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The impact of early pension withdrawals on household finances and inflation

Jaanika Meriküll*

Abstract

This paper exploits Estonia's pension reform in 2021 to examine how a large-scale income shock impacts household finances and inflation. The reform made the second-pillar pension contributions voluntary and allowed early withdrawals before retirement age. One-fifth of contributors withdrew their pension savings as soon as this option became available. Using National Accounts (NA) and Distributional Wealth Accounts (DWA) data from the third quarter of 2013 to the third quarter of 2022, we apply a synthetic differences-in-differences method to assess aggregate-level impacts. We explore the household-level dynamics by applying data from the Household Finance and Consumption Survey (HFCS). The reform led to a rise in deposits alongside a reduction in consumer debt balances. However, there was also a strong response in consumption as the consumption of leavers went up substantially, suggesting a marginal propensity to consume (MPC) of 15% of the amount withdrawn early from pensions. The positive balance sheet effects declined over a year, and consumption stayed elevated, keeping quarterly inflation 1–2 percentage points higher than it would otherwise have been. Withdrawals were concentrated among households with a high MPC, amplifying the reform's impact on consumption.

JEL Codes: D12, D14, E21, H55, E65

Keywords: Pension reform, liquidity shock, consumption, MPC, savings, debt, inflation, Distributional Wealth Accounts, Household Finance and Consumption Survey

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Non-technical summary

Central and Eastern European countries introduced a three-pillar pension system around the turn of the century. The Estonian pension system was reformed in the same way, so that the first pillar was a pay-as-you-go state pension, the second was a defined-contribution funded pension, and the third was the supplementary funded pension. All cohorts born in 1983 or later were enrolled in the second pillar without being allowed to opt out, while earlier cohorts could choose whether to contribute. Once the decision to contribute had been made, it was binding until retirement. This system was then changed in 2021 so that early withdrawals from the second pillar were allowed before the saver reached retirement age. The main motivation for this reform was the poor performance of the pension funds, and it was expected that households could achieve better performance by investing the funds themselves. Three-quarters of the working-age population were contributing to the second pillar by the time of the change, and one-fifth of them decided to withdraw their pension savings. The money withdrawn was as much as 4.6% of the GDP of the year.

This paper estimates how this large liquidity shock affected households' finances through their consumption, savings, investments and debt, and what its implications were for inflation. The paper takes a short-term view and evaluates the effect of the change over five quarters, from the third quarter of 2021 to the third quarter of 2022, focusing on the first wave of withdrawals in September 2021. The aggregate effects are studied, and the aggregate data used are taken from the National Accounts (NA) and the Distributional Wealth Accounts (DWA). The aggregate effects are simulated to the subgroup of withdrawers using the balance sheet of households from the Household Finance and Consumption Survey (HFCS) conducted in 2021 shortly before the reform. The HFCS survey is used to study the selection of households into withdrawing depending on their marginal propensity to consume (MPC). The inflationary effects are estimated using data from the Harmonised Indexes of Consumer Prices (HICP) at constant tax rates and decomposing inflation into demand and supply components using the approach of Shapiro (2023). The main estimation method is synthetic difference-in-differences (Arkhangelsky et al., 2021), which constructs a synthetic control group for the Estonian aggregates that combines aggregates from 18 EU countries.

It is found that the change led to an increase in deposits, a decline in the outstanding balance of consumer loans, and increased consumption. The increase in consumption was concentrated in the very first month of the withdrawals in the third quarter of 2021, and it is estimated that the consumption of the withdrawers increased by 29% over the last quarter and 87% over the last month before the change. The increase in deposits was also strongest in the very first month and the excess deposits then declined over the course of a year, while the outstanding balance of consumer loans declined increasingly and the effect was the largest a year after the first wave of withdrawals. There was a short-lived increase in risky financial assets because of the change, but this effect had disappeared by the third quarter after the reform. We do not find that the reform had any effects on the outstanding balance of housing loans.

Given the effects of the change on household finance items, it is evaluated how the money withdrawn was spent. The estimates show that half of the money withdrawn was still held in deposits four quarters after the first wave of withdrawals, while up to 30% of it was used to pay back consumer debt and 15% was consumed. These estimates suggest that the MPC from the money withdrawn was 15% a year after this income shock. This MPC estimate is lower than the marginal propensity to spend from the pension fund withdrawals that were targeted as fiscal stimulus (Kreiner et al., 2019; Hamilton et al., 2024). However, the amount of money withdrawn was large in Estonia, at 7.5 months of income for the withdrawers, and the MPC of 15% corresponds to one average month of income being consumed. The household-level data from the HFCS show that households with a high MPC were selecting to withdraw and that this amplified the response of consumption to the change.

It is also found that the change pushed inflation higher. The effects on inflation were strongest during the second and the third quarters after the first withdrawals and the change made inflation 1-2 percentage points higher than it would otherwise have been. The decomposition of inflation into supply and demand-driven components indicates that the demand-driven inflation came in the periods shortly after the reform. The HICP components that were shown by the synthetic difference-in-differences estimates to be affected by the change and were identified as affected because of the positive demand factor were clothing, goods for household maintenance, vehicles and a lot of recreational activities.

Contents

1. Introduction

Ageing populations and fiscal pressures have pushed many countries to replace their pay-as-you-go pension systems with multi-pillar mandatory funded pension systems. There was a wave of pension reforms that created such systems around the turn of the last century and the decades since have witnessed substantial growth in individual pension funds (Hinrichs, 2021; OECD, 2024). This paper discusses the reversal of a key part of one such reform in Estonia in 2021. This was a large and permanent reversal of the principle behind one of the pillars of the pension system that was set up in 1997, and we denote that reform as the *reversal* throughout the paper. The reversal made participation in the second pillar voluntary for people of all ages and allowed the withdrawal of accumulated pension assets before retirement age. Three-quarters of the population who were of primary working age had contributed to the second pillar at the time of the reversal, and 20% of those contributors chose to withdraw their savings immediately. The assets withdrawn because of the reversal were as large as 4.6% of the pre-reform yearly GDP.

This paper evaluates the short-term impact of such a large-scale income shock on the finances of households, and specifically on their consumption, savings and debt. We also consider the implications of the shock for inflation. The paper takes the aggregate view and traces how the money withdrawn was spent. The reversal aimed to make the system more flexible and cost-efficient by allowing contributors to save independently outside the pension funds. As a result of the reversal, the assets in the pension funds could just switch accounts and move into private investments. Alternatively, households could use the assets to pay back debt, fund initial equity in new collateralised debt, or increase consumption. The potential side effects of the reversal on macroeconomic stability are also considered, since an unexpected income shock of that type could lead to higher demand and excess inflation. We trace all the expenditure components of households, looking at their consumption, savings in deposits, investments in risky financial assets, and debt payments of consumer loans and mortgages.

The synthetic difference-in-differences method of Arkhangelsky et al. (2021) is applied to derive a synthetic control group for each of the macro aggregates of the treatment country, Estonia. The main data sources for the analysis are the quarterly national accounts data from Eurostat and the quarterly Distributional Wealth Accounts (DWA) data from the European System of Central Banks. The data range from the third quarter of 2013 to the third quarter of 2022. Different control groups are created depending on the coverage of countries in the DWA data, so there is a control group with a longer time series starting from the third quarter of 2013 and covering 14 countries, and a control group with a shorter time series that starts in the fourth quarter of 2017 and covers 18 countries. A third control group is created that covers only the Baltic states of Latvia and Lithuania, which are the two closest neighbours of Estonia.

The micro-foundations behind the aggregate findings are studied using household-level data from the Estonian Household Finance and Consumption Survey (HFCS) from 2021. These data were collected shortly before the reversal and show which contributors were intending to withdraw their pension savings during the first wave of withdrawal and which were not. The HFCS data are used to derive the distribution of the marginal propensity to consume (MPC) of those staying in the second pillar and those leaving it. The misalignments between the MPC distributions of stayers and leavers indicate where there may be selection into withdrawing the pension assets because of the MPC. The HFCS data collect the self-reported MPC of households from a question about how they would use unexpected lottery winnings within a year, like in Jappelli and Pistafferi (2014). In addition to the MPC estimate, we use the HFCS data for the balance sheets of stayers and leavers before the reversal to simulate the implications of the aggregate effects on the subgroup of leavers.

The paper is related to two strands in the literature. The first is the strand that looks at how pension reforms affect household finances. There are several papers that study the saving behaviour of households that are exposed to pension reform, and they mostly find that additions to pension wealth crowd out private savings (Attanasio and Rohwedder, 2003; Lachowska and Myck, 2018). It has also been found that having less saved in pension wealth induces people to make private investments in real estate (Botazzi et al., 2011; Jappelli and Padula, 2016) and reduces the consumption of households (Jappelli and Padula, 2016). These findings indicate that the reversal of the pension reform should have the opposite effect to the introduction of pension privatisation, so the reduction in pension wealth should induce private saving and investment in real estate, and reduce consumption. Our paper contributes to the literature on the short-run effects of pension reforms.

The second line of research linked to our paper is that on MPC heterogeneity. The cohorts born in 1983 or later were enrolled in the second pillar without the possibility to opt out; older cohorts could choose whether to join, but the decision was irreversible. The unexpected nature of the reversal of the second pillar can be taken as a liquidity shock for the participants. It has been shown that there is a lot of heterogeneity in how consumption by households responds to windfall gains, as households with fewer liquid assets are more likely to consume the gains than households with more liquid assets (Jappelli and Pistaferri, 2014), while the strongest response comes from wealthy hand-to-mouth households (Fagereng et al., 2021). There is also evidence on intertemporal MPCs showing that small windfall gains are consumed more quickly than large windfall gains (Fagereng et al., 2021, Jappelli et al., 2024). We contribute to this literature by investigating whether households with a high MPC are more likely to choose to withdraw their pension assets, and in this we complement the earlier studies on the reversal that have focused on the liquidity channel (Agarwal et al., 2020; Wang-Ly, N.; Newell, 2022; Korasteljov et al., 2023; Bulõgina and Kukk, 2025) and that show that it was mostly liquidity-constrained households that withdrew their pension assets.

A lot of countries including Chile, Peru, Mexico, Kosovo, India, Malaysia, Australia, the US and Iceland allowed households to make withdrawals from their pension funds to support their incomes at the time of Covid-19 (Casey and Mustafa, 2024; Wang-Ly and Newell, 2022). Similar liquidations of pension assets were made during the Great Recession in Denmark (Kreiner et al., 2019) and are permanently available in the US or in cases of economic hardship in Canada and Australia (Beshears et al., 2015). There is limited evidence on the MPC in these instances of withdrawals. Hamilton et al. (2024) estimate that total expenditures were 43-48% of the amounts withdrawn after eight weeks during the Covid-19 pandemic in Australia. Kreiner et al. (2019) estimate that total expenditures amounted to 65% of the money withdrawn during the Great Recession in Denmark. However, these papers cannot distinguish between expenditures and consumption, and they estimate the expenditures that followed policies that were targeted as a fiscal stimulus. We contribute to this literature by deriving an MPC for the funds that were withdrawn following a reform that introduced early pension withdrawals but was not designed as a fiscal stimulus. There is an increasing body of literature suggesting that heterogenous MPCs and heterogeneous exposure to aggregate shocks amplify volatility of business cycles (Patterson, 2023).

The paper finds that the reversal had strong short-term effects on household finances. Household balance sheets saw increases in deposits and risky financial assets, and a reduction in the outstanding amounts of consumer loans. However, we also find a strong effect on consumption, as consumption by leavers went up by 29% on a quarterly basis or 87% on a monthly basis during the first month after the reversal. We find that the positive balance sheet effects on deposits and risky financial assets declined over the course of a year after the withdrawal, while consumption stayed elevated for a year. The MPC of the withdrawers is estimated from aggregate estimates to be around 15%. The strong response in consumption can be explained by households with a high MPC selecting into the group of withdrawers. Our counterfactual estimates show that if the households withdrawing had had the same MPC as those that continued to save in the second pillar, their response in consumption would have been 13% lower than it actually was. Our results also illuminate the effects on macroeconomic stability, as inflation was elevated by the reversal and stayed elevated for a year. Quarterly inflation was 1-2 percentage points higher because of the reversal. We also decompose inflation into its demand and supply components and confirm that the increase in the demand component coincided with the reversal.

The paper is organised as follows. The next chapter explains the original pension reform and the reversal of part of it in Estonia and puts it into the context of pension systems in other Central and Eastern European countries. The third section describes the data and methods. The fourth section presents the results for the household aggregate data, studies the micro-foundations behind the aggregate results using the HFCS micro-data, and evaluates the effects on inflation. The last section summarises the findings.

2. The privatisation of pensions in Estonia and the partial reversal in 2021

The pension system in Estonia was reformed like those of all the other Central and Eastern European (CEE) countries at around the time that those countries joined the European Union (EU) (Orenstein, 2008). Estonia's three-pillar pension system replaced the old pay-as-you-go system and increased the role of private contributions and earnings-dependence in pension rights. The aim of the reform was stated by the government formed in 1997 as: "To ensure the long-term stability and solvency of the national pension system, to accelerate economic development, to reduce the share of the shadow economy, and to increase each individual's interest in saving for their retirement ..." (Vabariigi Valitsus, 1997). The system consisted of three pillars following the World Bank classical model (World Bank, 1994), where the first pillar was the pay-as-you-go state pension, the second was the defined contribution mandatory funded pension, and the third was the supplementary funded pension. The changes in the pension system were gradual, as the reforms to the first pillar were introduced in 1999, the second pillar was introduced in 2002, and the third pillar opened in 1998 (see the overview by Piirits and Võrk, 2019).

The three-pillar pension system was introduced in Estonia as part of the global wave of pension privatisation. The privatisation of pensions was motivated mainly by fiscal arguments and it facilitated the liberal political and economic transition of the low-cost and low-wage CEE countries[1]. The reforms were introduced independently of the EU accession negotiations of the CEE countries and have been seen as attempts to introduce welfare systems in CEE countries that were more liberal and modern than the social model in Western Europe at the time (Orenstein, 2008). Society ageing was also an important argument, since the proportion of people who were of pension age was growing even faster in Central and Eastern Europe than it was in Western Europe. The main drivers of the increase in the old-age dependency ratio were increasing life expectancy, declining birth rates, and excess mortality among the working-age population because of the economic transition in the 1990s (Cerami, 2011). Pension funds were

[1] Orenstein (2008) explains that CEE liberals aimed to become a low-cost production hub within the EU and pension privatisation signalled to investors that the region was committed to keeping non-wage labour costs low.

also seen as important institutional investors that could support the development of local capital markets (Naczyk and Domonkos, 2016)[2].

The Estonian pension system was considered one of the more egalitarian ones in the CEE region. It maintained both systems, with a pay-as-you-go part and individualised accounts, and it allowed a majority of the population to choose whether to have an individualised part or not (Orenstein, 2008). Only the younger cohorts, who were 19 or younger at the time of the reform as they were born in 1983 or later, were enrolled in the second pillar without being allowed to opt out; workers in the prime working age had the choice of whether to join or not. Those who joined contributed 2% of their gross wage to the individualised account, while the state added an additional 4% from the individual's social tax contributions. The part that the state contributed from the social tax was deducted from the first pillar entitlements (Estonian Pension Centre, pensionikeskus.ee). The participation rate was close to 100% by 2021 for those for whom participation was compulsory, showing that most of the younger residents were participating after spending at least some time in the labour market; see Figure 1. The participation rate was also very high for those who were older and for whom participation was voluntary, at close to 80% below the age of 60 and 40% for those over 60.

