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Heterogeneous effects of social policy in Poland: A short-to-medium term analysis

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Abstract

The introduction of the Family 500+ program significantly increased the disposable income of households with children, potentially affecting their consumption patterns. We estimate cohort-specific VEC and STR models based on adjusted Household Budget Survey, to assess short- and medium-term changes in income elasticities and interest rate semi-elasticities across four household types defined by the number of adults and children. The analysis focuses on behavioral responses before and after major expansions of social assistance, capturing potential regime shifts in consumption. The findings underscore the importance of household heterogeneity in assessing the macroeconomic impact of large-scale social transfers.

The results reveal that only the lowest-income, single-parent households exhibited a significant increase in income elasticity of consumption, rising from 1.03 to 1.19 after the program's implementation. The response in other groups was moderate (families with three or more children) or marginal (families with one or two children). This highlights that despite the large scale of the program, it did not lead to an overall boost in consumption among those who benefited from it. In addition, the analysis identifies divergent changes in interest rate sensitivity across household types, with a decline observed among lower-income families with three or more children, and a rise among higher-income groups. These patterns may reflect changes in credit access or substitution between debt-financed and transfer-financed consumption.

Key words: social assistance, households heterogeneity, economic regime change, econometric model

JEL classification: I38, H53, D12, C22

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Introduction

The introduction of the Family 500+ program (hereafter F500+) in Poland marked a transformative moment in social policymaking. Introduced in March 2016, the new benefit provided stable monthly financial assistance to families with children. Its design and size meant an unprecedented reallocation from a balanced mix of cash transfers, tax breaks, and services to a strong emphasis on direct cash transfers. The program's implementation in 2016 Q2 led to a significant increase in non-pension social benefits, rising by about 1.0 percentage point to 3.4% of GDP in 2017-2018. After subsequent extensions, the benefits increased to 4.5% in 2020-2023 and to 5.1% of GDP in 2024, when there was an increase from 500 PLN to 800 PLN per child per month.

Before the expansion to each child regardless of family income in 2019, the F500+ program covered nearly 60% of all children up to the age of 18 and almost doubled the total expenditure on families and children in Poland compared to the year prior to its introduction[4]. The advocates of the program underlined that unlike previous social policies, the F500+ provided a significant and steady monthly income, initially in the amount of 500 PLN (equivalent to 110-120 EUR, which at the time of introduction was equal to 27% of the minimum wage) for families and contributed to a substantial reduction of poverty among low-income families. In addition to the short-term effects of the program, which included an increase in individual consumption and alleviation of poverty, especially among children from the poorest households [Bieńˊ, 2022], the mandatory analysis of regulation change to the act introducing the F500+, emphasised that the consequences of the program would be also visible in the longer term. These included a possible increase in fertility and the development of human capital through improved educational opportunities for children from low-income families [Gromada, 2018]. On the other hand, serious controversy arose concerning the possible misallocation of resources, the unnecessary expansion of the welfare state, and the potential negative impact on the labor supply *via* decreasing women labor market participation. In particular, concerns were raised in the public debate that the program's reliance on a single criterion ignored the heterogeneity of households with significantly different consumption patterns, leading to questions about the optimality of such allocation of social assistance funds.

The multiple concerns surrounding the introduction of the F500+ and questions on its long term net effects, call for a detailed empirical analysis. There are many potential directions for

[4] Expenditure on social protection benefits was 1.5% of GDP in 2015, 2.6% of GDP in 2017, and 3.0% of GDP in 2019 when the program was extended to the first child in the middle of the year.

research but the short duration of the program and shortage of available data make it difficult to provide fully reliable empirical answers to the questions related to the effects of the program. Previous empirical studies have primarily focused on the effects of the F500+ on labor market participation, poverty reduction, and fertility rates. However, there has been no detailed analysis of how the program has influenced household consumption patterns, despite its potential to significantly alter spending behavior through increased disposable incomes. This study aims to fill the gap in the literature by examining the short- to medium-term effects of the increased disposable incomes on the consumption patterns of the households with children following the introduction of the Family 500+ program and its subsequent expansions. According to the most general hypothesis, the increase in household incomes may affect short- and medium-term income elasticity of demand and modify households' sensitivity to interest rate fluctuations. In particular, the study tests whether the F500+ had a stronger effect on consumption behavior among families with multiple children, due to their higher marginal propensity to consume and greater reliance on social transfers. To verify this, we estimated the parameters of the private consumption functions, allowing us to obtain an empirical confirmation of potential changes in the behavior of households with different numbers of dependent children. We used time series derived from the Household Budget Survey conducted by the Statistics Poland (*Główny Urząd Statystyczny*), which enabled the construction of a unique database accounting for differences in income and expenditure among different types of households. The empirical results provide grounds for asserting that the responses of the analyzed households to increased social welfare transfers are heterogeneous. Changes in households' propensity to take out consumer loans are also identified.

The article is structured as follows. The first section presents a review of the literature devoted to empirical studies on the effects of increased social assistance. Changes in the social assistance system in Poland between 2005 and 2024 are discussed in the second section, while the third outlines the procedure for constructing the time series used in the estimation. The following three sections present the specific research hypotheses, the adopted modeling strategy for consumption in the identified household groups and the empirical results. Section seventh contains the key findings and their extended discussion. The last section concludes.

1. Literature Review

Within the framework of endogenous growth theory, social policy is recognized as a crucial factor in fostering broad-based social development, shaping long-term economic growth, and contributing to sustained poverty reduction [Haile, Niño-Zarazúa, 2018]. In the short term, however, the theoretical predictions of the effects of the social transfers are often conflicting and highly dependent on the demographic characteristics of transfer beneficiaries, whether they are permanent or one-time assistance and the distributed amounts. Empirical research presents similarly contradictory findings regarding the impact of social spending on economic growth. Studies by Khan and Bashar [2015] indicate a pro-growth effect of social spending, while research by Afonso and Alegre [2011] identify a long-term negative impact on growth in a panel of the EU countries, which they attribute to labor market distortions caused by social transfers and the limited productivity-enhancing potential of such expenditures. Afonso and Alegre [2011] also argue that a shift of resources toward public investment or education would be more supportive of long-term growth. A meta-analysis by Awaworyi Churchill and Yew [2017] further suggests that negative effect is particularly pronounced in developed countries, mainly due to diminishing marginal returns, as transfer levels rise, especially in high-income countries. Meanwhile Pennings [2021], in thea study based on the United States, found that states receiving higher transfers tended to experience faster short-term growth in GDP and labor income, with strong effects especially for permanent transfers, rather than for temporary onetransfers. PA panel study of OECD countries by Furceri and Zdzienicka [2012] also found that an increase in social spending raises GDP, and that this effect is comparable to that of total government spending and is particularly significant during periods of severe economic downturns. The largest impact was observed, but among the subcategories of social spending, expenditures on health and unemployment benefits have the largest impact.

Awaworyi Churchill and Yew [2017] highlight the assumed trade-off between public spending and economic efficiency, primarily driven by labor market effects, although the evidence remains inconclusive. Mathers and Slater [2014] indicate that cash transfers can provide incentives for greater labor force participation. This type of assistance can expand employment opportunities, particularly for poorer households, and serve as a source of funding for job search costs and skill acquisition. By stimulating consumption, it may also help sustain jobs during economic downturns. Supporting this perspective, Meyer and Rosenbaum [2001] found that financial incentives, especially via an expanded earned income tax credit, increased labor supply among low-income single mothers.

