10.887)	-5,118.223*** (84.721)	-13,122.668*** (280.837)
Constant	11,978.484** (5,377.392)	424.034 (355.107)	-487.752 (3,472.818)	-15,974.335 (20,169.681)
Observations	555,902	3,699,958	800,600	559,353
R-squared	0.070	0.031	0.069	0.372
Year FE	YES	YES	YES	YES
Control	YES	YES	YES	YES

Notes: This table presents the estimated impacts of the 2013 reduction in price subsidy on MPS in LTF for different model assumptions. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimate

Table A4: Full estimation for Table 4C (Dep var: LTF contributions)

	(1)	(2)	(3)	(4)	(5)	(6)
	Requiring filing throughout the study period			Alternative measure of ATI		
	Low	Middle	High	Low	Middle	High
Post	-1,011.843*** (325.919)	-8,572.207*** (2,938.985)	8,826.057 (13,844.864)	-1,309.670*** (451.933)	-7,949.186* (4,304.444)	-48,042.080*** (15,803.192)
Treatment	180.403** (91.961)	3,155.528 (2,472.549)	5,854.346*** (1,434.579)	117.153 (140.993)	4,062.099 (3,851.534)	8,911.252*** (1,511.722)
Treatment x Post	149.926 (134.860)	9,835.026*** (3,268.733)	650.421 (1,805.162)	186.013 (186.875)	4,258.905 (4,902.892)	3,572.027* (1,875.132)
Income	0.012*** (0.000)	0.059*** (0.003)	0.083*** (0.002)	0.009*** (0.001)	0.063*** (0.004)	0.086*** (0.003)
Post x Income	0.002*** (0.001)	0.010*** (0.004)	0.007** (0.003)	0.004*** (0.001)	0.009* (0.005)	-0.001 (0.004)
Treatment x Income	-0.000 (0.000)	-0.004 (0.003)	-0.007*** (0.001)	0.000 (0.000)	-0.008** (0.004)	-0.007*** (0.001)
Treatment x Post x Income	-0.000 (0.000)	-0.013*** (0.004)	-0.001 (0.001)	-0.000 (0.000)	-0.018*** (0.005)	-0.004*** (0.002)
Female	755.819*** (13.994)	5,785.695*** (93.750)	17,113.935*** (341.804)	1,414.757*** (17.804)	6,424.891*** (145.193)	26,721.326*** (408.825)
Age	-73.822*** (8.154)	-818.537*** (58.829)	-1,302.814*** (211.599)	37.498*** (8.758)	-522.632*** (76.433)	-286.876 (216.510)
Age-squared	-0.173* (0.092)	2.495*** (0.642)	0.941 (2.407)	-2.019*** (0.102)	-1.919** (0.855)	-3.612** (1.865)
Number of Kids	-179.533*** (8.228)	-494.507*** (57.913)	-1,624.132*** (219.703)	-230.494*** (11.291)	-760.320*** (89.741)	-1,359.051*** (250.887)
Married	-271.593*** (15.595)	-1,618.470*** (104.584)	-3,469.136*** (399.177)	-654.418*** (20.971)	-2,807.044*** (164.739)	-2,797.160*** (467.569)
Having mortgage	-490.202*** (12.743)	-5,193.863*** (85.733)	-18,689.613*** (308.860)	-67.196*** (17.308)	-3,983.372*** (130.640)	-9,927.034*** (355.698)
Constant	-90.473	304.410	31,034.425***	365.097	3,539.303	24,587.928*

	(278.741)	(2,558.623)	(11,599.980)	(386.528)	(3,720.975)	(13,261.365)
Observations	3,342,535	908,428	630,784	4,713,166	875,598	611,318
R-squared	0.030	0.072	0.438	0.039	0.062	0.322
Year FE	YES	YES	YES	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES

Notes: This table presents two robustness tests: 1) Limiting the sample to taxpayers who filed tax returns throughout 2009-2016. Post is a dummy variable that equals one for years after the 2013 tax change and 2) Using an alternative measure of adjusted taxable income. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimate