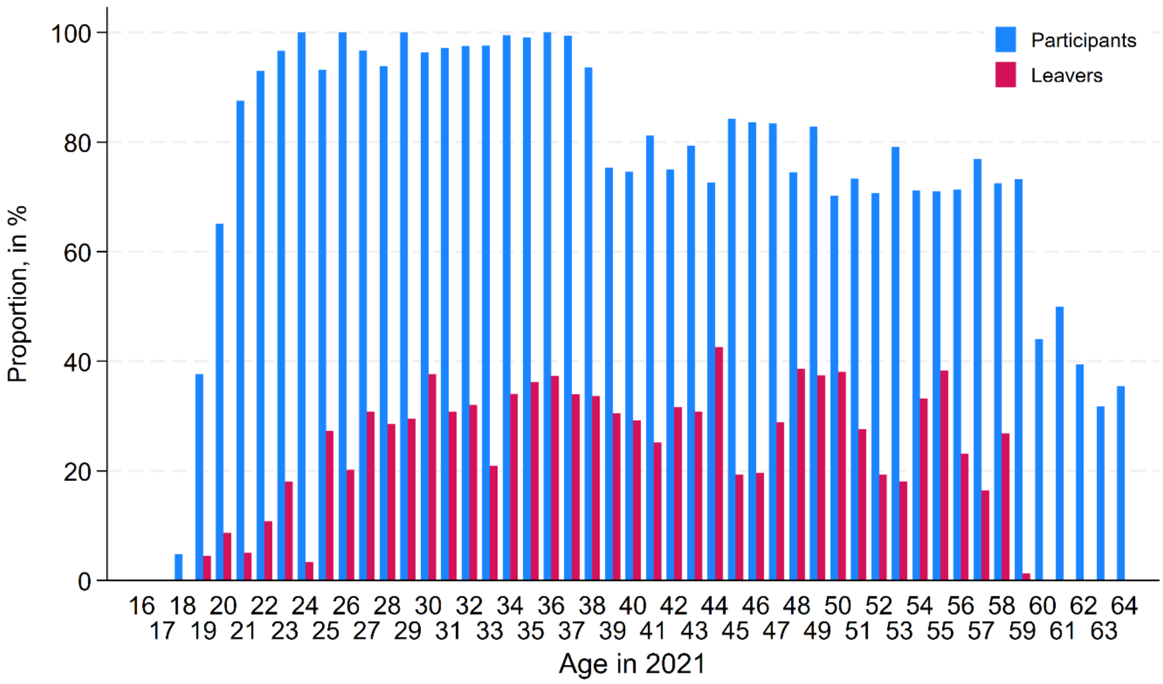

Figure 1. Participants and leavers from the second pillar by age, 2021.

Notes: Participation in the second pillar was compulsory for those who were born in 1983 or later, so who were 36 or 37 at the time of the survey. Participants shows the proportion of participants within each yearly age group from 16-64 before the first wave of withdrawals in January to August 2021, and leavers shows the proportion of those participants who had applied to withdraw their assets during the first wave in September 2021. The average participation in the total age group 16-64 was 75%, and in the age group 16 and older was 58% before the first wave of withdrawals.

Source: Household Finance and Consumption survey in 2021

[2] This was not an argument used in Estonia, where most of the second pillar assets were held in foreign securities (Naczyk and Domonkos, 2016).

The outcomes of the pension privatisation were expected to be that inequality in pension income would increase (Piirits and Võrk, 2019), and private savings would be crowded out for those who were forced to enrol in the earnings-related second pillar (Attanasio and Rohwedder, 2003). There is however no unconditional evidence that the mandatory enrolment of younger cohorts crowded out private investment by them. The proportion of leavers did not differ statistically significantly between the cohorts that had mandatory enrolment and the slightly older cohorts that did not, as 32.0% with a standard error (SE) of 2.4 of participants aged 32–37 left in 2021 during the first wave and 30.5%, with an SE of 2.7, of participants aged 38–42. There is also no evidence that the cohorts that had mandatory enrolment in the second pillar had smaller savings in other financial assets than those cohorts that were slightly older than them; see Figure 2. The only statistically significant difference between the accumulated financial assets of these narrowly defined age groups was in third pillar assets, where older cohorts tended to have more assets than younger ones, with an average in 2021 of 419 euros with an SE of 97 for those aged 32–37 and 1233 euros with an SE of 257 for the 38–42 age group.

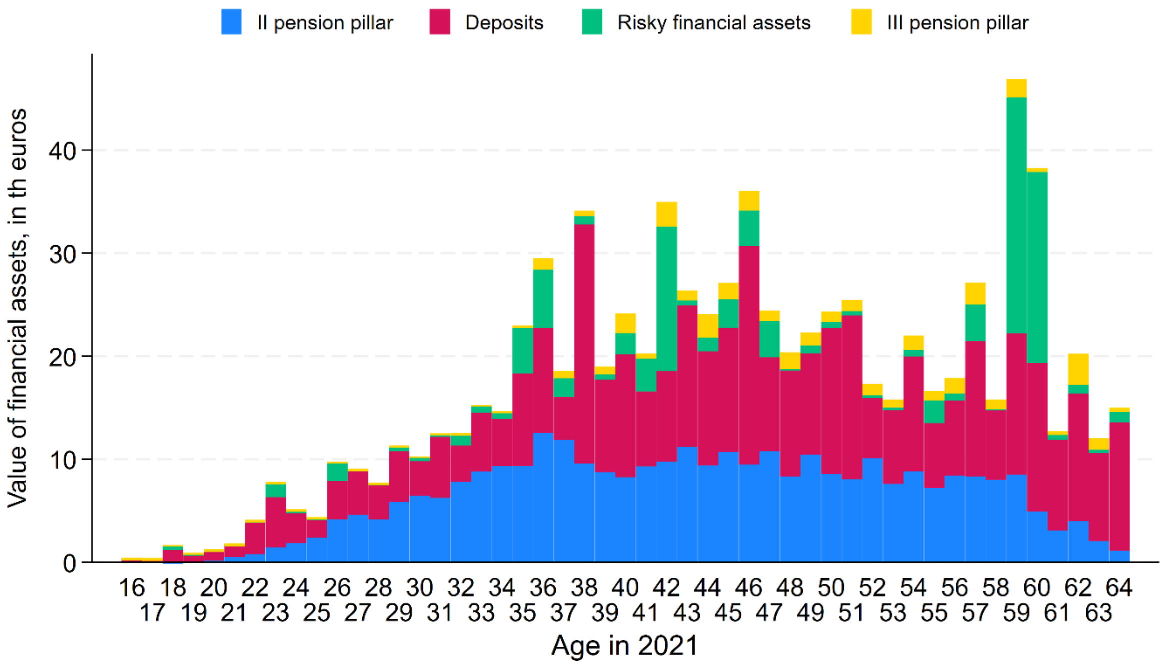

Figure 2. Distribution of financial assets by age, 2021.

Notes: Participation in the second pillar was compulsory for those who were born in 1983 or later, so who were 36 or 37 at the time of the survey. Risky financial assets does not include ownership of businesses that are not publicly traded. The figure shows the average value of assets by age group regardless of participation in the second pillar.

Source: Household Finance and Consumption survey in 2021

Since the initial wave of privatisation of pensions, a lot of countries have reverted their systems and transferred management of pension funds wholly or partly back to the public sector (Ortiz et al., 2018). The Great Recession presented the first hurdle to the three-pillar systems in Central and Eastern Europe, and it induced several temporary or permanent reversals (Naczyk and Domonkos, 2016). Hungary nationalised its mandatory second pillar to manage its public debt and regain access to international credit markets. Ironically it was public sector debt and the problems of financing the pay-as-you-go pension system that first drove Hungary to privatise its pensions in 1998, and it was the same issues that then caused the system to be reversed and the second pillar nationalised in 2010. The pension paid from the first pillar was raised substantially after the three-pillar pension system was introduced, and it became unsustainable to continue financing it with sovereign debt during the Great Recession (Datz and Dancsi, 2013).

The reversal of the pension reform in Hungary was the most extreme case in the CEE countries, but it was not the only one. The struggle to finance transition costs and the use of debt to finance the part of the social tax contributions that were directed into private pension funds drove Poland and Slovakia to make a partial reversal of their second pillars as well (Naczyk and Domonkos, 2016). The Polish reversal in 2014 was milder than the Hungarian one as Poland maintained the second pillar with reduced contributions and made participation voluntary. The Poles also nationalised the part of the accumulated assets that had been invested in sovereign bonds. The common factor in the Hungarian and Polish reversals was the combination of large public debt and the large share of domestic sovereign bonds in the accumulated second pillar assets, which made nationalising the second pillar assets a convenient strategy for reducing public debt. Poland carried out another set of reforms to the second pillar in 2016, when participation was made voluntary with an opt-out as the default (Ratajczak-Leszczynska and Manikowski, 2022). Slovakia had also had problems with its high level of public debt and so it reduced contributions to the second pillar and made participation voluntary in 2012. However, no assets were nationalised in Slovakia, probably because the proportion of assets held in domestic sovereign bonds was small. The Baltic countries also stopped the state contributions to the second pillar because of fiscal concerns during the Great Recession, but the state contributions were restored later and the missing contributions were compensated (Naczyk and Domonkos, 2016).

The public debt and fiscal concerns were the main drivers of the reversals of pension privatisation in these cases, but this was not an argument for reversing the system in Estonia in 2021[3]. Another driving force behind the three permanent reversals in Hungary, Poland and Slovakia was the long-term political opposition to the privatisation of pensions (Naczyk and Domonkos, 2016), but this was not a factor in the reversal in Estonia either. The formalisation of the three-pillar system in Estonia was a political compromise (Raudla and Staehr, 2003), but there was no long-term political opposition to it of the sort that facilitated the reversals in the other three countries. It was therefore surprising that it was one of the central political forces behind Estonia's liberal reforms in the 1990s, Isamaa, that came up with a proposal to reverse pension privatisation and make the second pension pillar voluntary in 2019. The argument given for why the system should be reversed was the poor performance of the private pension funds. The real returns of the funds were among the worst in the OECD countries and they were even negative in the earlier years (OECD, 2021 Table 9.3). The explanation for the poor performance was the lack of competition between funds. The performance of the second pillar was especially poor relative to that of the first pillar before the Great Recession because the domestic economy was performing relatively well. Three-quarters of the Estonian second pillar assets were held in foreign securities (Naczyk and Domonkos, 2016) and the returns on those second pillar assets were beaten by the growth in the first pillar, which was fuelled by one of the fastest rates of economic growth in the European Union[4].

[3] The general government consolidated gross debt was 18% of GDP at the time of the reform in 2021, which was way below the EU average of 87% and the lowest in EU (Eurostat gov_10dd_edpt1).

[4] Economic growth in real terms was 4% between 1996 and 2020 in Estonia, and the only country in the EU with a higher average growth rate was Lithuania with 4.2%, while the EU average was much lower at 1.4% (Eurostat nama_10_gdp).

When Isamaa became part of the coalition government in 2019, the reversal of the second pillar was started. One surprising element of the reversal was that nationalisation of assets was never discussed because there was no need to reduce public debt, and so the assets were privatised with the hope that individuals would be able to get higher returns by investing their pension savings themselves. The reversal took effect in 2021 and allowed participants to withdraw their savings from the second pillar on three occasions each year[5]. In the first round in September 2021, roughly 150,000 people withdrew their savings from the second pension pillar before they reached retirement age. This corresponds to 20% of participants leaving and 1.34 billion euros being withdrawn (Ministry of Finance, pension statistics for 2021). The money withdrawn amounted to 4.6% of the yearly GDP from before the reform (Eurostat series namaq_10_gdp). Income tax of 20% was automatically deducted from the withdrawals, and the money was deposited into people's bank accounts in September 2021.

Estonian residents received about 1.1 billion euros of additional net income on top of their usual income as a result of the reversal. This was about 70% of the average monthly disposable income of the Estonian household sector before the reform and 87% of its average monthly consumption[6]. It made 11% of the accumulated deposits, 90% of the risky financial assets, 51% of the outstanding consumer credit stock, and 12% of the outstanding housing credit stock of the household sector before the reversal (ESCB's Distributional Wealth Accounts). For leavers, the amount withdrawn was 7.5 times their usual monthly income (estimate from the 2021 wave of the HFCS data). This is the liquidity shock whose outcomes this paper traces. There were fewer leavers in all of the subsequent rounds of withdrawals, with some 12,000 in January 2022 and 23,000 in May 2022, while by 2023 the number of people withdrawing their pension savings became smaller than the number of new entrants and so the number of participants started increasing again (Ministry of Finance, pension statistics for 2022 and 2023). Given that all the subsequent rounds of withdrawals had a substantially smaller number of leavers, we focus in this paper on the outcomes of the first round of withdrawals.

3. Data and methods

The central issue of household problems in economics is how to allocate income between consumption and savings to maximise utility. In models with credit, households can also borrow to smooth their consumption. This household problem also frames our empirical strategy and we estimate whether households use the assets they withdraw from pension funds to save, consume or change their outstanding balance of debt[7]. The savings and debt payment parts are

[5] To get their pension savings paid out in September, participants need to submit the application to withdraw between 1 December the previous year and 31 March of the current year. The same five-month notification gap applies to the pay-outs in January and May (see information at Pension Centre at https://www.pensionikeskus.ee/en/ii-pillar/payments/payments-before-reaching-pensionable-age/.

[6] The disposable income of the household sector is not reported at quarterly frequency, so we take the average monthly value of income in the yearly data for 2020 as the pre-reform value. The average monthly disposable income was 1.542 billion euros in 2020 and the net money withdrawn, 1.072 billion euros, was equal to 70% of this (source RAM001 in Statistics Estonia). The consumption of the household sector and all the items from the Distributional Wealth Accounts are reported at a quarterly frequency and the reference period for before the reform is the second quarter of 2021. The average monthly consumption in that quarter was 1.232 billion euros and the net money withdrawn corresponds to 87% of this. These pre-reform references are used only for the descriptive overview here and are also reported in Table 1 in Appendix C, while the subsequent analysis proceeds from a much longer pre-reform timespan.

[7] We take the approach that transitory income shocks can affect consumption as there is plentiful empirical evidence for that; see for example the discussion of the Representative Agent vs the Heterogeneous Agent, New Keynesian models in Kaplan and Violante (2018) or empirical evidence on Estonian data (Kukk et al., 2016).

split into two. We distinguish on the savings side between risk-free savings such as deposits, and savings in risky financial assets such as stocks and debt securities, and on the debt payment side we distinguish between consumer loans and housing loans. As a result, our empirical approach estimates the effect of the windfall gains from pension reform on five outcome variables: 1) consumption; 2) risk-free financial assets; 3) risky financial assets; 4) consumer debt; and 5) housing debt. Given the joint exposure of all these variables to the reform, we estimate separate specifications for each of them. All the outcome variables are analysed in nominal terms.

The definitions, sources and basic descriptive statistics of the variables are presented in Table 1. The timespan of the analysis is from the second quarter of 2013 to the third quarter of 2022 and it is determined by the availability of the Distributional Wealth Accounts data for Estonia from the European System of Central Banks (ESCB). We use data with quarterly frequency. We prefer this data source because it offers internationally comparable time series for household financial assets and liabilities. Alternative data sources, such as national accounts or the European Central Bank's (ECB) consolidated banking data have significant shortcomings. National accounts data do not cover savings for the household sector in Estonia and the ECB's consolidated banking data report the household deposits and the loan stock for that are registered in the reporting country for the whole bank group. Another reason for starting the dataset from the second quarter of 2013 is to exclude the Great Recession from our data. The Great Recession was much more severe in Estonia than in most other EU countries and we started the sample from after the recovery from this unusual event so that we would have a comparable control group for Estonia. The variables are differenced as suggested by the stationarity tests; see Table 1 in Appendix A[8].

Table 1. The definition of variables and descriptive statistics for Estonia, 2013Q3–2022Q3 (n=37)

Variable name	Definition and source	Mean	SD
ΔConsumption	Final consumption expenditures of households, current prices in million euro, seasonally and calendar adjusted (Eurostat namq_10_gdp), log difference multiplied by 100	1.7	3.5
ΔDeposits	Deposits of households (ESCB Distributional Wealth Accounts), log difference multiplied by 100	2.4	1.7
ΔRiskyFinAssets	The sum of two items: debt securities of households and listed shares of households (ESCB Distributional Wealth Accounts), log difference multiplied by 100	5.0	7.7
ΔConsumerCredit	Loans other than for house purchasing of households (ESCB Distributional Wealth Accounts), log difference multiplied by 100	1.0	2.3
ΔHousingCredit	Loans for house purchasing of households (ESCB Distributional Wealth Accounts), log difference multiplied by 100	1.5	0.7
ΔHICP	Harmonised Index of Consumer Prices (HICP) at constant tax rates (Eurostat, prc_hicp_cind), average monthly data per quarter is log differenced and multiplied by 100	0.8	1.8

Notes: All the variables except consumption are first seasonally adjusted using the TRAMO/SEATS algorithm; next the logarithmic transformation is made from the seasonally adjusted data. Consumption data are available seasonally and on working days adjusted from Eurostat, and the authors have performed no further adjustments to these data. Differences refer to log differences in per cent.

[8] The stationarity tests suggest applying the second difference for the housing credit however, as the tests at the first difference are close to rejecting the unit root, so we proceed from this transformation to make interpreting the results easier.

