DISCUSSION PAPER SERIES

DP17953

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MACROECONOMICS AND GROWTH
AND PUBLIC ECONOMICS

CEPR

*ISSN 0265-8003*

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Discussion Paper DP17953
Published 02 March 2023
Submitted 24 February 2023

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## Abstract

In this paper, I use an estimated structural life-cycle model featuring multiple consumption categories to assess the effectiveness of temporary cuts to the Value Added Tax (VAT) rates on non-durable luxuries and durables as fiscal stimulus instruments during recessions. I find a tax elasticity smaller than 0.5 for non-durable luxuries and a tax elasticity of around 10 for durables. I show that the tax cut on non-durables has an intratemporal substitution effect on non-durables, while the tax cut on durables acts through an intertemporal substitution mechanism in the purchase of durables that is stronger for high income, liquidity unconstrained, and younger households. This mechanism is amplified in less persistent recessions and dampened in the absence of a recession due to the interaction of durables' partial irreversibility with precautionary saving motives.



JEL Classification: D11, D15, E20, H20, H31

Keywords: Taxation, Consumption, Durable goods, Saving, Welfare



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# Consumption Tax Cuts in a Recession *

Francesca Parodi †

**Abstract**

In this paper, I use an estimated structural life-cycle model featuring multiple consumption categories to assess the effectiveness of temporary cuts to the Value Added Tax (VAT) rates on non-durable luxuries and durables as fiscal stimulus instruments during recessions. I find a tax elasticity smaller than 0.5 for non-durable luxuries and a tax elasticity of around 10 for durables. I show that the tax cut on non-durables has an intratemporal substitution effect on non-durables, while the tax cut on durables acts through an intertemporal substitution mechanism in the purchase of durables that is stronger for high income, liquidity unconstrained, and younger households. This mechanism is amplified in less persistent recessions and dampened in the absence of a recession due to the interaction of durables' partial irreversibility with precautionary saving motives.

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*I am very grateful to Orazio Attanasio, Richard Blundell, Mariacristina De Nardi, Eric French, Hamish Low, Cormac O'Dea, and to seminars participants at UCL, IFS, Collegio Carlo Alberto, Federal Reserve Board, PSE, 2021 SED Annual Conference, University of Padova, University of Glasgow, and Bank of Italy for their suggestions and comments. All errors are mine.

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# 1 Introduction

Consumption taxes have been used to stimulate economies undergoing a recessionary shock. Both the UK and France implemented Value Added Tax (VAT) cuts with the aim of helping their economies to recover after the 2008 financial crisis. More recently, in the attempt to boost consumption after the first wave of the Covid-19 pandemic, Germany has put in place temporary cuts of the VAT standard and reduced rates.

When choosing between consumption tax cuts and alternative stimulus policies in a recession, it is crucial for policy makers to take into account several factors. First, how households react to VAT cuts on different types of goods, for instance non-durables versus durables. Second, whether, in response to a consumption tax cut, households only adjust their consumption of the targeted goods or modify their purchases of other goods and their saving behavior as well. Third, how heterogeneous households differently react to the same VAT rate reform depending on their income level, their liquidity constraints, the age at which they are hit by the reform, and the overall state of the economy that they face. Lastly, policy makers have to assess the welfare impact of these reforms.

Despite the vast empirical literature on the impact of consumption tax cuts on prices, households' expenditure, and firms' profits that cleverly exploited actual tax reforms as natural experiments (see, for instance, Crossley et al. (2014) for the UK, and Benzarti and Carloni (2019) for France), there are still no quantitative studies that assess the effect of these reforms using dynamic structural models of household behavior.

In this paper, I study the effectiveness of temporary VAT cuts on different categories of consumption goods as fiscal stimulus tools in a recession by adopting a dynamic approach. This approach allows me to analyze the effects of such reforms both on households' intratemporal consumption choices and on their intertemporal decisions of investment in durables and financial assets, to assess the impact of these reforms across heterogeneous households, and to quantify their welfare consequences over households' lifetime.

I set up a structural household life-cycle model of consumption and saving that features three types of consumption goods that are taxed at different rates and react differently to changes in taxation: non-durable necessities, non-durable luxuries, and consumer durables. In particular, I integrate a static demand system for the choice between different categories of non-durables into a dynamic life-cycle model that properly accounts for durable investments and savings decisions in a context of income uncertainty and borrowing constraints. By doing so, I allow for non-homothetic preferences both between the two non-durable categories and between durables and the non-durable bundle. Moreover, durables play a twofold role in the model: on the one hand, they are consumption goods that deliver utility for multiple periods of time, on the other hand, they are consumption smoothing tools, alternative to financial assets, as they can be sold on the second hand market – subject to adjustment costs – and used as

collateral for borrowing.

I structurally estimate the model combining two sources of micro data on a representative sample of Italian households: the Household Budget Survey, a repeated cross-section, that collects expenditures on disaggregated sets of commodities and the Survey of Household Income and Wealth, a panel, that features data on income, savings, non-durable consumption, as well as stocks and flows of durable goods.

I then use the estimated model to conduct tax experiments and assess the effectiveness of hypothetical 12-month revenue neutral VAT cut reforms as fiscal stimulus instruments during an average recession. Modelling the recession as an unexpected negative 2% shock to households' earnings for two subsequent years followed by higher expected earnings' uncertainty, I simulate first a temporary and unexpected cut of 3 percentage points (from 10% to 7%) to the VAT rate on non-durable luxuries – mainly food away from home, hotels, and tourist services – and then a temporary and unexpected cut of 3 percentage points (from 22% to 19%) to the standard VAT rate on durables – mainly cars and furniture. Revenue neutrality of both reforms is guaranteed by a contemporaneous temporary adjustment of the labor income tax level.

I show that the immediate consumption stimulus effect of the VAT cut on non-durable luxuries is much smaller than that of the VAT cut on durables. More precisely, I find an increase of around 1.2% in consumption of non-durable luxuries in response to the 3 percentage points cut in their tax rate – a tax elasticity below 0.5 – and an increase of around 31% in durables' purchases as a consequence of the 3 percentage points cut in their tax rate – a tax elasticity just above 10. The higher tax elasticity of durables with respect to that of non-durables is in line with results in the existing empirical reduced-form literature exploring the effects of VAT changes in Europe and Japan[1], and sales tax holidays in US[2].

The VAT cut on non-durable luxuries acts through intratemporal substitution between the two categories of non-durables; households increase their consumption of non-durable luxuries, that became cheaper due to the reform, and decrease their consumption of non-durable necessities. The mechanism behind the large increase in durable spending immediately following the VAT cut on durables, instead, is one of intertemporal substitution: households bring forward purchases of durables that they would have made in the future to take advantage of the VAT cut. Indeed, in the simulated experiments, I show that the increase in purchases of durables at the time of the reform is followed by a drop in these purchases in the following two years. Therefore, the overall stimulus effect of the VAT cut on durables is still positive, but smaller

[1]Buettner and Madzharova (2021) show a significant increase in purchases of durables (household appliances) due to pre-announced VAT reforms across European countries. Cashin and Unayama (2016) and Cashin (2017) find strong temporary effects of VAT changes in Japan on durables' expenditures.

[2]Agarwal et al. (2017) find increases in spending on semi-durables (clothing and shoes) of up to 88% as a consequence of temporary sales tax holidays in the US and Baker et al. (2019) find that car purchases exhibit a tax elasticity of 8 in the context of pre-announced sales tax changes in the US.

than the one that takes into account only the year of implementation.

Looking at the effects of the two simulated tax reforms across heterogeneous households, I find that the intratemporal substitution effect of the VAT cut on non-durables is stronger for low income households and for low wealth households. These are the households that are most liquidity constrained and, therefore, have higher propensity to spend extra resources coming from a tax cut. On the other hand, I show that the intertemporal substitution effect of the VAT cut on durables is stronger for households in the first half of their life-cycle, for high income households, and for households at the top of the wealth distribution. These are households who can afford to bring forward future durables' purchases to today because they don't face binding liquidity constraints.

In terms of welfare implications, both revenue neutral VAT reforms turn out to have a negligible impact on average lifetime welfare computed at the time of implementation and to be regressive, redistributing towards richer, wealthier households and away from poorer, less wealthy ones.

To understand how households react to consumption tax changes depending on the state of the economy that they face, I explore the effects of the temporary VAT cuts under two alternative scenarios: no recession and deep recession. I show that, in both contexts, the intratemporal substitution effect of the VAT cut on non-durables and the intertemporal substitution effect of the VAT cut on durables are confirmed. However, with respect to the baseline average recession case, the intertemporal substitution on durables is attenuated in the absence of a recessionary shock, resulting in a tax elasticity of durables below 10, and it is amplified in the case of a deep recession, giving a tax elasticity of durables higher than 10. In the no recession scenario, households experience a weaker precautionary saving motive and, therefore, have lower incentives to accumulate durables as a buffer against increased uncertainty. This dampens the effect of the VAT cut on durables. In the deep recession scenario, households face a sharper but less persistent recessionary shock, lasting one year instead of two. The fact that they expect the uncertainty to resolve sooner makes them more willing to invest in a partially irreversible asset, such as durables, and strengthens the impact of the VAT cut on durables.

Lastly, I compare the analyzed consumption tax cuts to an alternative and equally costly – from the point of view of government revenues – stimulus policy that provides households with a one-off cash transfer, while leaving VAT rates unchanged. I find that such alternative policy has a smaller stimulus effect on consumption spending than the VAT cut reforms, but, differently from the VAT reforms, it has an overall positive welfare impact and it is progressive.

These quantitative findings that take into account the dynamic effects of fiscal reforms have relevant implications for policy makers having to choose among different fiscal stimulus tools during recessions. A reduction of the standard VAT rate on durables is more effective in boosting consumption than a VAT cut on non-durables, but its impact is mainly temporary.

Moreover, an equivalent cash-transfer is less effective in terms of consumption stimulus, but it creates larger welfare gains and it redistributes in favor of poorer and less wealthy households, compared to the VAT reforms. Hence, if the policy maker wants to boost consumption in the short run, especially in the context of a deep but less persistent recession, it should implement a temporary unanticipated VAT cut on durables. If, instead, the objective is to improve welfare and redistribute towards the most negatively affected groups of households, a one-off cash transfer could be preferred.

This paper relates to two main strands of the literature. First, the model draws insights from the empirical and theoretical literature studying consumer durables adjustment and households' choice among different types of consumption goods. In seminal work, Grossman and Laroque (1990), Eberly (1994), and Attanasio (2000) model households' durable adjustment by means of (S,s) rules. More recently, Bertola et al. (2005) and Fernandez-Villaverde and Krueger (2011) study the dynamics of expenditure in non-durable and durable goods in presence of adjustment costs and uncertainty. While, Browning and Crossley (2000) explore the elasticity of intertemporal substitution for luxury non-durable goods, Aguiar and Hurst (2013) show heterogeneity in consumption patterns across non-durable consumption subcomponents, and Hai et al. (2020) set up a consumption and saving model with non-durable and memorable goods. I contribute to this literature by integrating an intratemporal static demand system for multiple categories of non-durables within an intertemporal dynamic model for durables and savings.

Second, the quantitative tax experiments contribute to the growing literature investigating dynamic effects of fiscal policies within life-cycle models: Adda and Cooper (2000) study the effect of subsidies on durable goods market using a dynamic stochastic household discrete choice model of car ownership; Aaronson et al. (2012) investigate the income, spending and debt responses to minimum wage hikes in the US in a model where households can use durables as collateral for borrowing and face durables adjustment costs; Kaplan and Violante (2014) measure household consumption response to income tax rebates in the US in a framework with liquid and illiquid assets; Berger and Vavra (2015) explore the response of durables spending to policy changes during recessions and Gavazza and Lanteri (2018) study the car purchases response to a durable-replacement subsidy, such as the "Cash for Clunkers", implemented in the US after the 2008 financial crisis; Baker et al. (2020) embed an inventory problem into a consumption-saving life-cycle model to assess the spending response to changes in sales tax rates in the US. To my knowledge, this is the first paper that studies the effects of temporary consumption tax reductions on consumption (durable and non-durable), saving, and welfare in a structurally estimated life-cycle model with income uncertainty and borrowing constraint.

The rest of the paper is structured as follows. Section 2 briefly describes the policy context.

Section 3 sets up the model. Section 4 presents the data and Section 5 the estimation procedure. Section 6 and 7 report the simulated tax experiments and discuss the results. Section 8 concludes.

# 2 Consumption taxes across countries

Consumption taxes account for about 30% of total tax revenues across OECD countries. More specifically, VAT represents the most important consumption tax in all OECD countries, with the exception of the US, which do not have VAT at the federal level, but state and local sales taxes at different rates depending on goods and locations. Since the focus of the paper is on the impact that changes in consumption taxes have on the final consumers, in what follows I abstract from the specific features that differentiate VAT from sales taxes and I use the term consumption tax interchangeably with VAT. Hence, all the results presented for VAT can be generalized to consumption taxes, including sales taxes.

The policy context of the paper is Italy, where, similarly to other European countries, the central government levies VAT on consumption goods. The typical VAT schedule consists of differentiated rates applying to different categories of goods: reduced or zero rate on non-durable necessities, one or more intermediate rates on non-durable goods and services that are not necessities, and a standard rate on the rest of goods, mostly durables and semi-durables. For instance, Germany has one reduced rate at 7% and a standard rate at 19%, the UK has a zero rate, an intermediate rate at 5% and a standard rate at 20%, while Sweden has a zero rate, two intermediate rates (6% and 12%) and a standard rate at 25%. In particular, the Italian VAT schedule represents a midway case as it features three rates: a reduced rate of 4% applying to medicines and most food goods, an intermediate rate of 10% applying to food away from home, hotels, and tourist services, and a standard rate of 22% on semi durables and durables.

# 3 Life-cycle model with necessities, luxuries, and durables

I set up a dynamic life-cycle model of household consumption and savings decisions that allows to account separately for durable and multiple categories of non-durable consumption in a partial equilibrium framework with income uncertainty, borrowing constraints, and ex ante heterogeneity in education level.

***Household problem.*** Households are born as working adults at age $t_0 = 30$, the first time period in the model. Retirement is exogenous and takes place with certainty at age $T_r = 60$, so that working life lasts from period $t_0$ until period $T_r - 1$. From age $T_r$ the household is retired, receives a flat pension benefit from the government and faces an education specific, exogenous

probability of death until age $T = 85$, at which everyone dies with certainty.

Households solve the dynamic optimization problem:

$$\max_{c_{1,t},c_{2,t},d_t,a_t} \mathbb{E}_{t_0} \sum_{t=t_0}^{T} \beta^{t-t_0} \tilde{u}(c_{1,t}, c_{2,t}, d_t) \tag{1}$$

Subject to a set of constraints: the durables law of motion

$$d_t = (1-\delta)d_{t-1} + x_t \tag{2}$$

the budget constraint

$$c_t + Q(x_t)x_t + a_t = (1+r)a_{t-1} + T(y_t) \tag{3}$$

where, $c_t$ is the total expenditure in non-durables:

$$(1+\tau_1^n)\tilde{p_1}c_{1,t} + (1+\tau_2^n)\tilde{p_2}c_{2,t} = c_t \tag{4}$$

and $Q(x_t)$ is the non-linear price function for durables:

$$Q(x_t) = \begin{cases} q(1+\tau^d) & \text{if } x_t \geq 0 \\ q\pi & \text{if } x_t < 0 \end{cases} \tag{5}$$

and the borrowing constraint

$$a_t \geq -\chi d_t \tag{6}$$

In each period households decide how to optimally allocate their total resources among two non-durable categories of goods $(c_{1,t}, c_{2,t})$, taxed at rate $\tau_1^n$ and $\tau_2^n$ respectively, durables $(d_t)$ taxed at rate $\tau^d$, and savings in financial assets $(a_t)$.[3]

***Durables.*** When making their durable consumption decision, households take into account that durables can be bought and sold on the second-hand market. Hence, they decide whether to sell, buy or keep their durable stock invariant[4]. If households are not inactive, they also decide how much to buy (or sell) of durables, where $x_t$ represents the positive (or negative) variation in the amount of durable goods stock.

[3]I model the non-homogeneous non-durable consumption bundle $(c_t)$ as consisting of two groups of goods as dictated by the need to represent the VAT schedule in place in Italy as in the majority of other European countries as accurately as possible, but it is worth noting that this model is easily generalizable to the case of $n$ non-durable subcategories.

[4]In the model, households can either sell or buy durables in each period (with the limit case of inaction). This simplifying assumption is in line with the data where few net buyer (net-seller) households report having also sold (bought) durables in the time span from one wave of the survey to the next (see Appendix C.5 for details).

If the household decides to buy new durables ($x_t > 0$ ), it must pay the relative price of durables to non durables, $q$, times the VAT rate on durables, $\tau^d$, for each unit of durables purchased[5]. If, instead, the household decides to decrease its stock of durables by selling ($x_t < 0$ ), there are proceeds from selling durables on the second hand market that can be used to finance current non-durable consumption. However, households can actually sell at a value on the market only a fraction $\pi$ of the amount of durable stock they would like to get rid of. Indeed, a fraction $1 - \pi$ of the durable stock represents those durable goods that are an irreversible investment for the household. Durables' partial irreversibility is motivated by the existence of resale losses due to transaction costs that have been modelled in the literature on cars' market (see, for instance, Gavazza and Lanteri (2021) and Attanasio et al. (2022)) and, in the case of furniture and household appliances, by the absence of a second-hand market due to the well-known Akerlof's Lemons problem (Akerlof, 1970)[6]. This feature of the model allows to capture the varying degree of irreversibility of the different components of the durables stock that is observed in the data and therefore to better represent the constraints faced by households in reality.

The durables stock depreciates at the constant rate $\delta$, which coincides with the proportion of the stock that captures the service flow of durables from which the household derives utility[7]. For simplicity, I assume that there is no durable goods rental market and I abstract from housing as a durable good.

***Financial assets.*** Households can also save and borrow in a risk free financial asset whose associated constant interest rate is $r$. Only collateralized debt is allowed, in particular agents can borrow up to a fraction $\chi$ of their durables stock in each period implying a limited role of some durables categories as collateral. Differently from durables, financial assets are modelled as completely liquid, therefore households can access and adjust their financial assets stock at any time without paying any transaction costs.

[5]I assume that when households buy durables they always pay VAT on them, regardless of whether they buy on the first-hand or on the second-hand market. This corresponds to assuming that when durables are sold on the second-hand market they must go through an intermediate dealer which provides some services and therefore charges VAT on the good again before reselling it.