Ozlem Alper and Demiral [2016] as well as Piotrowska [2009], suggest that social spending may create a disincentive for labor force participation or efforts to seek better employment. For instance, a study on low-income individuals in the U.S. found that receiving unconditional monthly cash transfers of 1,000 USD[5] led to a 3.9 percentage decline in labor force participation and a reduction in hours worked over the 3-year program duration, without significant improvements in employment quality or human capital investment [Vivalt et al., 2024]. From the perspective of universal cash transfers, Bibler et al. [2023] analyzed labor market effects using Alaska's Permanent Fund Dividend as a case study. They found evidence of both a positive labor demand response and a negative labor supply response, linked to increased consumer spending, and due to reduced job-seeking. They also pointed to the occurrence of a decline in working hours among beneficiaries. However, Baird et al. [2018] found no significant change in hours worked or earnings when prime-age adults received transfers, such as in the Polish program. While the effects of social transfers on consumption and investment are widely recognized, evidence on the direction and strength remains mixed. In the long run, standard RBC models predict a decline in private consumption following an increase in government spending [Aiyagari et al., 1992; Baxter, King, 1993; Fatás, Mihov, 2001], while short-run IS-LM model suggest the opposite [Blanchard, 2003]. These models also differ in their predictions for investment: RBC models associate government consumption with higher investment, whereas IS-LM anticipates a crowding-out effect. Empirical research, however, predominantly indicates a positive effect on consumption. Furceri and Zdzienicka [2012] report a 0.35% increase in private consumption over three years following a 1% rise in social spending. Wilcox [1989] and Romer and Romer [2016] also identify a significant increase in the elasticity of consumption over a short period. Their study, based on the U.S., demonstrates that this effect was most pronounced within the first five months following a permanent 1% increase in social security benefits, which led to an average monthly rise in real personal consumption expenditures of over 1% in the first six months [Romer, Romer, 2016]. Furthermore, a 1% increase in benefits can reportedly resulted in a 0.5% decline in savings [Kopits, Gotus, 1980].

The impact of increased social transfers varies significantly across household income levels. Fiszbein et al. [2009] find that consumption increases when transfers target poorer households, who allocate most of their income to essential spending [Mathers, Slater, 2014]. The low-income households primarily experience an increase in consumption and a reduction in

[5] In the case of a full-time job, this is more than 80% of the gross salary of a person earning the minimum hourly wage.

precautionary savings, which in turn lowers the overall savings. Wealthier individuals may increase their investment risk (substituting social security for private security), potentially achieving higher returns [Fessler, Schurz, 2018; Evans, 1983]. However, Furceri and Zdzienicka [2012] find that investment elasticity in response to such positive shocks is not statistically different from zero, likely due to the weaker effect of social transfers on income growth in higher-income households. Fessler and Schurz [2018] find that households belonging to the bottom 25% of the income distribution are most responsive to reducing savings in favor of consumption when a positive shock occurs. This reflects higher marginal propensity to consume (MPC) among lower-income households [Jappelli, Pistaferri, 2014]. In addition, credit-constrained households with a higher share of benefit income in total income are less able to smooth consumption and thus show a stronger consumption response to unexpected income shocks [Gechert et al. 2020]. Social transfers can therefore be viewed as a buffer against various risks, helping poorer households to maintain an adequate level of consumption [Mathers, Slater, 2014]. Fagereng et al. [2019] also find that reducing savings may be further evident when additional income shifts a household's position in the income distribution, given that saving rates remain stable within each income bracket.

In the case of the F500+, previous studies have primarily examined its effects on household income and poverty reduction. For instance, Neugschwender [2024] estimates that without transfers from the program, the poverty rate among single parents would have reached around 70% in 2016–2020[6], and Bień [2022] shows that the risk of extreme poverty among children aged 0-17 fell after the program was introduced, and the improvement was particularly experienced by families with many children. Brzeziński and Najsztub [2017] also suggested that the program significantly reduced expenditure poverty. For part of the households, the transfers not only allowed them to improve the security of their basic needs, but also to accumulate savings, which was not previously possible for them [Bień, 2022]. In terms of labor market outcomes, a recent analysis by Gromadzki [2024] found no short-term effects on earnings and negative medium-term effects on household labor supply, particularly among low-income households. The study also reports a decline in savings of approximately 5%, and increased consumption among recipients. Contrary to Gromadzki [2024], difference-in-differences estimates using 2012–2018 data show that families obtaining the child benefit

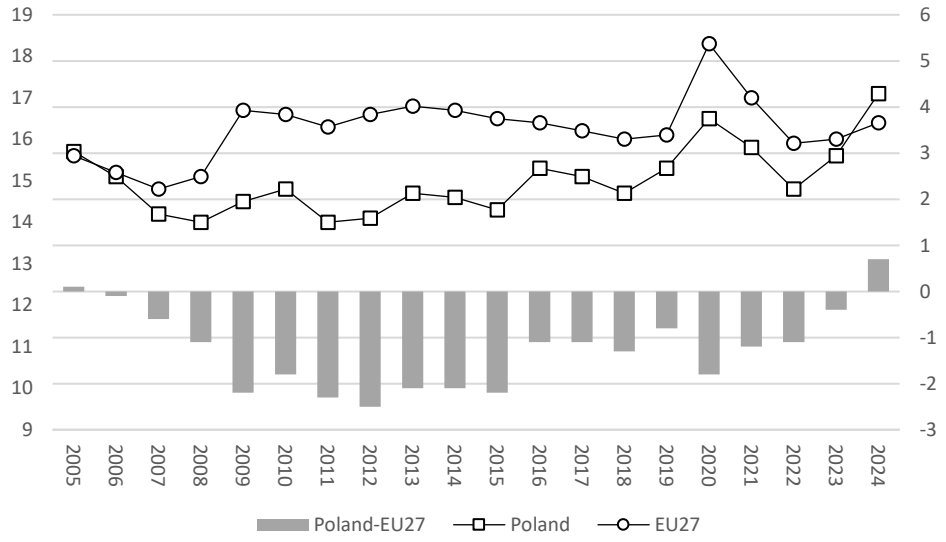
[6] According to Eurostat, the share of people at risk of poverty or social exclusion in households with one adult and dependent children in Poland declined from 44.8% in 2015 to 36.7% in 2020. This downward trend continued, and by 2023 the rate had fallen to 28.1%, which was the lowest in the European Union.

increased their saving rate by 8 percentage points after the 2016 reform, while the parents with one child not receiving the benefit (the control group) raised it by only 2.9 percentage points [Liberda et al., 2021]. One of the key goals of the F500+ was to encourage higher fertility by easing the financial burden of raising children. However, as Alimowski and Bartnicki [2022] show, increased fertility was observed only among families who already had children, and only during the initial phase of the program (prior to its expansion).

2. Social assistance in Poland in 2005-2024

After joining the EU in 2004 and before introducing F500+, social policy in Poland was passive in nature. Total general government expenditure on social benefits other than social transfers in kind dropped from around 17.0% of GDP in 2002 to its lowest level standing at 14.0% of GDP in 2008 and stabilized at 14.0-14.8% until 2016. From 2008 to 2015, social spending in Poland was about 2 percentage points below the EU average. After the introduction of F500+, this gap narrowed to an average of 1.1 p.p. in the period 2016–2022 (see Figure 1).

Figure 1. Share of general government total expenditure on social benefits other than social transfers in kind in GDP in Poland and EU (%, left scale),and the difference Poland – EU (p.p., right scale).



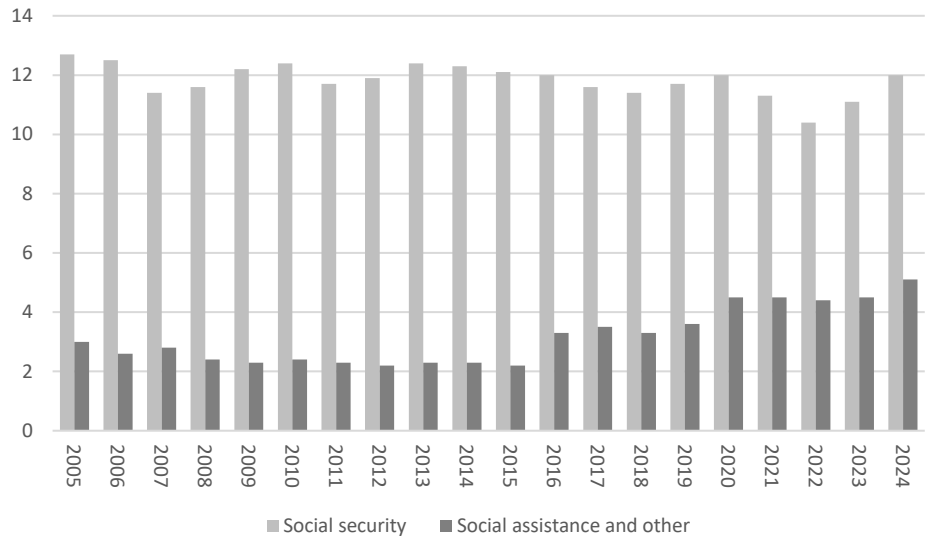
Source: EUROSTAT

The F500+ not only increased total social spending but also changed its structure. Social benefits other than transfers in kind can be divided into pensions and disability benefits conditional on participation in the social security system, and other benefits not dependent on prior contributions. Benefits paid by the social security sector accounted for the majority of

social protection expenditure in the general government sector (see Figure 2). Their share of GDP fluctuated around 12% until 2020 and fell to around 11% in 2021–2023 as a result of an increase in social security benefits due to very high price inflation in the previous years.

