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Differential Effects of Monetary Policy on Household Consumption: The Case of Israel*

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Abstract

We investigate the distinct effect of monetary policy on households' consumption in Israel, based on information from the Household Expenditure Surveys for 2003 to 2018. Analyzing aggregate distribution indices, a pseudo panel and the granular household data, and using the local projections methodology proposed by Jorda (2005), we find that (unexpected) changes in monetary policy mainly affect the expenditure on durables. The effect is mostly evident in the higher income quantiles, and to a lesser extent in the lower quantiles. We did not find significant evidence for a monetary policy effect on nondurables consumption. The findings support the existence of an intertemporal substitution effect and a negative wealth effect of the interest rate, and to a lesser extent the interest rate's effect on the exchange rate which would have increased the consumption of (imported) durables due to the appreciated exchange rate following an interest rate increase. The findings do not support a strong indirect effect of monetary policy on labor income, which is expected to influence aggregate consumption, particularly in lower quantiles with higher marginal propensity to consume.

Keywords: Monetary policy, consumption, inequality, local projections

השפעות דיפרנציאליות של מדיניות מונטרית על משקי הבית בישראל

סיגל ריבון

תקציר

הנייר בוחן את ההשפעה הדיפרנציאלית של המדיניות המונטרית על הצריכה של משקי הבית בישראל, בהתבסס על מידע המתקבל מסקר הוצאות משקי הבית לשנים 2003 עד 2018. הניתוח, שנעשה באמצעות מדדי התפלגות צריכה מצרפיים, פסאודו-פאנל ונתונים פרטניים על משקי הבית, תוך שימוש בגישה של תחזיות מקומיות (local projections) שהציע Jorda (2005), מוצא ששינויים (בלתי צפויים) במדיניות המונטרית משפיעים בעיקר על ההוצאות של משקי הבית לרכישת בני-קיימא. השפעה זו ניכרת בעיקר בחמישוני ההכנסה הגבוהים, ופחות בחמישונים הנמוכים. לא נמצאה השפעה מובהקת של המדיניות המונטרית על הצריכה השוטפת. ממצאים אלו תומכים בקיומה של השפעת תחלופה בין-זמנית והשפעת רכוש שלילית של הריבית, ובמידה פחותה בחשיבות ההשפעה של הריבית על שער החליפין, שייסוף שלו כתוצאה מעליית הריבית היה צפוי לפעול לגידול בצריכת בני-קיימא (מיובאים). הממצאים אינם תומכים בקיומה של השפעה עקיפה חזקה של המדיניות המונטרית על ההכנסה מעבודה, שאמורה היתה להשפיע על הצריכה הכוללת, בפרט בחמישוני ההכנסה הנמוכים, המאופיינים בנטייה שולית גבוהה יותר לצרוך.

מילות מפתח: מדיניות מונטרית, צריכה, אי-שיוויון, local projections

1. Introduction

Monetary policy's main objective is to preserve price stability, while minimizing the cost in terms of aggregate output fluctuations over time. Reducing inequality or generally influencing the income distribution has been seen traditionally as a normative issue and a task of fiscal policy. Nonetheless, in recent years, and in particular following the Global Financial Crisis (GFC), there has been growing interest in the distributional effects of monetary policy. Understanding these effects is important both in order to understand the channels through which policy is working and the policy's ability to achieve its primary goals, but is also important due to the significance ascribed by policy makers and the public in general to distributional issues.[1] Nonetheless, it is important to note that monetary policy may influence inequality in the short-, or even the medium-term, but the important factors determining inequality in the long run are fundamental attributes of the economy such as education and investment.

One mechanism by which monetary policy may influence price dynamics and achieve its goal of preserving price stability is by affecting aggregate demand. A central component of domestic demand is private consumption. Therefore, understanding the link between monetary policy and consumption is important. In particular, the effect on the behavior of various sectors of households and components of consumption may contribute to understanding the overall effect better. Investigating the distinctive effect of monetary policy on households with different characteristics will help in understanding the policy's transmission channels and its effectiveness.