[6]While for precious objects and, partly, for cars it is easy to have an external appraisal, this is not the case for furniture and household appliances. Because of asymmetric information about the actual quality of the good between the seller and the buyer, agents believe that certain durable goods offered on second-hand markets are on average such bad quality that they are only willing to pay very low prices for them so that the sellers with the good quality used durables are driven out of the market. Sellers of decreasing quality remain in the market until the willingness to pay of the potential buyers is driven down to zero and the market shuts down.

[7]In this model, the rate of durables depreciation and the rate of durables service flow coincide as they both represent the loss of value of durables stock due to usage, but not the loss of value for resale or collateral purposes represented by $\pi$ and $\chi$ in the budget and borrowing constraints, respectively.

***Earning process.*** The process governing earnings from labour is assumed to be exogenous and to differ across education level achieved by the head of the household ($s$: secondary or less, high school, college or more). Allowing the earnings process dynamics to depend on education level, intended as a proxy for lifetime socio economic conditions, allows to create ex-ante heterogeneity among households in the model. I assume that the logarithm of earnings at age $t$ can be modelled in the following way:

$$lnY_t^s = f^s(X_t, t) + y_t^s \tag{7}$$

$$y_t^s = z_t^s + \varepsilon_t^s \tag{8}$$

where, $f$ captures the deterministic component as a function of age and demographic characteristics of the household, $X_t$, and $y$ is the stochastic component which accounts for the dynamics in earnings that remain unexplained after taking into account the deterministic component. The stochastic component consists itself of a persistent shock, $z$, and a transitory shock, $\varepsilon$. Both the deterministic function and the persistency and variances of the stochastic shocks vary across education levels.

***Government.*** The government levies proportional consumption taxes and non linear progressive labor income taxes at the household level. Proportional consumption taxes – $\tau_1^n$, $\tau_2^n$, $\tau^d$ – can differ across consumption categories. The progressive labor income tax regime is approximated by the non linear tax-transfer function proposed by Feldstein (1969), Benabou (2002), and Heathcote et al. (2017) as follows:

$$y^{net} = T(y^{gross}) = \lambda(y^{gross})^{1-\tau^y} \tag{9}$$

where, $\lambda$ captures the level of taxation and $\tau^y$ the degree of progressivity. If $\tau^y > 0$ the tax is progressive, if $\tau^y < 0$ the tax is regressive, while $\tau^y = 0$ corresponds to a flat tax with rate $1-\lambda$.

***Solution.*** As in Parodi (2023), I solve the model exploiting the fact that, under weak separability between non-durables and durables, the intratemporal non-durable problem is completely characterized by the indirect utility function – the maximum level of utility achieved by optimally choosing how to allocate a given level of total expenditure on non-durables ($c$) between two non-durable categories at a given vector of non-durable prices ($P$) – up to a monotonic transformation (Gorman (1971b) and Blundell et al. (1994)). Therefore, the original life-cycle problem can be restated by replacing the direct utility from non-durable consumption with the corresponding indirect utility, thus linking intra and intertemporal decisions in a coherent way

(see Appendix A.1 for a formal discussion):

$$\max_{c_t,d_t,a_t} \mathbb{E}_{t_0} \sum_{t=t_0}^{T} \beta^{t-t_0} U(v(c_t, P_t), d_t) \qquad s.t. \tag{10}$$

Subject to constraints (2), (3) and (6).

The life-cycle intertemporal utility is a standard CRRA featuring Stone-Geary preferences between durables and non-durables:

$$U(v(c_t, P_t), d_t) = \frac{[(v(c_t/n_t, P_t))^{\theta}(\delta d_t - \epsilon^d)^{1-\theta}]^{1-\gamma}}{1-\gamma} \tag{11}$$

Where, $v(c_t, P_t)$ is the indirect utility capturing the optimal decisions of the intertemporal non-durable stage of the model as a function of total expenditure and prices. $\frac{1}{\gamma}$ is the elasticity of intertemporal substitution of consumption and $\theta$ is the expenditure share in non-durable goods. Non-durable consumption is adjusted by an equivalence scale $n_t$ in order to capture changing needs over time and economies of scale in consumption depending on the number of members living in the household. $\epsilon^d$ is the Stone-Geary parameter that makes within period preferences non homothetic in non-durables and durables and captures the extent to which durables are to be considered as a luxury good with respect to the non-durable bundle. In principle, the household derives utility from the service flow of durables rather than from the durable stock itself. As common in this literature, I assume for simplicity that the service flow is a constant proportion, $\delta$, of the stock in each period and therefore allow for the stock of durables to enter the utility function directly.

Conditional on the optimal total expenditure on non-durables chosen in the intertemporal problem, households decide on the optimal consumption quantities of the two non-durables by solving a static utility maximization problem:

$$\max_{c_1,c_2} u(c_1, c_2) \qquad s.t. \qquad (1+\tau_1^n)\tilde{p_1}c_1 + (1+\tau_2^n)\tilde{p_2}c_2 = c \tag{12}$$

where, $p_1 = (1+\tau_1^n)\tilde{p_1}$, $p_2 = (1+\tau_2^n)\tilde{p_2}$ and $P = [p_1, p_2]$ is the vector of non-durable prices inclusive of the VAT rates. I do not impose a specific functional form on the intratemporal direct utility $u(.)$. Instead, I model the indirect utility, $v(.)$, as the one resulting from the Almost Ideal Demand System (AIDS) model by Deaton and Muellbauer (1980a) (see Appendix A.2 for more details).

***Recursive formulation.*** All in all, the household's problem is:

$$V_t(a_{t-1}, d_{t-1}, y_t) = \max_{a_t,d_t} \{U(v(c_t, P_t), d_t) + \beta\, \mathbb{E}_{y_{t+1}|y_t} V_{t+1}(a_t, d_t, y_{t+1})\} \tag{13}$$

subject to the constraints (2), (3) and (6).

The problem is solved numerically as described in Appendix B.

# 4 The Data

I use two data sets: the Bank of Italy Survey on Household Income and Wealth (SHIW) and the Italian National Institute of Statistics Household Budget Survey (ISTAT HBS). Details on both dataset and on sample selection are are in Appendix C.

The SHIW is a longitudinal dataset collecting information on income, wealth and consumption for a representative sample of Italian households. The non-durable consumption measure definition includes expenditures in food, clothing, entertainment, medical expenses, housing repairs and imputed rents[8]. SHIW collects information on three categories of durable goods: vehicles (such as cars, caravans, motorbikes, bicycles, boats), furniture (such as household electrical appliances and furnishings), jewellery (including jewellery, antiques, old coins and other precious objects). Households are asked to report the value of the stock and of the flow for each category (except for furniture).

Table 1: Mean durables flows and stocks (euros), SHIW

| | Value of stock | Value of purchase | Value of sale |
|---|---|---|---|
| Vehicles | 10,669.80 | 1,894.62 | 221.67 |
| | (11,984.44) | (5,961.74) | (1,498.30) |
| Furniture | 14,289.48 | 827.86 | |
| | ( 16,767.61) | (2,816.99) | |
| Jewelry | 4,884.12 | 168.31 | 16.02 |
| | (17,537.89) | (1,999.85) | (560.71) |

Notes: Standard deviations in parentheses.

[8]while the PSID only started collecting data on non-durable consumption other than food since 1999, the non-durable consumption measure definition in SHIW has remained the same since its very first wave.

Table 2: Average expenditure shares (%) in main non-durables categories, HBS

| necessities | | luxuries | |
|---|---|---|---|
| 1. Food at home | 90.04 | 1. Food away from home | 63.28 |
| 2. Books and newspapers | 8.62 | 2. Housing repairs | 21.11 |
| 3. Medical expenses | 1.34 | 3. Personal care | 8.65 |
| | | 4. Holiday and travel | 4.61 |
| | | 5. Entertainment | 2.36 |
| total | 34.40 | total | 65.60 |

ISTAT HBS is the most comprehensive cross sectional expenditure survey in Italy. It collects detailed information on the consumption of all commodities at the level of each single item purchased by the household during an average week and allows me to disaggregate non-durable consumption into its subcomponents according to their differential treatment in terms of consumption tax rates. I classify as non-durable necessities those goods that are currently taxed at the lowest rate (4%) and as non-durable luxuries those that are taxed at the intermediate rate (10%)[9]. Necessities include food at home, books and newspapers and some medical expenses. Luxuries include food away from home, hotels and holidays, housing repairs and additions, entertainment and personal care services and goods .

# 5 Estimation

In order to estimate the model, I adopt a two-step strategy, similar to the one used by Gourinchas and Parker (2002) and French (2005). In the first step, I estimate the parameters governing the intratemporal static non-durable consumption problem, the earnings process, and the non-linear labor income tax function outside of the life-cycle model. In the second step, taking the parameters estimated in the first step as given, I estimate the parameters governing intertemporal preferences and durables dynamics in the life-cycle model. Due to the set-up of the model, the parameters of household's preferences that determine the optimal allocation of resources within each period and over the life-cycle are identified and estimated consistently from two different sets of moments and exploiting two different datasets.

[9]The composition of the groups of goods taxed at the different rates was not subject to any relevant reforms over the period covered in the data.

## 5.1 First Step

***Intratemporal demand system.*** I model the intratemporal problem of how to optimally allocate total expenditure in non-durable consumption between a non-durable necessity and a non-durable luxury according to the Almost Ideal Demand System (AIDS) model by Deaton and Muellbauer (1980a). The desirability of this model rests in its great flexibility: the general functional form of the PIGLOG cost function on which AIDS is based implies that the demand functions derived from it are first-order approximations to any set of demand functions derived from utility-maximizing behavior. Hence, AIDS can nest different types of preferences, including non homothetic ones that are needed in order to be able to characterize goods as necessities or luxuries, without imposing restrictions on the direct utility functional form.

The indirect utility function characterizing the intratemporal problem according to AIDS takes the following form:

$$v(c,P) = exp\left\{\frac{ln(c) - ln(a(P))}{b(P)}\right\} \tag{14}$$

where, $c$ is total budget for non-durable consumption in the two ($k = 2$) non-durable goods categories, $P$ is the vector of prices including taxes, $ln(a(P))$ and $b(P)$ are the price index and the Cobb-Douglas price aggregator, respectively:

$$ln(a(P)) = \alpha_0 + \sum_{i=1}^{k}\alpha_i lnp_i + \frac{1}{2}\sum_{i=1}^{k}\sum_{j=1}^{k}\eta_{ij}lnp_i lnp_j \tag{15}$$

$$b(P) = \prod_{i=1}^{k} p_i^{\beta_i} \tag{16}$$

Applying Roy's identity to (14) the Marshallian demand functions in each of the two category of goods $c_i$ can be derived and, from there, the expenditure shares in each of the two categories, $w_i = \frac{p_i c_i}{c}$, as a function of total budget and prices are computed. These translate into the following demand system estimation equations:

$$w_{it} = \alpha_i + \sum_{j=1}^{k}\eta_{ij}lnp_{jt} + \beta_i ln\left\{\frac{c}{a(p)}\right\} + e_{it} \tag{17}$$

Where, $t$ denotes the observation index and $e_{it}$ is assumed to represent unobservable components in demand, here assumed to be measurement error for simplicity.

The parameters to be estimates are $\alpha, \beta$ and $\eta$. Some restrictions on these parameters are required. $\sum_{i=1}^{k}\alpha_i = 1$, $\sum_{i=1}^{k}\beta_i = 0$, $\sum_{j=1}^{k}\eta_{ji} = 0$ must hold in order to satisfy adding-up, while $\sum_{j=1}^{k}\eta_{ij} = 0$ in order to satisfy homogeneity.

The estimation exploits ten subsequent waves of the HBS spanning years from 2003 to 2012. The price data, that are not included in the consumption survey, are obtained from

ISTAT Consumer Price Index database[10]. As the variability of prices for the same goods over time and across families is small, I use price data disaggregated at the regional level in order to create further variability.

The estimation equations in (17) is affected by an endogeneity problem because total expenditure in non-durables on the right hand side also features as the denominator of the dependent variable. To deal with this endogeneity issue, I use a grouping estimation strategy. In particular, I use a discrete instrument for the continuous endogenous variable total expenditure that consists of a group variable constructed as all possible combinations of the values taken by the demographic variables education, age (of head of household), year, region.

Moreover, since I want to take into account the fact that the number of household components may have an impact on consumption choices of different categories of non-durables, I transform total expenditure in equivalent terms using the equivalence scale (Appendix C.4) and estimate the AIDS on the equivalized expenditure.

Table 3: AIDS estimated parameters

| | $\alpha_1$ | $\beta_1$ | $\eta_{11}$ | $\eta_{12}$ |
|---|---|---|---|---|
| share $c_1$ | 0.8513*** | -0.0587*** | -0.0101 | 0.0101 |
| | (0.0125) | (0.0014) | (0.0127) | (0.0127) |

Notes: $N = 13,989$. Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ .

Once estimated the parameters of interest, I predict the expenditure shares and derive budget elasticities and compensated own- and cross-price elasticities (details on the derivation are in Appendix D.1 ).

Table 4: Predicted expenditure shares and elasticities at the means

| | shares | budget elasticity | price 1 | price 2 |
|---|---|---|---|---|
| share $c_1$ | 0.337*** | 0.826*** | -0.603*** | 0.603*** |
| | (0.001) | (0.004) | (0.037) | (0.037) |
| share $c_2$ | 0.663*** | 1.088*** | 0.307*** | -0.307*** |
| | (0.001) | (0.002) | (0.019) | (0.019) |

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ .

[10]More precisely, the price series for the two categories of non-durables are constructed by taking the weighted average of the price series of more disaggregated categories of goods.

Table 4 shows that the non-durables taxed at 4%, $c_1$, are indeed necessities and the non-durables taxed at 10% , $c_2$, are a luxuries as their budget elasticities are smaller and greater than one, respectively. Table 4 also suggests that the necessity non-durables and the luxury non-durables are substitute of each other as the compensated cross-price elasticities are positive and significant. Compensated own-price elasticities are negative for both goods as predicted by the theory (Negativity property).

The estimation of the parameters of the AIDS demand system on the two non-durables allows to predict the behavioural response of the two non-durable consumption shares to price changes (and therefore VAT reforms) taking into account substitution and income effect. Most importantly for the aim of this paper, estimation of AIDS delivers estimates of the price indices in (15) and (16) to be then used to compute the estimated indirect utility of the second-stage intratemporal consumption problem conditional on the total expenditure in non-durables chosen in the first stage intertemporal model as from (14). These price indices are precisely what links the within-period allocation (demand system) and the between-period allocation (life-cycle model) in a coherent way.

***Earning process.*** I estimate the parameters governing the deterministic and stochastic parts of the earnings process of the household for three different education groups (secondary school or less/high school/ college or more) separately. The logarithm of earnings of household $i$ whose head is aged $t$ is modelled as follows :

$$ln(Y_{i,t}) = D_t + \beta_1 age_{i,t} + \beta_2 age_{i,t}^2 + \beta_3 status_i + \beta_4 reg_i + y_{i,t} \tag{18}$$

$$y_{i,t} = z_{i,t} + \varepsilon_{i,t} \tag{19}$$

$$z_{i,t} = \rho z_{i,t-1} + u_{i,t} \tag{20}$$

$$\varepsilon_{i,t} \sim (0, \sigma_\varepsilon^2), \qquad u_{i,t} \sim (0, \sigma_u^2), \qquad z_{i,0} \sim (0, \sigma_{z_0}^2)$$

The deterministic part of the earnings process consists of year dummies and a quadratic in age conditional on marital status and region of residence. While, the stochastic part ($y$), that captures the effect of unobservables not included in the deterministic component, features a persistent component ($z$), following an AR(1) stochastic process with non constant variance, and a purely transitory component ($\varepsilon$) that represents measurement error. All in all, the parameters to be estimated are $\Psi = \{\beta_1, \beta_2, \beta_3, \beta_4, \rho, \sigma_u^2, \sigma_\varepsilon^2, \sigma_{z_0}^2\}$ and the approach to estimation is the one proposed by Guvenen (2009). Results from the estimation of the deterministic and stochastic components are presented in Figure 1 and Table 5. Identification and estimation details are reported in Appendix D.2.

Estimation of the non-linear labor income tax function that transforms gross earnings into net is in Appendix D.3.

Figure 1: deterministic profiles of log earnings by education

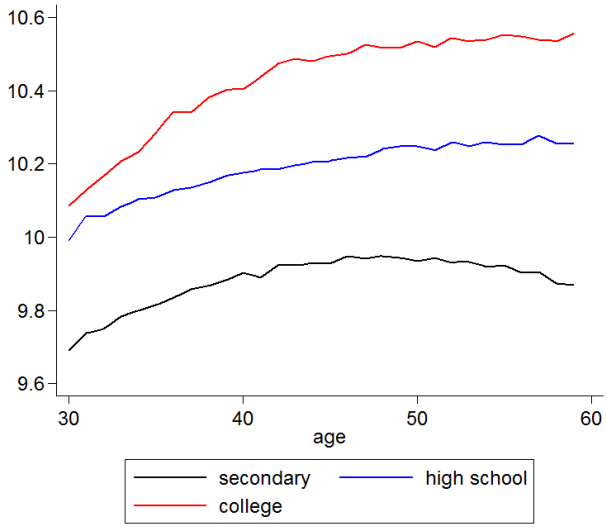



Table 5: Estimates of stochastic earnings process parameters by education

| | Education level | | |
|---|---|---|---|
| | secondary | high school | college |
| $\rho$ | 0.9682 | 0.9734 | 0.9428 |
| | (0.0390) | (0.0300) | (0.0873) |
| $\sigma_u^2$ | 0.0068 | 0.0054 | 0.0136 |
| | (0.0082) | (0.0052) | (0.0309) |
| $\sigma_\varepsilon^2$ | 0.0968 | 0.0697 | 0.0512 |
| | (0.0174) | (0.0108) | (0.0229) |
| $\sigma_{z_0}^2$ | 0.0802 | 0.0579 | 0.2168 |
| | (0.0422) | (0.0511) | (0.1519) |
| $N$ | 2,678 | 2,052 | 691 |

Notes: Bootstrapped standard errors in parentheses.

## 5.2 Second Step

The second step of the two step estimation procedure consists in the structural estimation of the parameters characterizing the life-cycle model, those related to intertemporal preferences and those related to durables dynamics, via the Method of Simulated Moments (MSM). The estimation technique is explained in details in Appendix D.4.

