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 more 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.

Keywords Personal income tax · Tax subsidy · Long-term savings · Retirement savings · Developing countries

JEL Classification H24 · H31

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

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the high costs associated with these subsidies (Joint Committee on Taxation, 2019; Tanzi & Zee, 2000) and the rising share of elder population in many countries.

Recently, increasing availability of high-quality administrative data has 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 has 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-favoured 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 the capital market is less developed.

This paper uses a panel of tax return data for the population of Thai taxpayers from 2009 to 2016 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 lowered the subsidies associated with tax deductions for long-term savings across the income distribution.² We focus on contributions to tax-deductible long-term equity fund (LTF) since its contribution decision is much less rigid than that of other deductions for long-term saving.³

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-favoured accounts. While we are not able to demonstrate if the reduction in taxpayers' savings reflects a cut in total savings or a shift to non-tax-incentivized savings, the

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 Sect. 2.

³ LTF represents long-term investment in domestic equity mutual funds and constitutes the largest tax expenditure associated with all tax breaks for long-term savings. We illustrate the difference between the LTF and other deductions for long-term saving in Sect. 2.

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 the 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 of making 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 studies 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 & 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) provide powerful insights into 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 of 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. Our study focuses on the LTF since its investment decision is more flexible than the other two deductions (RMF and PVD) as illustrated below.

Although LTF, RMF and PVD are all provided to encourage saving and investment, there are important differences with respect to investment type, holding length, contribution limit and contribution floor (Table 1). With respect to investment type, the LTF represents an investment in mutual funds of which domestic equity accounts for at least 60% of their portfolio, while the RMF represents an investment in general mutual funds. The PVD includes both registered-employers provident funds and government pension fund. While both the LTF and the RMF involve active investment decisions, the PVD contribution is made passively via automatic salary deduction. Taxpayers are generally permitted to adjust their PVD monthly contributions in a narrow window (typically a two-week period in December) before the start of a calendar year.

Regarding holding length, during the study period, taxpayers are required to hold the purchased LTF units for at least 5 calendar years. For the RMF, taxpayers are generally required to hold the purchased units until they are at least 55 years old, or if over that age, must hold the units for at least five calendar years. For the PVD, taxpayers are generally required to hold the purchased units until retirement (with minimum age of 55) and must hold the units for at least five calendar years.⁴

Contribution to the LTF is also subject to a limit that is more generous than that of RMF and PVD and does not depend on any other deductions. During the study period, the deduction for LTF contribution is capped at 15% of gross income and 500,000 baht (approximately 2.5 times of Thailand's GDP per capita in 2020). The

⁴ Taxpayers who violate the holding length requirements of LTF, RMF and PVD are generally subject to strict penalty. They will have to return all or some of the tax benefit associated with deduction and pay the fine in some cases.

Table 1 Key characteristics of the major tax deductions for long-term saving (LTF, RMF and PVD)

Investment type	Long-term equity fund (LTF)		Retirement mutual fund (RMF)		Provident fund (PVD)	
	Mutual funds with at least 60% domestic equity	Active investment decision	General mutual funds	Active investment decision	Employer- and government-provident funds	Passive investment decision (automatic salary deduction)
Holding length	5 years		Until at least 55 years old		Two requirements: (1) Hold until retirement (with minimum age of 55), and (2) Hold at least 5 years	
Contribution limit	Two requirements: (1) 15% of gross income, and (2) 500,000 baht		If over 55, hold at least 5 years		Two requirements: (1) 15% of gross income, and (2) Sum of all retirement-saving < = 500,000 baht	
Contribution floor	No		Two requirements: (1) 15% of gross income, and (2) Sum of all retirement-saving < = 500,000 baht		Once invested, 2% of gross income until retirement	
Source Revenue Department

Fig. 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 Sect. 3 and includes all taxpayers. *Source:* Authors' estimate

deductions for RMF and PVD, on the other hand, are each capped at 15% of gross income and their sum cannot exceed 500,000 baht.⁵

Finally, there is no minimum contribution requirement for the LTF. Taxpayers can freely decide whether to contribute or to change contribution amount in any year. For the RMF, once invested, taxpayers are required to contribute to the RMF at least the minimum of 3% of gross income and 5,000 baht every year until reaching age 55. For the PVD, once invested, employees generally have to contribute at least 2% of gross income until retirement.