A different pattern emerges for social benefits other than social security benefits. Until 2016 these benefits averaged at 2.4% of GDP. The introduction of the F500+ marked a level shift in this category up to around 3.4% of GDP in 2017-2018, and the expansion of the program to include all children, regardless of their parents' income resulted in a further increase, with non-pension social benefits averaging 4.5% of GDP between 2020 and 2023. During that latter period, the ratio of nominal benefits to nominal GDP remained relatively stable due to the introduction of other benefits, such as the so-called thirteenth and fourteenth pensions. Another rise to 5.1% of GDP in 2024 was a result of a change in the benefit amount from 500 to 800 PLN per child.

Figure 2. General government total expenditure on social benefits other than social transfers in kind disaggregated, % of GDP



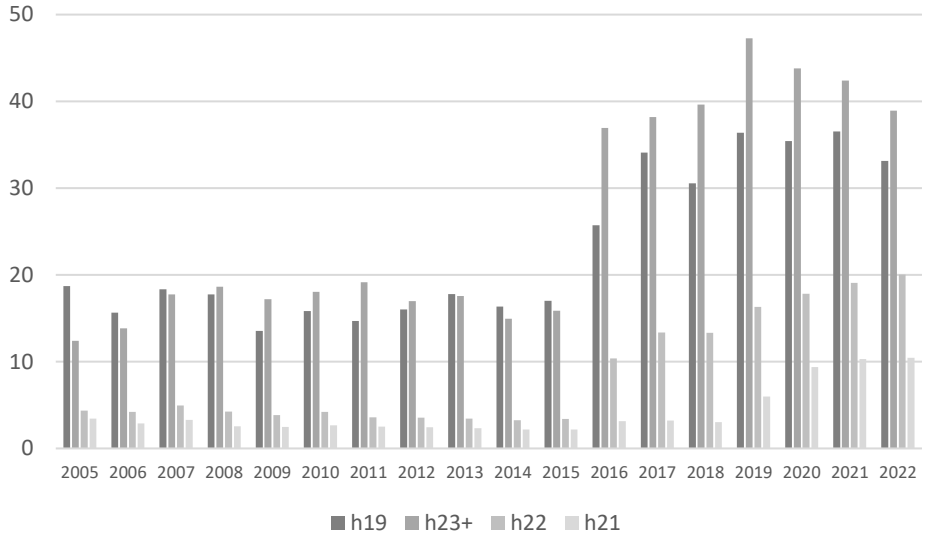
Source: own calculations based on EUROSTAT data.

Consistent with previous studies, a direct, short-term assessment based on Statistics Poland data confirm the program's positive impact on poverty reduction. The child poverty rate dropped from 9.0% in 2015 to 5.8% in 2016 and 4.7% in 2017, reflecting the full-year effect of the program. However, with the benefit's nominal value remaining unchanged its poverty-reducing effect weakened over time, particularly during periods of high inflation in 2022-2023. Consequently, child poverty increased again, reaching 5.7% in 2022 and 7.6% in 2023. In

response, the government raised the benefit from the 1 January 2024, resulting in child poverty falling to 5.4%.

The aggregate poverty rate does not capture the full range of heterogenous distributional effects induced by the F500+. Brzeziński and Najsztub [2017] addressed heterogeneity of household based on data collected immediately after the program implementation, and indicated that the F500+ had positive distributive consequences, with most gains visible in the lowest income deciles. In 2016 around 42% of gains went to the poorest 20% of households while the richest 20% received only 10% of the total support. Moreover, for the first income decile group, the program increased household disposable income by 37.9%. Accounting for the household effects of scale on poverty measurement, the benefit reduced relative income poverty rates among children by 64-71%, while for single parents by 75-89%.

Figure 3. Shares of the social assistance in households disposable income less social assistance (%).

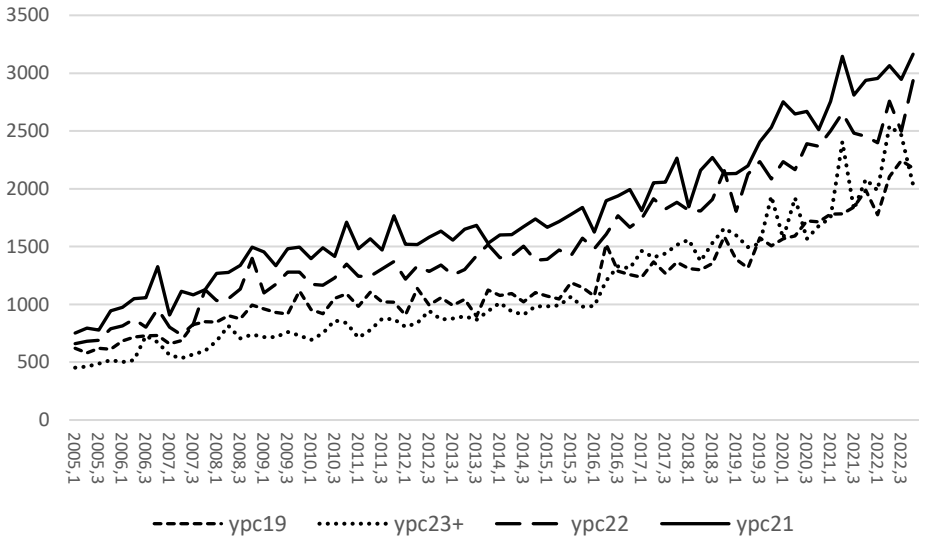


Source: own calculations based on Statistics Poland data.

Limiting the analysis to changes in disposable income only is insufficient to capture potential behavioral responses of households to increased income after 2016. Figure 3 shows changes in the social assistance in relation to household disposable income (net of social assistance). Figure 4 presents the levels of per capita income. To reflect heterogeneity of F500+, four household types were distinguished: single-adult households with children (h19), families with three or more children (h23+), and families with one or two children (h21 and h22, respectively). Per capita income in these cohorts between 2005 and 2022 is denoted as ypc19, ypc23+, ypc22, and

ypc21 (*vide* Figure 4). The conclusions from the preliminary graphical analysis are clear - the F500+ had the strongest impact on disposable incomes in lower-income households. In cohort h23+, the share of social assistance relative to adjusted disposable income excluding transfers in cash, reached approximately 40%, while in the group h19 it oscillated around 35%. In the higher-income cohorts (h22 and h21), the effects were visible only in 2019, when the benefit was unconditionally extended to the first child in the household unconditionally. In the group h22, the share of social assistance in disposable income approached 20% in 2021–2022, while in the group h21 the impact of F500+ was notably smaller. The graphical analysis does not support a substantial increase in per capita income in the higher-income groups.

Figure 4. Nominal disposable income per capita in groups 19, 23+, 22 and 21 (PLN).



Source: own calculations based on CSO data.

The time series presented in Figures 3 and 4 come from a unique database constructed specifically for the purpose of this study. To perform the cohort-level analysis, we constructed a dataset linking household microdata with macroeconomic aggregates, where household income Y and consumption C in the selected cohorts are defined as fractions of macroaggregates specified in accordance with the ESA2010 classification: $C^i = \omega_{iC} C, Y^i = \omega_{iY} Y, i = \{19, 23+, 22, 21\}$. The shares ω_C^i and ω_Y^i are calculated using the micro data collected in the Household Budget Survey in Poland (HBS hereafter). The database is described in more detail in the Appendix.

4. Theoretical framework and working hypotheses

The empirical analysis of household expenditures in Poland begins with the aggregate private consumption function. Under the standard assumptions, the level of consumption (C) is determined by household financial wealth (W^H) and permanent income including current and future discounted income from labor and social transfers (Y)[7]:

$$c = \beta y + (1 - \beta) w^H, \quad (1)$$

where $0 < \beta \leq 1$.