The parameters to be estimated are $\Theta = \{\gamma, \theta, \beta, \epsilon^d, \pi, \chi, \delta\}$. Only two parameters are

exogenously assigned values suggested by the literature: the interest rate, $r$, is set to 2.5% and the relative price of durables to non-durables, $q$, is set to 1. This results in 7 estimating parameters with 50 targeted moments (see Appendix D.4 for details on the targeted moments), hence the model is overidentified. The second step estimated parameters are reported in Table 14 together with their asymptotic standard errors. The estimates are all statistically significant. The estimated preference parameters $\gamma$, $\theta$ and $\beta$ are in line with the existing literature. The large, negative value found for $\epsilon^d$ suggests that durables are luxury goods.

Table 6: Second step estimated parameters

| Parameters | Value (annual) | Definition | SE |
|---|---|---|---|
| $\gamma$ | 3.72 | Coeff. of relative risk aversion | 1.6922 |
| $\theta$ | 0.85 | Non-durable consumption share | 0.0019 |
| $\beta$ | 0.99 | Discount factor | 0.0016 |
| $\epsilon^d$ | -476.42 | Stone-Geary coeff. for durables | 40.5815 |
| $\pi$ | 0.47 | Fraction of non irreversible durables | 0.0089 |
| $\chi$ | 0.11 | Fraction of collateralizable durables | 0.0145 |
| $\delta$ | 0.01 | Durables depreciation rate | 0.0013 |

The estimates of the parameters governing durables' dynamics, $\pi$, $\chi$ and $\delta$, imply that about 50% of durables' stock can be sold on the second hand market, while only 11% has collateral value and that durables depreciate slowly at the 1% rate. These estimates are plausible given the composition of durables in the dataset. 50% irreversibility is in line with the fact that, as from Table 1, roughly half of the durables stock is represented by the furniture category whose selling value is not asked in the survey due to lack of a second hand market. A share of durables that can be used as collateral for borrowing of about 10% is plausible as it mainly captures collateralized car loans, given the limited diffusion of other forms of consumer credit in Italy. Durables' depreciation rate at 1% is slightly lower than cars' depreciation rates previously estimated in the literature (see Adda and Cooper (2000)) because the durable bundle in the dataset also includes goods, such as furniture or jewelry, that depreciate at a slower rate than cars.

As it is usually the case in this kind of structural life cycle models, it is not possible to provide a formal proof for the identification of each parameter separately from the others. However, it is worth investigating which aspects of the data, and therefore which empirical moments, contribute more heavily to the identification of which estimated parameters.

The coefficient of relative risk aversion, $\gamma$, is identified from the mean life-cycle profile of financial assets and non-durable consumption as suggested by other studies (Cagetti (2003), Gourinchas and Parker (2002)). The higher the level of assets and the smoother the pattern of

consumption over the life-cycle, the more risk averse are households and, therefore, the higher will be the estimated $\gamma$.

The weight of non-durable consumption in the utility function, $\theta$, is identified by construction from the life-cycle profile of mean non-durable consumption share of total consumption and also from the covariances between non-durable and durable consumption.$\beta$, the discount factor, is identified from the mean life-cycle profiles of the two sources of wealth in the model (financial assets and durables). The larger the holdings of wealth at all stages of life, the more patient are households in discounting the future and the higher will be the estimated value of $\beta$.

The Stone-Geary durables parameter, $\epsilon^d$, captures the extent to which durables are a luxury good and ensures that the marginal utility of consuming zero durables in each life period is finite. It is identified by the mean profile of durables over the life-cycle and also by the covariances between non-durable and durable consumption at different points in life. The slower households consumption of durables with respect to non-durables increases as they become wealthier from one period to the next of the life-cycle, the more durables are perceived as luxuries and the flatter the curvature of households' preferences in durables and, therefore, the higher (in absolute value) the estimated $\epsilon^d$ will be.

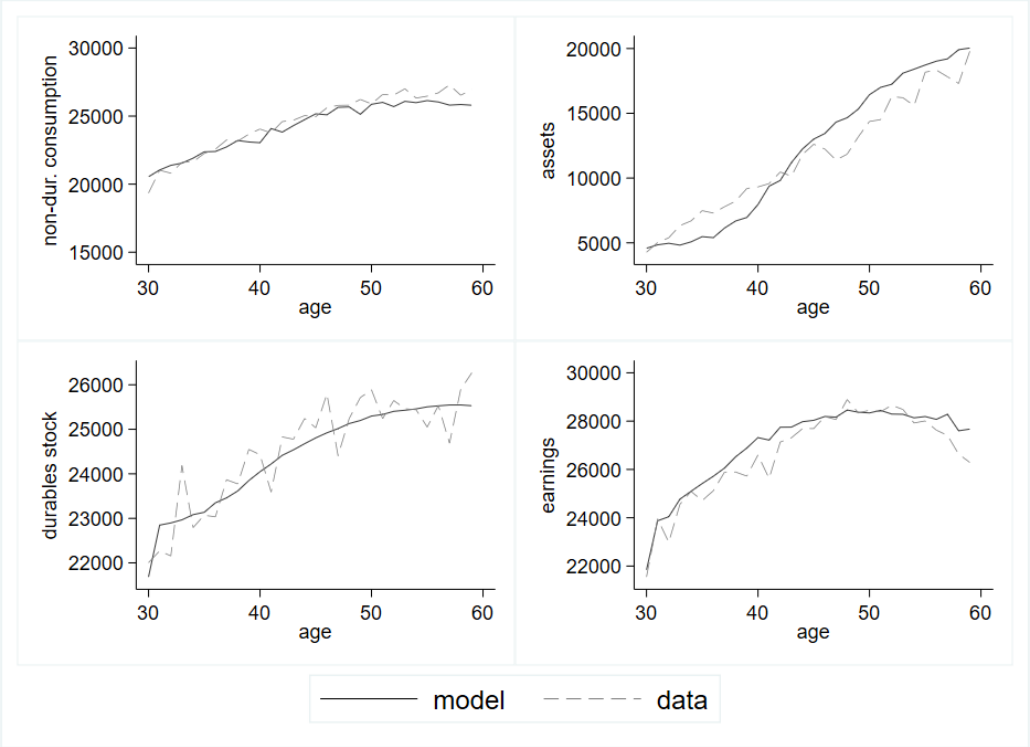
The fraction of durables stock that is collateralizable, $\chi$, is identified by the mean patterns of financial assets and of financial assets-durables ratio over the life-cycle, especially at beginning of working life when individuals are more likely to borrow. Also, covariance between assets and durables at different stages of life helps in identifying this parameter. The more negative the mean assets early in life and the higher the ratio between assets liabilities and durables, the higher is the collateral value of durables and so the higher the estimated $\chi$ will be.

Finally, durables depreciation rate $\delta$ and reversibility rate $\pi$ are closely interrelated in this model as they jointly determine the dynamics of durables accumulation over the life-cycle. The higher depreciation, the slower is durables accumulation, but also the more frequent are adjustments to the stock. The higher reversibility, the higher is the incentive to accumulate durables as a smoothing device, and again the more frequent are adjustments to the stock. The identification strategy for these two parameters relies on the availability of data on the value of both durables stock and durables flow in each wave of the panel data and is reported in Appendix D.4.

## 5.3 Model Fit

Figure 2 shows that the simulations produced by the estimated model fit the data very well in terms of mean life-cycle profiles of non-durable consumption, financial assets, durables stock and earnings. In particular, my model replicates very closely both the levels and the patterns over age observed in the data.

Figure 2: Fit of targeted moments, model vs data




Notes: profiles of average non-durable consumption, financial assets, durables' stock, and net earnings by age computed in the data and in the simulations from the model.

# 6 The VAT Cut Experiments

In this section, I use the estimated model to conduct counterfactual exercises in order to assess the effectiveness of VAT temporary cuts as fiscal stimulus instruments during recessions. First, I simulate a temporary and unanticipated cut of the intermediate VAT rate, the one that applies to non-durable luxuries, from 10% to 7%. Second, I simulate a temporary and unanticipated cut of the standard VAT rate on durables, from 22% to 19%. A 3 percentage point reduction in VAT rates in in line with the reforms implemented in the UK in 2009, in Germany in 2020, as well as in other European countries (see Buettner and Madzharova (2021) for a summary). I look both at the effect of these reforms on consumption of three categories of goods – necessities, luxuries, and durables – and on saving choices and at their welfare implications across households of different age, income, and wealth levels.

The timing of the simulated experiments is the following. In period $t = -1$, households are hit by an aggregate income recession that is modelled as an unpredictable shock to the steady state of an economy that does not feature aggregate shocks. More specifically, the recession consists of an unexpected drop in households' earnings equal to 2% of the sample median annual

earnings for two subsequent years (two periods in the model).

The magnitude and length of the drop are chosen to represent an average recession and are in line with the existing literature: Krusell and Smith Jr (1999) calibrate the aggregate component of the income shock to be 2% lower in a bad state of the economy than in a good one and assume that the bad state lasts for 2 years; Glover et al. (2020) define the US economy to be in a recession in year $t$ if the deviation of GDP per capita from the trend in that year is at least -2%. Moreover, the simulated earnings' drop is equal, in absolute terms, for all households to allow for the fact that, as suggested by the existing evidence (see Adams-Prassl et al. (2020) and Guvenen et al. (2014)), during recessions there are large differences in earning losses between groups of individuals who enter the recession with different levels of earnings and that the percentage drop is greater, in relative terms, for households belonging to the bottom of the earnings distribution.

In period $t = 0$, the second period of recession, an unexpected VAT cut is implemented and it is known to the households that the cut will last only for one year (one period). All simulated VAT reforms are revenue neutral with respect to the status quo economy under recession. Revenue neutrality is ensured by a one-off adjustment of the level of the labor income tax, captured by parameter $\lambda$ in the non-linear tax function (equation 9 in Section 3), implemented in the same period of the VAT cut .

In period $t = 1$, the VAT rate and the earnings' level are back to pre-reform and pre-recession levels. However, to allow for the fact that recessions are periods characterized by higher risk[11], simulated households are assumed to face increased uncertainty in earnings for the two periods following the loss in realized earnings. This increased earnings' uncertainty is modelled as a 75% higher standard deviation of the idiosyncratic shocks to the household's earnings process, as in Storesletten et al. (2004), in periods $t = 1$ and $t = 2$.

Some additional features of the simulated experiments are worth emphasizing. First, the model does not allow for aggregate uncertainty, therefore the recession is represented by a so called MIT shock to earnings in the simulations. This approach is in line with a number of recent studies in the literature on heterogeneous-agent models. Boppart et al. (2018) propose an intuitive linearization technique for solving heterogeneous-agent models with aggregate uncertainty that uses a simplified economy with MIT shocks as a good approximation to the full-blown economy with aggregate shocks. Kaplan et al. (2018) study the effects of a temporary expansionary monetary policy shock in an heterogeneous-agent model without aggregate shocks, but with a one-time unexpected interest rate shock followed by a deterministic transition back to the steady state. More recently, in the context of the Covid-induced economic recession, Guerrieri et al. (2022) consider an MIT shock to hours of labor and Fuchs-Schündeln et al.

[11]This has been argued in the literature by Storesletten et al. (2004), Bayer et al. (2019), and Fernández-Villaverde et al. (2011), among others.

(2022) allow for one-time unexpected school closure and income shocks in heterogeneous-agent economies without aggregate uncertainty.

Second, the simulated VAT cuts are assumed to be fully passed through to consumers and are reflected one-to-one on final retail prices inclusive of VAT. The existing empirical literature studying consumption taxes' pass-through across different commodities and countries has reached contrasting conclusions: Poterba (1996) and Kopczuk et al. (2016) show full pass-through of sales taxes on consumer prices in the US, Besley and Rosen (1998) find over-shifting for some non-durable commodities, while Carbonnier (2007) and Benzarti and Carloni (2019) report under-shifting in the French new car sales and restaurants markets, respectively. More recently, Fuest et al. (2020) analyze the effect on supermarket retail prices of the temporary VAT cuts implemented in Germany in 2020 during the Corona pandemic and find that about 70% of the tax cuts were passed on to consumers. While Buettner and Madzharova (2021) look at changes in VAT on consumer durables across EU countries and find evidence of a complete pass-through occurring within four months from the implementation of the tax change. This empirical evidence suggests that the assumption of a full pass-through within one year, i.e. one time period in the model, is plausible. As a consequence of this assumption, the tax elasticities that I find are to be considered as upper bounds with respect to the case of less than full pass-through.

Third, each simulated household is hit by the recession and by the relevant reform only once during a life-cycle at age 35, 45, or 55. This feature allows to evalaute the different effects that the recession and the policy changes might have for households at different life stages. The fraction of simulated households belonging to each of the three age groups is obtained from the age distribution in the sample of households aged 30 to 60 used for estimation. In particular, 25.40% of households are aged 30-39, 38.24% are aged 40-49, and 36.36% are aged 50-60. These weights are used to aggregate the effects of the simulated recession and reforms across age groups. Moreover, the age distribution is taken into account when computing the government budget and, therefore, the revenue neutrality of the reforms.

Lastly, two assumptions in the model have important implications for the simulated tax experiments that follow. Given the partial equilibrium framework of the model, the simulated effects presented in the following sections are to be interpreted as first round responses to the temporary fiscal policies, before any general equilibrium effect on prices or on labor supply and labor demand. Moreover, the labor supply margin is exogenous in the model and this implies that the analysis abstracts from potential distortionary effects of the simulated tax cuts on labor supply decisions of the households. On the other hand, the presence of multiple goods in the model is key as it allows to take into account the distortions in consumption choices among different categories of consumption goods caused by the VAT changes.

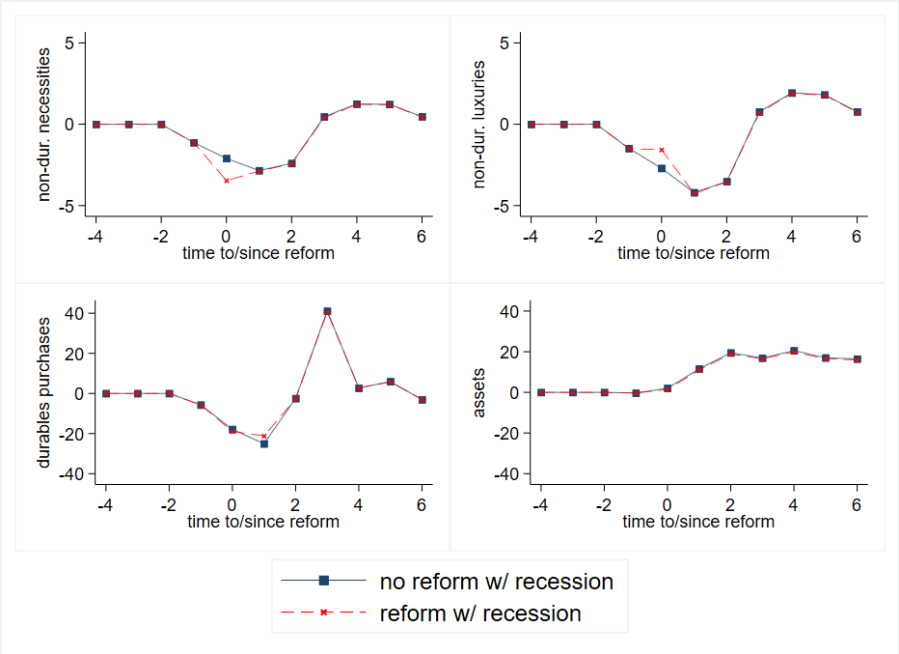
In the following subsections, I discuss the results of the tax experiments under the baseline

scenario of an average recession described above, then I explore the effects of the same reforms under two additional alternative scenarios: i) No Recession, ii) Deep Recession.

## 6.1 Temporary VAT cut on non-durable luxuries

Figure 3 shows the effects of the recessionary shock (blue solid lines) and of the temporary reduction of the VAT rate on non-durable luxuries in presence of the recession (red dashed lines) with respect to the baseline scenario of no recession and no reform.

Figure 3: Effects of recession and reform on households' choices, overall




Notes: % changes in households' choices with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group.

As a response to the recession and in the absence of VAT reforms, on average, households reduce their purchases of non-durables necessities, non-durable luxuries, and durables for multiple periods, reaching a minimum of around -3%, -5%, and -30%, respectively, at time $t = 1$. These drops in expenditures on consumption sub categories that are generated by the simulated recession are in line with the existing empirical evidence on the impact of recent recessions on Italian households' consumption of different goods (see Rondinelli (2014), Rodano and Rondinelli (2014)) that show how demand for necessities dropped less than demand for services (non-durable luxuries) and of demand for consumer durables. Moreover, after the end of the recession, consumption of all goods starts to recover and surpasses pre-recession levels by period $t = 3$, but this pent-up demand mechanism turns out to be stronger for durables than for non-durables, as suggested by the literature (Beraja and Wolf, 2021). Hence, the

simulated model succeeds in mimicking empirical demand elasticities of different types of consumption goods to unexpected changes in households' budgets and this allows to put stock in the simulated tax experiments.

The temporary VAT cut on non-durable luxuries, accompanied by the contemporaneous rise in labor income taxes to keep revenue neutrality, produces an intratemporal substitution effect between the two non-durable categories: households increase their consumption of non-durable luxuries, that are now cheaper, and decrease their consumption of non-durable necessities with respect to what they would have done in the absence of the reform.[12] Consumption of non-durable luxuries increases by 1.17% in period $t = 0$, with respect to the recession/no reform scenario, in response to the 3 percentage points VAT rate cut: a tax elasticity of around 0.40[13].

Looking at the effects of the reform across heterogeneous groups of households, Figures 4, 5, and 6 show that the intratemporal substitution effect on non-durable luxuries is equally strong across the three age groups, but it is quantitatively more relevant for households in the bottom half of the wealth and of the lifetime income distributions (Q1 and Q2)[14]. These households are more liquidity constrained, hence their marginal propensity to consume out of an increase in their total resources, due to the fact that some non-durables became cheaper, is higher than for households at the top of both wealth and income distributions.