The estimation strategy applies the synthetic difference-in-differences (SDID) approach, which combines the conventional differences-in-differences (DID) model with the synthetic control model following Arkhangelsky et al. (2021). The idea of this method is to adjust a difference-in-differences model with unit and time weights. The difference-in-differences model is specified as follows:

$$\Delta Var_{it} = \alpha_i + \rho^h Treat_{it}^{t+h} + \tau_t + \varepsilon_t \quad (1)$$

where Var_{it} denotes each of the five outcome variables for each country *i*, *i=1, ..., 19*. We use data from the Distributional Wealth Accounts and the National Accounts for other countries in addition to Estonia in order to have a control group for our treated country, Estonia[9]. We control for unit fixed effects, α_i, and time fixed effects, τ_t. We expect the effect of the reversal to be captured by ρ^h. The variable $Treat_{it}^{t+h}$ is defined for five different values of the time period *h* in the local projection style, *h=0, ..., 4*. If *h=0*, it is equal to one for Estonia in 2021Q3 and is equal to zero for the rest of the observations in the sample. In this case, the estimation sample ends at 2021Q3. If *h=1*, the variable $Treat_{it}^{t+h}$ is equal to one for Estonia in 2021Q3 and 2021Q4 and equals zero otherwise and in this case the sample ends at 2021Q4; and so on for *h=2*, *h=3* and *h=4*. Given that the withdrawals were deposited to owners' accounts in September 2021, the treatment variable *h=0* captures the effects of reversal by month 1, *h=1* by month 4, *h=2* by month 7, *h=3* by month 10 and *h=4* by month 13[10].

The shortcoming of the conventional difference-in-differences approach is that it takes in all the countries in the control group with equal weighting. However, some sample countries are more suitable as controls for our treatment country, Estonia, than others are, depending on the pre-treatment dynamics of the outcome variables. The assumption of parallel trends is often violated when equal weights are assigned to a large set of units in the control group or when the control group is chosen arbitrarily without data-driven procedures being used. The synthetic control approach of Abedie et al. (2010) offers a data-driven procedure that fits well with our empirical setting of a comparative case study with one treatment unit and a large set of units in the control group. This method derives weights for the control units, $\widehat{\omega}_i$ where $\sum_{i=1}^{N} \widehat{\omega}_i = 1$, using a factor model so that the mean squared error between the outcome of the treatment group and the outcome of the synthetic control group is minimised for the pre-treatment period.

Arkhangelsky et al. (2021) develop this method further and propose the synthetic difference-in-differences approach. This method adds another set of weights to the synthetic control model, time weights $\hat{\lambda}_t$ where $\sum_{t=1}^{T} \hat{\lambda}_i = 1$, and these increase the weight of any pre-treatment periods that are more similar to the post-treatment periods. This method also adjusts the unit weights so that they are less sparse and engage more countries in the control group and so assign the weight of zero less frequently. The unit weights are chosen so that the constant difference is allowed between treatment and control over time; instead of identical pre-treatment trends like

[9] There are 20 countries for which the Distributional Wealth Accounts data are available, but we have to exclude Malta from the sample because Eurostat does not report the final consumption expenditures of households in the National Accounts for Malta. The final list of countries in our database is Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Estonia (EE), Greece (EL), Spain (ES), Finland (FI), France (FR), Hungary (HU), Ireland (IE), Italy (IT), Lithuania (LT), Luxembourg (LU), Latvia (LV), the Netherlands (NL), Portugal (PT), Slovenia (SI) and Slovakia (SK).

[10] Consumption is a flow variable and the ρ^h for $Treat^{h=0}$ refers to the change in consumption due to a reversal obtained within a month, where reference consumption is at quarterly frequency. The quarterly effect can be transferred to the monthly effect for ρ^h of $Treat^{h=0}$ by multiplying it by three. Household assets and liabilities are stock variables and refer to the household position at the end of the quarter in the DWA (see DWA methodology at https://data.ecb.europa.eu/sites/default/files/2024-01/DWA%20Methodological%20note_0.pdf). For assets and liabilities, the treatment effect always shows the change in position from the end of one quarter to the end of the other due to the reversal.

in the synthetic control model, there are consequently parallel pre-treatment trends. With two sets of weights, the synthetic difference-in-differences estimation of the average treatment effect on the treated, $\widehat{\rho^h}$, is obtained by (Arkhangelsky et al., 2021):

$$(\widehat{\rho^h}, \hat{\alpha}, \hat{\gamma}, \hat{\delta}, \hat{\tau}) = \underset{\rho^h,\alpha,\gamma,\delta,\tau}{\arg\min} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (\Delta Var_{it} - \alpha_i - \rho^h Treat_{it}^{t+h} - \tau_t)^2 \widehat{\omega}_i \hat{\lambda}_t \right\} \tag{2}$$

With equal unit and time weights, the estimate of $\widehat{\rho^h}$ equals the OLS estimate of the difference-in-differences model shown in equation (2). The results of the conventional OLS without these weights are also presented for reference. For the synthetic difference-in-differences, we use the placebo intervention method to derive standard errors for our estimate. In this method, the statistical inference is made by comparing the estimated treatment effect to a distribution of effects obtained by randomly assigning treatment to control units (Abedie et al., 2010). Bootstrapped or jack-knife standard errors are not feasible for a setting where there is only one treatment unit.

Table 2 presents the average growth rates of the treatment and control groups at the time before the reform. The Distributional Wealth Accounts data are available for 14 control group countries from the second quarter of 2013, and this defines our first treatment group. However, these data are missing for the first sample years for the other Baltic countries, which have the closest macro-dynamics to Estonia. To extend the control group to neighbouring countries, we also introduce a second control group where the data start from the third quarter of 2017 and that has the four additional countries of Hungary, Latvia, Lithuania and the Netherlands. We also define a third control group, which consists of the two closest neighbours to the treatment country, Latvia and Lithuania. As expected, the pre-treatment dynamics in the second control group are closer to those of the treatment country than are those of the first control group, and the third control group is closer to the treatment country than the second one is.

Table 2. The average growth of the outcome variables in Estonia and in the control group, pre-treatment period

	Time-series 2013Q3–2021Q2		Time-series 2017Q4–2021Q2		
	Estonia, mean (n=32)	Control group 1: 14 countries, mean (n=448)	Estonia, mean (n=15)	Control group 2: 18 countries (n=270)	Control group 3: 2 countries (n=30)
ΔConsumption	1.2	0.5	1.1	0.3	0.9
ΔDeposits	2.3	1.0	2.7	1.6	2.9
ΔRiskyFinAssets	5.2	0.6	6.0	1.2	2.2
ΔConsumerCredit	1.2	–0.05	0.6	0.2	0.1
ΔHousingCredit	1.3	0.7	1.7	0.9	1.3
ΔHICP	0.3	0.2	0.4	0.3	0.4

Notes: All the variables except consumption are first seasonally adjusted using the TRAMO/SEATS algorithm; next, the logarithmic transformation is made from the seasonally adjusted data. Consumption data are available seasonally and on working days adjusted from Eurostat, and the authors have performed no further adjustments to these data. Differences refer to log differences in per cent.

In addition to the macro data, we use also microdata from the 2021 wave of the Household Finance and Consumption Survey (HFCS) in Estonia. The advantage of this database is that it was collected between January and August 2021, so shortly before the reversal of the pension system. This gives us a good benchmark for the balance sheet of households shortly before the reversal. We also know who had filled in the application to withdraw their assets in that

September, as we obtained this from the register of the Pension Centre and merged that information with the household balance sheet. The HFCS also collects a lot of background variables on households and we focus on the MPC question in this paper. The MPC of households was self-reported in response to the following question (question hiz050x in HFCS, 2020): "Imagine you unexpectedly receive money from a lottery, equal to the amount of income your household receives in a month. What per cent would you spend over the next 12 months on goods and services, as opposed to any amount you would save for later or use to repay loans?". The same self-reported MPC has previously been used by Jappelli and Pistafferi (2014) to study household MPC heterogeneity and it has been shown that it provides estimates that are similar to the actual behaviour of households (Parker and Souleles, 2019). We apply the HFCS data to understand the micro-foundations behind the aggregate response and to understand whether households with a high MPC were more likely to choose to withdraw their pension savings. Unfortunately, we do not have this data available for after the reversal so that we could use this data to estimate the effect of reversal on leavers' balance sheet. We calibrate the response of leavers using the estimated aggregate level effects and household balance sheet from before the reversal.

4. Results

4.1 Household finances at the aggregate level

This subsection presents the results of the aggregate data estimations for the outcome variables of household finances. The results of the conventional difference-in-differences (DID) and the synthetic difference-in-differences (SDID) are shown in Table 3. Given that the SDID estimates are better at identifying the average effect of treatment on the treated, we mostly use these estimates for our interpretation of the results, while the DID estimates are shown for reference. Our preferred set of estimates is shown in the last column, column (6), where the control group is created using the synthetic difference-in-differences method and the set of countries in the control is narrower, containing only Latvia and Lithuania as the closest neighbour countries. The graphical results are shown in Appendix B, which presents the size of the unit and time weights, the results when a single country is used in the control group, and the outcome dynamics for Estonia and the synthetic control group.

The first conclusion from the results is that the effects are either very similar across estimation methods and control groups or quite dispersed, depending on the outcome variable observed. The results for deposits, risky financial assets and the stock of consumer loans are very similar whichever countries are in the control group. There is convincing evidence that deposits and risky financial assets increased and the stock of consumer credit declined because of the reversal. The results for deposits are similar also across estimation methods, as the DID and SDID give very similar estimates. The outstanding amount of deposits increased by 7–8% by $h=0$ or the first month, but the effect had declined to 2% by $h=1$ or month four and to 1–2% by $h=2$ or month seven, and it became mostly statistically insignificant after that. The DWA data report household balance sheet items for the end of the quarter, so the effect felt by $h=0$ is the change from June to September or the effect at the end of month one, and the effect seen by $h=1$ is the average change over two quarters, from June to September and from September to December, or the average accumulated effect by month four.

Table 3. Effects of the reversal on household finances, DID and SDID estimates

	Time-series since 2013Q3				Time-series since 2017Q4	
	Control group 1: 14 countries		Control group 2: 18 countries		Control group 3: 2 Baltic countries	
	(1) DID	(2) SDID	(3) DID	(4) SDID	(5) DID	(6) SDID
ΔConsumption(t):						
$\text{Treat}^{h=0}$(t) (1 in 2021Q3,	–1.5*	0.1	–1.3**	0.4	–0.3	3.4***
0 otherwise)	(0.7)	(3.2)	(0.6)	(2.7)	(0.9)	(0.8)
$\text{Treat}^{h=1}$(t) (1 in 2021Q3–	0.4	1.1	0.5	0.4	0.3	1.1***
2021Q4, 0 otherwise)	(0.5)	(1.7)	(0.4)	(2.0)	(0.9)	(0.2)
$\text{Treat}^{h=2}$(t) (1 in 2021Q3–	1.5***	2.0*	1.3***	1.5	0.5	0.9***
2022Q1, 0 otherwise)	(0.3)	(1.1)	(0.3)	(1.5)	(0.5)	(0.0)
$\text{Treat}^{h=3}$(t) (1 in 2021Q3–	1.1***	1.8	1.0***	1.4	0.3	1.0***
2022Q2, 0 otherwise)	(0.3)	(1.2)	(0.3)	(1.5)	(0.6)	(0.1)
$\text{Treat}^{h=4}$(t) (1 in 2021Q3–	0.8**	1.6**	0.7**	1.2	–0.1	0.3***
2022Q3, 0 otherwise)	(0.3)	(0.8)	(0.3)	(1.2)	(0.5)	(0.02)
ΔDeposits(t):						
$\text{Treat}^{h=0}$(t) (1 in 2021Q3,	7.6***	7.3***	7.6***	7.8***	8.1***	8.2***
0 otherwise)	(0.2)	(0.4)	(0.1)	(1.1)	(0.2)	(0.1)
$\text{Treat}^{h=1}$(t) (1 in 2021Q3–	2.0***	1.7***	2.0***	2.1**	2.4***	2.4***
2021Q4, 0 otherwise)	(0.1)	(0.5)	(0.1)	(0.8)	(0.1)	(0.02)
$\text{Treat}^{h=2}$(t) (1 in 2021Q3–	1.1***	0.6	1.2***	1.2	1.9	1.9**
2022Q1, 0 otherwise)	(0.2)	(0.4)	(0.2)	(1.0)	(0.8)	(1.0)
$\text{Treat}^{h=3}$(t) (1 in 2021Q3–	0.3*	–0.2	0.4***	0.4	1.1	1.2
2022Q2, 0 otherwise)	(0.2)	(0.4)	(0.1)	(0.7)	(0.7)	(0.7)
$\text{Treat}^{h=4}$(t) (1 in 2021Q3–	0.2	0.1	0.3**	0.4	1.1	1.1
2022Q3, 0 otherwise)	(0.2)	(0.5)	(0.1)	(0.6)	(0.7)	(0.7)
ΔRiskyFinAssets(t):						
$\text{Treat}^{h=0}$(t) (1 in 2021Q3,	13.7***	10.1**	13.3***	7.9**	15.2**	6.0**
0 otherwise)	(1.0)	(4.7)	(0.7)	(3.1)	(2.0)	(2.6)
$\text{Treat}^{h=1}$(t) (1 in 2021Q3–	10.5***	6.2	10.3***	5.3**	12.6	1.2
2021Q4, 0 otherwise)	(0.8)	(4.1)	(0.7)	(2.4)	(4.7)	(6.2)
$\text{Treat}^{h=2}$(t) (1 in 2021Q3–	4.8***	3.1	4.4***	1.1	5.7	–4.1
2022Q1, 0 otherwise)	(0.7)	(2.4)	(0.5)	(1.4)	(2.6)	(3.5)
$\text{Treat}^{h=3}$(t) (1 in 2021Q3–	3.0***	1.4	2.5***	–0.2	2.0	0.1
2022Q2, 0 otherwise)	(0.7)	(3.5)	(0.4)	(1.2)	(0.9)	(0.2)
$\text{Treat}^{h=4}$(t) (1 in 2021Q3–	1.4**	1.0	0.9**	0.6	0.3	–0.6***
2022Q3, 0 otherwise)	(0.6)	(4.7)	(0.4)	(1.7)	(0.4)	(0.03)
ΔConsumerCredit(t):						
$\text{Treat}^{h=0}$(t) (1 in 2021Q3,	–4.1***	–3.6	–3.6***	–3.6*	–6.0*	–2.4**
0 otherwise)	(0.5)	(2.7)	(0.4)	(2.0)	(1.4)	(0.9)
$\text{Treat}^{h=1}$(t) (1 in 2021Q3–	–3.4***	–3.2	–2.9***	–2.8**	–5.2**	–1.7***
2021Q4, 0 otherwise)	(0.3)	(2.0)	(0.3)	(1.4)	(0.9)	(0.3)
$\text{Treat}^{h=2}$(t) (1 in 2021Q3–	–2.4***	–2.0	–1.9***	-0.7	–4.6**	–4.0***
2022Q1, 0 otherwise)	(0.5)	(2.6)	(0.5)	(2.2)	(0.6)	(0.1)
$\text{Treat}^{h=3}$(t) (1 in 2021Q3–	–1.6***	–1.3	–1.0**	0.1	–3.6**	–3.2***
2022Q2, 0 otherwise)	(0.3)	(2.3)	(0.5)	(1.8)	(0.4)	(0.0)
$\text{Treat}^{h=4}$(t) (1 in 2021Q3–	–1.1***	–1.0	–0.4	0.4	–2.6***	–2.5***
2022Q3, 0 otherwise)	(0.2)	(2.0)	(0.4)	(1.7)	(0.05)	(0.01)
ΔHousingCredit(t):						
$\text{Treat}^{h=0}$(t) (1 in 2021Q3,	0.5**	0.3	-0.04	-0.03	–1.2	–0.2
0 otherwise)	(0.2)	(0.8)	(0.3)	(1.6)	(1.6)	(2.6)
$\text{Treat}^{h=1}$(t) (1 in 2021Q3–	0.7**	0.6	0.3	0.2	–0.6	0.2
2021Q4, 0 otherwise)	(0.2)	(0.8)	(0.2)	(1.6)	(1.3)	(2.1)
$\text{Treat}^{h=2}$(t) (1 in 2021Q3–	0.5***	0.4	0.2*	0.3	–0.5	–0.1
2022Q1, 0 otherwise)	(0.2)	(0.6)	(0.1)	(0.9)	(0.7)	(1.1)
$\text{Treat}^{h=3}$(t) (1 in 2021Q3–	0.7***	0.5	0.5***	0.5	–0.2	0.2
2022Q2, 0 otherwise)	(0.2)	(0.5)	(0.1)	(0.8)	(0.7)	(1.1)

$Treat^{h=4}(t)$ (1 in 2021Q3–2022Q3, 0 otherwise)	0.8*** (0.2)	0.7 (0.5)	0.7*** (0.2)	0.7 (0.8)	–0.1 (0.7)	0.2 (1.1)
No of observations: $Treat^{h=0}(t)$	495	495	304	304	48	48
No of observations: $Treat^{h=1}(t)$	510	510	323	323	51	51
No of observations: $Treat^{h=2}(t)$	525	525	342	342	54	54
No of observations: $Treat^{h=3}(t)$	540	540	361	361	57	57
No of observations: $Treat^{h=4}(t)$	555	555	380	380	60	60

Notes: Each coefficient in the table refers to separate estimates of equation (1) or (2). DID is the difference-in-differences estimation and SDID is the synthetic difference-in-differences estimation. The effect of the treatment variable $Treat^{h=0}(t)$ are estimated on a timespan up to 2021Q3 or by M1; $Treat^{h=1}(t)$ up to 2021Q4 or by M4; $Treat^{h=2}(t)$ up to 2022Q1 or by M7; $Treat^{h=3}(t)$ up to 2022Q2 or by M10; and $Treat^{h=4}(t)$ up to 2022Q3 or by M13. Differences refer to log differences in percentage.