The literature in this field has been developing along two major avenues. The first is the theoretical viewpoint, with models that depart from the assumption of a representative agent and usually study—within the framework of a New-Keyensian macroeconomic model—the effect of incorporating heterogeneous agents on the outcome of these models. The second strand of literature is the empirical one, investigating different aspects of the relationship between monetary policy and inequality of wealth or income, in the majority of studies, or consumption in some of the papers.

Concerning the theoretical aspects, Gali (2018) states that heterogeneity, alongside the current broad interest in zero lower bound issues, is at the center of New-Keynesian macroeconomics. Particularly in the presence of heterogeneity, which allows for lenders and borrowers, and financial frictions, different households will have a different marginal

[1] The Bank of Israel's new law from 2010 includes "reducing social gaps" in the Bank's objectives.

propensity to consume, and the macroeconomic effect of the shock will depend on the extent it affects the distribution of income and wealth across households. Gornemann, Kuester and Nakajima (2016) offer a New-Keynesian heterogeneous-agent DSGE model with asset-market incompleteness, heterogeneity in preferences and skills, a frictional labor market, and sticky prices, in order to analyze the effects of monetary policy, and find that contractionary monetary shocks lead to an increase in earnings, income, wealth, and consumption inequality. Kaplan, Moll and Violante (2018) present a theoretical model with heterogeneous agents and find that in such a model, which takes into account the existence of assets with different degrees of liquidity and returns, the main effect of policy is the indirect effect, due to the response of the macroeconomic conditions, specifically labor demand. This effect outweighs the relatively small impact, in their model, of the substitution effect. Hintermaier and Koeniger (2018), using a calibrated model with incomplete markets, find that there are sizeable differences in the consumption responses of households to changes in the real interest rate and house prices, which may be contributing to differences in the composition of households by age, income and wealth. Slacalek, Tristani and Violante (2020) use a small model and micro household survey data, and show that while wealthier households (non hand-to-mouth) are sensitive to the direct effect of interest rates through the intertemporal substitution channel, poorer households, which are liquidity constrained, will change their consumption due to the indirect effect of temporary changes in their income. Using a HANK (Heterogeneous Agents New Keynsian) model, they show that the variation of households' balance sheets in different European countries leads to variation in the response of (non-durable) consumption to monetary shocks.[2]

A number of studies offer different classifications of the transmission channels from monetary policy to changes in the distribution of the variable in concern. Ampudia, et al. (2018) suggest classifying the transmission as via direct and indirect channels. The direct effects are those directly influencing the behavior of the household, such as the intertemporal substitution effects due to the change in the interest rates that are revealed in the tendency to save, and households' financial income. The indirect effects are those stemming from the changes in the general macroeconomic situation – the response of prices, employment, and wages. They find, based on their empirical analysis of the euro area, that the indirect income channel has remarkable importance relative to the other channels. Bunn, Pugh and Yeates

[2] See also Auclert (2017), describing the expected theoretical channels by which monetary policy may affect differently the aggregate spending of households with different marginal propensity to consume.

(2018) refer to six main channels: Lower interest rates – lower payments for borrowers and income for savers (direct); Financial wealth (direct); Housing wealth (direct); Pension wealth (direct); Labor income – lower unemployment and higher wages (indirect); and the effect of inflation on the real value of debt and assets (indirect).

Alternatively, Colciago, et al. (2019) in their literature survey, choose to classify the effects of monetary policy as an income effect due to the change of interest rates on households' savings, a wealth effect due to the response of asset prices held by households, or a substitution effect due to the effect of real interest rates on the price of current consumption relative to that of future consumption.

Samarina and Nguyen (2019), in their empirical analysis of monetary policy's effect on income inequality in the euro area, distinguish between the real macroeconomic channel, captured by wages and unemployment, and the financial channel.