Figure 1 illustrates tax expenditure, participation and average conditional contribution associated with each type of the tax deductions.⁶ LTF 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.

In terms of participation, 11.4% of all taxpayers report having 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 also 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 Fig. 2 shows the reliance on LTF, RMF and PVD 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 Fig. 2 further illustrates the importance of LTF relative

⁵ The sum of PVD, RMF and other retirement-saving deductions (pension insurance, National Saving Fund and Teacher's Fund) cannot exceed 500,000 baht.

⁶ 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.

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

(B) Share of total LTF, RMF and provident fund contributions

Fig. 2 Uses of tax deduction for long-term saving/investment by age (2018). *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 PVD. LTF is long-term equity fund, *RMF* retirement mutual fund and *PVD* provident fund. *Source*: Authors' estimate

to RMF and PVD. While only 11% of taxpayers report LTF contributions in 2018, total LTF contributions constitute roughly the same share as total PVD contributions in the portfolio of total long-term saving contributions.

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 2013.⁷ The main objective was to lower tax burden in order to increase the country's tax competitiveness. As described in detail in Sect. 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

⁷ 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.

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%	
750,001-1,000,000	20%	20%	} Middle income Around 65 th percentile
1,000,001-2,000,000	30%	25%	
2,000,001-4,000,000	30%	30%	} High income Above 90 th percentile
Above 4,000,000	37%	35%	

Fig. 3 Income cutoffs used in the baseline analysis. *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

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-favoured pension systems around the world typically yield 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 analyse 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 focus on the LTF contribution rather than the RMF and PVD contributions since the LTF contribution decision is likely to be much more flexible.^{8,9} This is due to

⁸ We also present the effects on the sum of all long-term saving (LTF, RMF and PVD contributions) in one of the sensitivity tests.

⁹ Note that although the share of taxpayers with PVD contribution is large, its contribution decision is quite rigid. Comparing with the LTF, the PVD has lower contribution limit and strict minimum contribu-

the differences with respect to holding length, contribution limit, contribution floor and the way in which taxpayers can change the contribution amount as described in Sect. 2.

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 onwards. 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.¹⁰ 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 and 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.¹¹

Following Chetty et al. (2014), we examine the effects of the price subsidy reduction using marginal propensity to save (MPS).¹² To quantify the effect on the MPS, we estimate the following equation for each income group:

$$\begin{aligned} \text{Sav}_{i,t} = & \beta_0 + \beta_1 \text{Treat}_{i,t} + \beta_2 \text{Post}_{i,t} + \beta_3 \text{Treat}_{i,t} * \text{Post}_{i,t} + \beta_4 Y_{i,t} + \beta_5 \text{Treat}_{i,t} * Y_{i,t} \\ & + \beta_6 \text{Post}_{i,t} * Y_{i,t} + \beta_7 \text{Treat}_{i,t} * \text{Post}_{i,t} * Y_{i,t} + \beta_8 X_{i,t} \\ & + \text{yearFE} + \text{coeffFE} + \text{yearFE} * \text{coeffFE} + \varepsilon_{it}, \end{aligned} \quad (1)$$

where $\text{Sav}_{i,t}$ =savings contribution, $\text{Treat}_{i,t}$ =1 for treatment group (0 for control group), $\text{Post}_{i,t}$ =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 (coeffFE), and year-income-cutoff fixed effects. The coefficient β_7 represents the causal effect of the reduction in the tax subsidy on

Footnote 9 (continued)

tion requirement. Generally, most taxpayers can adjust their PVD contributions only in a narrow window before the start of the year.

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

¹¹ The 90th percentile of adjusted taxable income is around 1 million baht in 2013.

¹² 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 Sect. 4.

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 our study. First, we control for year-fixed effects in the model estimation. This allows us to account for changes in macroeconomic conditions 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. Fourth, 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 to 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 account 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 behaviour 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 for tax avoidance. 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).¹³

Table 2 provides summary statistics on contributions and other characteristics of taxpayers in our baseline analysis.

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.

¹³ We provide an estimation with an alternative measure of ATI in one of the robustness tests.