There is somewhat more variation between the results for risky financial assets and the stock of consumer credit found by different estimation methods, and we focus here on the SDID estimates. Risky financial assets increased by 6–10% by *h=0*, then the effect declined to 1–6% by *h=2* and became mostly statistically insignificant afterwards. The stock of consumer loans declined by 2–4% by *h=0*, 2–3% by *h=1*, 1–4% by *h=2*, and according to the Baltic sample by 3% by *h=3* and *h=4*. The decline in the stock of consumer loans felt the most persistent effect, which was still strong in month 13 in the Baltic sample. The effect by *h=1* or month four shows the average effect over two treatment periods, *h=2* shows three treatment periods or month seven, and so on. So the strongest effect on deposits and risky financial assets appears during the first treatment period or by month one and the strongest effect on consumer loans is during the third period or by month seven.

The results for housing credit and consumption are qualitatively different for different estimation methods and control groups. The results for the outstanding amount of housing credit show a positive effect when estimates with a larger control group and the DID method are used, while the effect is statistically insignificant in all the other estimates. Given that the growth in housing credit was stronger in Estonia and the other Baltic countries than in control groups 1 or 2, as shown in Figures 1–3 in Appendix B, we trust the results with the Baltic sample or with a weighted control group, and conclude that there is no statistically significant effect on the stock of housing loans. The results for consumption show the dynamics of the estimated SDID effects for control groups 1 and 2 are different to those for control group 3. The wider control group suggests the strongest response from consumption is in *h=2* or by month seven, and the Baltic sample suggests the strongest response is in *h=0* or by month one. The results with the Baltic countries in the control group are the preferred ones, because consumption was stronger in the Baltic countries than in other euro area countries shortly after treatment and the Baltic countries are more suitable as controls. The related papers also suggest that the effect of an income shock on consumption should be largest shortly after the transfer of money is made (Fagereng et al., 2021; Jappelli et al., 2024) and there is evidence of similar consumption dynamics in the micro-data for consumption after the reversal in the third quarter of 2021 (Bulõgina and Kukk, 2025).

Like with financial assets, the effect on consumption is concentrated in the first period, or month one after the reversal. Aggregate consumption was 3.5% (exp(0.034)–1) higher in the third quarter of 2021 because of the reversal[11] and the average effect over two post-treatment quarters had declined to 1.1% by the last quarter of 2021. Given that this response in aggregate

[11] This increase of 3.5% is growth where quarterly consumption is a reference, and given that the monthly consumption is on average one third of quarterly consumption, the month-over-month consumption growth was around three times larger or 10.5% in September 2021. This interpretation differs from that found from balance sheet items because they are stock variables whose values do not differ in monthly or quarterly frequency.

consumption was created by a small subgroup of withdrawers within the total population, the increase in consumption among those withdrawing their money was substantial. The withdrawers were 12% of the adult population and accounted for 12% of consumption[12], so the response of withdrawers can be deducted by dividing all the coefficients in Table 3 by 0.12. This gives an increase in consumption of 29% for the withdrawers by month one if quarterly consumption is used as the base[13], 9% by month four, 8% by month seven and month ten, and 3% by month 13. So the response in consumption was strongly concentrated in the very first period, but consumption then remained elevated for several quarters and the largest accumulated effect was observed by the second quarter of 2022 (see Table 1 in Appendix C)[14]. Similar derivations for the subgroup of withdrawers indicate that the deposits of withdrawers more than doubled, because the deposits of those who withdrew were only 4% of total deposits before the reversal as shown by the HFCS individual-level registry data. The risky financial assets of withdrawers increased even more because the share of those assets held by withdrawers was as small as 0.2%, and the average value of those assets was also very small for them at 23 euros.

One of the key characteristics of the financial profile of leavers was that they had very few liquid assets (Korasteljov et al., 2023; Bulõgina and Kukk, 2025), so the money withdrawn was a substantial amount of their financial assets. We also find that the leavers had much larger liabilities than the stayers, as the debt of the leavers made up 46% of the outstanding balance of consumer credit and 20% of the housing credit. Our estimates show that the aggregate consumer credit stock had declined by 2.4% by month one, which implies that the credit stock of the leavers had declined by 5.1% (coefficients in column (6) of Table 3 divided by 0.46) and this effect then increased to 8.6% per quarter by month seven. All these consumption and balance sheet effects suggest that the finances of the withdrawers were very strongly affected by the reversal.

We next decompose how the money withdrawn was allocated using the estimated effects from Table 3 and the value of the outcome variables in the second quarter of 2021, before the reversal. We proceed from the preferred estimates from the SDID method with Latvia and Lithuania in the control group. The intermediate steps of the calculations are shown in Appendix C and the main findings are summarised in Figure 3. This back-of-the-envelope analysis allows us to trace most of the 1.1 billion euros withdrawn in September 2021, and the accumulated total effects for all the sample periods studied are very close to this amount; see Table 2 in Appendix C. The results suggest that more than half of the assets withdrawn were saved as deposits up to a year after the reversal or by month 13. The effect on consumer loans was also substantial and we assign up to 30% of the assets withdrawn to the reduction in the outstanding amount of consumer loans. Around 250 million euros of consumer loans were paid back according to our estimates, and this estimate is well in line with the decline in the

[12] The participation rate in the second pillar was 58% for the population aged 16 and older, and 20% of participants withdrew their assets, meaning 12% of the adult population were exposed to the reversion. This share coincides with the share of consumption of goods and services of adult leavers. We derive the consumption of goods and services by adult household members in the HFCS using the variables hi0220 and dh0006, and find the share of consumption by leavers to be equal to their population share of 12%. Leavers have lower consumption than stayers, at 970 euros per month against 1030, but the higher consumption of the stayers was balanced by the low consumption of 920 euros per month of those who did not participate in the second pillar.

[13] As discussed in footnote ten, this would correspond to 87% growth in month-over-month consumption.

[14] The amounts withdrawn in the second and third rounds could have contributed to making consumption elevated as well. Although the amounts withdrawn were smaller than in the first round, at 0.095 and 0.181 billion euros against 1.34 billion (Sotsiaalministeerium, Rahandusministeerium, 2022), the concentration of consumption in the very first months after the reversal probably contributed to consumption being elevated in the first half of 2022.

outstanding amount of consumer loans given out by credit institutions, which declined by 120 million euros and 70 million in the first two quarters after the reversal[15]. Substantial amounts were also consumed, as up to 15% of the money withdrawn went on consumption. Risky financial assets only increased during the first period and the effect disappeared by later quarters, while the effect on housing credit was statistically insignificant for all the periods and so we refrain from interpreting these effects.

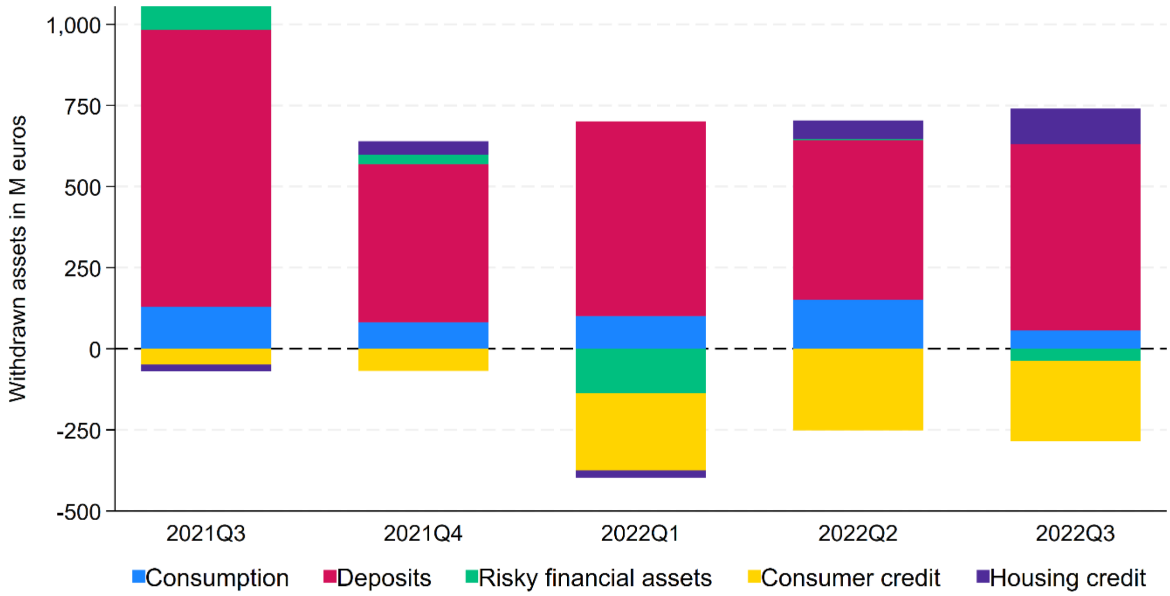

Figure 3. The allocation of the assets withdrawn in million euros, accumulated effects of SDID estimates using the Baltic sample

Notes: The period 2021Q3 refers to $Treat^{h=0}$, 2021Q4 to $Treat^{h=1}$, 2022Q1 to $Treat^{h=2}$, 2022Q2 to $Treat^{h=3}$ and 2022Q3 to $Treat^{h=4}$. Coefficients are obtained from the last column of Table 3 and the effects are put into monetary terms using the last quarter value before the reversal in 2021Q2. Appendix C shows the intermediate calculations behind the figure.

In total, the findings suggest that the assets withdrawn from pension funds were either saved as deposits and risky financial assets, used to pay back consumer credit, or consumed, and that the largest share of the assets stayed in the deposit accounts of the withdrawers, were used to pay back consumer debt, or were consumed. We also find that the consumption effects were concentrated in the first quarters after the reversal.

4.2 Why was consumption so responsive? Micro-foundations

One of the key findings so far and in the related literature has been that the MPC was high for the pension money withdrawn. Our estimates from Table 3 and Appendix C indicate that the withdrawers had already consumed 11% of the money they had withdrawn within September 2021, so within the third quarter of 2021. Bulõgina and Kukk (2025) also find that the main effect on expenditures was realised within the first month after the withdrawal, and the excess amount in deposits had disappeared by the third month after the withdrawal. This subsection

[15] See Bank of Estonia statistics on credit institutions at https://statistika.eestipank.ee/#/en/p/FINANTSSEKTOR/147. The consumer loans given out by credit institutions amount to one third of total consumer credit.

seeks to understand whether households chose to withdraw their money because of their MPC (self-reported in HFCS). We learned in the previous section that there was no difference between the levels of consumption of leavers and stayers, but here we hypothesise that the households withdrawing had a higher MPC than those that continued to participate in the second pillar, which could explain the strong response in consumption that was observed.

Figure 4 presents the results for the MPC. The first finding is that the MPC of the leavers is 5.3 percentage points higher than that of the stayers. If there were no selection into withdrawing because of the MPC, the response of consumption to the reversal would have been 13% lower than it was. Therefore the response in consumption was amplified by the households with a higher MPC choosing to withdraw. This is a sizeable amplification mechanism compared to the 20% amplification caused by the MPC that arises because households with lower incomes and a higher MPC are more vulnerable to aggregate macroeconomic shocks (Patterson, 2023). The withdrawing households also robustly reported more impatience, as 31% of withdrawers were willing to give up 20% of their income to get access to the gain immediately instead of waiting for a year for example, while only 16% of stayers were as impatient (self-reported question hiz040a in HFCS).

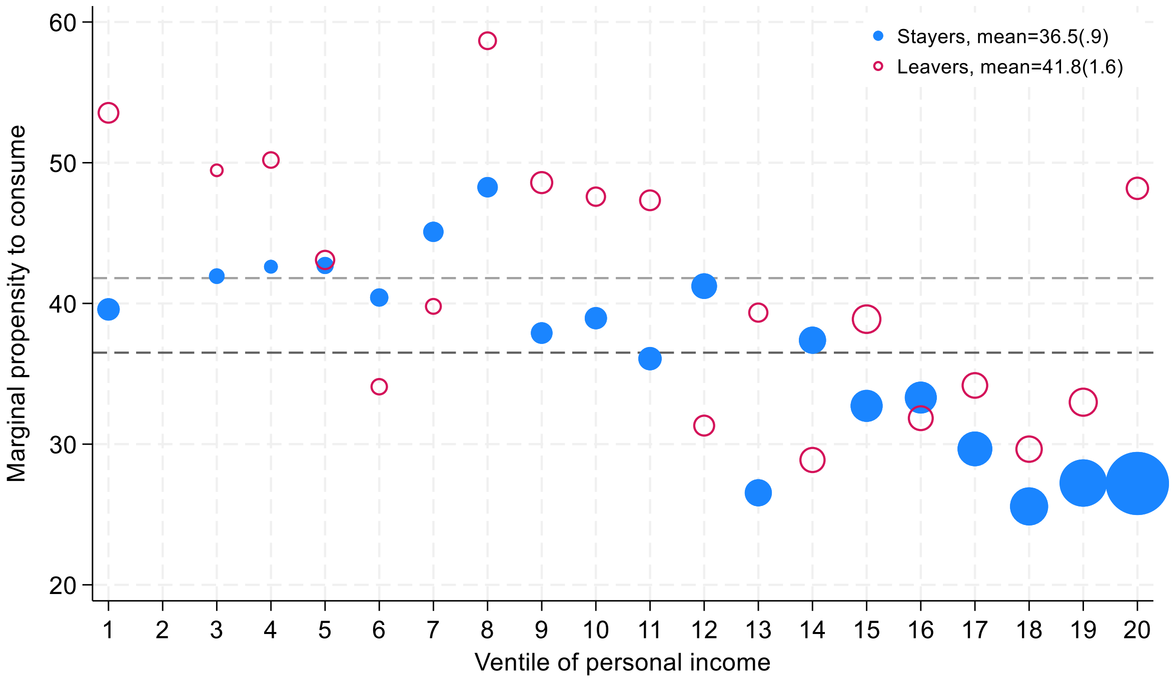

Figure 4. Stayers and leavers in the second pillar by the marginal propensity to consume (MPC)

Notes: Marker size indicates the second pillar pension assets accumulated pre-reversal by income ventile and the decision to leave or stay. The vertical lines show the average MPC of stayers and leavers and the mean value together with standard errors in brackets are reported in the legend. MPC is collected at the household level, and the decision to leave and income at the individual level.

Source: Household Finance and Consumption Survey 2021.

Another message from Figure 4 is that the division of the MPC between stayers and leavers was especially high for individuals with low or high incomes. While the MPC of stayers decreases monotonically as income rises, the MPC of leavers has a non-linear pattern and is high for the leavers from the lowest income ventiles *and* for those in the highest income ventile. This group of high-income leavers are probably the wealthy hand-to-mouth group and the large size of their assets in the second pillar meant they also had an important role in driving the strong response in consumption.

We also observe that the self-reported MPC would predict that a much larger share of pension assets should have been consumed after the reversal than was suggested by the aggregate estimates in Appendix C. The households withdrawing self-reported that they would consume 42% of a windfall gain equal to their monthly income within a year after receiving it, but the aggregate estimates suggest that they had spent only 15% of their withdrawn pension savings by the second quarter of 2022. The lower level of actual spending could be because the nature of the shock was different as it was not a windfall gain but a withdrawal of pension assets. Another plausible explanation is the size of the shock, since the self-reported MPC refers to a windfall gain of one month's income, but the actual average assets withdrawn equalled the income of 7.5 months, since the average sum withdrawn was 6600 euros after taxes according to the HFCS. Fagereng et al. (2021) show that the size of the shock is highly relevant for explaining the MPC for windfall gains, as smaller sums are more likely to be consumed within a year. The estimated marginal propensity of expenditures (MPE) from pension fund liquidations that were targeted as a fiscal stimulus and were smaller in size give an upper bound for our MPC estimates, as the related literature suggests the MPE to be around 0.65 (Kreiner et al., 2019) estimated from an average payout of 1900 US dollars or 0.43–0.48 (Hamilton et al., 2024) estimated from an average payout of 5700 US dollars[16].