Table A5: Full estimation for Table 4D (Dep var: all long-term saving)

	All long-term saving		
	(1)	(2)	(3)
	Low	Middle	High
Post	-1,339.351*** (457.865)	-19,501.806*** (3,852.289)	-73,485.032*** (20,058.667)
Treatment	297.901** (137.877)	11,046.055*** (3,311.375)	7,084.497*** (2,098.029)
Treatment x Post	225.886 (193.087)	12,431.567*** (4,292.702)	9,552.371*** (2,625.091)
Income	0.045*** (0.001)	0.126*** (0.004)	0.148*** (0.004)
Post x Income	0.002** (0.001)	0.021*** (0.005)	-0.004 (0.005)
Treatment x Income	-0.000 (0.000)	-0.015*** (0.004)	-0.007*** (0.002)
Treatment x Post x Income	-0.000 (0.000)	-0.017*** (0.006)	-0.008*** (0.002)
Female	1,292.472*** (20.285)	8,512.569*** (121.898)	34,788.958*** (482.751)
Age	812.424*** (9.152)	2,876.699*** (64.597)	124.872 (257.063)
Age-squared	-10.552*** (0.109)	-38.171*** (0.726)	7.309** (3.003)
Number of Kids	155.539*** (13.663)	686.409*** (80.202)	-2,081.219*** (314.257)
Married	825.018*** (24.037)	-533.837*** (140.580)	2,010.402*** (570.481)
Having mortgage	263.569*** (19.524)	-4,935.981*** (110.617)	-18,323.439*** (435.021)
Constant	-20,916.821*** (373.691)	-104,441.284*** (3,266.434)	-21,962.048 (16,435.267)
Observations	5,596,899	1,248,546	834,125
R-squared	0.089	0.068	0.451
Year FE	YES	YES	YES
Control	YES	YES	YES

Notes: This table presents the estimated impacts of the 2013 reduction in price subsidy on MPS in all long-term saving (LTF, RMF and PVD contributions). Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimate

Table A6: Full estimation for Table 5
(Dep var: Indicator variables for LTF contribution at various levels)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Middle-income taxpayers				High-income taxpayers		
	Having LTF contribution	Contribute at least 2.5% of income	Contribute at least 5% of income	Contribute at least 7.5% of income	Having LTF contribution	Contribute at least 2.5% of income	Contribute at least 5% of income	Contribute at least 7.5% of income
Post	0.002 (0.002)	-0.013*** (0.002)	-0.022*** (0.002)	-0.018*** (0.001)	-0.114*** (0.010)	-0.107*** (0.011)	-0.105*** (0.011)	-0.075*** (0.011)
Treatment	-0.064*** (0.001)	-0.056*** (0.001)	-0.055*** (0.001)	-0.045*** (0.001)	0.046*** (0.002)	0.044*** (0.002)	0.035*** (0.002)	0.033*** (0.001)
Treatment x Post	-0.009*** (0.001)	-0.006*** (0.001)	-0.002 (0.001)	-0.000 (0.001)	-0.004* (0.002)	-0.005** (0.002)	-0.000 (0.002)	-0.003 (0.002)
Female	0.092*** (0.001)	0.077*** (0.001)	0.061*** (0.001)	0.041*** (0.001)	0.162*** (0.002)	0.145*** (0.002)	0.116*** (0.002)	0.097*** (0.001)
Age	-0.010*** (0.001)	-0.012*** (0.001)	-0.011*** (0.000)	-0.010*** (0.000)	-0.008*** (0.001)	-0.010*** (0.001)	-0.013*** (0.001)	-0.011*** (0.001)
Age-squared	0.000 (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	-0.000** (0.000)	0.000* (0.000)	0.000*** (0.000)	0.000*** (0.000)
Number of Kids	-0.011*** (0.001)	-0.009*** (0.001)	-0.006*** (0.001)	-0.002*** (0.000)	-0.015*** (0.001)	-0.014*** (0.001)	-0.012*** (0.001)	-0.008*** (0.001)
Married	-0.023*** (0.001)	-0.019*** (0.001)	-0.016*** (0.001)	-0.012*** (0.001)	-0.017*** (0.002)	-0.017*** (0.002)	-0.017*** (0.002)	-0.015*** (0.002)
Having mortgage	-0.042*** (0.001)	-0.048*** (0.001)	-0.050*** (0.001)	-0.044*** (0.001)	-0.051*** (0.001)	-0.066*** (0.001)	-0.079*** (0.001)	-0.082*** (0.001)
Constant	0.618*** (0.012)	0.609*** (0.011)	0.542*** (0.011)	0.422*** (0.009)	1.122*** (0.021)	1.116*** (0.021)	1.077*** (0.021)	0.916*** (0.020)
Observations	1,248,546	1,248,546	1,248,546	1,248,546	834,125	834,125	834,125	834,125
R-squared	0.093	0.080	0.064	0.046	0.149	0.141	0.130	0.105

Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Control	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This table presents the distributional effects for middle and high-income taxpayers. Dependent variables are indicator variables which equal 1 if LTF contribution exceeds a specified level and zero otherwise. Post is a dummy variable that equals one for years after the 2013 tax change. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimate

Table A7: Full estimation for Table 7 (Dep var: LTF contributions)

	(1)	(2)	(3)	(4)
	Middle-income		High-income	
	<=40	>40	<=40	>40
Post	-5,288.235 (4,745.122)	-10,241.990*** (2,943.170)	-37,120.799 (23,182.448)	-41,616.510*** (14,265.704)
Treatment	-1,705.186 (4,110.182)	7,617.959*** (2,499.420)	9,710.859*** (2,605.472)	2,573.314* (1,459.315)
Treatment x Post	12,961.710** (5,366.360)	4,460.164 (3,234.639)	11,453.975*** (3,250.648)	3,016.594* (1,818.115)
Income	0.046*** (0.003)	0.079*** (0.005)	0.077*** (0.004)	0.079*** (0.003)
Post x Income	0.003 (0.006)	0.012*** (0.004)	-0.008 (0.005)	0.003 (0.003)
Treatment x Income	-0.003 (0.005)	-0.011*** (0.003)	-0.008*** (0.002)	-0.004*** (0.001)
Treatment x Post x Income	-0.018** (0.007)	-0.006 (0.004)	-0.008*** (0.003)	-0.003** (0.001)
Female	8,685.979*** (150.158)	4,479.892*** (85.558)	20,222.566*** (417.292)	21,000.380*** (380.106)
Age	-4,383.170*** (262.686)	-820.800*** (131.340)	41.302 (704.685)	-6,919.550*** (556.317)
Age-squared	55.049*** (3.866)	2.977** (1.294)	-8.115 (10.403)	59.509*** (5.615)
Number of Kids	-1,979.128*** (108.906)	-239.916*** (52.286)	-4,528.227*** (329.979)	-353.337 (219.084)
Married	122.080 (174.860)	-1,681.081*** (97.171)	-392.065 (505.694)	-2,567.097*** (435.952)
Having mortgage	-7,828.125*** (135.336)	-3,083.592*** (77.553)	-12,585.364*** (389.379)	-13,611.323*** (335.863)
Constant	43,755.535*** (5,742.666)	7,859.350** (3,970.820)	7,881.855 (21,969.837)	177,456.838*** (17,591.397)
Observations	429,701	818,845	278,702	555,423
R-squared	0.066	0.046	0.334	0.416
Year FE	YES	YES	YES	YES
Control	YES	YES	YES	YES

Notes: This table presents the heterogeneity analyses of the tax responsiveness by age. Treatment is a dummy variable that equals one for those in the treatment group. Treatment x Post is the interaction variable between Treatment and Post. Treatment x Post x Income is the triple-interaction variable among Treatment, Post and Income. Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' estimate