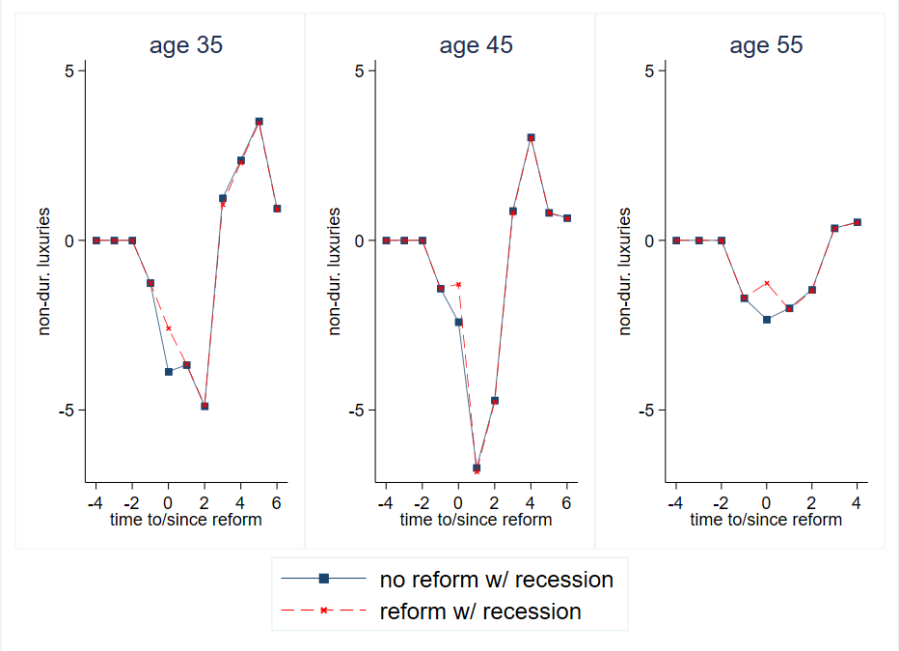
Moreover, Figures 5 and 6 show that the drop in consumption of non-durable luxuries due to the recession, in the absence of the stimulus reform, is larger and more persistent for higher wealth and higher income households (Q3). These are the households who consume disproportionately more non-durable luxuries before the recession and therefore can make larger cuts of their expenditure on these goods and increase their savings in financial assets to self-insure in the face of the earnings' drop and of the higher uncertainty caused by the recession (see graphs for financial savings across groups in Appendix E.1).

[12]This VAT cut also creates a small positive income effect on durable purchases: households devote part of the extra resources deriving from their now cheaper non-durable consumption basket to increase purchases of the non-targeted goods (durables). This income effect would be larger if the VAT reform was not revenue neutral.

[13]Tax elasticities are computed taking the recession/no reform scenario as the baseline in order to isolate the effect of the reform from that of the recession.

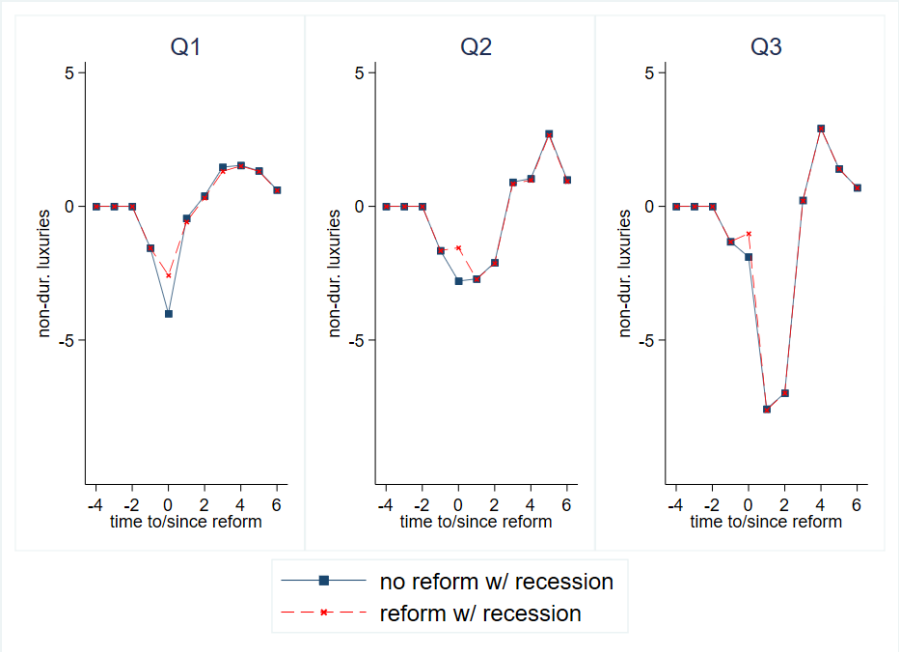
[14]Total wealth includes both liquid (financial assets) and illiquid (durables) assets. Lifetime income is measured as the average of the income realizations over the household's life-cycle in absence of recession.

Figure 4: Effects of recession and reform on targeted goods, by age at implementation



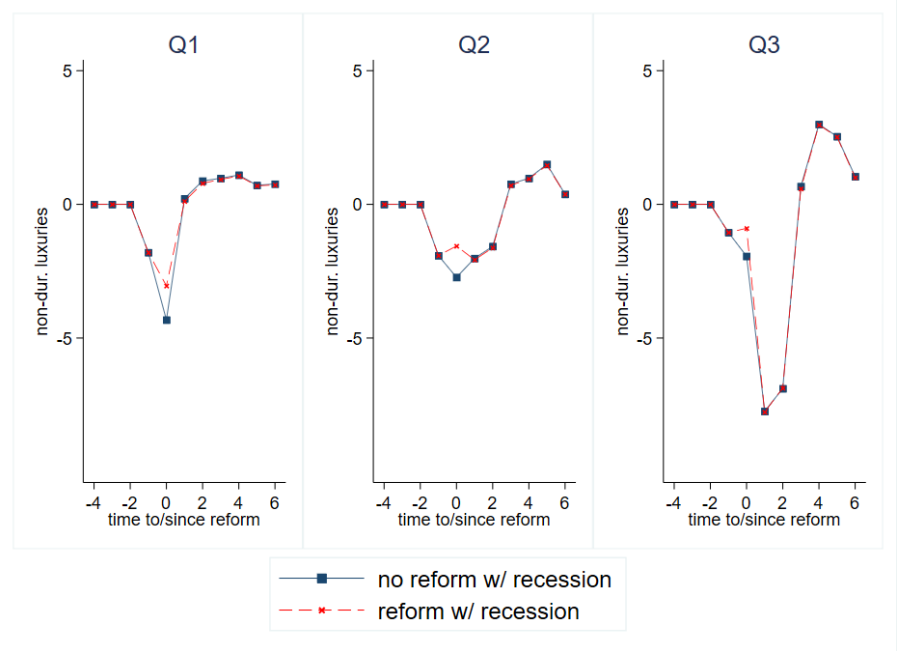

Notes: % changes in households' non-durable luxuries consumption with respect to no recession/no reform scenario. Age 35-45-55 is age at which households are hit by temporary reform.

Figure 5: Effects of recession and reform on targeted goods, by wealth tercile




Notes: % changes in households' non-durable luxuries consumption with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of total wealth distribution in no recession/no reform scenario.

Figure 6: Effects of recession and reform on targeted goods, by income tercile



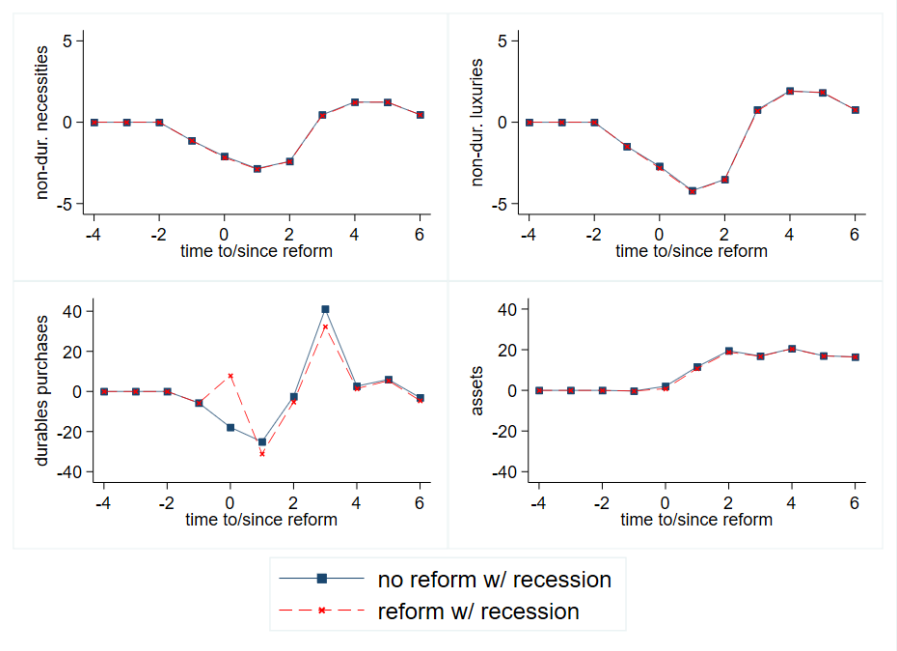

Notes: % changes in households' non-durable luxuries consumption with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of lifetime income distribution in no recession/no reform scenario.

## 6.2 Temporary VAT cut on durables

The second counterfactual experiment consists of a temporary cut of the VAT standard rate, which applies to consumer durables, coupled with a temporary raise in labor income tax to keep revenue neutrality. Durables are peculiar as they are both a consumption good and a saving tool, and they can be used as collateral for borrowing. Moreover, differently from non-durable consumption choices, durables consumption decisions are dynamic and characterized by some degree of irreversibility, in that households have to commit to a durable investment before future uncertainty is resolved.

Figure 7 shows a large effect of the unanticipated revenue neutral VAT cut on durable purchases at the time of implementation. More specifically, expenditure on durables increases by 31.4%, with respect to the scenario of recession with no reform, in response to the 3 percentage points cut in VAT rate in period $t = 0$. This implies a tax elasticity of around 10. The higher tax elasticity of durables with respect to that of non-durables is in line with results in the existing empirical literature: Cashin and Unayama (2016) and Cashin (2017) find strong temporary effects of VAT changes in Japan on durables' expenditures, Buettner and Madzharova (2021) show a significant increase in purchases of durables (household appliances) due to pre-announced VAT reforms across European countries, Agarwal et al. (2017) find increases in spending on semi-durables (clothing and shoes) of up to 88% as a consequence of temporary sales tax

Figure 7: Effects of recession and reform on households' choices, overall




Notes: % changes in households' choices with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight of each age group.

holidays in the US and Baker et al. (2019) find that car purchases exhibit a tax elasticity of 8 in the context of pre-announced sales tax changes in the US.

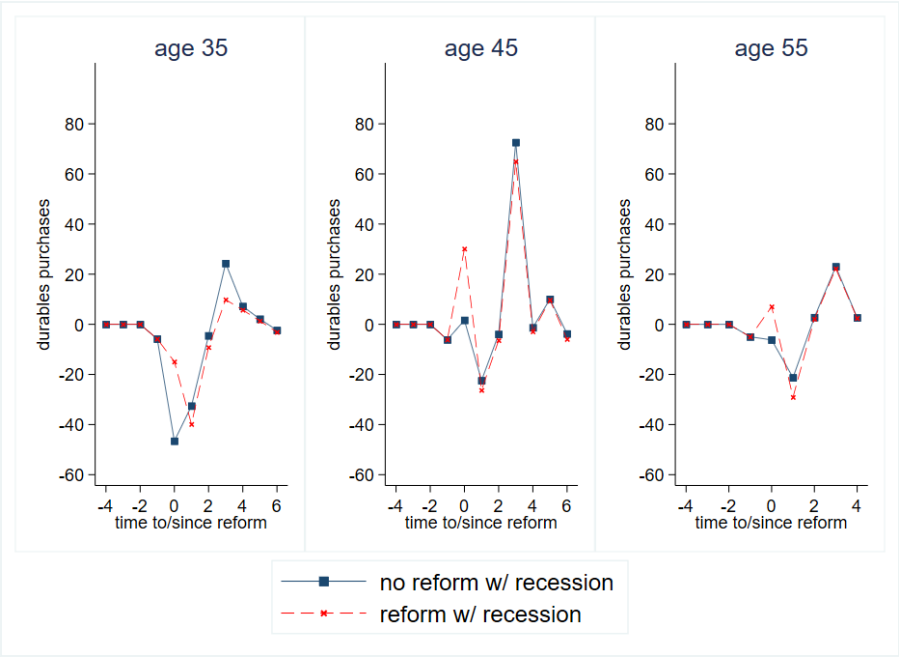
Figure 7 also shows that the sharp increase in durables' purchases at the time of the reform implementation is followed by a drop in purchases after the end of the tax cut, which dampens the pent-up demand mechanism with respect to the no reform scenario. This suggests that the VAT cut on durables has an intertemporal substitution effect on the targeted goods: when households learn about the tax cut, they bring forward purchases of durables that they would have made in the future. Hence, this reform offsets the drop in purchases of durables due to the recession at the time of implementation, however its effect is mostly temporary as it stems more from shifting purchases over time rather than creating additional purchases.

Assessing the strength of the intertemporal substitution effect over the life-cycle and across heterogeneous households, Figure 8 shows that it is stronger for households who are hit by the reform in the first half of working life. These are the households who are still in the process of building up their durables' stock, to be used for borrowing and self insure, and who will derive utility from durables for a longer time horizon. These households are also the most sensitive to expected higher aggregate uncertainty, as their savings in financial assets jump up more in response to the recession (see graphs in Appendix E.2). Figure 9 and 10 suggest that it is mostly households at the top of the wealth and income distributions that increase durables purchases as a response to the VAT cut on durables. These are the least liquidity constrained households who can afford to perform more intertemporal substitution of resources. This result

is in line with recent empirical evidence (Green et al., 2020) showing that liquidity constraints can substantially reduce the impact of a temporary incentive to purchase durables, especially during recessions.

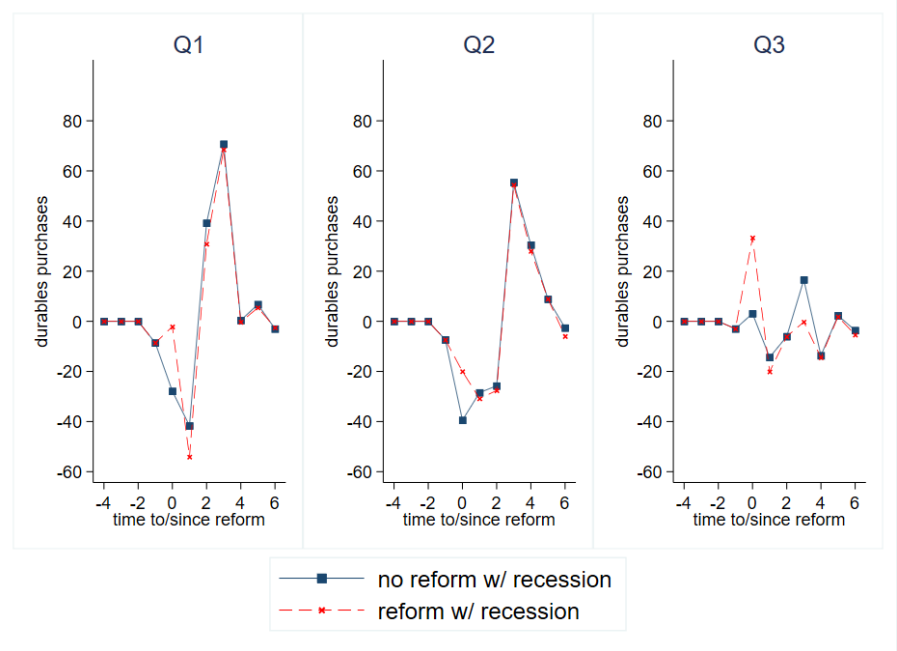
Moreover, Figures 8, 9, and 10 show that, in the absence of the reform, households at the beginning of working life and households belonging to the bottom parts of the wealth and income distributions cut their durable consumption the most when hit by the recession. Being more constrained, these households tend to sell their durables in order to smooth their non-durable consumption in the face of the recession.

Figure 8: Effects of recession and reform on targeted goods, by age at implementation



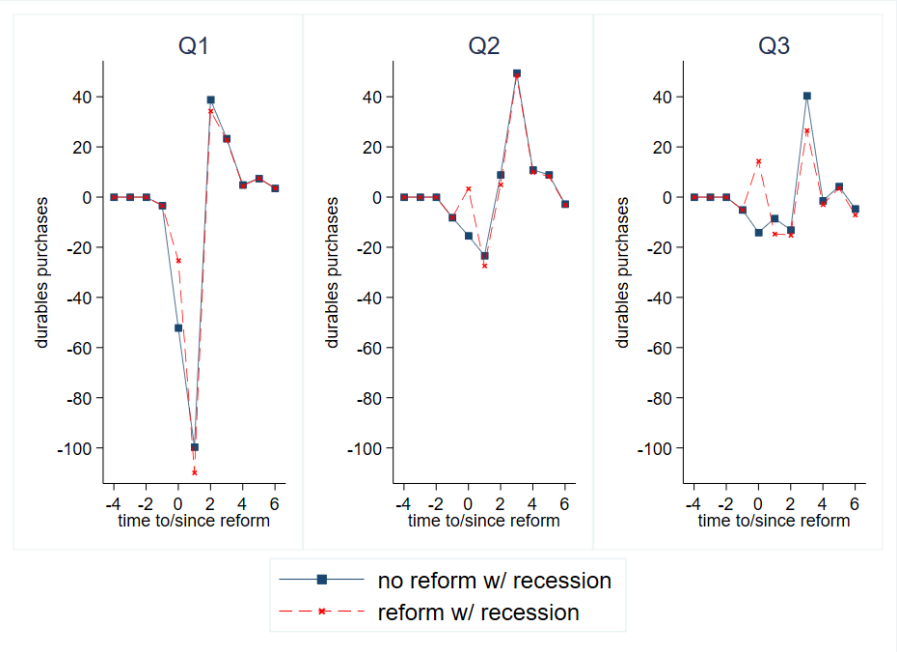

Notes: % changes in households' durables purchases with respect to no recession/no reform scenario. Age 35-45-55 is age at which households are hit by temporary reform.

Figure 9: Effects of recession and reform on targeted goods, by wealth tercile




Notes: % changes in households' durables purchases with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of total wealth distribution in no recession/no reform scenario.

Figure 10: Effects of recession and reform on targeted goods, by income tercile




Notes: % changes in households' durables purchases with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of lifetime income distribution in no recession/no reform scenario.

## 6.3 Welfare analysis

Table 7 presents the welfare and distributional consequences of the two simulated revenue neutral VAT reforms overall and across heterogeneous households in terms of consumption equivalent variation (CEV) with respect to the recession/no reform scenario.