In short we confirm that there is a strong selection into early withdrawal of pension assets dependent on the MPC of the household. Households with high MPC and impatient ones were more likely to withdraw their pension assets, and this amplified the response in aggregate consumption.

4.3 Economic stability, inflation

The key factor for economic stability is inflation and the key aim of monetary policy is to smooth the economic cycle and keep inflation low and stable. The size of the income shock caused by the reversal was so substantial that it probably affected economic stability. The assets withdrawn totalled 1.34 billion euros in September 2021, of which 20% went into the government budget and the rest into private accounts. The quarterly GDP in the second quarter of 2021 was 7.96 billion euros, so the size of the liquidity shock was 17% of the total value added created in the previous quarter. This subsection asks whether this shock affected inflation. We apply the same estimation method as in equations (1) and (2) and the same set of control groups; the results are shown in Table 4.

Focusing on the SDID estimates, as they are more accurate than the DID ones, shows that the reversal was not inflationary in the very first quarter, but inflation started to rise from the second quarter after the reversal, or from month two to month four. Inflation was calculated as the quarterly average of monthly inflation, as shown in Table 1, so it is unlikely to show up in the very first quarter. The estimates for the treatment period $h=1$ show excess inflation of 1% on average per quarter for Estonia over the synthetic control group and 2% for the longer treatment periods $h=2$ and $h=3$. The additional estimates from the figures are shown in Figure 4 in Appendix B and suggest that the estimates on the wider control groups 1 and 2 probably overestimate this effect. The Baltic countries were exposed to much higher inflation than the other euro area countries during the treatment period, but this was related to the increase

[16] Wang-Ly and Newell (2022) report the average payment to be 7569 A$ in Australia, which corresponds to 5682 US$ by the average exchange rate of 1.332 in 2021.

in energy prices and not to the reversal of pensions. All the Baltic countries were affected by the surge in energy prices caused by the start of Russia's war in Ukraine in 2022, since they were partially reliant on energy imports from Russia before the onset of the war. We trust the estimates from the Baltic sample the most, like with the estimates for household finances, and these results imply that the reversal increased inflation from the fourth quarter of 2021 to the second quarter of 2022, and kept it higher by up to 1.8 percentage points per quarter.

Table 4. The effect of the reversal on inflation, DID and SDID estimates

	Time-series since 2013Q3				Time-series since 2017Q4	
	Control group 1: 14 countries		Control group 2: 18 countries		Control group 3: 2 Baltic countries	
	(1) DID	(2) SDID	(3) DID	(4) SDID	(5) DID	(6) SDID
ΔP(t):						
$Treat^{h=0}(t)$ (1 in 2021Q3,	–0.7***	–0.7***	–0.8***	–0.6	–1.7*	–1.0
0 otherwise)	(0.1)	(0.2)	(0.1)	(0.5)	(0.5)	(0.9)
$Treat^{h=1}(t)$ (1 in 2021Q3–	1.1***	1.2***	0.9***	1.0**	–0.05	0.7
2021Q4, 0 otherwise)	(0.1)	(0.2)	(0.1)	(0.5)	(0.5)	(0.8)
$Treat^{h=2}(t)$ (1 in 2021Q3–	2.4***	2.5***	2.2***	2.4***	1.0	1.7**
2022Q1, 0 otherwise)	(0.1)	(0.3)	(0.1)	(0.6)	(0.5)	(0.9)
$Treat^{h=3}(t)$ (1 in 2021Q3–	2.8***	2.9***	2.6***	2.6***	1.1*	1.8***
2022Q2, 0 otherwise)	(0.1)	(0.4)	(0.2)	(0.6)	(0.3)	(0.5)
$Treat^{h=4}(t)$ (1 in 2021Q3–	1.9***	1.8***	1.6***	1.3*	–0.1***	–0.1***
2022Q3, 0 otherwise)	(0.1)	(0.4)	(0.2)	(0.7)	(0.0)	(0.0)

Notes: Each coefficient in the table refers to separate estimates of equation (1) or (2). DID refers to the difference-in-differences estimation and SDID to the synthetic difference-in-differences estimation. The effect of treatment variable $Treat^{h=0}(t)$ is estimated on a timespan up to 2021Q3 or by M1; $Treat^{h=1}(t)$ up to 2021Q4 or by M4; $Treat^{h=2}(t)$ up to 2022Q1 or by M7; $Treat^{h=3}(t)$ up to 2022Q2 or by M10; and $Treat^{h=4}(t)$ up to 2022Q3 or by M13. Differences refer to log differences in per cent.

We run several robustness tests. First we run the same estimates as for the headline reported in Table 4 for the full set of 3-digit HICP components; see Appendix D. Higher prices for the energy components or transportation cannot be linked to the reversal, but the effects on clothing, furniture, household appliances, household maintenance, purchases of vehicles and personal effects are likely to be related to the reversal.

To exclude the negative supply shock coming from the energy sector, we run a decomposition by Shapiro (2024) that divides aggregate inflation into its supply and demand-driven components. This approach uses consumer price component-level data for prices and quantities to assign each industry either a supply or a demand-driven unexpected shock in each period using a sign-restrictions approach. The share of supply or demand-driven shocks in shaping inflation is obtained as a weighted average of the individual components going through either a demand or a supply shock, where the weights for the HICP item basket determine the importance of each component. Shapiro (2024) applies this methodology to US data and disentangles inflation into 129 components. Gonçalves and Koester (2022) apply the same methodology to decompose euro area inflation using Eurostat data. The Eurostat data allow fewer components to be disentangled, giving 72 price components that are merged with the turnover data of 45 NACE categories for services and trade. Although there are some differences in the data, both papers conclude that high post-pandemic inflation was driven equally by increases in supply and demand components.

We follow this methodology to split inflation into its demand and supply components and apply this to the Eurostat data for Estonia. There are even fewer categories available for Estonia, as 61 inflation components are merged with 28 industries from trade, services and manufacturing, and we conduct this analysis at the quarterly frequency. Appendix E presents further details about the decomposition methodology and the full set of components, while Figure 5 presents the contribution of the positive demand component alone to inflation. The results highlight the role of the positive demand component in the first phase of the high inflation after the pandemic. Figure 1 in Appendix E demonstrates that the second phase of the inflation surge in 2022 was mostly driven by a negative supply component. The increase in the positive demand-driven component in inflation coincides with the post-pandemic recovery in demand, but given that the increase in the positive demand component coincides with the time of the reversal and that this component stays elevated in 2022, there is support for the argument that some of the inflation was driven by the reversal. The components affected by the demand factor also confirm that clothing, household maintenance items, vehicles and many recreational activities were experiencing a demand shock at the time of the reversal.

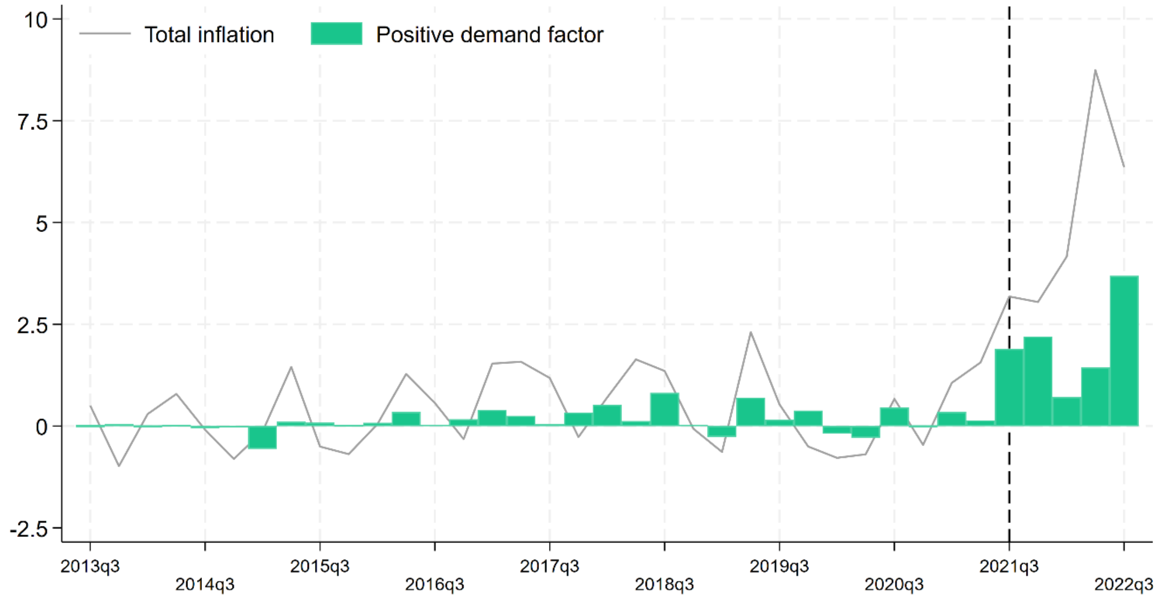

Figure 5. The contribution of the positive demand factor to the dynamics of inflation, 2013Q3–2022Q3

Notes: Appendix E presents the methodology and further decomposition into positive and negative supply and demand components.

5. Summary

Ageing populations and fiscal challenges have led many countries to shift from pay-as-you-go pension systems to multi-pillar funded models. However, Estonia implemented a major reversal of part of its pension reform in 2021, making participation in the earnings-dependent second pillar voluntary and allowing early withdrawals of the savings accumulated. This policy change resulted in a significant income shock, with 20% of eligible contributors withdrawing their savings immediately, taking the equivalent of 4.6% of the GDP one year before the reversal. This paper evaluates the short-term effects of this reversal on household finances, focusing on consumption, savings and debt. It explores whether households reinvested these assets, reduced their liabilities, or increased consumption, while also assessing the macroeconomic implications in the form of excess inflation.

The study uses a synthetic difference-in-differences approach to analyse aggregate-level data from Eurostat's National Accounts and ESCB's Distributional Wealth Accounts between the third quarter of 2013 and the third quarter of 2022, alongside micro-level insights from the Household Finance and Consumption Survey. The findings indicate that the reversal led to a temporary rise in deposits, increased investment in riskier financial assets, and reduced consumer loan balances, but it also triggered an increase in consumption. Our estimates using quarterly consumption as a base suggest that consumption by leavers increased by 29% in the first month after the reversal and estimates using monthly consumption as a base find an increase of 87%. The balance sheet effects get weaker over a year, as some of the liquid assets were consumed or were used to pay back debt. However, our results suggest that up to half of the assets withdrawn were still stored as deposits a year after the reversal and the effect on reinvestment in riskier financial assets was temporary. Around 15% of the assets withdrawn were consumed a year after the reversal, indicating that the MPC of the pension withdrawers was slightly lower than that estimated using withdrawals made during the Great Recession (Kreiner et al., 2019) or the Covid-19 shock (Hamilton et al., 2024). The study highlights the role of marginal propensities to consume (MPC) in the withdrawal decision, showing that households with a high MPC were more likely to withdraw their pension savings, amplifying the consumption surge.

The Estonian pension reform reversal of 2021 demonstrated that allowing early withdrawals from mandatory pension savings can have significant short-term effects on household finances and macroeconomic stability. The surge in consumption, driven by households with a high MPC, contributed to temporary inflationary pressures. We find the reversal had a positive effect on inflation and show that this was induced by a strong demand component. Further studies on micro-data and a longer timespan are warranted to reveal what happened to the accumulated deposits and the balance sheets of the withdrawers by the time they retired.

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Appendixes

Appendix A – Estonian data, stationarity tests

Table 1. Stationarity tests, Estonia 2013Q2–2022Q3

	Variable in levels		Variable in first differences	
	ADF test with intercept	ADF test with intercept & trend	ADF test with intercept	ADF test with intercept &trend
Log(Consumption)	0.79	–1.35	–6.59***	–6.85***
Log(Deposits)	1.20	–1.36	–3.03**	–3.09
Log(RiskyFinAssets)	0.45	–2.27	–3.15**	–7.77***
Log(ConsumerCredit)	–1.65	–1.10	–3.40**	–3.50*
Log(HousingCredit)	1.93	1.66	0.74	–0.42
Log(HICP)	–0.10	–3.22*	–4.22***	–4.66***

Notes: The table reports Augmented Dickey-Fuller test t-statistic with lag length one; the null hypothesis refers to the unit root, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All the variables except consumption are first seasonally adjusted using the TRAMO/SEATS algorithm; next, the logarithmic transformation is made from the seasonally adjusted data. Consumption data are available seasonally and on working days adjusted from Eurostat, and the authors have performed no further adjustments to these data.

Appendix B – Synthetic difference-in-differences models

The figures presented in this appendix show model outcomes and weights from the synthetic difference-in-differences program sdid for Stata (Clarke et al., 2023). Group 1 refers to estimates over a longer timespan from 2013Q3 to 2022Q2 and has 14 countries in the control group; Group 2 refers to estimates over a shorter timespan from 2017Q4 to 2022Q2 and has 18 countries in the control group; and Group 3 is for estimates over the same shorter time span with only the other two Baltic countries in the control group. The total set of countries in the control groups is listed in footnote nine.

The figures in the left column show the effect of the reversal when each control group country is used as a single control, which is denoted by the dot marker on the figure. The average effect using a synthetic control group of all the countries is denoted by the horizontal line and corresponds to the estimate for $h=4$ in Table 3. The size of the dot marker shows the unit weight for each country in the control group, $\widehat{\omega}_i$. The single control estimates are obtained as difference-in-differences estimates with a treatment country and one country at a time in the control group, and by applying the time weights, λ_t. The average treatment effect on the treated is a $\widehat{\omega}_i$-weighted average of the effects with a single control.

The figures in the right column show the dynamics of the outcome variables before and after the reversal for the treated country Estonia and the synthetic control group. This figure also shows the time weights, λ_t, which are displayed as the green shaded area of the graph, and the scale is presented on the right-hand side of the vertical axis. The vertical line shows the time of the event in 2021Q3.

The estimates for control group 3, which contains only the two Baltic countries, give very similar estimates to those when a single country is used in the control group. This is because the time weights dominate over the country weights in this case. Instead of these almost identical effects from this Baltic subsample, we show the DID estimates or estimates without time weights, λ_t; see Figure 3 below.

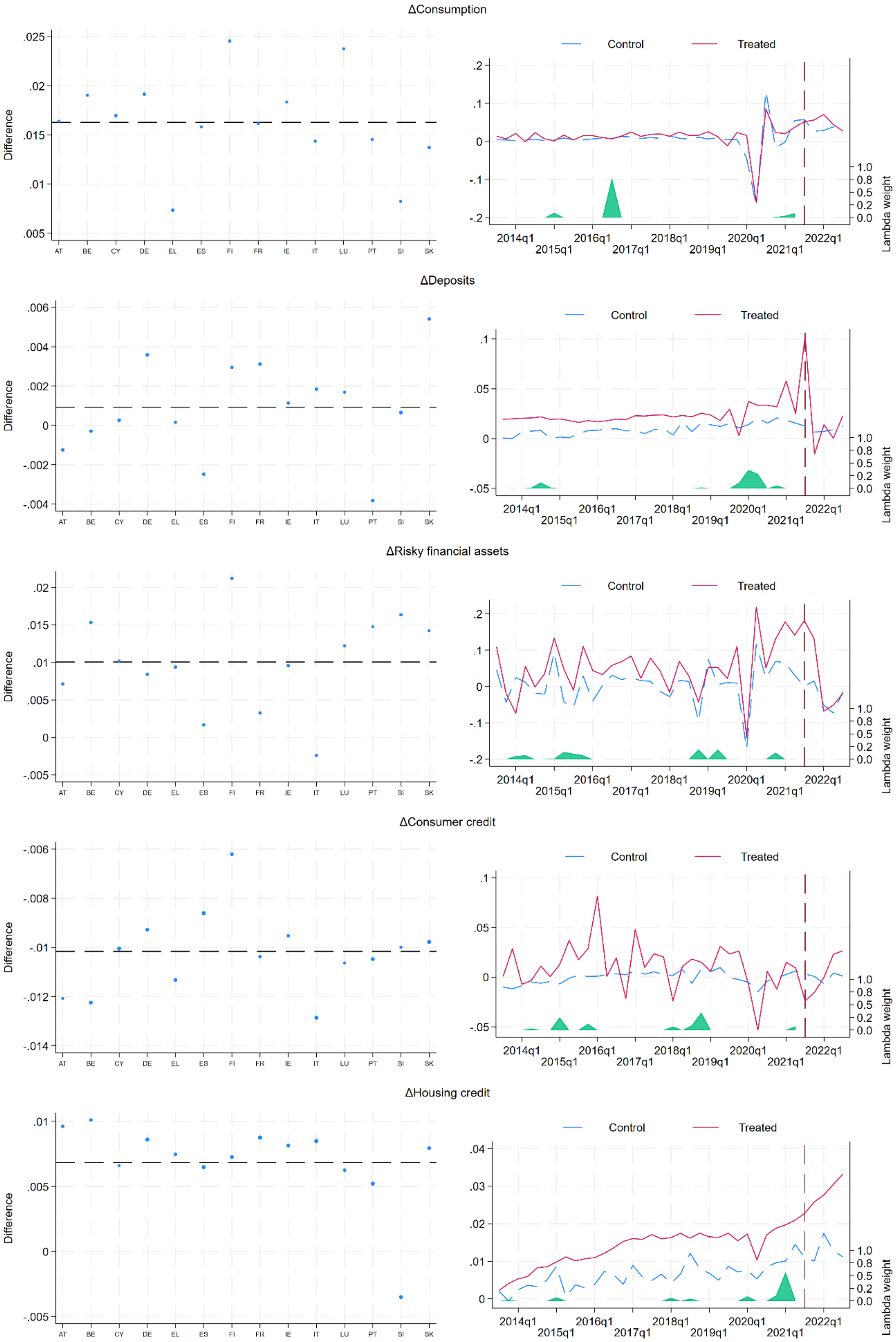

Figure 1. The synthetic difference-in-differences model for Group 1 and the effect of the reversal by month 13, 2013Q3–2022Q3 (see the notes at the beginning of Appendix B)