The above equation represents the relationship at steady-state. In finite time horizons, in which individual consumption deviates from equilibrium (1), Keynesian liquidity constraints of households can play an important role. To account for intertemporal substitution, the model is extended to include the real interest rate (R):

$$c_t = \beta_0 + \beta_1 y_t + \beta_2 w_t^H - \beta_3 R_t + u_t, \quad (2)$$

where: β_k – the long-run equilibrium parameter, $k = 0, 1, 2, 3$; $t = 1, \dots, T$; $u_t \sim n.i.d.(0, \sigma^2)$; all variables are expressed in real terms. Consumer utility maximisation implies long-term homogeneity of individual consumption with respect to wealth and income, $\beta_1 + \beta_2 = 1$ ($\beta_1, \beta_2 > 0$; in empirical applications: $\beta_1 \gg \beta_2$), and a decrease in consumption as a result of an increase in real interest rates, $\beta_3 > 0$.

The small sizeof the available time series may prevent an empirical confirmation of the convergence of β_1 and β_2 estimates to the theoretical values. In such cases, inferring the determinants of consumption on the basis of short-run models defined for growth rates or first differences (e.g. Romer and Romer 2016, Furceri and Zdzienicka 2012; Gechert et al. 2020) is insufficient and inconclusive, due to: (i) neglecting the equilibrium relationship linking *levels* of private consumption, household income and wealth, (ii) a disconnect between the short-term parameter estimates and the underlying equilibrium conditions, and (iii) ignoring the short-term adjustments of private consumption toward the equilibrium path. To address these limitations, this article concentrates on the medium-term relationships between the levels of the relevant variables. In general, it is hypothesized that, in the medium run, the elasticities of β_1 and β_2 tend to sum up to a value below unity due to the ongoing convergence of the system toward a new equilibrium path following a substantial increase in household income, $\beta_1 + \beta_2 < 1$. Exceptions are also possible. In the case of low-income households, the above-average growth

[7] Natural logarithms of the variables are denoted in lowercase letters throughout the article.

in consumption expenditure cannot be ruled out in the medium term as a reaction to previous income poverty, $\beta_1 + \beta_2 > 1$. In both cases the in-sample elasticities defined in this way are expected to converge toward their equilibrium values in the long term.

In the study we aim to expand existing research on the impact of the F500+ by examining its specific effects on consumption and propensity to take out consumer loans in predefined four cohorts of households. Therefore, in line with the most general and intuitive hypothesis increases in disposable income can lead to changes in the medium-term elasticities β_{kt}^{i}:

$$c_t^i = \beta_{0t}^i + \beta_{1t}^i y_t^i + \beta_{2t}^i w_t^{H,i} - \beta_{3t}^i R_t^i + u_t^i, \quad (3)$$

where superscript i distinguishes household type, i ={19, 23+, 22, 21}.

Figures 2-3 show the variation in *per capita* disposable income $y^{PC,i}$ and the share of social assistance income in total income h^i. The conclusions are intuitive and clear-cut: per capita incomes are higher in households with fewer dependent children, while the importance of transfers received under the F500+ is greater in households that are less income-rich and support more children. For these reasons, the first tested partial hypothesis considers an increase in the medium-term income elasticity of consumption as a result of a rising share of social transfers in total household income. Since the relative income gains were highest among the lower-income household groups 23+ and 19, smaller in group 22, and the least pronounced among the wealthiest households with one child 21, the expected results pointed to relatively large increases in the medium-term elasticities in the first two cohorts, and the smallest increase in cohort 21.

An analogous set of partial hypotheses can be formulated with respect to changes in the elasticity of consumption relative to households' wealth. However, testing these hypotheses is problematic for two reasons. First, reliable data on household wealth levels for the specific household groups are not available, and only aggregate figures for the entire economy can be used. Second, the aggregate size of F500+ social transfers is negligible compared to the overall households' wealth (0.5-0.6% in 2019-2023). It may be different for the poorest-income households, but even in that case it seems weakly justified to assume that social assistance transfers are perceived as a factor permanently increasing the wealth stock.

The third group of the partial hypotheses was formulated with respect to the semi-elasticity β_3^i. It was hypothesized that an increase in the share of income from social benefits in total household income could lead to bidirectional changes in the value of β_3^i. An increase in this

parameter may occur in households with relatively higher creditworthiness. Such a mechanism would reflect the substitution of funds from consumer loans with resources obtained from social assistance. Conversely, a decline in β_3^i would correspond to an improvement in debt repayment capacity, also driven by the cash inflows from the F500+. As a third possibility, the case of zero sensitivity of consumer demand to changes in credit costs was considered. This scenario may apply to low-income households lacking credit access. In all three cases the final conclusions about the direction of shifts in the sensitivity of demand to changes in the real interest rate were formulated on the basis of both the estimates and the statistical precision of the β_3^i estimates.Estimation of the parameters of equation (3) and subsequent verification of hypotheses on β_{kt} require identifying the coefficient drivers $\boldsymbol{x}_{(j)t}$, such that $\beta_{kt} = f_k(\boldsymbol{x}_{(j)t})$, $j = 1, \dots, J$ (details in: Swamy et al. 2010, Hall et al. 2017). Identifying the components of the vector $\boldsymbol{x}_{(j)t}$ is not trivial, but in many empirical applications, it is not necessary. A sufficient solution for describing the variation of β_{kt} parameters can be the use of a function derived from the family of generalized logistic curves with values of interval $\langle 0, 1\rangle$ (e.g. Granger and Teräsvirta 1993, Teräsvirta 1994).

A cursory analysis of the share of social transfers in disposable income (Figure 3) leads to the hypothesis of potential structural changes in household consumption demand in 2016 and 2019. Among households with lower per capita incomes (19 and 23+), changes in elasticities may have occurred when the shares of social welfare transfers increased from about 20 to 25-30%; analogous research hypotheses can be formulated for the parameters describing the demand of the other two groups of households.

The above premises provide justification for considering the first-order logistic function to describe changes of the equilibrium parameters:

$$c_t^i = \beta_0^i + \beta_1^i y_t^i + \beta_2^i w_t^{H,i} - \beta_3^i R_t^i + \\ + G^i(s_t^i; \gamma^i, \mu^i) \cdot (\beta_0^{i'} + \beta_1^{i'} y_t^i + \beta_2^{i'} w_t^{H,i} - \beta_3^{i'} R_t^i) + u_t^i. \qquad (4)$$

where: $G(s_t; \gamma, \mu) = (1 + \exp(-\gamma(s_t - \mu)))^{-1}$. The values of the transition variable s_t^i determine the positioning of the economic system in one of two regimes; for $s_t^i = \mu^i$ there is a transition between regimes, and it is smoother the smaller the value of the parameter γ^i; parameters μ^i and γ^i are estimated.

In the first regime, when $G^i(s_t^i; \gamma^i, \mu^i) = 0$, the equilibrium is defined by the relation:

$$c_t^i = \beta_0^i + \beta_1^i y_t^i + \beta_2^i w_t^{H,i} - \beta_3^i R_t^i; \qquad (5a)$$

in regime two, defined for $G^i(s_t^i;\gamma^i,\mu^i)=1$, the equilibrium relationship is as follows:

$$c_t^i=(\beta_0^i+\beta_0^{i\prime})+(\beta_1^i+\beta_1^{i\prime})y_t^i+(\beta_2^i+\beta_2^{i\prime})w_t^{H,i}-(\beta_3^i+\beta_3^{i\prime})R_t^i. \quad (5b)$$

Inferring the magnitude and direction of changes in the income elasticity of consumption, the elasticity of private consumption with respect to wealth, and the semi-elasticity of consumption with respect to interest rates requires estimating the parameters $\beta_k^{i\prime}$.

The partial research hypotheses are summarized in Table 1.

Table 1. Partial hypotheses

Household group i	Parameter		
	β_1'	β_2'	β_3'
21	0	0	>0
22	$\cong 0$	0	>0
23+	>0	0	<0
19	$\gg 0$	0	0

Note: β_k' represents the regime-specific deviation in parameter β_k associated with the implementation of the F500+.

5. Modelling strategy

The standard procedure for constructing smooth transition autoregressive models (STR hereafter) involves five steps. In the first one, the optimal lags of the variables in a linear autoregressive distributed lag model are determined. Next, hypotheses about the linearity of the relationship between the variables are verified. If nonlinearity is found, a sequence of hypotheses is tested, which, in the most commonly considered cases, leads to a choice between logistic functions of 1 and 2 degrees as alternative approximations of the changes in economic regimes. The final steps include parameter estimation and evaluation of the model's stochastic properties.