Table 7: Welfare Consequences (CEVs) of VAT reforms

| | | Overall | |
|---|---|---|---|
| VAT cut of $\tau_2^n$ | | 0.000 | |
| VAT cut of $\tau^d$ | | -0.001 | |
| by age at reform: | 35 | 45 | 55 |
| VAT cut of $\tau_2^n$ | 0.000 | 0.000 | 0.001 |
| VAT cut of $\tau^d$ | 0.000 | 0.000 | -0.001 |
| by income tercile: | Q1 | Q2 | Q3 |
| VAT cut of $\tau_2^n$ | -0.001 | 0.002 | 0.003 |
| VAT cut of $\tau^d$ | -0.001 | 0.000 | 0.001 |
| by wealth tercile: | Q1 | Q2 | Q3 |
| VAT cut of $\tau_2^n$ | -0.002 | 0.002 | 0.004 |
| VAT cut of $\tau^d$ | -0.001 | 0.000 | 0.001 |

Notes: CEV(%): consumption equivalent variation with respect to recession/no reform scenario computed at $t = 0$. Aggregation across age groups takes into account the relative sample weight of each age group.

Both reforms have a negligible overall impact on lifetime welfare computed at the time of implementation as the benefit of lower VAT rates is offset by the cost of higher labor income tax needed to keep government budget balance. Moreover, both reforms turn out to be regressive as they redistribute towards richer, wealthier households and away from poorer, less wealthy ones. This result is not surprising since the two simulated reforms reduce the taxation of subcategories of consumption that are consumed disproportionately more by those belonging to the upper part of the income and wealth distributions.

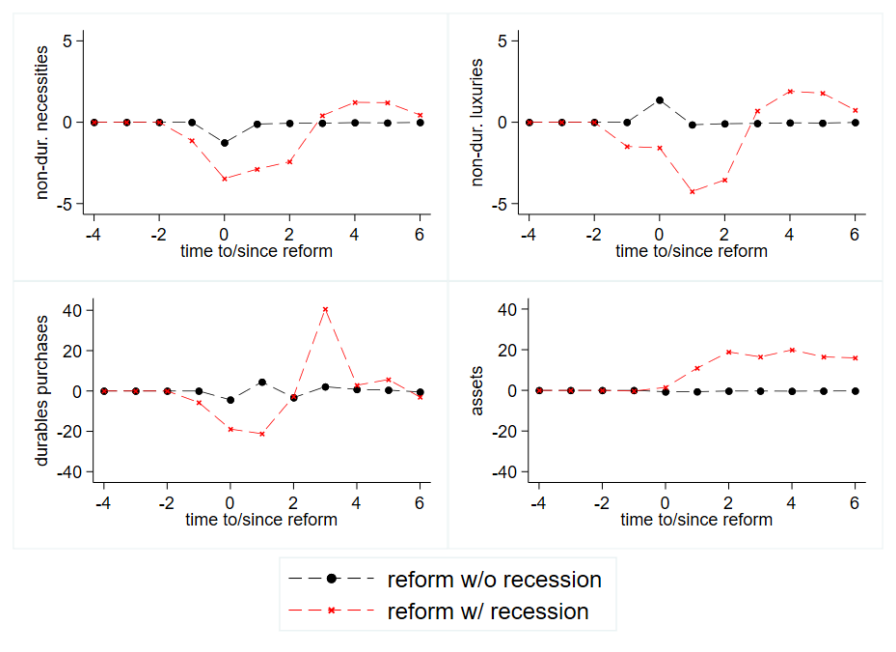
## 6.4 Alternative scenario: No Recession

To disentangle the interaction between the state of the economy that households face and their response to tax changes, here I study the effects that the same VAT reforms presented in the previous sections would have if they were to be implemented in the absence of a recession. Figures 11 and 12 report households' responses to revenue neutral VAT cuts on non-durables and on durables, respectively, in the steady state (black dashed lines) on top of those obtained above in the average recession scenario (red dashed lines).

The VAT cut on non-durable luxuries under no recession has an intratemporal substitution effect on the targeted goods with a tax elasticity[15] slightly higher – an increase of 1.37% in non-durable luxuries purchases – than under the average recession scenario (top right panel of Figure 11). The VAT cut on durables in the absence of the recessionary shock has again a positive intertemporal substitution effect on durables' purchases, but with a lower tax elasticity with respect to the case of average recession: an increase of 29.14% in durables' purchases (bottom left panel of Figure 12).

These differences in tax elasticities are explained by the stronger precautionary saving mechanism that characterizes households' behavior during recessions. To buffer against the increased uncertainty, households reduce their consumption of non-durables and build up their savings in the two assets available in the model, durables and financial assets[16]. When this mechanism interacts with the VAT reforms, it dampens the consumption stimulus effect of a VAT cut on non-durables and strengthens that of a VAT cut on durables.

Figure 11: Effects of reform on households' choices, VAT cut on non-durable luxuries

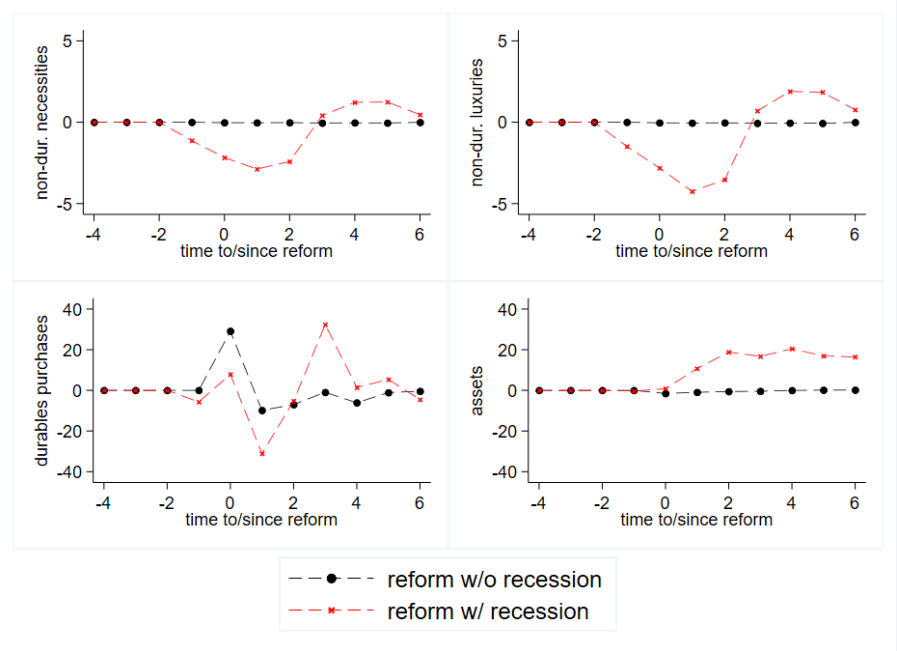



Notes: % changes in households' choices with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. No Recession scenario.

[15]Here, I compute tax elasticities using as baseline the no recession/no reform scenario and compare them to the tax elasticities in Sections 6.1 and 6.2, where, instead, the baseline is the recession/no reform scenario.

[16]Note that the recession has an overall negative effect on durables'purchases because the competing mechanims of households selling durables to smooth non-durable consumption against the negative income shock prevails on the precautionary saving motive.

Figure 12: Effects of reform on households' choices, VAT cut on durables




Notes: % changes in households' choices with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. No Recession scenario.

## 6.5 Alternative scenario: Deep Recession

So far I have considered an average recession, here I look at how the VAT reforms would perform if they were to be implemented in the context of a larger but less persistent recessionary shock. I label this as a deep recession scenario and calibrate it to the Covid-induced reduction in Italian GDP per capita between 2019 and 2020, reported in OECD (2023). The timing of events in this simulated scenario is the following: in period $t = 0$, the unexpected drop in earnings equal to 6% of median annual earnings realizes and it only lasts for one year (one period in the model). At the same time, the relevant VAT cut and revenue neutrality adjustment to labor income tax are implemented[17]; in period $t = 1$, earnings and tax rates are back to the pre-recession/pre-reform levels, but households face higher earnings' uncertainty, modelled as a 75% higher standard deviation of the idiosyncratic shocks to the household's earnings process.

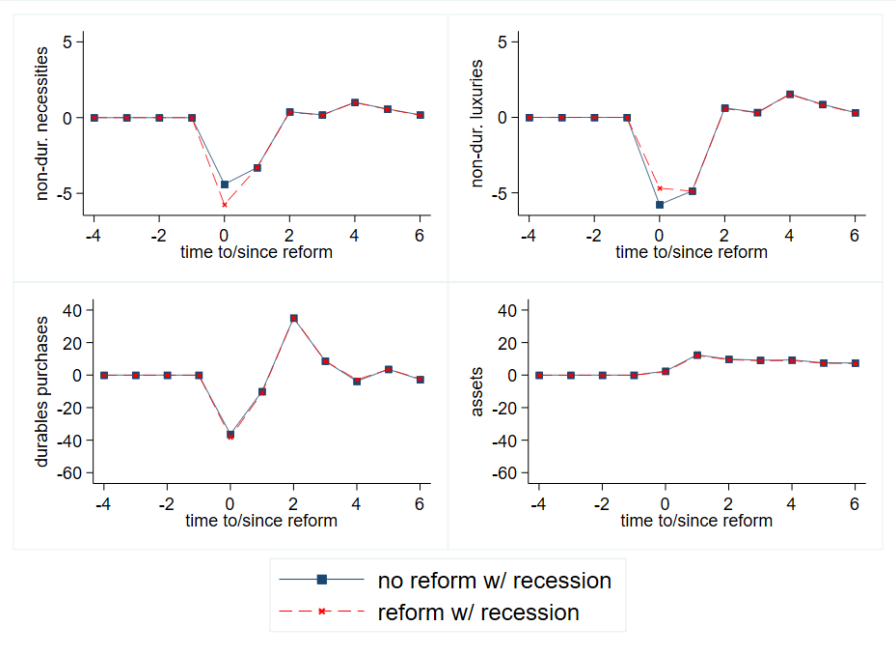
Figures 13 and 14 show that the drops in expenditures on consumption sub categories (blue solid lines) are larger in this deep recession scenario than in the average recession one. In particular, durable purchases decline by up to 40%. These drops are qualitatively in line with the existing empirical evidence on the impact of the recent pandemic recession on non-durable

[17] Although I still consider VAT cuts of 3 percentage points, the reforms are not identical to the ones under the average recession scenario because the level of labor income tax that ensures revenue neutrality is computed with respect to a baseline economy undergoing a deep recession.

and durable consumption (see Guglielminetti and Rondinelli (2021) for Italy).[18]

In particular, the intratemporal substitution effect of the VAT cut on non-durable luxuries in the case of a deep recession (Figure 13) results in an increase of 1.16% of expenditure on the targeted goods, very similar to the elasticity obtained under the average recession scenario. Whereas, the VAT cut on durables (Figure 14) has an even stronger intertemporal substitution effect with respect to the case of average recession. More precisely, it gives rise to a 50.27% increase in durables' purchases at time of implementation, $t = 0$, that is a tax elasticity larger than 10. The effect of the tax cut on durables' purchases is amplified in the case of a deep recession with respect to the case of an average recession because, when households experience a quicker recovery and expect the uncertainty to resolve sooner, they are more willing to invest in a partially irreversible asset, such as durables, than when they face a recession that has more long lasting effects.

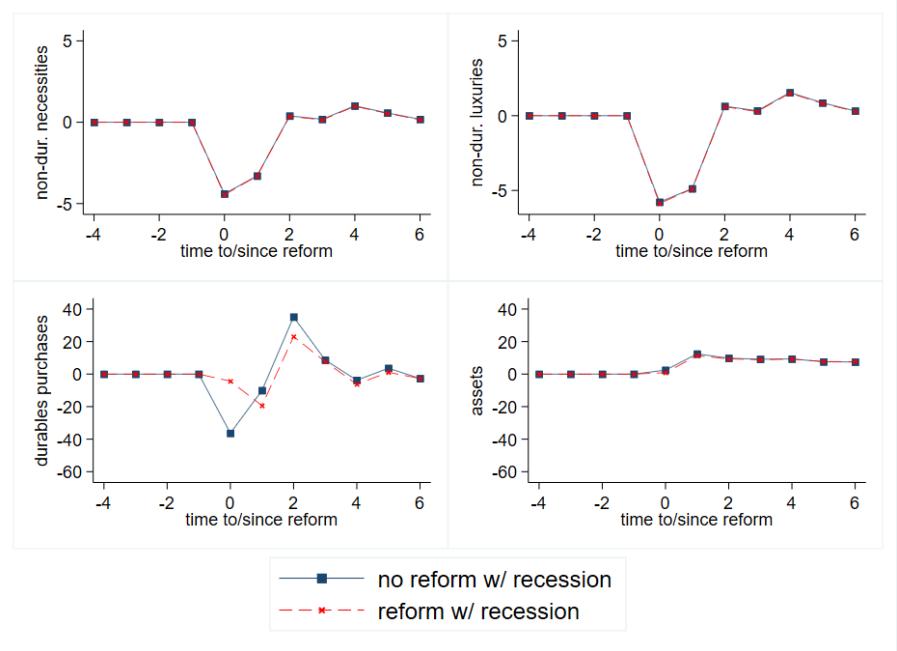
Figure 13: Effects of reform on households' choices, VAT cut on non-durable luxuries




Notes: % changes in households' choices with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. Deep Recession scenario.

[18]Quantitatively, due to the strict lockdown measures that I do not model here, the pandemic generated an even sharper decline of expenditure in non-durable services (i.e. restaurants and hotels) than the one simulated.

Figure 14: Effects of reform on households' choices, VAT cut on durables




Notes: % changes in households' choices with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. Deep Recession scenario.

# 7 Alternative stimulus policy: cash-transfers

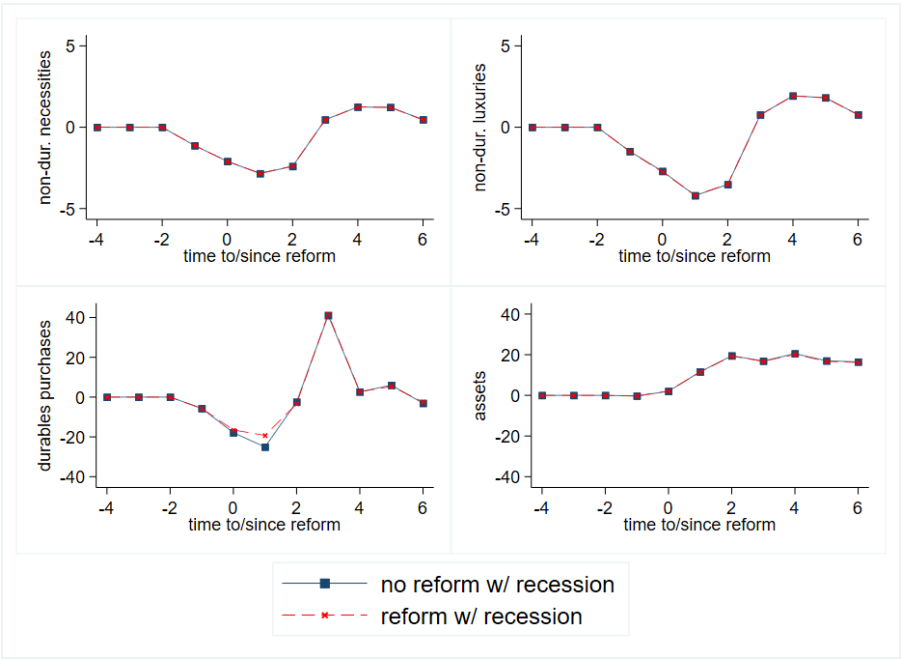
In this Section, I experiment with an alternative fiscal policy that could be adopted to stimulate economies undergoing a recession. I assume that the government makes a one-off cash transfer to households in period $t = 0$, while keeping VAT rates unchanged. For the sake of comparability, I set the amount of this cash transfer so to make this reform equivalent from the point of view of the government – in terms of lost revenues before the rise in labor income taxes that guarantees revenue neutrality – to the VAT cut on non-durable luxuries in the average recession scenario[19]. Revenue neutrality with respect to the baseline average recession scenario is again ensured by adjusting the level of labor income tax at $t = 0$.

As shown in Figure 15, the transfer has no effect on non-durable consumption and a small positive effect on durables. Durables' purchases increase by 1.63% at time $t = 0$, the year of implementation, and by 7.77% at $t = 1$, the year following the payment, with respect to the no transfer/recession scenario. Hence, the cash transfer has a smaller consumption stimulus effect than either of the two VAT reforms.

[19]To do so, I compute the cost in terms of lost revenues of the temporary VAT cut on non-durables analyzed in Section 6.1 (the most costly of the two VAT reforms before revenue neutrality) and then divide this total amount by the number of simulated agents, taking into account the age distribution in the actual population. This results in a one-time transfer of around 400 euros per household.

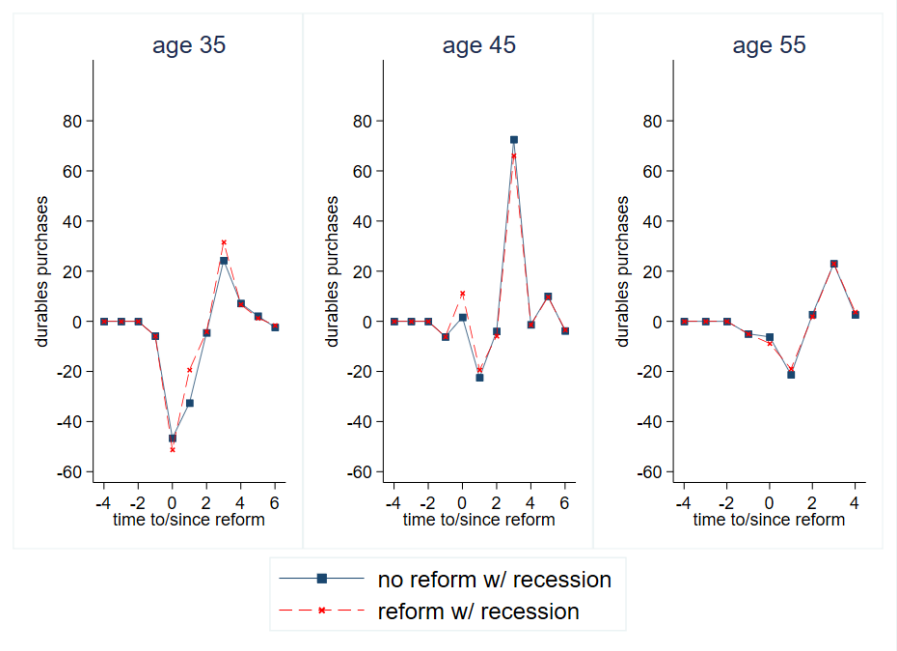
Figure 16 shows that the positive average effect of the transfer on durables at time $t = 0$ is driven by middle aged households who are still in the process of building up their desired durables' stock. While, Figures 17 and 18 show that the increase in purchases at time $t = 1$ is due to households belonging to the bottom of the wealth and income distributions. These households, that are liquidity and borrowing constrained, have higher marginal propensity to consume durables out of a fiscal stimulus payment. They save the cash transfer during the recession and then invest in durables as the economy starts to recover. Indeed, these same groups of households turn out to increase their savings in financial assets at time $t = 0$ in response to the transfer (see Appendix E.3 for graphs).