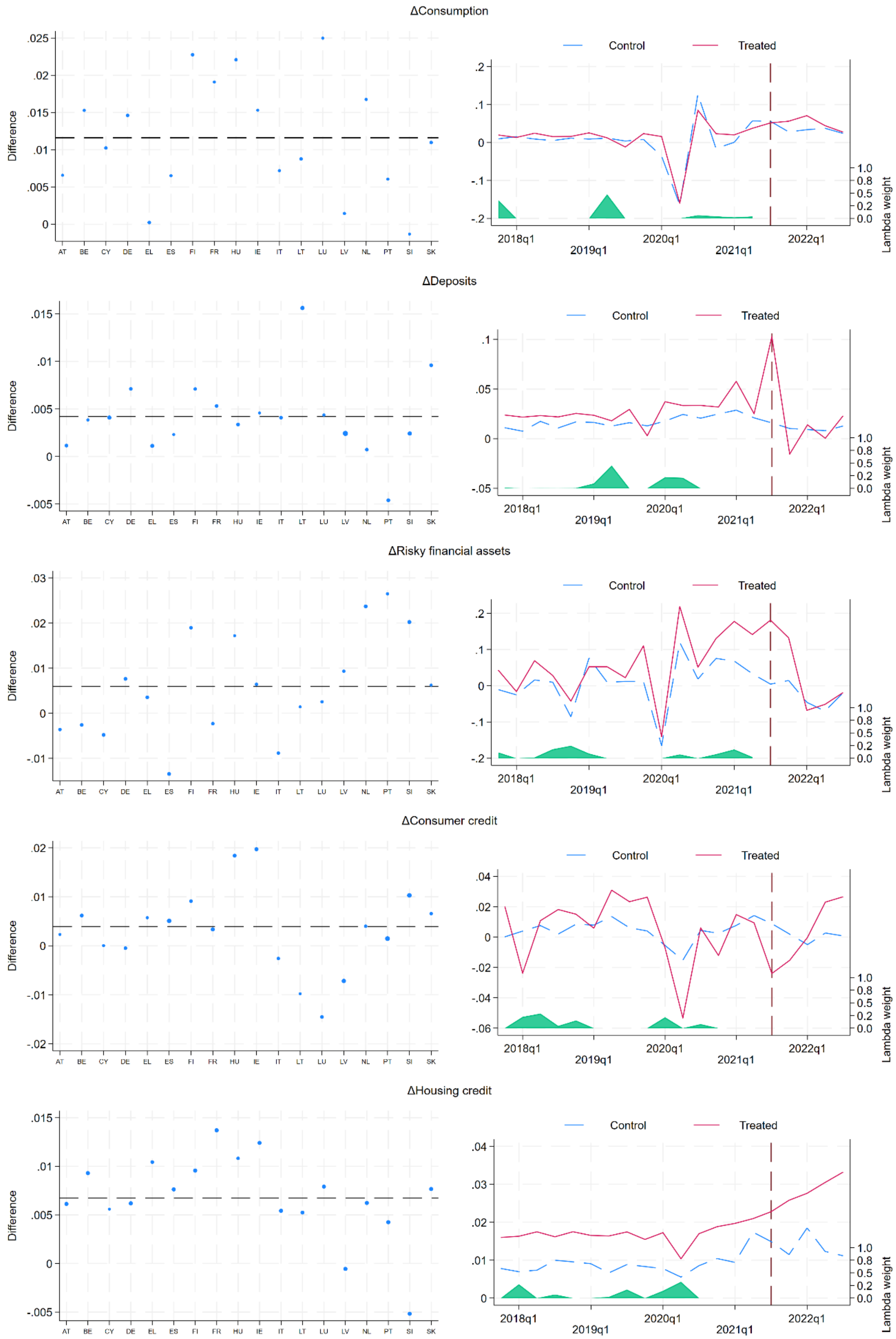

Figure 2. The synthetic difference-in-differences model for Group 2 and the effect of the reversal by month 13, 2017Q4–2022Q3 (see the notes at the beginning of Appendix B)

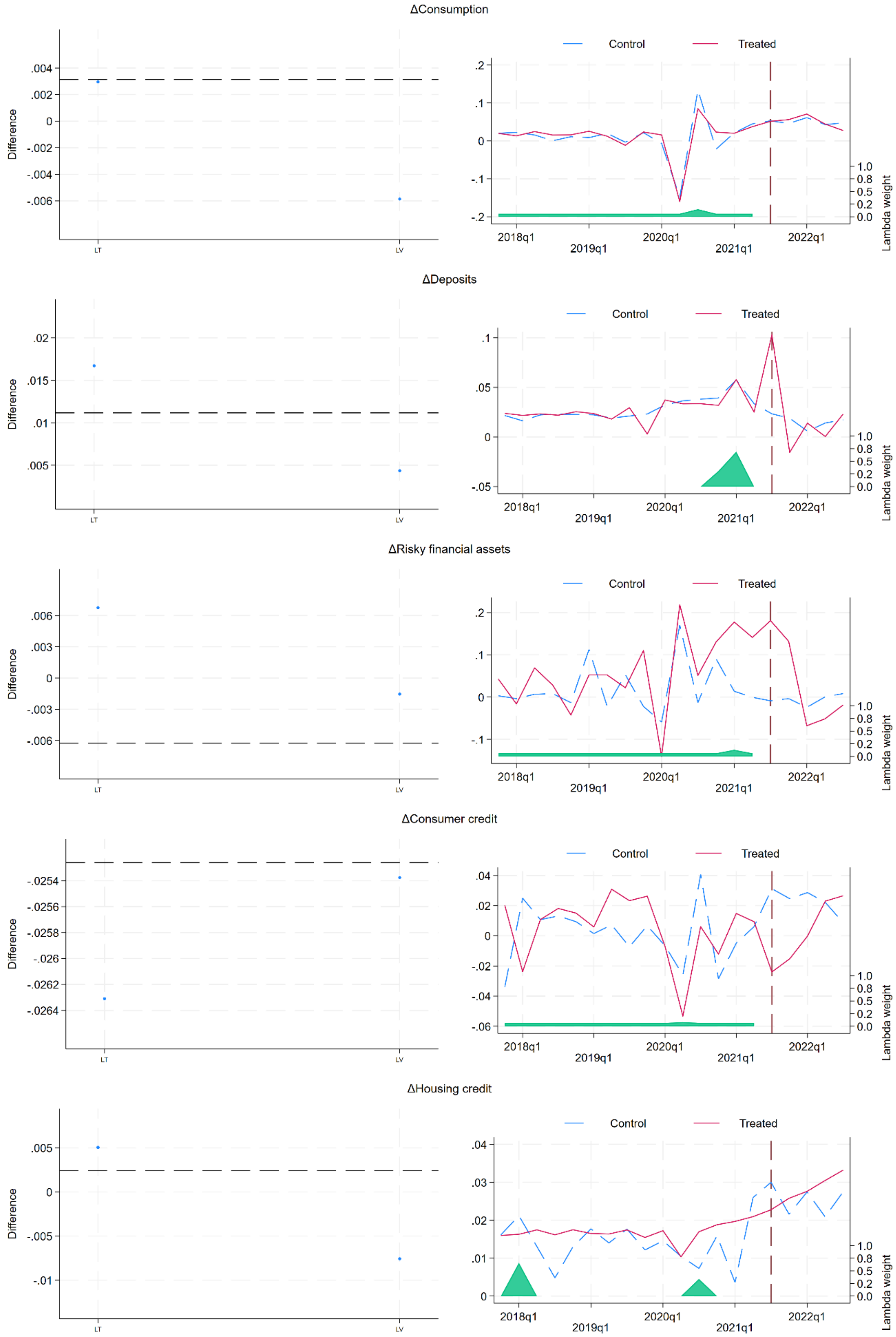

Figure 3. The synthetic difference-in-differences model for Group 3 and the effect of the reversal by month 13, 2017Q4–2022Q3 (see the notes at the beginning of Appendix B)

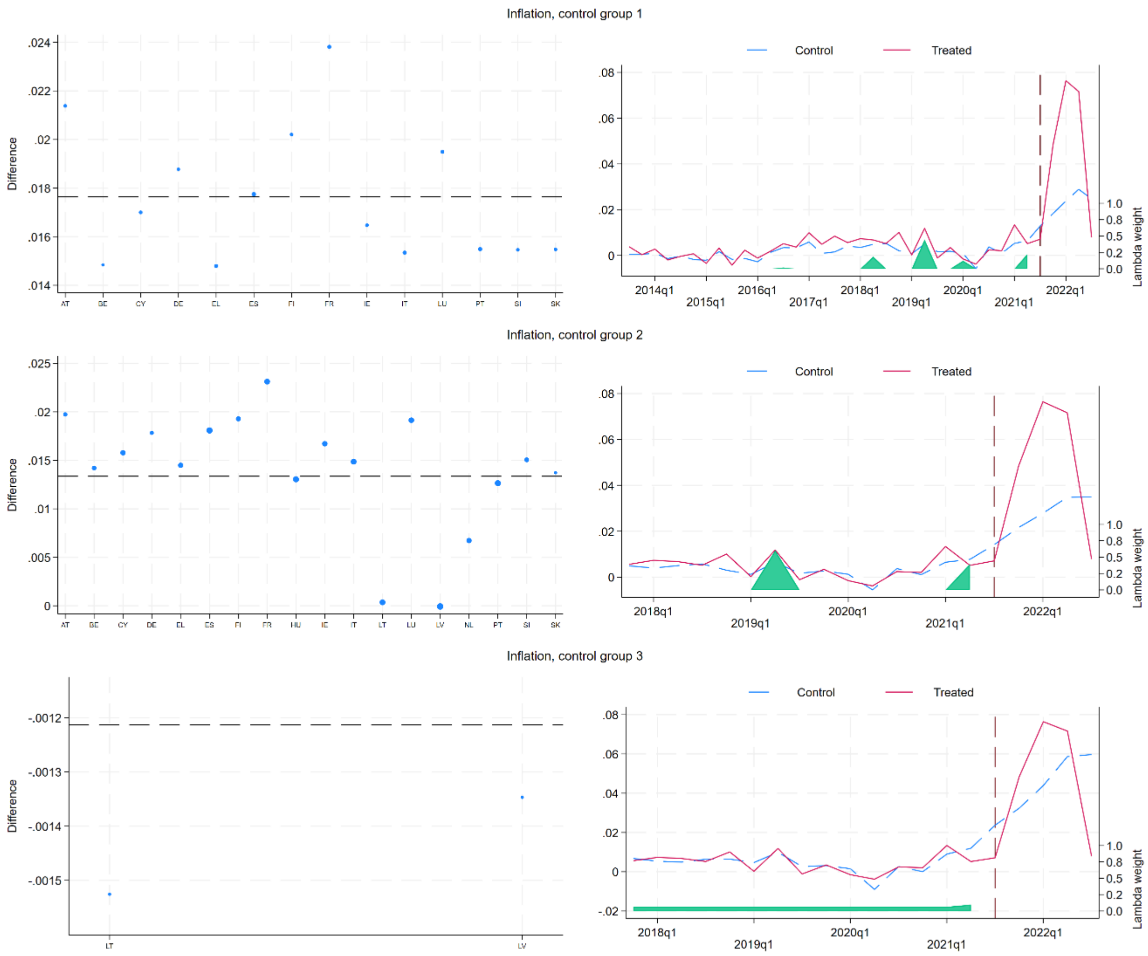

Figure 4. The synthetic difference-in-differences model and the effect of the reversal on inflation, 2013Q3–2022Q3 (see the notes at the beginning of Appendix B)

Appendix C – Tracing how the withdrawals were spent

This appendix traces how the 1.1 million euros withdrawn from pension assets in September 2021 were spent. Table 1 derives the effect of the reversal on the amounts consumed, saved, and used to pay back debt. The table employs coefficients from Table 3 in the main text on the Baltic sample and the base value of consumption, savings, and debt in the last quarter before the reversal, 2022Q2, to derive these estimates. Table 2 employs the estimates in million euros from Table 1 and derives the total amount of money spent because of the reversal that we can trace with our analysis. The table also presents the share of each item in the total. We treat the effect on credit in million euros as an absolute value in this analysis of Table 2, because the assets withdrawn could have been spent either on increasing or reducing the outstanding amount of debt.

Table 1. The effect of the reversal on household finances in 2021Q3–2022Q3, accumulated effects by SDID estimates on the Baltic sample

	ΔConsumption		ΔDeposits		ΔRiskyFinAssets		ΔConsumerCredit		ΔHousingCredit	
Level in M EUR 2021Q2	3696.7		10019.6		1186.0		2095.4		8963.8	
Time	Effect in %	Change in M EUR	Effect in %	Change in M EUR	Effect in %	Change in M EUR	Effect in %	Change in M EUR	Effect in %	Change in M EUR
2021Q3	3.5	128.7	8.5	853.6	6.2	73.4	–2.3	–49.0	–0.2	–20.1
2021Q4	1.1	84.3	2.4	487.2	1.2	28.6	–1.6	–68.3	0.2	41.5
2022Q1	0.9	105.3	2.0	600.1	–4.0	–136.7	–3.9	–238.4	–0.1	–22.0
2022Q2	1.0	146.1	1.2	491.8	0.1	4.0	–3.1	–251.4	0.2	57.2
2022Q3	0.3	58.5	1.1	575.5	–0.6	–36.5	–2.5	–248.6	0.2	108.7

Notes: Coefficients are obtained from Table 3 in the main text and transferred from log points to per cent by taking the exponential. The period 2021Q3 refers to $Treat^{h=0}$, 2021Q4 to $Treat^{h=1}$, 2022Q1 to $Treat^{h=2}$, 2022Q2 to $Treat^{h=3}$ and 2022Q3 to $Treat^{h=4}$. The shaded cells indicate the statistically significant effects.

Table 2. Allocation of assets withdrawn from the second pension pillar in 2021Q3–2022Q3, accumulated effects by SDID estimates on the Baltic sample

Time	The sum of estimated effects in M EUR	Proportion of consumption	Proportion of deposits	Proportion of risky financial assets	Proportion of consumer credit	Proportion of housing credit
2021Q3	1124.9	0.114	0.759	0.065	0.044	0.018
2021Q4	709.8	0.119	0.686	0.040	0.096	0.058
2022Q1	829.2	0.127	0.724	–0.165	0.288	0.027
2022Q2	950.5	0.154	0.517	0.004	0.264	0.060
2022Q3	954.8	0.061	0.603	–0.038	0.260	0.114

Notes: Estimated effects in million euros are obtained from Table 1 in Appendix C; the effects of consumption and financial assets and the absolute value of the effects on credit are summarised in the first column and the remaining columns report the proportion of each item in the estimated sum. The period 2021Q3 refers to $Treat^{h=0}$, 2021Q4 to $Treat^{h=1}$, 2022Q1 to $Treat^{h=2}$, 2022Q2 to $Treat^{h=3}$ and 2022Q3 to $Treat^{h=4}$. The shaded cells indicate the statistically significant effects.

Appendix D – The effect of the reversal on inflation components, SDID estimates

Group 1 refers to estimates over a longer timespan from 2013Q3 to 2022Q2 and has 14 countries in the control group; Group 2 refers to estimates over a shorter timespan from 2017Q4 to 2022Q2 and has 18 countries in the control group; Group 3 is for estimates over the same shorter time span with only the two Baltic countries in the control group. The total set of countries in the control groups is listed in footnote nine.