A modified approach was used in the analysis of potential changes in income elasticities of individual consumption of the distinguished household groups. Four vector error correction models VEC [Johansen, 1995; Juselius, 2006] were estimated for each household group linking the variables present in equations (4)-(5):

$$\Delta\boldsymbol{y}_{(m)t}^i=\boldsymbol{\alpha}^i(\boldsymbol{\beta}^{i\mathrm{T}}\boldsymbol{y}_{(m)t-1}^i)+\sum_{s=1}^{S-1}\boldsymbol{\Gamma}_s^i\Delta\boldsymbol{y}_{(m)t-s}^i+\boldsymbol{u}_{(m)t}^i, \quad (6)$$

where: $\boldsymbol{y}_{(m)}^{i}$ – vector of M endogeneous variables, $\boldsymbol{\beta}^{i}$ – cointegrating matrix, $\boldsymbol{\alpha}^{i}$ – adjustment matrix, $\boldsymbol{\Gamma}_{s}^{i}$ – matrices compising short-term parameters, $\boldsymbol{u}_{(m)}^{i}$ – error term, $\boldsymbol{u}_{(m)}^{i} \sim n.i.d.$, $m = 1, \ldots, M$, $s = 1, \ldots, S-1$; $\boldsymbol{\beta}^{T}$ denotes transposition od $\boldsymbol{\beta}$.

The equilibium conditions are met when $\boldsymbol{\beta}^{i\mathrm{T}}\boldsymbol{y}_{(m)t}^{i} = \boldsymbol{\beta}^{iT} \cdot [1, c_t^i, y_t^i, w_t^{H,i}, R_t^i]^T = \mathbf{0}$.

Evidence of cointegration among variables eliminates the risk of basing conclusions on spurious regressions and makes it possible to identify the equilibrium relationships toward which the model variables adjust. Together with the verification of the hypotheses of variable cointegration, it is possible to determine the optimal lag length S and to perform equilibrium parameters' stability analysis.

In the second step of the analysis, an attempt was made to construct STR models describing the mechanisms shaping the demand of the distinguished households types[8]:

$$c_t^i = \sum_{s=1}^{S} \theta_s^i c_{t-s}^i + \sum_{s=0}^{S} \psi_{1s}^i y_{t-s}^i + \sum_{s=0}^{S} \psi_{2s}^i w_{t-s}^{H,i} - \sum_{s=0}^{S} \psi_{3s}^i R_{t-s}^i +$$

$$+G^i(s_t^i; \gamma^i, \mu^i) \cdot (\sum_{s=1}^{S} \theta_s^{i\prime} c_{t-s}^i + \sum_{s=0}^{S} \psi_{1s}^{i\prime} y_{t-s}^i + \sum_{s=0}^{S} \psi_{2s}^{i\prime} w_{t-s}^{H,i} - \sum_{s=0}^{S} \psi_{3s}^{i\prime} R_{t-s}^i) \quad (7)$$

in which the equilibrium parameters β_{kt}^i are defined according to standard identities:

$$\beta_{kt}^i = \sum_{s=0}^{S} \psi_{ks}^i \left(1 - \sum_{s=1}^{S} \theta_s^i\right)^{-1} + G^i(s_t^i; \gamma^i, \mu^i) \cdot \sum_{s=0}^{S} \psi_{ks}^{i\prime} \left(1 - \sum_{s=1}^{S} \theta_s^{i\prime}\right)^{-1}, \quad (8)$$

The reason for modifying the estimation procedure of the model (4) is the limited applicability of the STR approach. *First and foremost*, the use of single-equation STR models or their multidimensional generalisations, i.e. smooth transition STVEC models [Hubrich, Teräsvitra, 2013], leads to reliable results only when sufficiently long time series are used. Such a condition is not met by the data available for Poland. *Second*, according to the authors' best knowledge the problem of structuring nonlinear vectors and testing structuring constraints in STVEC models has not been yet solved. Consequently, multidimensional STVECs' analogues of μ^i and γ^i are the only parameters that can be given an economic interpretation [cf. Hubrich, Teräsvitra, 2013:313], and drawing conclusions about the properties of the modeled system is possible only by analyzing generalized impulse response functions. Thus, if the main purpose of the study is to verify hypotheses allowing for changes in income elasticities of consumption and semi-elasticities of individual consumption with respect to interest rates, the usefulness of STVEC models is negligible. *Third*, focusing research on single-equation STR models allows for the

[8] In order to simplify the notation, the deterministic variables and errors terms have been omitted.

structuring of potential single nonlinear cointegrating relationships, but still does not free the analysis from the risks associated with the use of linearity tests and optimal transition function selection tests, for which only asymptotic distributions are known. Moreover, adopting the one-dimensional STR approach means adopting arbitrary weak exogeneity restrictions, which can lead to inappropriate estimates of equilibrium parameters when there are adjustments of even one regressor to the cointegration trajectory.

Therefore, the advantages of the estimation procedure adopted in analyses of private consumption in Poland are threefold. *First*, the methods for structuring and testing economically interpretable cointegrating vectors in VEC models are well and widely known. *Second* the Johansen procedure allows simultaneous analysis of cointegrating relationships and analysis of the stability of equilibrium parameter estimates $\boldsymbol{\beta}^i$ by using recursive estimation. Potential structural changes in equilibrium relationships can be identified and roughly mapped in by extensions of cointegrating vectors with deterministic trends and dummy variables. *Third*, the equilibrium parameters in the VEC model without structural breaks are the weighted averages of the elasticities of potentially two economic regimes. As such, VEC model estimates are an important benchmark in assessing elasticities in STR models.

6. Empirical results

The estimation of the parameters of equation (5) was carried out using quarterly data covering the period 2005-2022. The decomposition of households on basis of 4 selected groups made it impossible to estimate the wealth held $w_t^{H,i}$ and the real interest rate R_t^i for each of the analyzed cohorts. Therefore, the following simplified equilibrium equations were estimated for both regimes under consideration:

$$c_t^i = \beta_0^i + \beta_1^i y_t^i + \beta_2^i w_t^H - \beta_3^i R_t, \tag{9a}$$

$$c_t^i = (\beta_0^i + \beta_0^{i\prime}) + (\beta_1^i + \beta_1^{i\prime}) y_t^i + (\beta_2^i + \beta_2^{i\prime}) w_t^H - (\beta_3^i + \beta_3^{i\prime}) R_t. \tag{9b}$$

To empirically test the theoretical relationships specified in equations (9), a set of VEC models was estimated for each household cohort. Household wealth was defined as a sum of capital stock, net foreign assets and debt of the government sector; the variable exhibited a smooth, near-linear upward trend. The inability to determine real interest rates for each group of households is due to the unavailability of information on both consumption baskets prices and inflation expectations for each cohort. Therefore, the real interest rate was determined as the

difference between the nominal interest rate on the 10-year bond and the observed consumer price inflation: $R_t = I_t - \Delta p_t^{CPI}$; P_t^{CPI} – consumer price index. This approach corresponds to assuming a static expectations formation, which can be considered a non-controversial solution for households with limited access to information on inflationary processes in the medium-term. At first approximation, the choice of the long-term interest rate as the variable determining intertemporal substitution by households may appear controversial. There are at least two reasons for including this variable in private consumption equations. First, the stream of additional household income does not have to be spent exclusively on increasing consumption expenditure, but may – and in most cases does – increase savings in the form of financial assets with longer maturities. Second, it is difficult to assume that an increase in disposable income will cause changes in the propensity to borrow only short-term loans to finance current consumption. A fully valid alternative is the assumption of increased financing of expenditure on durable goods.

In the first stage of the empirical investigation, the parameters of four VEC models $\boldsymbol{y}_{(m)t}^{i} = \boldsymbol{\beta}^{iT} \cdot [1, c_t^i, y_t^i, w_t^{Hi}, R_t]^T$ were estimated, one for each cohort. The analysis of the models successively included (I) determination of the lag S providing optimal properties of the error terms using (i) Schwarz and Hannan-Quinn information criteria, (ii) tested hypotheses tests, and (ii) LM autocorrelation tests in the VAR models, (II) exclusion and weak exogeneity tests, (III) cointegration tests, (IV) assessment of the error terms properties and (V) evaluation of parameters recursive estimates. In all VEC model variants the wealth was assumed weakly exogenous.