Figure 15: Effects of recession and cash-transfer on households' choices, overall



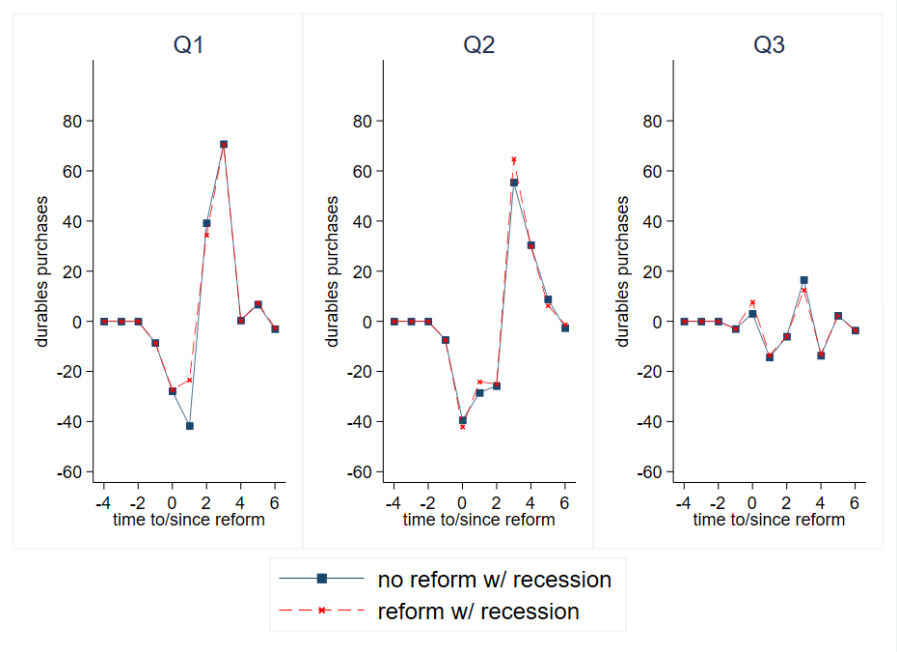

Notes: % changes in households' choices with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group.

Figure 16: Effects of recession and cash-transfer on durables, by age at implementation



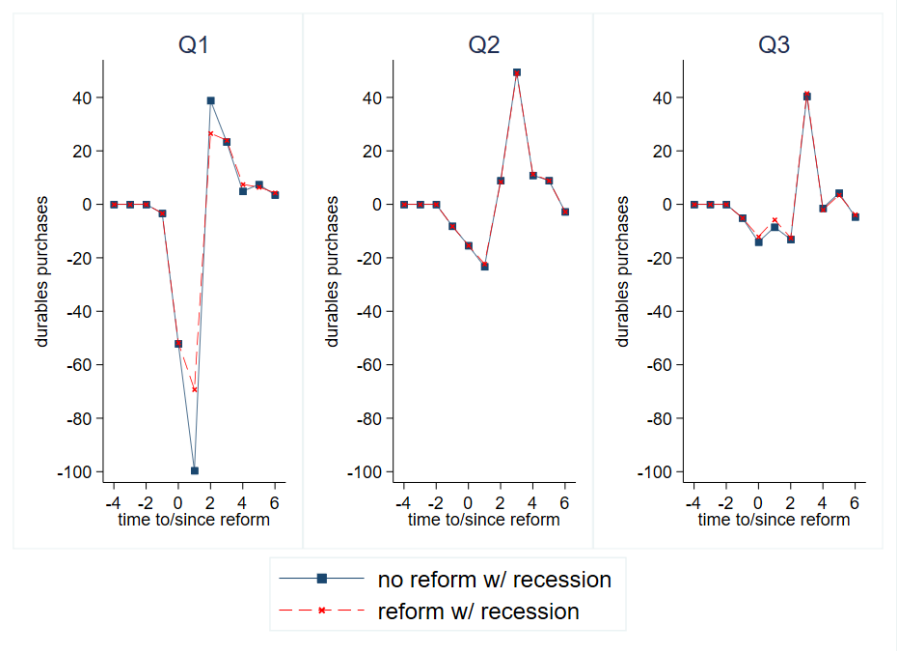

Notes: % changes in households' durables purchases with respect to no recession/no reform scenario. Age 35-45-55 is age at which households are hit by temporary reform.

Figure 17: Effects of recession and cash-transfer on durables, by wealth tercile




Notes: % changes in households' durables purchases with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight sample of each age group. Q1, Q2, Q3 represent first, second, third terciles of total wealth distribution in no recession/no reform scenario.

Figure 18: Effects of recession and cash-transfer on durables, by income tercile




Notes: % changes in households' durables purchases with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative sample weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of lifetime income distribution in no recession/no reform scenario.

Table 8 reports the welfare consequences of the revenue neutral cash transfer in terms of consumption equivalent variation (CEV) with respect to the baseline recession/no reform scenario. Differently from the VAT reforms, the cash transfer has a positive overall welfare effect (+0.04%) and it is progressive, creating larger welfare gains for poorer and less wealthy households. The progressivity of this stimulus policy is due to the fact that the amount of the transfer paid is the same, in absolute terms, across all households, hence it is larger, in relative terms, for lower income households.

Table 8: Welfare Consequences (CEVs) of Cash-Transfer

| | | | |
|---|---|---|---|
| Overall: | | 0.039 | |
| by age at reform: | 35 | 45 | 55 |
| | 0.040 | 0.036 | 0.045 |
| by income tercile: | Q1 | Q2 | Q3 |
| | 0.059 | 0.019 | -0.006 |
| by wealth tercile: | Q1 | Q2 | Q3 |
| | 0.054 | 0.029 | 0.011 |

Notes: CEV(%): consumption equivalent variation with respect to recession/no reform scenario computed at $t = 0$. Aggregation across age groups takes into account the relative sample weight of each age group.

# 8 Conclusions

In this paper, I set up and estimate a structural life-cycle model that integrates a static demand system for the choice between different categories of non-durables – necessities and luxuries – into a dynamic life-cycle model for saving and durable investment decisions. I use the model to conduct counterfactual tax experiments and assess the effectiveness, as fiscal stimulus tools, of revenue neutral temporary cuts to the VAT rates on non-durable luxuries and on durables implemented during a recession.

I find that the the stimulus effect on targeted goods of the VAT cut on durables is larger than the one of the VAT cut on non-durable luxuries. The VAT cut on non-durables has an intratemporal substitution effect, while the VAT cut on durables acts through an intertemporal substitution mechanism that is stronger for young, high income, and liquidity unconstrained households. Moreover, I show that this intertemporal substitution on durables' purchases is amplified if households face a less persistent recession as they are more willing to invest in a partially irreversible asset like durables when they expect uncertainty to resolve sooner. While, it is dampened in the absence of a recession due to weaker precautionary saving motives.

Finally, I consider a lump sum cash-transfer as an alternative stimulus policy and show that, keeping constant the cost for the government, this policy has no relevant stimulus effect on consumption, but, differently from the VAT reforms, it is welfare improving and progressive.

These results suggest that during recessions policy makers willing to boost consumption in the short run should consider temporary unanticipated VAT cuts on durables, while policy makers interested in redistributing towards the poorer and most negatively affected groups of households should opt for cash-transfers.

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# Appendices

# A Theoretical Framework

## A.1 Two-stage Approach

The solution procedure exploits the two-stage budgeting results of Gorman (1959). The equivalence between the original solution and the two-stage solution that I adopt is guaranteed by the assumption of weakly separable preferences between non-durable and durable consumption. More precisely, as stated in Sections 5.1. and 5.2 of Deaton and Muellbauer (1980b) and proved in Gorman (1971a), weak separability is both a necessary and a sufficient condition for the second stage (the intratemporal stage) of two-stage budgeting. If any subset of commodities appears only in a weakly-separable utility function, then quantities purchased within the group can always be written as a function of group expenditure and prices within the group alone.

Here, following Blundell et al. (1994), Browning and Meghir (1991), and the seminal work of Pollak (1969) on conditional demand functions, I restate the problem in more general terms to show the implications of weak separability between two sets of consumption goods.

Let $x$ be total consumption and $p$ a vector of prices of individual goods, then within period allocation of total consumption to the different individual goods is completely characterized by the indirect utility function $V(p, x)$ and is invariant to monotonic transformations of utility $V$ (Deaton and Muellbauer (1980b)). Intertemporal allocations are therefore determined by the period-specific utility function $U = F[V(p, x)]$ where $F[.]$ is a strictly increasing monotonic transformation such that $U$ is strictly concave in $x$.

Assume goods are partitioned into two groups. The first is the group of non-durables with total expenditure $x$ and quantity and price vectors $(q, p)$. The second is a group of conditioning goods – such as durable goods in the case of my model – denoted by quantity and price vectors $(z, r)$. Then, period-specific preferences can be represented by the conditional indirect utility function (Blundell et al. (1994)):

$$U(p, z, x) = F[V(p, x), z] \tag{21}$$

This function gives the maximum utility in the period for an agent who has total expenditure $x$ on the first group of goods, non-durables, with given prices $p$ and conditional on goods in the second group, durables. Factors in $z$ enter the consumption function, but not the demand system as they are weakly separable from $q$.

Weak separability can also be defined in terms of conditional cost function as in Browning and Meghir (1991) Proposition (Section 2 of their paper) : "The set of goods $q$ is weakly

separable from $[z]$ if and only if the conditional cost function takes the form $c(p, g(z, u))$."[20], where $g$ is a fuction of the conditioning goods, $z$, and of the utility, $u$, from the consumption of the goods of interest. It follows that, under weak separability, conditioning goods have only income effects on the demand of the goods of interest. In other words, the marginal rate of substitution between any two individual goods in $q$ is not affected by changes in $z$, if not via an income effect through total expenditure $x$.

Moreover, weak separability has the following implication: the form of within-period preferences is independent of the normalization $F[.]$ in 21. More specifically, the shape of Engel curves and the form of within-period substitution are independent of the parameters determining intertemoporal substitution. Meaning that, as stated in Browning and Meghir (1991) (Section 2 of their paper), the demand system that governs the within-period allocations is correctly specified whether or not the quantity of the conditioning goods in $z$ are chosen optimally, whether or not the conditioning goods are at a corner solution, and without the need to model explicitly the budget constraint for the conditioning goods. Hence, the two-stage budgeting approach remains legitimate even in presence of borrowing/collateral constraints and adjustment costs of durable goods because, under weak separability, these features affect the intertemporal allocation of total expenditure on non-durables, but not within period demand.

## A.2 Almost Ideal Demand System

AIDS is a special case of the general class of PIGLOG preferences. PIGLOG preferences are characterized by an expenditure (or cost) function formulation that ensures that the resulting demand functions are first-order approximations to any set of demand functions derived from utility-maximizing behavior. Specifically, the PIGLOG expenditure function - the minimum expenditure as a function of given level of utility and prices - is the following:

$$log(c(u,p)) = (1-u)log(a(p)) + (u)log(b(p)) \qquad u \in [0,1]$$

where, $a(p)$ represents cost of subsistence ($u = 0$) and $b(p)$ represents cost of bliss ($u = 1$).

When specific functional forms for $log(a(p))$ and $log(b(p))$ are assumed, AIDS expenditure function obtains:

$$log(c(u,p)) = \alpha_0 + \sum_k \alpha_k logp_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{k,j} logp_k logp_j + u\beta_0 \prod_k p_k^{\beta_k} \tag{22}$$

Provided that $\sum_i \alpha_i = 0$ and $\sum_j \gamma^*_{k,j} = \sum_k \gamma^*_{k,j} = \sum_j \beta_j = 0$, equation (22) has enough parameters to be a flexible functional form.

[20]The proof of this Proposition is in the Appendix of their paper.

For a utility-maximizing consumer, total expenditure $x$ coincides with the value of the expenditure function $c(u, p)$ and this equality can be inverted so to obtain $u$ as a function of $x$ and $p$, which is precisely the AIDS indirect utility function specification used in the model:

$$v(x, p) = exp\left[\frac{log(x) - log(a(p))}{b(p)}\right]$$

# B Computational Details

The model features a non convexity due to the irreversibility of a fraction of the durables stock which cannot be sold on the second-hand market and to the presence of VAT tax rate on purchases but not on sales of durables. These two characteristics make selling durables less profitable than it would otherwise be and, therefore, represent an implicit adjustment cost of selling durables stock for the household. Such non convex adjustment cost implies that the household's decision problem is not a well behaved convex dynamic programming problem and, therefore, the standard numerical approaches, relying on the differentiability of the value function, cannot be applied in this specific case. Instead, in order to solve the model, I adopt a discrete state-space dynamic programming technique.

I discretize the two endogenous states (financial assets and durables) over two finite logarithmically spaced grids. I first find and store the set of optimal choices of next period financial assets for each possible value of next period durables by maximizing the objective function over the assets grid conditional on durables. I then find the optimal choice of next period durables by picking the point on the durables grid that, together with the corresponding optimal asset choice, delivers the highest value of the objective function.

The continuous stochastic AR(1) process for the exogenous state, stochastic component of earnings, is discretized and approximated using a Markov chain over five grid points closely following Tauchen (1986). Finally, non durable consumption choice and durables' investment and disinvestment flows are implied by the budget constraint and by the durables law of motion.

Given a terminal value function equal to zero for the time period in which the household is dead, I iterate backwards in time and find the age-dependent optimal policy and value functions for each period of the household's life. Then, using these policy functions, I simulate life cycle patterns of non durable consumption, durables flow, durables stock and financial assets for many possible paths of the stochastic labour income process.

# C Data

## C.1 SHIW dataset

The SHIW was first conducted in 1965 and then repeated annually with time-independent samples (repeated cross sections) of households up to 1987. Since 1987 the Survey was conducted every other year (except for a three year interval between 1995 and 1998) and, starting from the 1989 wave, each wave includes households interviewed in previous years (panel households) in the sample. The overall sample comprises around 8000 households in each wave since 1987 and is representative of the Italian resident households population. The unit of analysis is the household, defined as the group of persons residing in the same dwelling who are related by blood, marriage or adoption. Institutional population is not included. The numerosity of the panel component has increased gradually over time and is now roughly 57% of the overall sample.

More in detail, SHIW collects the following information: socio-economic and demographic characteristics of the household; current occupational status and past employment history of adult household members; different sources of income including payroll and self-employment income, pensions, transfers, and property income of adult household members; household's wealth at the end of the year in terms of properties lived in or owned by the household, imputed rents, household financial and real assets and liabilities; household's expenditure in non-durables and durables during the year.

The sample for the survey is drawn in two stages: first, the municipalities (stratified by region and population) are selected; second, the households to be interviewed are selected within each municipality from civic registers. Panel households are selected according to a rotating-panel sampling design: households that had participated in at least two earlier surveys are all included in the sample, plus a fraction of those interviewed only in the previous wave are randomly selected to be interviewed again in the current wave, while a fresh sample is drawn in every wave. The adoption of this rotating-panel strategy allows to minimize drop-out problems and therefore reduces the problem of non random sample attrition. In the most recent wave of the survey the rate of response among contacted households was much higher for panel households (82,2%) than for non panel ones (35,8%) and non random attrition is reportedly not a major problem in the SHIW data.

Table 9 shows in some more detail the structure and numerosity of the the SHIW rotating panel by reporting the number of households interviewed in more than one wave. For instance, among the 8156 households in the last wave (2014), 13 participate since 1987, 64 since 1989, 166 since 1991 and so on. Table 9 also allows to pin down how many households are observed for, say, three subsequent waves in each year: in 2014 there are 579 households that have been

interviewed in three subsequent waves, 806 households in 2012 wave, 856 households in 2010 wave, 995 households in the 2008 sample and so on.

Table 9: Structure of SHIW

| Year first | Year of survey | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| interview | 1987 | 1989 | 1991 | 1993 | 1995 | 1998 | 2000 | 2002 | 2004 | 2006 | 2008 | 2010 | 2012 | 2014 |
| 1987 | 8027 | 1206 | 350 | 173 | 126 | 85 | 61 | 44 | 33 | 30 | 28 | 23 | 21 | 13 |
| 1989 | | 7068 | 1837 | 877 | 701 | 459 | 343 | 263 | 197 | 159 | 146 | 123 | 102 | 64 |
| 1991 | | | 6001 | 2420 | 1752 | 1169 | 832 | 613 | 464 | 393 | 347 | 293 | 244 | 166 |
| 1993 | | | | 4619 | 1066 | 583 | 399 | 270 | 199 | 157 | 141 | 124 | 106 | 78 |
| 1995 | | | | | 4490 | 373 | 245 | 177 | 117 | 101 | 84 | 75 | 62 | 46 |
| 1998 | | | | | | 4478 | 1993 | 1224 | 845 | 636 | 538 | 450 | 380 | 267 |
| 2000 | | | | | | | 4128 | 1014 | 667 | 475 | 398 | 330 | 256 | 170 |
| 2002 | | | | | | | | 4406 | 1082 | 672 | 525 | 416 | 340 | 221 |
| 2004 | | | | | | | | | 4408 | 1334 | 995 | 786 | 631 | 395 |
| 2006 | | | | | | | | | | 3811 | 1143 | 856 | 648 | 414 |
| 2008 | | | | | | | | | | | 3632 | 1145 | 806 | 481 |
| 2010 | | | | | | | | | | | | 3330 | 1015 | 579 |
| 2012 | | | | | | | | | | | | | 3540 | 1565 |
| 2014 | | | | | | | | | | | | | | 3697 |
| sample size | 8027 | 8274 | 8188 | 8089 | 8135 | 7147 | 8001 | 8011 | 8012 | 7768 | 7977 | 7951 | 8151 | 8156 |
| % panel hhs | | 14.6 | 26.7 | 42.9 | 44.8 | 37.3 | 48.4 | 45.0 | 45.0 | 50.9 | 54.4 | 58.1 | 56.6 | 54.7 |

Table 10 shows that panel and non panel households are similar in terms of demographic and socio-economic characteristics, thus suggesting that nonrandom attrition is not a major problem in the SHIW data.