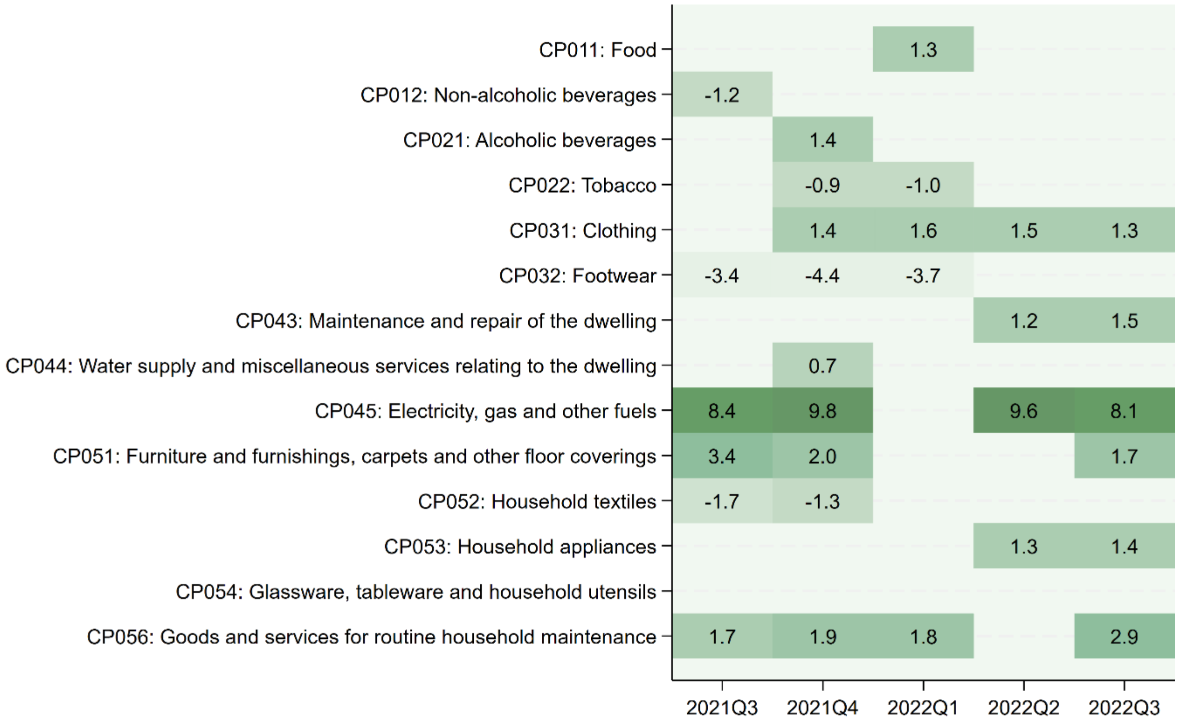

Figure 1. The effect of the reversal on inflation of goods, SDID estimates on Group 1

Notes: The figure reports the estimates of equation (3) for those inflation components where the effect of the reversal was statistically significant at least at a 10% level of significance. 2021Q1 on the horizontal axis refers to $Treat^{h=0}$, 2021Q3 to $Treat^{h=1}$ etc.

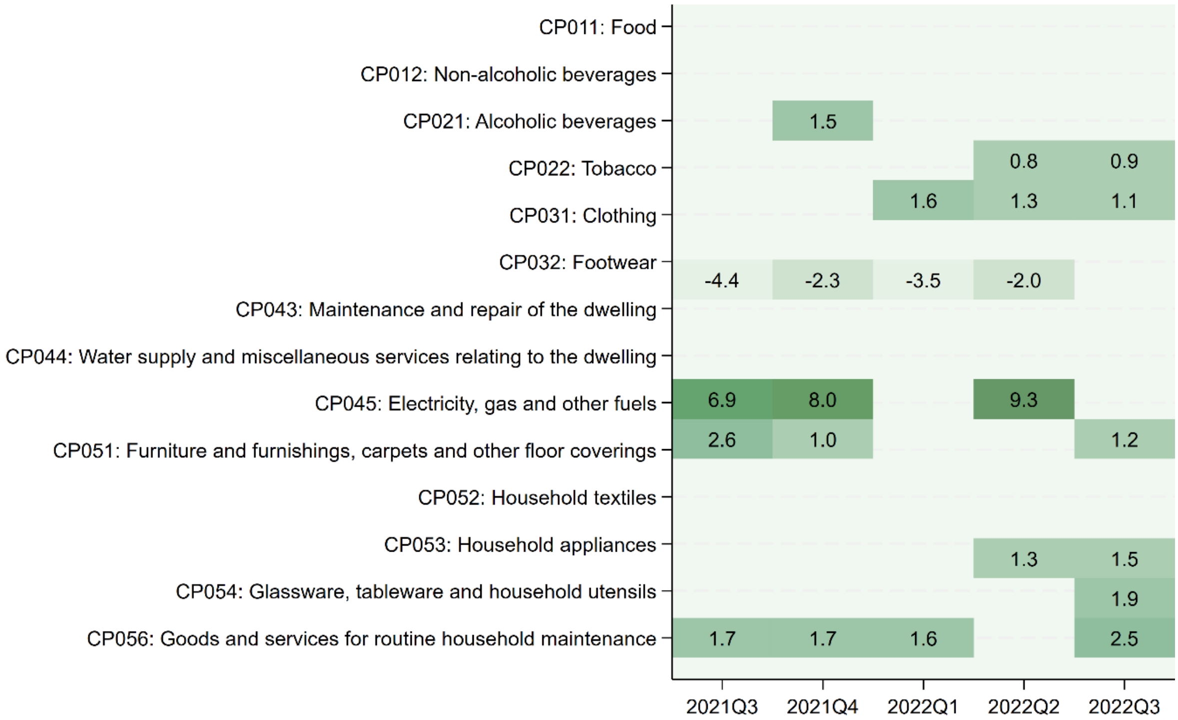

Figure 2. The effect of the reversal on inflation of goods, SDID estimates on Group 2

Notes: The figure reports the estimates of equation (3) for those inflation components where the effect of the reversal was statistically significant at least at a 10% level of significance. 2021Q1 on the horizontal axis refers to $Treat^{h=0}$, 2021Q3 to $Treat^{h=1}$ etc.

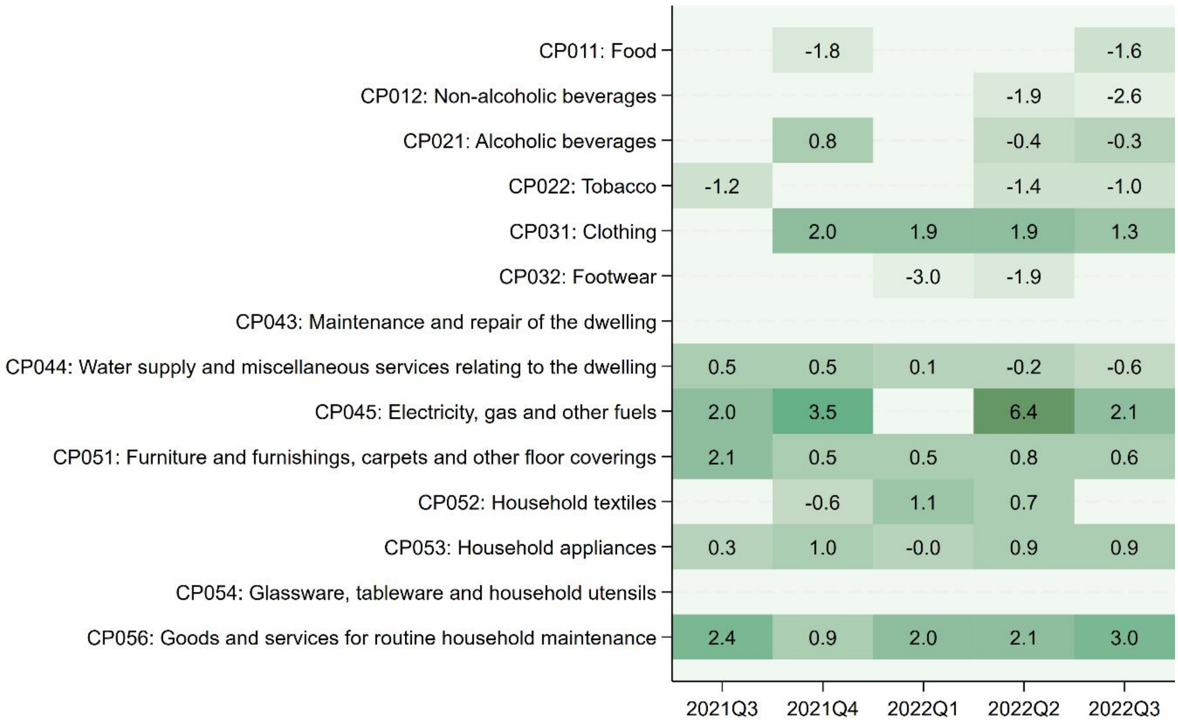

Figure 3. The effect of the reversal on inflation of goods, SDID estimates on Group 3

Notes: The figure reports the estimates of equation (3) for those inflation components where the effect of the reversal was statistically significant at least at a 10% level of significance. 2021Q1 on the horizontal axis refers to $Treat^{h=0}$, 2021Q3 to $Treat^{h=1}$ etc.

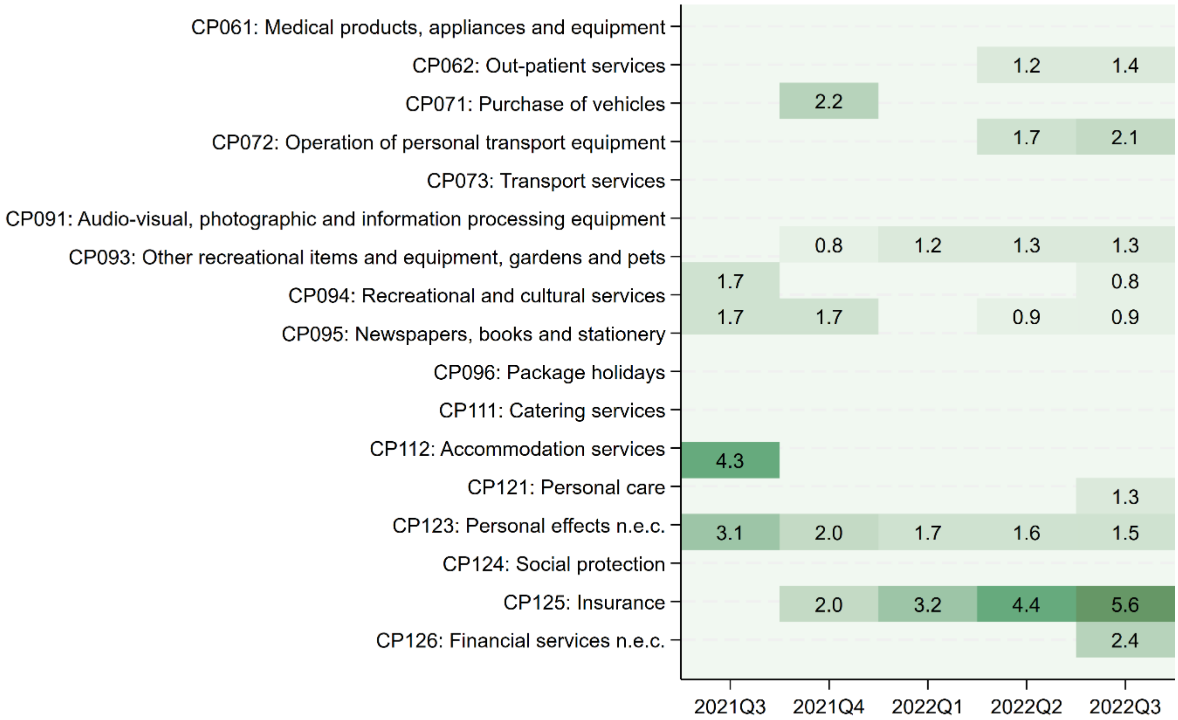

Figure 4. The effect of the reversal on inflation of services, SDID estimates on Group 1

Notes: The figure reports the estimates of equation (3) for those inflation components where the effect of the reversal was statistically significant at least at a 10% level of significance. 2021Q1 on the horizontal axis refers to $Treat^{h=0}$, 2021Q3 to $Treat^{h=1}$ etc.

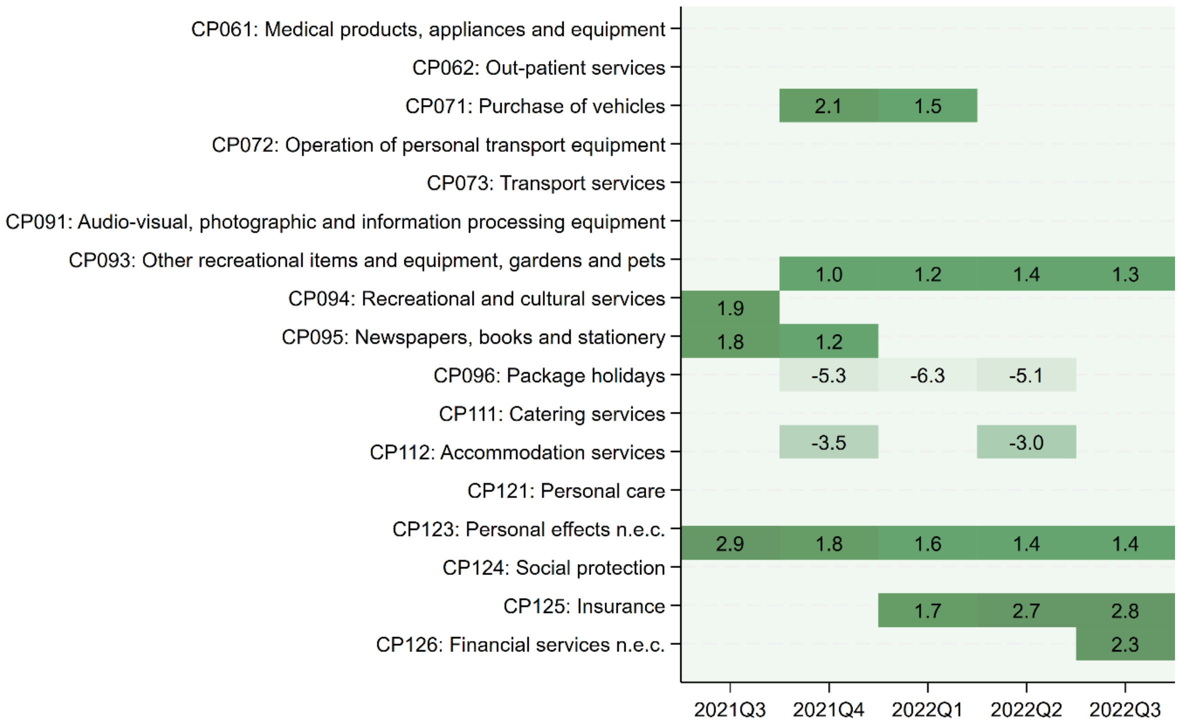

Figure 5. The effect of the reversal on inflation of services, SDID estimates on Group 2

Notes: The figure reports the estimates of equation (3) for those inflation components where the effect of the reversal was statistically significant at least at a 10% level of significance. 2021Q1 on the horizontal axis refers to $Treat^{h=0}$, 2021Q3 to $Treat^{h=1}$ etc.