The results indicate that in nearly all variants of the VAR models, the optimal lag is two quarters. There is strong evidence supporting the exclusion of (i) the wealth proxies from the VAR models for i ={22, 23+} and (ii) the real interest rate from the models for i ={21, 19}, although the exclusion tests of the household wealth in the VAR models for i ={21, 19} are borderline. Cointegration tests support the presence of one cointegrating vector in each VEC model, $r = 1$. Due to poor interpretability of the estimates, the variable w^H was removed from the VEC models for i ={21, 19}.

Table 2. Estimates of the cointegrating vectors.

Household group:	c^i	y^i	w^H	R	$const$	ECT	$r = 1$ (p-value)
19	1	-1.18	0	-	1.44	-0.44	0.335
		(23.9)			(3.4)	(2.8)	
23+	1	-0.80	0	3.31	-1.81	-0.72	0.175
		(33.8)		(3.4)	(8.2)	(4.7)	
22	1	-0.70	0	3.82	-3.05	-0.70	0.119
		(20.4)		(5.2)	(8.4)	(3.7)	
21	1	-0.86	0	-0.91	-1.49	-0.36	0.337
		(19.8)		(0.9)	(3.2)	(2.7)	

Note: ECTs stand for error correction terms in Δc_t^i equations; the last column reports p-values in the cointegration tests for $r = 1$; t-ratios are reported in parentheses.
Source: own calculations.

Table 2 summarizes the results of the estimation of equilibrium parameters and parameters characterizing the speed of the return to equilibrium[9]. In three cases, the estimated income elasticities of consumption rank below unity, indicating the medium-term nature of the models; in the case of the equilibrium relationship describing consumption in the poorest income group of households, there is an overshooting effect.

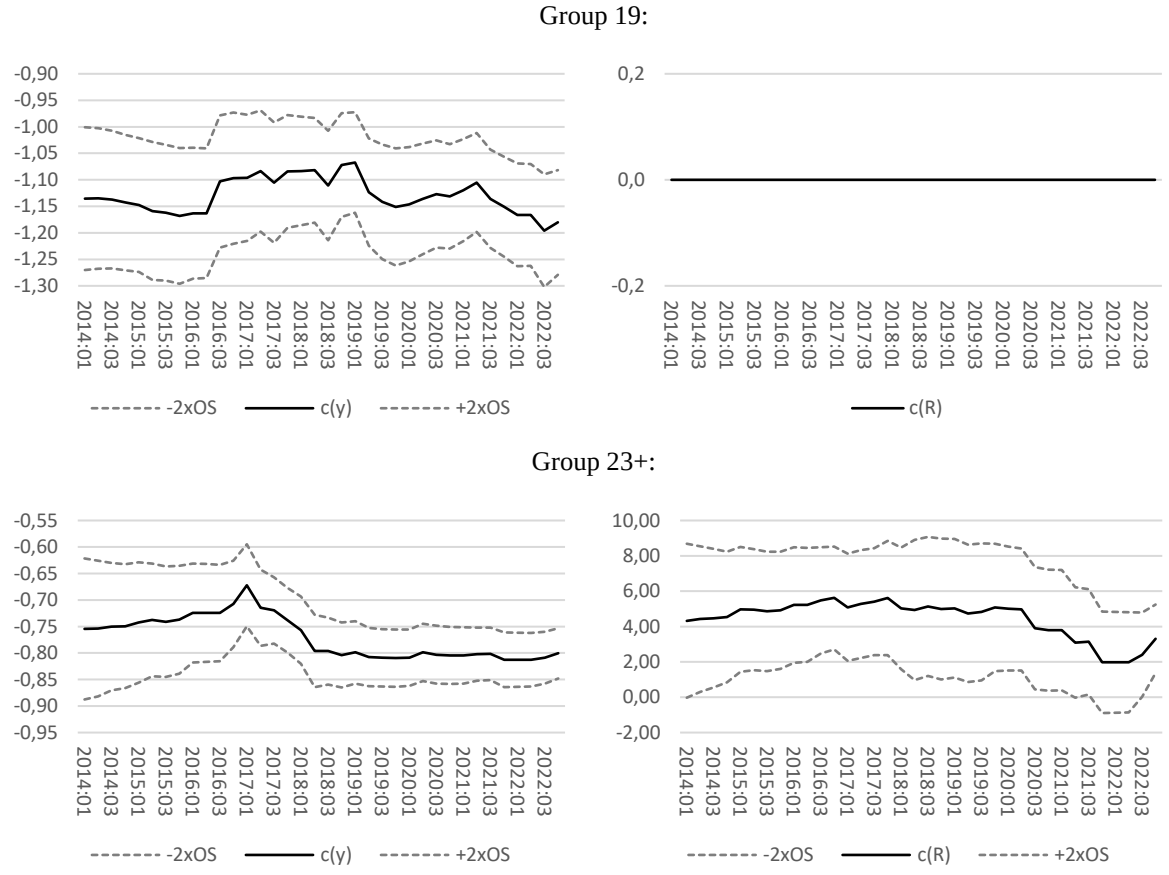
Although the results of the cointegration analysis confirm the existence of equilibrium relationships between private consumption and income in the considered household groups, and the short-term adjustments pull all c_t^is towards the equilibrium paths an analysis of the recursive estimates of the cointegrating vectors point to some drawbacks of the VECs models' parameters estimates. Figure 5 shows changes in the cointegrating parameter estimates as the sample extends to 2023Q4. Notably, shifts in selected parameter estimates occur around the turn of 2016–2017 and 2019–2020, i.e. the periods corresponding to the introduction and expansion of the F500+. Only minor changes in the income elasticities of consumption are observed for the lower-income household groups 19 and 23+, while marked shifts appear in the semi-elasticities of consumption with respect to interest rates in the higher-income groups 22 and 21.

As indicated in the previous section the basic limitations of single-equation smooth transition models are a consequence of their sensitivity to limited sample sizes. This is why in constructing single-equation STR models of c_t^i parameter estimates of the VEC models were taken into

[9] The detailed estimation results are available on request.

account as reference values. *First*, it was assumed that the wealth does not affect households expenditures in medium term. *Secondly*, due to the presence of only one structural change, a deterministic trend was assumed for the transition variable, $s_t = t$. Identifying the periods when the transition between systems occurs makes it possible to estimate the share of social assistance income in other disposable income at which changes in household behavior become evident (see Figure 3). *Third*, due to forcing the assumption of weak exogeneity of income y_t^i, which is only satisfied in the VEC model for the cohort 19, to make the initial STR models more flexible a four-quarter lag horizon was adopted, as indicated by Schwarz and Hannan-Quinn criteria and autocorrelation tests. A general-to-specific modelling strategy was applied; zero restrictions were consistently and sequentially imposed on parameters with either the greatest or the smallest lags. *Fourth*, due to the small sample size, liberal significance levels were applied and no zero restrictions were imposed on parameters whose estimates were relatively high, despite the fact that the *t*-ratios associated with these estimates fluctuated around 1.

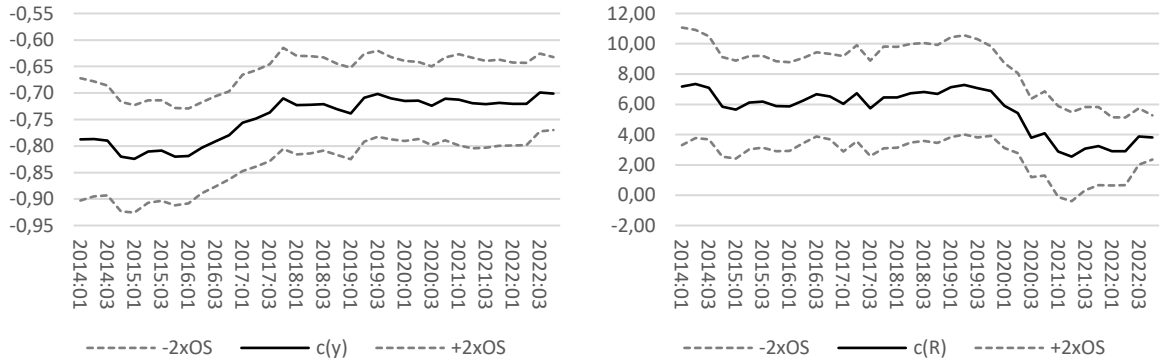
Figure 5. Recursive estimates of income elasticities of private consumption $c(y)$ and semi -elasticities on real interest rates $c(R)$ in VEC models.