Table 10: Comparison of means and standard deviations

| Variable | hhs in 2010 sample only | hhs in 2010 and 2012 samples | hhs in 2012 sample only |
|---|---|---|---|
| consumption | 25299.21 | 26381.97 | 24180.87 |
| | (16200.07) | (15376.81) | (14579.85) |
| durable consumption | 1627.81 | 1233.78 | 952.76 |
| | (5086.05) | (4300.55) | (3596.78) |
| non-durable consumption | 23671.40 | 25148.18 | 23228.106 |
| | (14515.29) | (14069.37) | (13409.34) |
| disposable income | 33146.58 | 31788.48 | 29289.21 |
| | (25129.62) | (22629.14) | (22604.65) |
| gender of head of hh | 1.46 | 1.45 | 1.46 |
| | (0.5) | (0.5) | (0.5) |
| age of head of hh | 55.10 | 53.09 | 55.81 |
| | (17.18) | (15.37) | (17.21) |
| education of head of hh | 3.25 | 3.43 | 3.19 |
| | (1.07) | (1.04) | (1.07) |
| family size | 2.49 | 2.60 | 2.43 |
| | (1.28) | (1.32) | (1.31) |
| geographic area | 1.81 | 1.85 | 1.80 |
| | (0.85) | (0.88) | (0.87) |
| observations | 2315 | 1015 | 3540 |

## C.2 HBS

HBS sampling scheme is organized in two-stages: firstly, municipalities are selected among two groups according to the size of population; chief towns of provinces are fully included and selected to take part to the survey every month, while the remaining are grouped in strata according to some economic and geographic characteristics and are extracted every 3 months; second, households are randomly selected within the stratum from the registry office records. As a result, the survey unit is the legal family recorded by the registry office. Sample size is around 28,000 households from 480 municipalities and weights allowing for a recalibration of population in each stratum and for the distribution by household size within region are also provided for.

Data are recorded by means of two complementary methods: a diary (Libretto degli Acquisti) where the household keeps track of expenditures made and of quantities of internally produced goods consumed in the previous 7 days (Taccuino degli Autoconsumi); a proper interview for the remaining purchases done in the previous month and for durables bought in the previous 3 months. It has to be remarked that expenditure is provided on a monthly basis, so commodities recorded on a wider recording period are made monthly in the survey by dividing the amount for the number of months they are recorded for.

## C.3 Sample selection

I use the SHIW waves 1989 to 2014 and HBS waves 2003 to 2012. Sample selection in both data sets satisfies the following criteria. Given that the model focuses on households' economic choices during working age, only households whose head is aged 30-60 are kept in the sample. Most young people still live with their parents around age 20 in Italy. Moreover, there is a well known (Jappelli and Pistaferri (2000)) head of household bias in SHIW data at early ages due to a strong positive correlation between wealth and young household headship.

As the model does not allow for singles and family transitions, such as marriage, divorce and widowhood, single households or households whose head reports changing marital status at a given wave are dropped from all waves in which they are observed. In SHIW, this means dropping about 20% of observations in the original sample of households in the selected age range (15% of the dropped observations are singles). Hence, the final SHIW dataset is an unbalanced panel of around 43,000 household-year observations, where about 25% of households are observed for at least five subsequent waves (i.e. ten years).

All monetary values are CPI adjusted (base year 2014). Variables for durables stock and flow, non-durable consumption and financial assets are all trimmed at the 95th percentile of the age specific distribution in order to mitigate the impact of misreporting. The variable for financial assets includes bank and postal accounts, government bonds and stocks net of consumption debt, but, for consistency with the model, it excludes housing and mortgages. In order to be fully consistent with the choice of modelling financial assets as completely liquid, the data measure for net financial assets is adjusted for down payment (observed or imputed) for non home owners.

The variable for individual's net earnings is defined as the sum of compensation of employees and net income from self-employment and entrepreneurial income. It excludes pensions and income from property and assets, but includes government transfers. It is trimmed at the 1st and 98th percentiles of the education specific distribution.

## C.4 Consumption equivalence scale

I use the non-durable consumption equivalence scale provided by ISTAT.

| members in hh | 1 | 2 | 3 | 4 | 5 | 6 | 7 or more |
|---|---|---|---|---|---|---|---|
| coefficient | 0.60 | 1 | 1.33 | 1.63 | 1.90 | 2.16 | 2.40 |

## C.5 Descriptives: flows of durables

Table 11: Net buyers

| | 1% | 5% | 10 % | 25% | 50% | 75% | 90% | 95% | 99% |
|---|---|---|---|---|---|---|---|---|---|
| % purchases | 62.2 | 82.8 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| % sales | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17.2 | 34.8 |

$N = 19,957$

Table 12: Net sellers

| | 1% | 5% | 10 % | 25% | 50% | 75% | 90% | 95% | 99% |
|---|---|---|---|---|---|---|---|---|---|
| % purchases | 0 | 0 | 0 | 0 | 0 | 12.1 | 37.5 | 44 | 47.4 |
| % sales | 52.63 | 56 | 62.5 | 87.9 | 100 | 100 | 100 | 100 | 100 |

$N = 462$

# D Estimation

## D.1 First step: almost ideal demand system

Recall that the AIDS estimation equations, omitting time subscripts and error term, are given by:

$$w_i = \alpha_i + \sum_{j=1}^{k} \eta_{i,j} lnp_j + \beta_i ln \left\{ \frac{c}{a(P)} \right\} \tag{23}$$

where,

$$ln(a(P)) = \alpha_0 + \sum_{i=1}^{k} \alpha_i lnp_i + \frac{1}{2} \sum_{i=1}^{k} \sum_{j=1}^{k} \eta_{i,j} lnp_i lnp_j$$

$$b(P) = \prod_{i=1}^{k} p_i^{\beta_i}$$

Estimation of equations in (23) is conducted using the iterated linear least-squares estimator developed by Blundell and Robin (1999). This estimator consists of the following steps: for given values of price aggregators $(ln(a(P)), b(P))$, the parameters $(\alpha, \beta, \eta)$ are estimated using a linear moment estimator, these estimates are used to update price aggregators, and then iteration continues until numerical convergence occurs. If numerical convergence occurs, this procedure yields a consistent and asymptotically normal estimator of the parameters. Standard

errors of all parameters in all equations are then simultaneously calculated using the asymptotic variance-covariance matrix given in Blundell and Robin (1999), which takes into account the predicted regressors introduced in each equation as well as the correlation of the error terms across equations.

Using estimated parameters, expenditure elasticities and uncompensated and compensated price elasticities are computed at the mean point of the sample with their standard errors with the following formulas.

Differentiating (23) with respect to $lnc$ and $lnp_j$, respectively, gives:

$$\mu_i = \beta_i$$

$$\mu_{i,j} = \eta_{i,j} - \mu_i[\alpha_j + \eta_{j,j} lnp_j]$$

Hence, expenditure elasticities are given by:

$$\varepsilon_i = \mu_i / w_i + 1$$

uncompensated price elasticities are given by:

$$\varepsilon^u_{i,j} = \begin{cases} \mu_{i,j}/w_i & \text{if } i \neq j \\ \mu_{i,j}/w_i - 1 & \text{if } i = j \end{cases}$$

and compensated price elasticities are given by:

$$\varepsilon^c_{i,j} = \varepsilon^u_{i,j} + \varepsilon_i w_j$$

## D.2 First step: earning process

Under the assumption of non constant variance, the variance-covariance matrix of $y$ consists of the following theoretical moments[20]:

$$var(y_{i,t}) = var(z_{i,t}) + var(\varepsilon_{i,t}) = \rho^{2t}\sigma^2_{z_0} + (1-\rho^{2t})\frac{\sigma^2_u}{1-\rho^2} + \sigma^2_\varepsilon \tag{24}$$

$$cov(y_{i,t}, y_{i,t-j}) = cov(z_{i,t}, z_{i,t-j}) = \rho^j var(z_{i,t-j}) \qquad if \qquad j > 0 \tag{25}$$

[20]Given that SHIW is conducted every other year, I do not observe household earnings at every age, but only at age $t, t+2, t+4$... and have to adjust the model accordingly.

The identification strategy for the parameters of interest is the following: $\rho$ is identified from the slope of the covariance at lags greater than zero:

$$\frac{cov(y_{i,t}, y_{i,t-4})}{cov(y_{i,t-2}, y_{i,t-4})} = \frac{\rho^4 var(z_{i,t-4})}{\rho^2 var(z_{i,t-4})}$$

$\sigma_\varepsilon^2$ is identified from difference between variance and covariance at first lag, once $\rho$ has been identified:

$$var(y_{i,t-2}) - \frac{1}{\rho^2} cov(y_{i,t}, y_{i,t-2}) = var(z_{i,t-2}) + \sigma_\varepsilon^2 - \frac{1}{\rho^2}\rho^2 var(z_{i,t-2})$$

$\sigma_{z_0}^2$ is identified residually from variance at age zero, once $\rho$ and $\sigma_\varepsilon^2$ have been identified:

$$var(y_{i,0}) - \sigma_\varepsilon^2$$

Lastly, $\sigma_u^2$ is identified from difference between variance and covariance at second lag, once all other parameters have been identified :

$$var(y_{i,t-2}) - cov(y_{i,t}, y_{i,t-4}) - \sigma_\varepsilon^2 = \rho^4 var(z_{i,t-4}) + \sigma_u^2 + \sigma_\varepsilon^2 - \rho^4 var(z_{i,t-4}) - \sigma_\varepsilon^2$$

Full identification is achieved with two lags of the current age $(t, t-2, t-4)$, therefore the same household must be interviewed for at least three subsequent waves of SHIW in order to be included in the earning process' estimation sample.

The predicted residuals from the regressions in (18) are consistent estimators of $y$, hence to construct the empirical counterparts of the theoretical moments, the corresponding empirical moments are computed on the predicted residuals so to build the empirical variance-covariance matrix. Let $\mathbf{f}(\psi)$ be the vector of the unique moments of the symmetric theoretical variance-covariance matrix, which are functions of the parameters $\psi = \{\rho, \sigma_u^2, \sigma_\epsilon^2, \sigma_{z_0}^2\}$ to be estimated, and $\mathbf{m}$ be the vector of the corresponding empirical moments. The estimators of the parameters in $\psi$ are found by minimizing the weighted (diagonal weighting matrix) distance between theoretical and empirical moments:

$$\hat{\psi} = \arg\min_{\psi} [\mathbf{m} - \mathbf{f}(\psi)]' \mathbf{\Omega} [\mathbf{m} - \mathbf{f}(\psi)] \tag{26}$$

Results of estimation are reported in Table 5 and are in line with those found in the existing literature. Two additional remarks are in order.

First, my estimates are obtained on the sub sample of households in which at least one of the spouses is working, either as an employee or as a self employed. This means that I am selecting the households that participate into the labour market that could be systematically different from those that are left out of the sample due to having zero wages and this can of course result into selection bias of the estimated parameters that I am not correcting for.

However, the work requirement sample selection that I apply results into dropping only around 16% of all household observations in the age range 25-59, hence applying the sample selection correction should not affect my results substantially.

Second, in principle the term $\varepsilon_{i,t}$ might be thought of as a mix between transitory shock and measurement error, however, as already mentioned before, I assume that all estimated transitory shocks to wages represent measurement error. In SHIW the fundamental cause of measurement error for income data is under reporting of earnings. It has been shown (Biancotti et al. (2008)) that income and wealth are voluntarily underestimated by the respondents more severely in the south and when the head of the household is self employed, poorly educated or older. If under reporting is not systematic the tendency to under report can be a relevant cause of additional variance of the measurement error.

## D.3 First step: Tax function

To estimate the parameters of the non linear labor income tax function in (9), I take its logarithmic transformation:

$$ln(y^{net}) = ln(\lambda) + (1 - \tau^{y})ln(y^{gross}) \tag{27}$$

The tax base is labor income, therefore, $y^{net}$ represents earnings net of taxes and inclusive of transfers and $y^{gross}$ measures earnings before taxes and transfers. I estimate (27) on gross and net earnings from SHIW data. To take into account the fact that tax credits depend on income sources, I estimate different tax functions for workers and retirees. Estimates in Table 13 confirm that the level of taxation is lower for retirees than for working age households. Progressivity, instead, does not significantly differ by employment.

Table 13: estimated parameters of labor income tax function

| | working life | retirees |
|---|---|---|
| $\lambda$ | 2.39 | 2.98 |
| $\tau^{y}$ | 0.11 | 0.13 |

The estimated tax function in (27) provides a good approximation to the actual tax system with a R-squared of 0.96.

## D.4 Second step

### D.4.1 Method of simulated moments estimation

The Method of Simulated Moments (MSM) estimation technique, first introduced by McFadden (1989), consists in finding the parameters that minimize the weighted distance between

moments computed in the data and the analogous moments computed on the simulated panel produced by the life-cycle model by means of an iterative procedure. More precisely, the vector of estimates of the parameters of interest, $\hat{\Theta}$, is the solution to the following minimization problem:

$$\hat{\Theta} = \arg\min_{\Theta} \left\{ \sum_{k=1}^{K} \left[ (m_k^d - m_k^s(\Theta))^2 / Var(m_k^d) \right] \right\} = \arg\min_{\Theta} \left\{ g(\Theta)' W g(\Theta) \right\} \tag{28}$$

where, $m_k^d$ denotes the $k^{th}$ data moment computed over $N$ observations in the sample, $m_k^s(\Theta)$ represents the $k^{th}$ simulated moment computed over $S$ simulations obtained under a specific set of parameters values $\Theta$ and $g(\Theta)$ is the $K$x1 vector collecting all distances between empirical and simulated targeted moments. These squared distances are weighted by the diagonal matrix $W$ whose entries on the main diagonal are the inverse of the empirical variances. I do not use the asymptotically optimal weighting matrix because of its small sample properties, as suggested by Altonji and Segal (1996). The simulations are initialized to the empirical, education-specific joint distributions of the three state variables (earnings, financial assets, durables) at age 30-31. The aim is to embed in the model the initial heterogeneity among households, within and across education levels, that is observed in the data at the start of working life, also taking into account the strong correlations that exist among the three state variabes.

The MSM estimation is performed by iterating back and forth between the solution of the life-cycle model and the minimization of the MSM objective function in (28). Starting from a given set of initial values of the parameters to be estimated, the solution of the dynamic programming problem is found and the corresponding optimal policy functions are obtained. Then, using these decision rules, the life-cycle choices of a large number of simulated agents are produced so to get a simulated panel. Targeted moments are computed in the data sample and in the simulated panel and the MSM objective function is constructed and minimized with respect to the estimating parameters. The values of the parameters that solve the minimization problem are returned. If the value of the associated minimized objective function is the minimum the routine terminates, otherwise the routine starts over again using the current values of the parameters as initial values for the next iteration [21].

Given the non-convexities in the durable choice, the MSM objective function may not be a smooth function of the model parameters everywhere in their domain. Therefore, I use the derivative-free Nelder-Mead optimisation routine [22].

[21] The code for solution, simulation and estimation of the model is written in Fortran90. The solution part of the code is parallelized on 8 processors using OpenMP libraries.

[22] Implemented in Fortran using routine from NAG library. I experimented starting the algorithm from various initial values to ensure that the minimum found is global.

### D.4.2 Identification

The proof of the identification of the parameters for durables depreciation $\delta$ and irreversibility $\pi$ goes as follows. Starting from the durables law of motion: $d_t = (1-\delta)d_{t-1} + x_t$.

For net sellers, $\tilde{d} = \pi d$ and $\tilde{x} = \pi x$ are observed in data and the durables law of motion can be rewritten in terms of observables:

$$\pi d_t = (1-\delta)\pi d_{t-1} + \pi x_t \rightarrow \tilde{d}_t = (1-\delta)\tilde{d}_{t-1} + \tilde{x}_t$$

$$1 - \delta = \frac{\tilde{d}_t - \tilde{x}_t}{\tilde{d}_{t-1}}$$

hence, $\delta$ is identified in the sub sample of households who are net sellers between two subsequent waves.

For net buyers, $\tilde{d} = \pi d$ and $\tilde{x} = (1+\tau^d)x$ are observed and the transformed durables law of motion in terms of observables is:

$$\begin{aligned}(1+\tau^d)\pi d_t = (1-\delta)(1+\tau^d)\pi d_{t-1} + (1+\tau^d)\pi x_t \rightarrow \\ (1+\tau^d)\tilde{d}_t = (1-\delta)(1+\tau^d)\tilde{d}_{t-1} + \pi\tilde{x}_t\end{aligned}$$

$$1 - \delta = \frac{\tilde{d}_t - \frac{\pi}{1+\tau^d}\tilde{x}_t}{\tilde{d}_{t-1}}$$

$$\pi = (1+\tau^d)\frac{\tilde{d}_t - (1-\delta)\tilde{d}_{t-1}}{\tilde{x}_t}$$

once $\delta$ has been identified, also $\pi$ is identified in the sub sample of households who are net buyers between two subsequent waves.

The moments that I target in estimation are tractable approximations of the above theoretical relationships:

$$\frac{1}{N_s T}\sum_{i=1}^{N_s}\sum_{t=1}^{T}\left[\frac{\tilde{D}_{i,t} - \tilde{X}_{i,t}}{\tilde{D}_{i,t-1}}\right] \qquad \text{and} \qquad \frac{1}{N_b T}\sum_{i=1}^{N_b}\sum_{t=1}^{T}\left[\frac{\tilde{D}_{i,t} - \tilde{X}_{i,t}}{\tilde{D}_{i,t-1}}\right] \tag{29}$$

computed separately over the sub samples of net sellers ($N_s$) and net buyers ($N_b$).