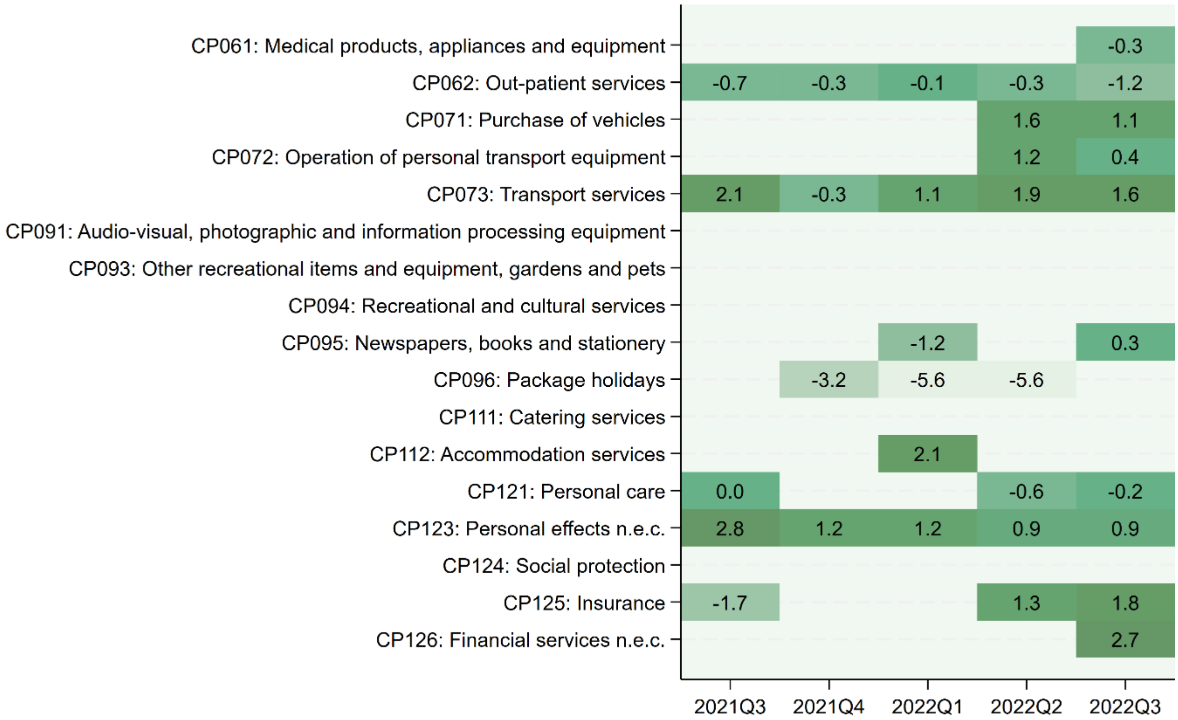

Figure 6. The effect of the reversal on inflation of services, SDID estimates on Group 3

Notes: The figure reports the estimates of equation (3) for those inflation components where the effect of the reversal was statistically significant at least at a 10% level of significance. 2021Q1 on the horizontal axis refers to $Treat^{h=0}$, 2021Q3 to $Treat^{h=1}$ etc.

Appendix E – Decomposing inflation into supply and demand-driven factors

We apply the approach of Shapiro (2024) to decompose HICP inflation into demand-driven and supply-driven factors. This approach uses disaggregated data at the level of HICP items to identify whether each category is going through a demand shock or a supply shock and decomposes aggregate inflation as a weighted average of the components experiencing each type of shock. We use Eurostat data for this decomposition, which is available for 61 COICOP categories for a long enough period, and in which some of the categories are more detailed, like food, and some like services are less detailed. Unfortunately, these data are not available for the tax-corrected HICP series for long enough, so the decomposition deviates from the HICP time series used in the rest of the paper. For each category, we construct a time series for prices and quantities. The prices are obtained from the HICP statistics, and the quantities are obtained from turnover statistics for businesses in trade, services and manufacturing. The data are available for fewer sectors, so we link 61 HICP series for prices with 28 series for quantities. The following equations are estimated for each HICP category:

$$q_{i,t} = \alpha + \sum_{j=1}^{4} \beta_j^{qp} p_{i,t-j} + \sum_{j=1}^{4} \beta_j^{qq} q_{i,t-j} + v_{i,t}^{q} \qquad (1)$$

$$p_{i,t} = \alpha + \sum_{j=1}^{4} \beta_j^{pp} p_{i,t-j} + \sum_{j=1}^{4} \beta_j^{pq} q_{i,t-j} + v_{i,t}^{p} \qquad (2)$$

where $q_{i,t}$ stands for the logarithm of quantities and $p_{i,t}$ for the logarithm of prices. The lagged terms on the right-hand side control for trends and $v_{i,t}^{q}$ and $v_{i,t}^{p}$ capture the surprise developments. The coefficients in equations (1) and (2) are allowed to vary over time and the equations are estimated using quarterly data and five-year rolling windows from 2008Q2 to 2022Q3. Shapiro (2024) applied this approach in the monthly frequency data and a ten-year rolling window with 12 lags, but data limitations mean we are proceeding from quarterly data and a shorter period in the window. The equations are estimated in each time window and the residuals $v_{i,t}^{q}$ and $v_{i,t}^{p}$ are saved for the last sample year, then the time window is forwarded by one quarter, the coefficients are re-estimated and the residuals for the last year are again saved. So each time window saves one additional value for the residuals, except the last window, which saves the last four quarters. The saved residuals are assigned a sign or label for each time period using the following restrictions:

$$S_{i\in \text{sup}(+),t} = \begin{cases} 1 \; if \; v_{i,t}^{p} < 0, v_{i,t}^{q} > 0 \\ 0 \; otherwise, \end{cases}$$

$$S_{i\in \text{sup}(-),t} = \begin{cases} 1 \; if \; v_{i,t}^{p} > 0, v_{i,t}^{q} < 0 \\ 0 \; otherwise, \end{cases}$$

$$S_{i\in \text{dem}(+),t} = \begin{cases} 1 \; if \; v_{i,t}^{p} > 0, v_{i,t}^{q} > 0 \\ 0 \; otherwise, \end{cases}$$

$$S_{i\in \text{dem}(-),t} = \begin{cases} 1 \; if \; v_{i,t}^{p} < 0, v_{i,t}^{q} < 0 \\ 0 \; otherwise, \end{cases}$$

(3)

After each component has been assigned a category of positive or negative supply shock or positive or negative demand shock for each quarter, the quarterly HICP inflation for categories is used to obtain the weighted average of total HICP inflation using the HICP item weights from the last quarter. Figure 1 below presents the positive and negative supply and demand components for 2013Q2 to 2022Q3, while Figure 5 in the main text shows just the positive demand component and total inflation.

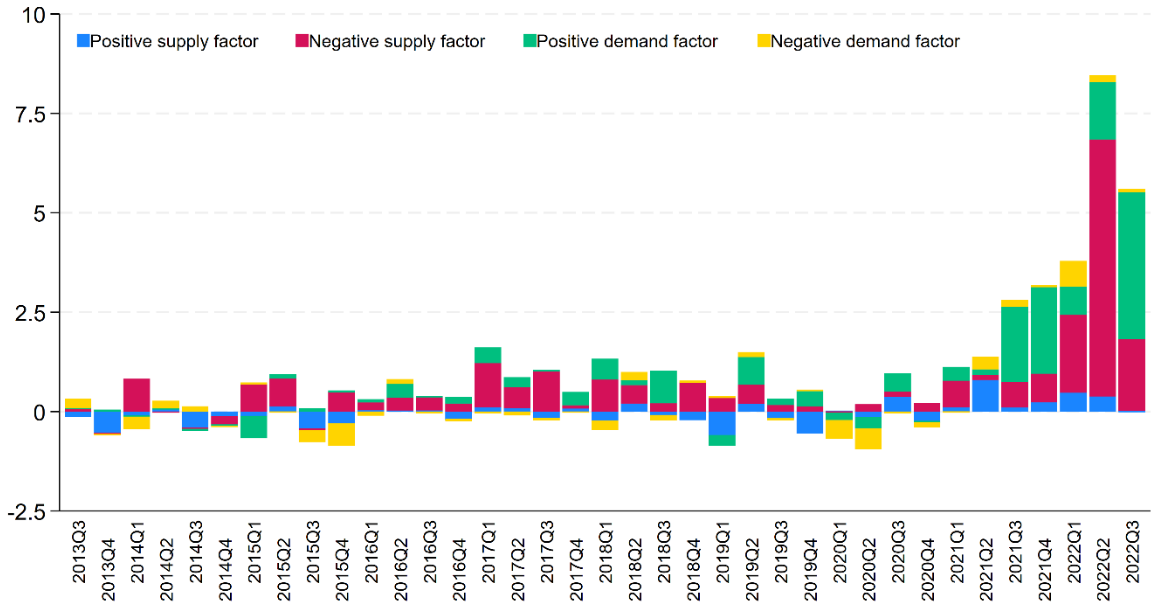

Figure 1. Inflation components by supply and demand factors, Estonia 2013Q3–2022Q3
Notes: Please see the methodology at the beginning of Appendix E.

Table 1. HICP items' COICOP categories and NACE 2008 industry links

COICOP label	COICOP	NACE
All-items HICP	0	g
Bread and cereals	111	c107
Meat	112	c101
Fish and seafood	113	c102
Milk, cheese and eggs	114	c105
Oils and fats	115	g4711
Fruit	116	g4711
Vegetables	117	g4711
Sugar, jam, honey, chocolate and confectionery	118	c108
Food products n.e.c.	119	c108
Coffee, tea and cocoa	121	c108
Mineral waters, soft drinks, fruit and vegetable juices	122	c11
Spirits	211	c11
Wine	212	g4711
Beer	213	c11
Tobacco	22	g4711
Clothing materials	311	g4771_g4772
Garments	312	g4771_g4772
Other articles of clothing and clothing accessories	313	g4771_g4772
Cleaning, repair and hire of clothing	314	s
Footwear	32	g4771_g4772
Housing, water, electricity, gas and other fuels	4	d
Furniture and furnishings	511	g474_g476
Carpets and other floor coverings	512	g474_g476
Repair of furniture, furnishings and floor coverings	513	s
Household textiles	52	g4771_g4772
Major household appliances whether electric or not and small electric household	0531_0532	g474_g476
Repair of household appliances	533	s
Glassware, tableware and household utensils	54	g474_g476
Tools and equipment for house and garden	55	g474_g476
Goods and services for routine household maintenance	56	n81
Health	6	q
Motor cars	711	g451
Motor cycles, bicycles and animal drawn vehicles	0712_0714	g451
Spare parts and accessories for personal transport equipment	721	g452
Fuels and lubricants for personal transport equipment	722	g452
Maintenance and repair of personal transport equipment	723	g452
Other services in respect of personal transport equipment	724	g452
Passenger transport by railway	731	h49
Passenger transport by road	732	h49
Passenger transport by air	733	h51
Passenger transport by sea and inland waterway	734	h50
Combined passenger transport	735	h49
Other purchased transport services	736	h49

Postal services	81	h53
Telephone and telefax equipment and services	082_083	j61
Equipment for the reception, recording and reproduction of sound and picture	911	g474_g476
Photographic and cinematographic equipment and optical instruments	912	g474_g476
Information processing equipment	913	g474_g476
Recording media	914	j59
Repair of audio-visual, photographic and information processing equipment	915	s
Major durables for indoor and outdoor recreation including musical instruments	0921_0922	g474_g476
Maintenance and repair of other major durables for recreation and culture	923	m75
Games, toys and hobbies	931	g474_g476
Equipment for sport, camping and open-air recreation	932	g474_g476
Gardens, plants and flowers	933	g4778_g4779_g478_g479
Pets and related products; veterinary and other services for pets	0934_0935	m
Recreational and cultural services	94	r
Newspapers, books and stationery	95	j58
Package holidays	96	n79
Education	10	p85
Restaurants, cafés and the like	1111	l56
Canteens	1112	l56
Accommodation services	112	l55
Miscellaneous goods and services	12	s

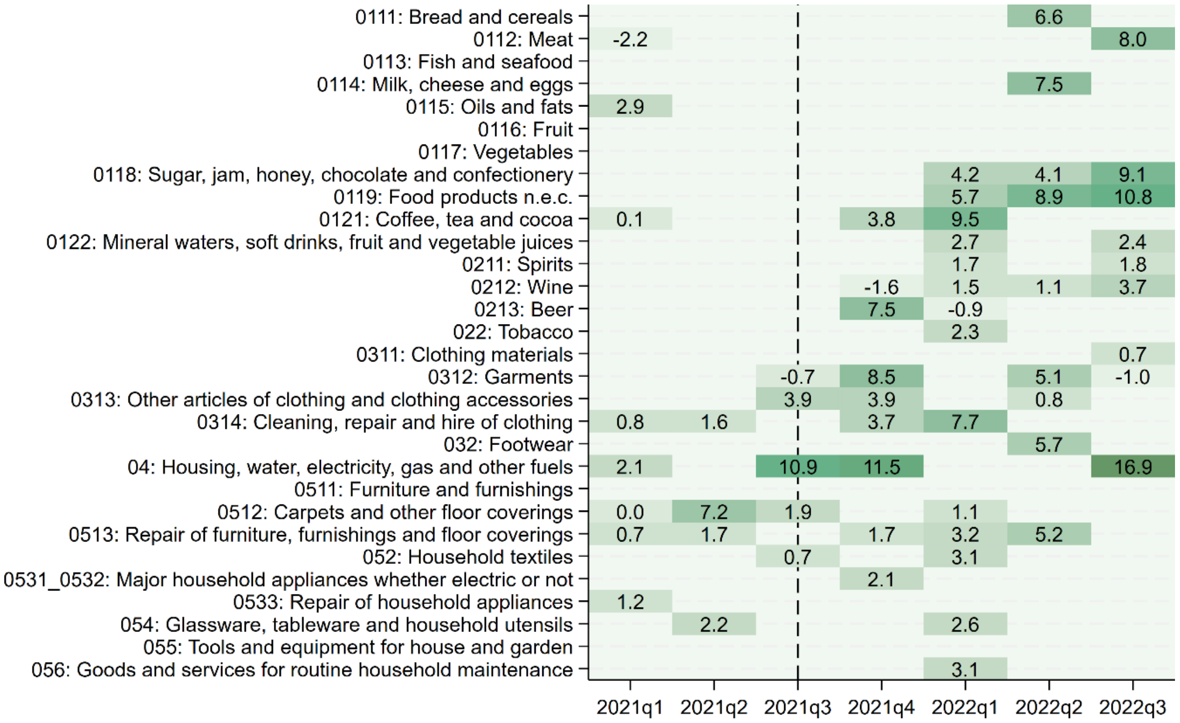

Figure 2. Inflation components affected by a positive demand factor, goods in Estonia 2013Q3–2022Q3

Notes: The figure reports the quarterly inflation of those components that were identified as being affected by a positive demand factor; empty cells refer to periods and components not affected by the positive demand factor. Please see the methodology at the beginning of Appendix E.

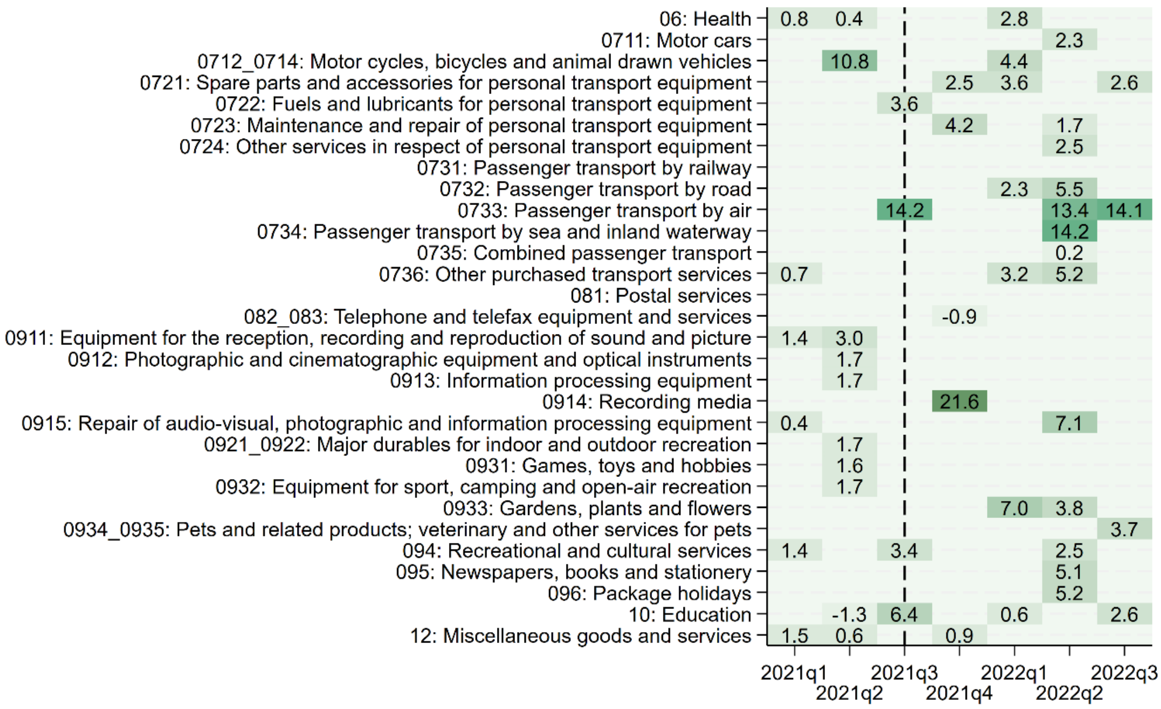

Figure 3. Inflation components affected by a positive demand factor, services in Estonia 2013Q3–2022Q3

Notes: The figure reports the quarterly inflation of those components that were identified as being affected by a positive demand factor; empty cells refer to periods and components not affected by the positive demand factor. Please see the methodology at the beginning of Appendix E.

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