The empirical investigation of the effect of monetary policy on the distribution of major economic variables like income or consumption, or on inequality, has gained interest in the monetary literature in recent years, though the conclusions regarding these questions are still very much unclear, with different analyses reaching various and ambiguous conclusions. Deutsche Bundesbank (2016) points out that the existing literature finds only a relatively weak distributional effect of monetary policy, and that policy rate cuts may cause a only a slight reduction in inequality. O'Farrell, et al. (2016) examine the income and wealth inequality trends in selected OECD countries and also conclude that in practice the effects of monetary policy on income and net wealth inequality are estimated to be small. They find that cross-country differences in the size and composition of household financial assets are what are relevant for differences in the effectiveness of monetary policy.

A summary of the body of literature concerned with central bank policy and income and wealth inequality may be found in Colciago, et al. (2019).[3]

Considering the effect of monetary policy on wealth, a BIS paper by Domanski, Scatigna and Zabai (2016) supports the view that monetary policy affects wealth inequality mostly due to the rise in equity prices, to a lesser extent due to the rise in home prices, and has only a negligible effect due to changes in interest rates and bond prices.

Many other papers choose to look at the effect of monetary policy on income inequality, which is central in evaluating inequality in society. In regard to the transmission of monetary

[3] Table 1 in their paper summarizes the findings of about 20 empirical papers, investigating the effect on income and wealth inequality, starting from the 1990s, but mostly from recent years. Table 2 in their paper presents a summary of studies referring to the effect of unconventional monetary policy.

policy, diverse effects on the income of different sectors is expected to affect their consumption. Assuming lower income households have a higher marginal propensity to consume, if (accommodative) monetary policy has a stronger effect on lower income households, the effect on total consumption will be larger relative to the case where the income of higher-income households is affected. The literature's conclusions concerning income are ambiguous. Park (2018), using a VAR that includes a Gini coefficient for Korea, finds that contractionary monetary policy significantly increases the inequality as measured by the Gini coefficient after one year; Mumtaz and Theophilopoulou (2017) examine the effect of monetary policy on inequality in income, earnings and consumption – both total and excluding durables and housing, in the UK, by including indices of inequality (Gini and cross-section standard deviation) in a standard SVAR and find that contractionary monetary shocks contribute to a rise in inequality of both income and consumption, because they have a larger negative effect on the lower quantiles.[4] Kronick and Villarral (2019), using a similar framework for Canada, find that the very accommodative monetary policy after the GFC contributed to an increase in income inequality. Hafemann, Rudel and Schmidt (2017), examining the US, Canada and Norway, also find that expansionary monetary policy contributes to an increase in the Gini coefficient for market income in all three countries. Inui, Sudo, and Yamada (2017), who study the impact of monetary policy shocks on Japanese households using micro-level data, find a procyclical effect – higher income inequality for accommodative monetary policy only before the 2000s (using data starting from 1981). They find that the transmission from income inequality to consumption inequality is minor.

A new ECB paper by Hauptmeier, et al. (2020) analyzes the heterogeneity in the regional patterns of monetary policy transmission using granular data on the city- and county- level activity in the euro area. They find that the output effect is more pronounced and prolonged in the lower ranges of the income distribution. Therefore, policy tightening increases regional inequality while accommodative policy will tend to mitigate it.

A smaller portion of papers concentrates on analyzing the effect of monetary policy on consumption inequality. Although income and wealth inequality are more common and widespread indices, in order to understand the eventual effect of monetary policy on activity and prices, it is the reaction of demand – and in particular household consumption – and its

[4] Israel and Latsos (2019) investigate the effect of unconventional monetary policy in Japan on income inequality and find that expansionary policy tends to reduce gender and education inequality in labor income.

heterogeneity, that matters. Several papers relate to consumption inequality alongside inequality measures for income or wealth. Mumtaz and Theophilopoulou (2017), mentioned above, is one of those papers. Coibion, et al. (2017) show persistent increase in inequality indices for income, earnings, expenditure and consumption in reaction to contractionary monetary policy. Loukoianova, et al. (2019) find for Australian data that a household's reaction to monetary policy depends the level of household debt: households with higher levels of debt tend to reduce their consumption and durables expenditures more than other households in response to contractionary monetary policy shocks. Berg, et al. (2019) show evidence of a wealth effect of monetary policy surprises on consumption by finding that older households' consumption reacts more strongly to monetary policy surprises than consumption among younger and less wealthy households. Gelos, et al. (2019) find that the responsiveness of households' consumption has declined after the GFC.