### D.4.3 Targeted Moments

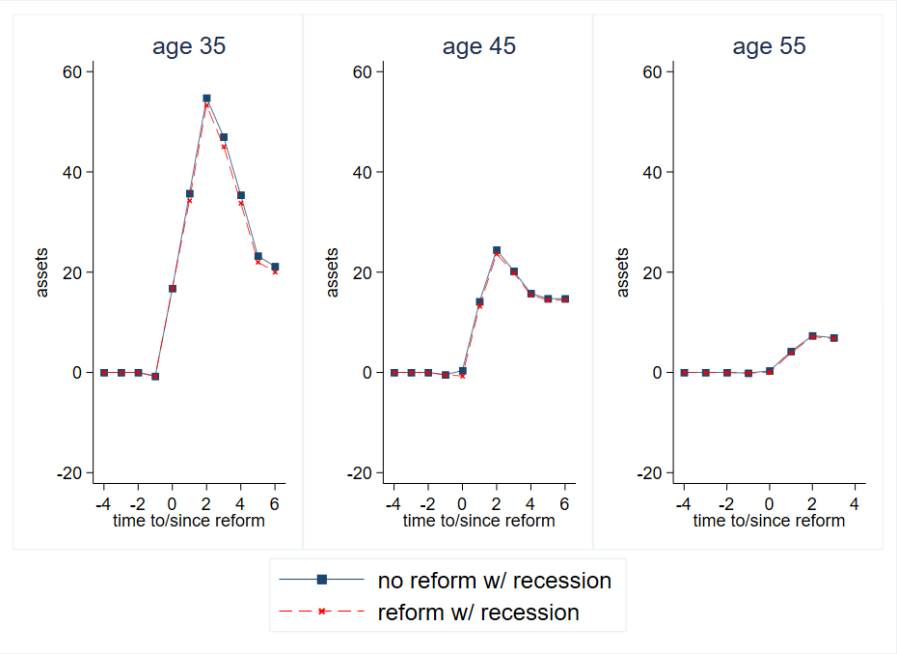
Table 14: Targeted Moments, MSM

| Definition | No. of moments |
|---|---|
| Non-durable consumption | |
| OLS coeffs.: 3rd order age polynomial | 4 |
| means: age 55-59 | 5 |
| Durables | |
| OLS coeffs.: 2nd order age polynomial | 3 |
| means: age 55-59 | 5 |
| Financial assets | |
| OLS coeffs.: 2nd order age polynomial | 3 |
| means: age 55-59, by education | 15 |
| Non-durable – Durable consumption | |
| OLS coeffs.: 3rd order age polynomial | 4 |
| covariances: age 35, 45, 55 | 3 |
| Financial assets – Durables | |
| OLS coeffs.: 2nd order age polynomial | 3 |
| covariances: age 35, 45, 55 | 3 |
| Durables' stock – flows | |
| net sellers' subsample, eq. 29 | 1 |
| net buyers' subsample, eq. 29 | 1 |

# E Additional Results from Tax Experiments

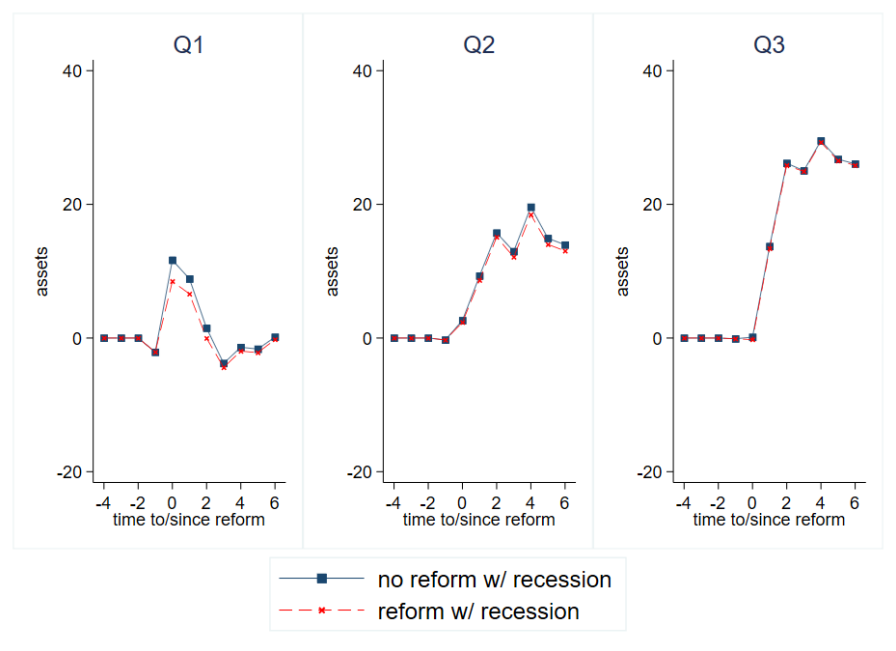
## E.1 Temporary VAT cut on non-durable luxuries

Figure 19: Effects of recession and reform on savings, by age at implementation



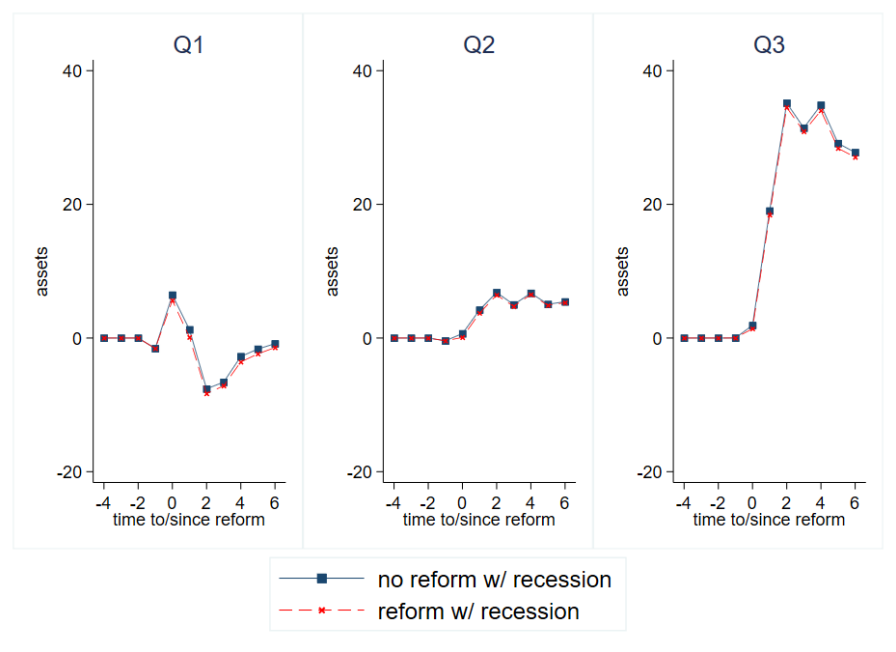

Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Age 35-45-55 is age at which households are hit by temporary reform.

Figure 20: Effects of recession and reform on savings, by wealth tercile




Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of total wealth distribution in no recession/no reform scenario.

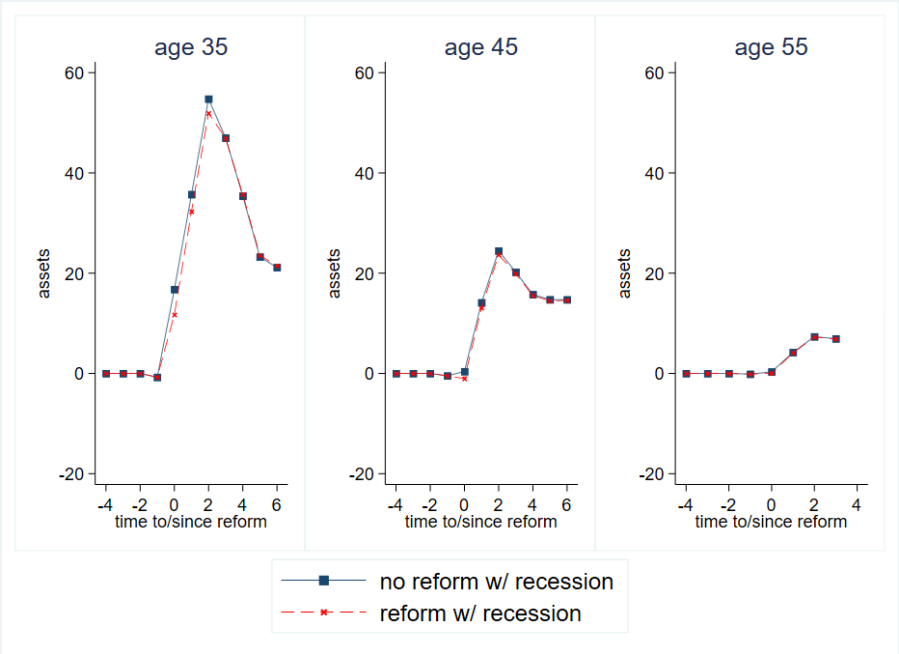
Figure 21: Effects of recession and reform on savings, by income tercile




Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of lifetime income distribution in no recession/no reform scenario.

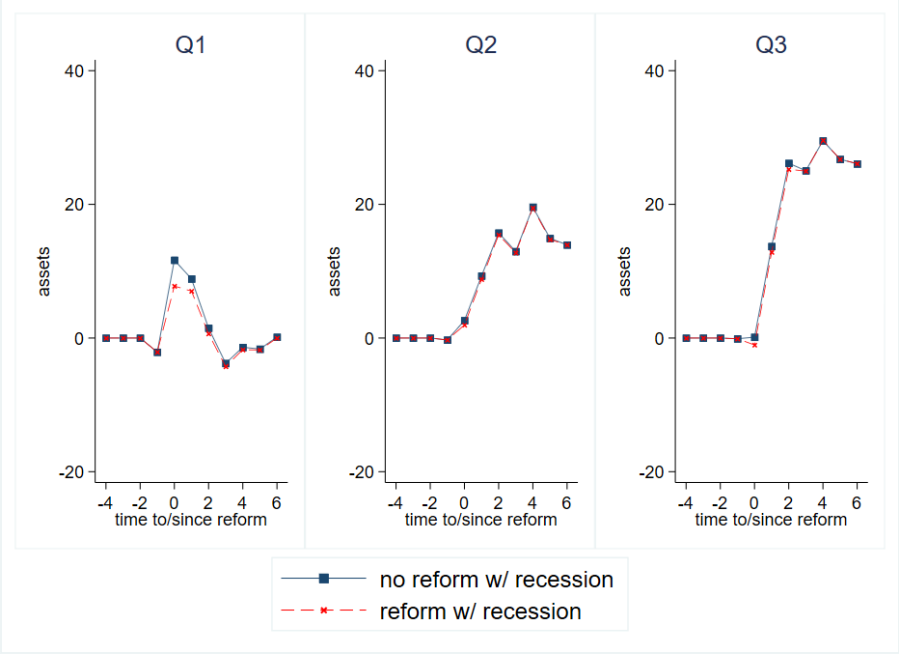
## E.2 Temporary VAT cut on durables

Figure 22: Effects of recession and reform on savings, by age at implementation



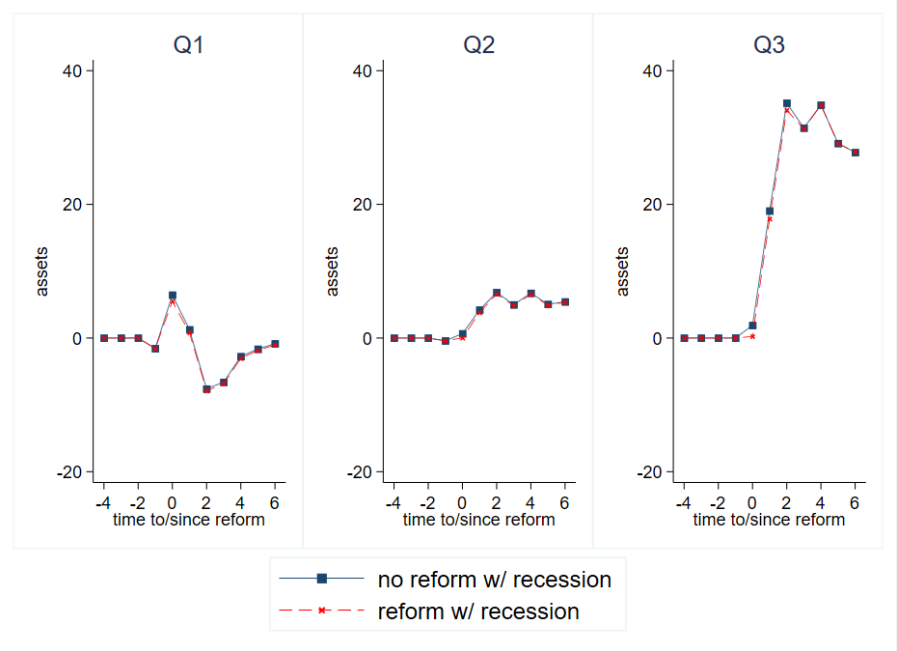

Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Age 35-45-55 is age at which households are hit by temporary reform.

Figure 23: Effects of recession and reform on savings, by wealth tercile




Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of total wealth distribution in no recession/no reform scenario.

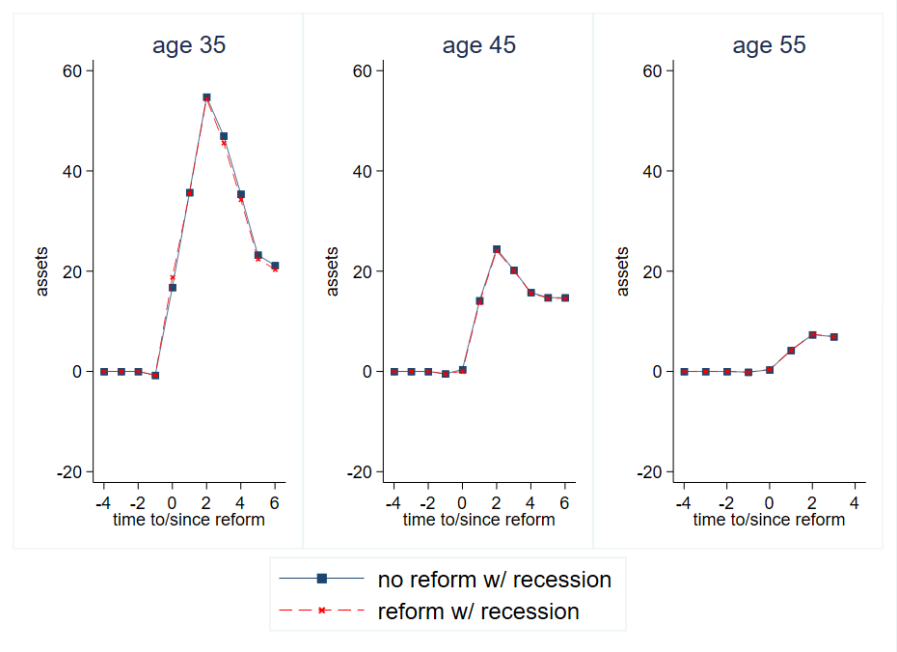
Figure 24: Effects of recession and reform on savings, by income tercile




Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of lifetime income distribution in no recession/no reform scenario.

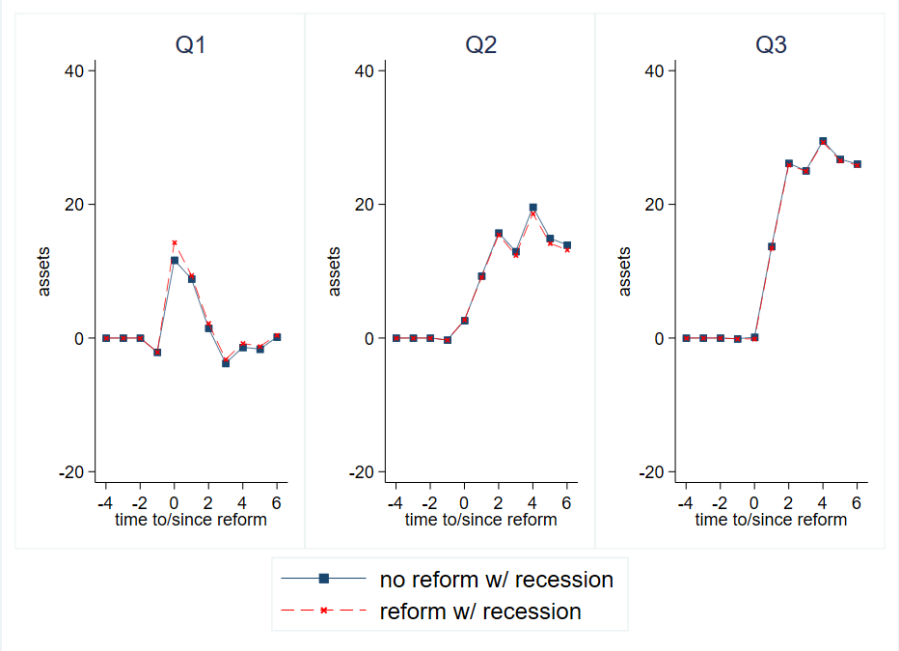
## E.3 Cash-Transfer

Figure 25: Effects of recession and cash-transfer on savings, by age at implementation



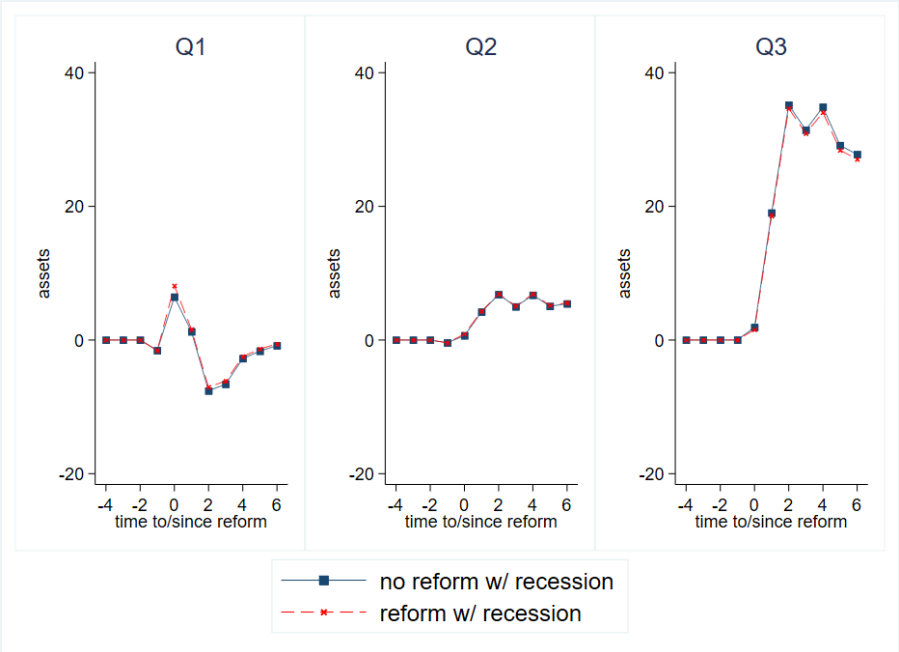

Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Age 35-45-55 is age at which households are hit by temporary reform.

Figure 26: Effects of recession and cash-transfer on savings, by wealth tercile




Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of total wealth distribution in no recession/no reform scenario.

Figure 27: Effects of recession and cash-transfer on savings, by income tercile




Notes: % changes in households' savings in financial assets with respect to no recession/no reform scenario. Aggregation across age groups takes into account the relative weight of each age group. Q1, Q2, Q3 represent first, second, third terciles of lifetime income distribution in no recession/no reform scenario.