Table 2 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%		

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

Source: Authors' estimate

Fig. 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 Eq. (2). Shaded bar represents the 95% confidence interval. Full estimation tables are in the online supplementary appendix. *Source:* Authors' estimate

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

$$\text{Sav}_{i,t} = \beta_0 + \beta_1 \text{Treat}_{i,t} + \beta_2 Y_{i,t} + \beta_3 \text{Treat}_{i,t} * Y_{i,t} + \text{coeffFE} + \varepsilon_{it}, \quad (2)$$

where all variables are defined in Eq. (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 Eq. (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.

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 [Eq. (1)]. Table 3 presents the empirical results of Eq. (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 3). 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 represents a reduction in the MPS in LTF by 22.6%. The estimate is also similar without control variables (Column 3 of Table 3). 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

(A) Low-income taxpayers **(B) Middle-income taxpayers** **(C) High-income taxpayers**

Table 3 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 $\times$ post	−0.000	−0.000	−0.012***	−0.012***	−0.004***	−0.004***
$\times$ Income	(0.000)	(0.000)	(0.004)	(0.004)	(0.001)	(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

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 $\times$ Post is the interaction variable between Treatment and Post. Treatment $\times$ Post $\times$ 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 Eq. (1). Standard errors are heteroscedasticity-robust and clustered at individual level. Numbers in parentheses indicate standard error. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Full estimation table is in the appendix.

Source Authors' estimate

of MPS is -0.8 .¹⁴ 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 3).

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.¹⁵ 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-favoured 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-favoured account, and the response here therefore likely reflects the cut in the 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

¹⁴ 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 cutoff. Using the number of taxpayers in each cut off as weight, the weighted change is -7.0% .

¹⁵ Chetty et al. (2014) investigate 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 $-84\%/34.1\% = -2.46$.

Table 4 Effects on level of LTF contributions (Dep var: LTF contributions)

	(1) Low-income taxpayers	(2) Middle-income taxpayers	(3) Middle- income taxpayers
Treatment × 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)	1029	8320	59,338
Year FE	YES	YES	YES
Control	YES	YES	YES

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 × 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. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Full estimation table is in the online supplementary appendix

cut on the contribution level will also depend on the Treatment-x-Post interaction coefficient which is positive and significant for both middle- and high-income groups (Table 7 in 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.

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:

$$\text{Sav}_{i,t} = \beta_0 + \beta_1 \text{Treat}_{i,t} + \beta_2 \text{Post}_{i,t} + \beta_3 \text{Treat}_{i,t} * \text{Post}_{i,t} + \beta_4 X_{i,t} + \text{yearFE} + \text{coeffFE} + \text{yearFE} * \text{coeffFE} + \varepsilon_{it}, \quad (3)$$

where variables are defined as in Eq. (1). The coefficient β_3 represents the causal effect of the reduction in the tax subsidy on the level of savings contribution. Table 4 presents the empirical results of Eq. (3) for low-, middle- and high-income taxpayers. All columns use LTF contributions as a dependent variable.

We estimate that the 2013 tax change, on average, lowers LTF contributions by 339 baht for middle-income taxpayers in the treatment group (Table 4). This reduction reflects the combination of the coefficients on Treatment-x-Post and Treatment-x-Post-x-Income in Tables 3 and 7. Relative to the pre-2013 mean level for treated middle-income taxpayers, this represents a reduction of 4.1% in the LTF contribution level. Consistent with the baseline result in Table 3, we find that the impact is relatively smaller for high-income taxpayers. The 2013 reform lowers the LTF contribution by 1.6% for treated high-income taxpayers.

Table 5 Robustness tests

	(1)	(2)	(3)	(4)	(5)	(6)
	Low-income		Middle-income	High-income		
(A) Separate estimation for each income cutoff (Dep var: LTF contributions)						
	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 × Post	−0.001	−0.000	−0.012***	−0.004***	0.001	−0.001
x Income	(0.001)	(0.000)	(0.004)	(0.001)	(0.016)	(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
Narrower bands around income cutoffs						
	(1)	(2)	(3)	(4)	(5)	(6)
		Low	Middle			High
(B) Placebo and narrower bands around income cutoffs (Dep var: LTF contributions)						
Treatment × post × 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
Alternative ATI						
Requiring filing throughout the study period						
	(1)	(2)	(3)	(4)	(5)	(6)
	Low	Middle	High	Low	Middle	High
(C) Requiring filing throughout the study period and alternative assumption of adjusted taxable income (Dep var: LTF contributions)						
Treatment × post × 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)