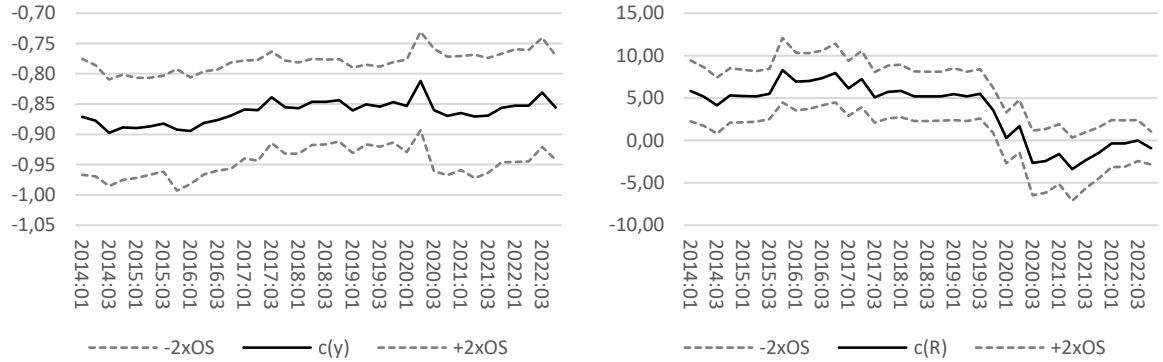
Note: The dashed lines represent the interval of 2 standard deviations.
Source: own calculations

Figure 5 (cont.). Recursive estimates of income elasticities of private consumption c(y) and semi-elasticities on real interest rates c(R) in VEC models.

Group 22:



Group 21:



Note: The dashed lines represent the interval of 2 standard deviations.
Source: own calculations

The detailed results of the final STR models estimation are summarized in table 3 whereas the estimates of medium-term equlibrium parameters are reported in table 4.

Particularly noteworthy are the heterogeneous estimates of short-term income elasticities observed in the periods preceding the introduction of the F500+. The strongest demand response is found among households in group 19 (0.874), while significantly weaker responses are recorded in groups 22 and 21 (0.458 and 0.525, respectively). In cohort 23+, the short-term elasticity is considerably lower (0.251), however, the estimate of the parameter on lagged income y_{t-1}^{23+} equal to 0.369, places the overall short-term response of this group between those

of the aforementioned cohorts. The estimates of the short-term elasticities remain virtually unchanged following the implementation of the program.

Short-term semi-elasticities on real interest rates indicate that the consumption expenditures of the households group 19 are insensitive to changes in the cost of borrowing in both regimes. In group 23+, the response of private consumption to interest rates is immediate and strongest, while in group 21 it is weaker and delayed. For the final assessment of the magnitude of the impact of interest rates on private consumption, the shifts in semi-elasticities occurring in the second economic regime are crucial: demand sensitivity declines in group 23+, rises in group 22, and – again with a delay – increases in high-income group 21.

Table 3. Estimates of the STR models' parameters.

Parameters:	c^{19}	c^{23+}	c^{22}	c^{21}
		Regime 1		
$const$	-0.090 (0.1)	2.788 (1.8)	1.998 (4.3)	1.003 (2.9)
c_{t-1}^{i}	-0.085 (0.9)	-0.206 (2.0)	0.164 (1.6)	0.380 (6.7)
c_{t-2}^{i}	0.198 (2.1)	-0.262 (2.5)	-	-
c_{t-3}^{i}	-	0.141 (0.9)	-	-
c_{t-4}^{i}	-	0.171 (1.3)	-	-
y_{t}^{i}	0.874 (9.1)	0.251 (3.7)	0.458 (7.2)	0.525 (10.5)
y_{t-1}^{i}	0.172 (1.8)	0.369 (4.7)	-0.028 (0.3)	-
y_{t-2}^{i}	-0.134 (1.3)	0.131 (1.5)	0.208 (3.0)	-
y_{t-3}^{i}	-	0.100 (0.9)	-	-
R_t	-	-6.868 (2.9)	- 2.120 (1.8)	-
R_{t-1}	-	-	-	-1.663 (1.5)
		Parameter change in regime 2		
$const$	-1.268 (0.6)	-0.301 (0.2)	-1.055 (0.6)	-0.062 (4.4)
c_{t-1}^{i}	-	-	-	-
c_{t-2}^{i}	-	-	-	-
c_{t-3}^{i}	-	-0.516 (2.6)	-	-
c_{t-4}^{i}	-	0.130 (0.8)	-	-
y_{t}^{i}	-	-	-	-
y_{t-1}^{i}	-0.501 (2.6)	-	-	-
y_{t-2}^{i}	0.284 (1.6)	-	-	-
y_{t-3}^{i}	0.363 (2.0)	0.356 (2.3)	-	-
R_t	-	2.446 (0.9)	-3.461 (2.2)	-
R_{t-1}	-	-	-	-1.332 (0.9)
μ^{i}	52.0 (27.4)	41.5 (0.0)	59.5 (0.0)	58.9 (2.7)
γ^{i}	60.1 (0.3)	1080.5 (0.0)	2043.5 (0.0)	394.5 (0.0)
AR(1)	0.55	0.43	0.95	0.12
AR(2)	0.79	0.36	0.21	0.12
AR(3)	0.47	0.54	0.54	0.16
AR(4)	0.68	0.64	0.69	0.32
ARCH(4)	0.95	0.05	0.13	0.95
JB joint	0.042	0.817	0.265	0.999
JB skewness	-0.28	-0.159	-0.126	0.002
JB kurtosis	4.36	3.205	2.079	2.989

Note: The table provides parameter estimates on the regressors (first column) in the equations of the dependent variables listed in the first row of the table. t-ratios are given in parentheses. AR(s) denotes the LM test for no autocorrelation of order s; ARCH(4) refers to the homoscedasticity test; JB is the Jarque–Bera normality test. p-values are reported for all tests.
Source: own calculations.

Table 4. Medium-term equilibrium elasticities in the model (9).

Parameters:	Household group:			
	c^{19}	c^{23+}	c^{22}	c^{21}
β_1	1.03	0.74	0.76	0.85
$\beta_1 + \beta_1'$	1.19	0.78	0.76	0.85
β_3	0	5.9	2.5	2.7
$\beta_3 + \beta_3'$	0	2.9	6.7	4.8

Source: own calculations

The estimates of μ^is indicate a transition between regimes in cohorts 21 and 22, shortly after the period of the extension of the F500+ program to the first child in a family, that is, between quarters 2019q3/2019q4 and 2020q1/2020q2 respectively. In contrast, the shift in household response in cohort 23+ occurred immediately after the program's introduction, between the first and second quarters of 2016. Large estimates of the smoothness parameters γ^i point to abrupt behavioral changes in the respective household types. The timing and speed of response among the poorest households (group 19) differ significantly. A clear correction in consumer demand is delayed, as the change in regime occurred between 2018q2 and 2018q3, indicating cautious spending behavior among this group of households.

The analysis of the estimates of medium-term parameters enables broader conclusions to be drawn (table 4). As expected, the overall effect of the increase in disposable income is strongest among the lowest-income households in group 19. The estimate of the medium-term elasticity suggests an overreaction in this household group. In the remaining groups, the effects of higher disposable income prove to be surprisingly moderate (group 23+) or indistinguishable from zero (cohorts 22 and 21). In summary, the estimated income elasticities of consumption point to a negligible amplification of the demand multiplier effect following the introduction of the F500+.

The conclusions regarding the effect of interest rates on individual consumption are unambiguous. In the period preceding the introduction of the F500+ program, the impact of interest rates appears to be stronger in group 23+, while it is weaker and of similar magnitude in the higher-income groups 22 and 21. The increase in disposable income under the second regime leads to divergent reactions: a decline in the sensitivity of demand to changes in real interest rates in the lower-income group 23+, and an increase in groups 22 and 21. These results can be interpreted in three ways. *First*, the income growth in group 23+ may have increased its tolerance for higher consumer credit costs, as these can be repaid using the additional funds received. *Second*, the reduced sensitivity of group 23+ households to changes in *R* may result

from improved creditworthiness [e.g. Malthers, Slater, 2014; Fessler, Schurz, 2018]. *Third*, the increase in medium-term equilibrium elasticities with respect to real interest rates in the demand equations for cohorts 22 and 21 may be interpreted as a consequence of declining interest in consumer borrowing, which is being replaced by funds received through social assistance programs.

The estimation results presented for the consumption functions across the four household cohorts should be interpreted as a first approximation. This is due to two main factors. *First*, the available time series are short and contain relatively little information about the system's equilibrium conditions following the introduction of the Family 500+ program. As a result, the estimation of STR model parameters during the period of increased social assistance spending is characterized by low precision. For these reasons, the final specification of private consumption equations across the examined household cohorts was guided by a joint consideration of parameter precision (as indicated by *t*-ratios) and the plausibility of the estimated coefficients. The underlying rationale is straightforward: a low *t*-ratio does not necessarily imply non-existence of an cause-effect relationship between regressand and regressors, but rather a lack of estimation precision due to data constraints. We anticipate that longer time series in future research will allow for more robust and precise estimation outcomes. Such an interpretation of the estimation results supports a general conclusion that the hypothesis of an above-average reaction of household income to consumption following the introduction of the F500+ finds little empirical support. The findings indicate that a significant increase in the income elasticity of consumption occurred only within the lowest-income household group 19. This suggests that the aggregate demand-side stimulus generated by the program was likely negligible at the macroeconomic level. At the same time, the data point to heterogeneous shifts in households responses to interest rate changes across the remaining cohorts 23+, 22, and 21. As a result, the net effect of the program on overall consumption demand remains ambiguous.

Second, it should be emphasized that the presented empirical results were obtained on the basis of time series covering only one episode of a significant increase in social assistance income. For this reason, adopting a deterministic trend as a transition variable s_t is a sufficient solution. In future studies involving larger samples covering a larger number of episodes of (i) fiscal (social benefits) expansion, (ii) fiscal tightening, or (iii) narrowing due to the lack of indexation of social assistance programs, the parameters' changes should emerge from the fluctuations of the share of social assistance income in total income, for example.

Conclusions

The article investigated the effects of the Family 500+ program on household consumption patterns in Poland across four household types by estimating income elasticities and interest rate semi-elasticities. The study used cohort-specific VEC and STR models, based on adjusted Household Budget Survey data, to examine how changes in disposable income and interest rates shaped private consumption patterns following the program's introduction and expansion. The study offers a novel contribution by providing micro-level, cohort-based analysis, compared to previous research, which primarily provided general conclusions about the economy as a whole. Moreover, the study's relevance is enhanced by the fact that many studies on the effects of increased social transfers have focused on developing countries, while unconditional programs such as the Family 500+, are rare in high-income economies. In addition, from a fiscal policy perspective, the findings may offer valuable insights into the effectiveness of income transfers in stimulating consumption. According to Gechert, Paetz and Villaneuve [2020], consumption responds much more strongly to increases in benefits than to reductions in premiums. Therefore, this study is an important contribution to the existing literature.

The results provide clear evidence of heterogeneous behavioral responses to changes in income and borrowing costs. A significant increase in the income elasticity of consumption was observed only among households with the lowest incomes, particularly single parents. This confirms the hypothesis that social transfers stimulate consumption primarily in groups with limited credit access and a high marginal propensity to consume. In other household group (families of two adults and at least one child), no significant increase in income elasticity was observed, suggesting that the additional transfers had limited impact on their consumption behavior. As a result, the aggregate consumption stimulus generated by the Family 500+ program appears limited, given the small share of group 19 in total household demand. The expected amplification of the demand multiplier did not materialize at the macroeconomic level, even after the program's universal extension in 2019. Given that only one of the four types of households analyzed showed a significant change in consumption elasticity, the program's overall impact on household consumption behavior appears limited. This indicates that, despite the scale of the transfer, the policy did not generate an additional widespread consumption response among beneficiaries.

The analysis also revealed divergent responses to interest rate changes across household groups. Among lower-income families with three or more children, sensitivity to borrowing costs declined, possibly due to improved creditworthiness or higher tolerance for debt. Meanwhile,

among families with only one or two children, interest rate sensitivity increased in response to the extension of the program to the first child, suggesting a substitution of credit with transfer-financed consumption. These findings suggest that welfare transfers may alter the sensitivity of some households groups to borrowing cost, which could have implications for cohort-level responses to monetary conditions.

Finally, several limitations should be noted. The empirical estimates are based on relatively short time series and survey data with known structural biases. Further progress will require access to more detailed, high-quality data and longer time horizons. In particular, future research should aim to identify behavioral changes in more narrowly defined income brackets within family types. Moreover, only one episode of transfer expansion was observed, which limits the ability to generalize conclusions about structural changes in household behavior. Expanding the empirical scope by including additional episodes of welfare adjustments - both administrative and inflation-induced - will be crucial for a robust policy evaluation.

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Appendix: Database

The HBS is the only available dataset containing detailed information on both household income and consumption. The survey is conducted by the Statistics Poland with randomly selected households providing data on demographic composition, living conditions, material

assets, and economic activity. Households are required to keep a diary reporting detailed income and expenditure information, which is then classified by income source and COICOP expenditure categories. Due to the self-reported survey nature this data is known to have significant drawbacks. The main issue is the non-random non-response bias, where in case of non-response of a randomly selected household another one in the primary sampling unit is being chosen. Households are drawn according to a two-stage random sampling scheme with clustering and rotation. Sampling weights are calculated as inverse probabilities of selection within each stratum, then calibrated by household size and urban/rural location to the values coming from the last Census. Inaccuracies in the data were corrected in four steps.

Firstly, historical data do not include weight calibration to population totals. Lack of the weights corrections yields a biased distribution of social transfers, especially those targeting households with children. Thus the first step of the data base construction consisted of calibrating HBS weights to five-year age group totals. This is done by minimizing the distance between new and original weights according to methods employed in Gomulka [1992], Deville and Sarndal [1992] and Creedy and Tuckwell [2004]; see also [Myck and,Najsztub, 2015]. Starting in 2023, GUS applies similar weight calibration to population totals [GUS, 2024].

Secondly, weight calibration is not enough to correct for the missing high and low income earners from the survey, which can bias the income structure present in the data [see: Bukowski and Novokmet, 2021, Bukowski et al., 2023 Brzeziński, Myck, Najsztub, 2022]. To overcome this issue we use average tax rates calculated from tax administration data for the analyzed period and scale incomes from net values to gross, obtaining social security contributions, health insurance contributions and PIT. We divide the net income distribution in the administrative data for main income categories available both in HBS and administrative data (employment, pensions, self-employment) into 500 groups and by individual/joint taxation. Each group is matched with the corresponding HBS quantile, and incomes are scaled proportionally. Tax components are then imputed based on group-level average tax rates. This statistically aligns the HBS income distribution with administrative data. Adjustments are minor for pensions, small for employment (mainly adding high earners), and substantial for self-employment. Self-employed respondents with declared activity but zero income were assumed to have losses drawn randomly from a calibrated distribution based on tax return data.

Thirdly, to align the HBS data with the national accounts ESA2010 data for consumption, we included imputed rents both for income and consumption, which were missing from HBS. We introduced an imputation method based on a log-linear model estimated for households

reporting rental expenditures (about 5% of the total) and then scaling the imputed totals to the values from the national accounts [source EUROSTAT]. Due to missing financial assets data, the Financial Intermediation Services Indirectly Measured (FISIM) component could not be included. We also added local taxes paid by farmers using Local Data Bank data [BDL, GUS], scaling totals by farm size in equivalent hectares. Local taxes paid by businesses were excluded due to lack of separation between household and non-household sectors in aggregate data.

Fourthly, much of households final consumption as it is reported in national accounts is unaccounted for in HBS. Not only the totals do not match, but the structure of consumption also differs. For consumption we used calculated HBS totals by COICOP and scaled them at household levels to those coming from national accounts from EUROSTAT. This improved product-level distribution slightly, but did not enhance income-based consumption structure.

The outlined corrections improve the quality of time series which still have some drawbacks however. In particular, the HBS ignores the seasonality of household income so the computations rely on annual averages, which is most noticeable for farming income. Similarly, due to limited demographic information (lack of information on education) in the administrative data average effective tax rates were used.