Table 5 (continued)

	Requiring filing throughout the study period			Alternative ATI		
	(1)	(2)	(3)	(4)	(5)	(6)
Low		Middle	High	Low	Middle	High
Observations	3,342,535	908,428	630,784	5,596,899	1,248,546	834,125
MPS (treatment/pre)	0.012	0.055	0.076	0.009	0.055	0.079
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes	Yes	Yes
All long-term saving						
	(1)		(2)			(3)
Low			Middle			High
(D) Effect of 2013 tax change on marginal propensity to save in other long-term savings (Dep var: All long-term saving)						
Treatment $\times$ Post $\times$ 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

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 $\times$ Post is the interaction variable between Treatment and Post. Treatment $\times$ Post $\times$ 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. ***, **, * and * denotes significance at the 1%, 5% and 10% levels, respectively. Full estimation tables are in the online supplementary appendix

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.

We first re-estimate Eq. (1) separately for each of the six income cutoffs. The results are provided in Panel A of Table 5. 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 5). 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 5).

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.¹⁶ 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 5. 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 5 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 5).

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 5).

Finally, we estimate the effects of the subsidy reduction on the MPS in 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 5).

¹⁶ 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.

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 4. 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 $7581 \times 0.05 = 379$ baht per middle-income taxpayer in the treatment group.¹⁷

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 0.3 baht of reduction in the long-term savings.

Our estimate implies that price subsidy is more effective at encouraging long-term saving for middle-income taxpayers than for their high-income counterparts. Many developing countries, however, employ tax deductions for long-term and retirement saving. In addition to Thailand, other examples include India, Indonesia, Malaysia and the Philippines. By design, tax deductions disproportionately benefit high-income taxpayers and most of the associated tax expenditure tends to flow to those at the top of the income distribution.¹⁸ Our findings, therefore, raise an important question about the merit of providing subsidy in the form of tax deduction.

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 6). This represents a 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 6). These findings suggest that, for the middle-income group, the price subsidy change has large effect on decisions

¹⁷ The mean LTF contribution for the treated middle-income group is 7581 baht in 2012.

¹⁸ In Thailand, for example, taxpayers in the top income quintile account for around 75% of the tax expenditure associated with tax deductions related to saving and investment in 2012 (Muthitacharoen & Phongpaichit, 2020).

Table 6 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 × 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.	0.133	0.116	0.093	0.062	0.390	0.358	0.296	0.253
Var (treatment/ pre)								
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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 × 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. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Full estimation table is in the online supplementary appendix

Source Authors' estimate

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 6).

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 the reduction in tax subsidy for long-term savings. Our analysis highlights 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 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. Hence, our findings suggest that price subsidy is more effective at encouraging long-term saving among middle-income taxpayers than among high-income counterparts. Such subsidies, however, are often provided in the form of tax deductions in developing countries. Since most of the tax benefits from deductions tend to accrue to high-income taxpayers, our findings underline the critical importance of taking into account individual responses when designing the tax incentive policy. This is especially crucial in the post-COVID-19 world where rising pressure on public finances will likely force many governments to review economic rationale of their tax subsidies.

Appendix

In Appendix, we provide (1) full estimation of the baseline result (Table 3) and (2) heterogeneity analysis of the tax responsiveness with respect to age.

We investigate heterogeneity of the responses to price subsidy reduction by age for middle- and high-income taxpayers (Table 8). 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 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 × 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 × 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 × 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 × Post × 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

Table 7 (continued)

(1) Low-income taxpayers		(2)	(3) Middle-income taxpayers		(4)	(5) High-income taxpayers		(6)
Control	NO	YES	NO	YES	YES	NO	YES	YES

This table presents the full estimation of the baseline estimation in Table 3. 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 $\times$ Post is the interaction variable between Treatment and Post. Treatment $\times$ Post $\times$ 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. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively

Source Authors' estimate

Table 8 Heterogeneity of the tax responsiveness by age (Dep var: LTF contributions)

	(1)	(2)	(3)	(4)
	Middle-income		High-income	
	< = 40	> 40	< = 40	> 40
Treat- ment $\times$ Post $\times$ 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

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 $\times$ Post is the interaction variable between Treatment and Post. Treatment $\times$ Post $\times$ 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. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Full estimation table is in the online supplementary appendix

Source: Authors' estimate

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