Some papers, written in recent years, focus on evaluating the effect of the unconventional monetary policy, in particular, the quantitative easing, on inequality.[5] Among these papers is the ECB study by Lenza and Slacalek (2018), which finds that quantitative easing (QE) in the euro area compressed the income distribution because many households in the lower income quantiles became employed. The effect of this QE on wealth inequality in the euro area was negligible. Casiraghi, et al. (2016) study the effect of the unconventional monetary policy in the euro area on Italian households and also find that the policy's moderating effect on income inequality outweighs that of the financial channel. Overall, they conclude that the effects on inequality are negligible.

In Israel, an unpublished manuscript by Zaban (2015) finds that a negative (expansionary) shock to monetary policy contributes to an increase in inequality, and attributes this effect to the asset channel – wealthier households tend to invest in housing, and enjoy higher yields on such assets when the interest rate is lower. I am not aware of any other academic research for Israel that investigated the relationship between monetary policy and inequality.

Empirical studies use different types of data and methods to analyze the relationship between monetary policy and inequality. Some look at aggregate indices of inequality – for a country or a panel of countries, while others choose to investigate granular data, usually from Expenditure Surveys. The methods vary, but among the common methods are

[5] A summary of empirical studies that relate to unconventional monetary policy may be found in Colciago, et al. (2018). See Table 2 there.

simulations based on calibration of expected effects (for example, Domanski, Scatigna and Zabai, 2016), panel regressions (see, for example, Cloyne, Ferreira and Surico, 2018, and Loukoianova et al., 2019) and small SVAR systems that include inequality indices (for example, Mumtaz and Theophilopoulou (2017), Hafemann, Rudel and Schmidt (2017), Park (2018) and Kronick and Villarral (2019)).

Many recent papers choose to investigate the effect of policy on inequality using local projections, as proposed by Jorda (2005). Coibion et al. (2017), relying on the Jorda (2005) methodology, examine the effect of monetary policy on a number of alternative inequality indices and find that contractionary monetary policy systematically increases inequality in labor earnings, total income, consumption and total expenditure. They conclude that household balance sheets play an important role in the transmission of policy. Furceri, Lougani and Zdzienicka (2018) apply the Jorda (2005) approach for the Gini coefficient to a panel of 32 advanced economies. They find asymmetric effects of monetary policy on income inequality. While contractionary policy increases income inequality, the effect of accommodative policy depends on the state of the business cycle. Gelos et al. (2019) also follow Jorda (2005) for the investigation of the response of consumption.

I chose to study the effect of monetary policy on consumption, as this is the variable of importance for the monetary policy transmission mechanism. In addition, it is reasonable to assume that the information about households' consumption retrieved from the Household Expenditure Survey (HES) is of better quality, relative to that concerning the household's income, and in particular non-wage (capital market) income, which is known to be very problematic in this kind of survey. Like many other studies, I use the Jorda (2005) Local Projection framework to analyze the effect of (unexpected) monetary policy changes on consumption – durable and other (excluding housing expenses), based on data retrieved from the Israeli HES for the years 2003–18.

I find that monetary policy affects only durables expenditure, while its effect on non-durable consumption is mostly insignificant. Moreover, this effect is usually stronger for higher income households, consistent with the existence of the wealth effect found in several other papers. Therefore, contractionary monetary policy, which reduces higher income households' expenditure more than that of lower income households, will tend to reduce dispersion in consumption, while accommodative policy will increase dispersion. Our findings support a stronger intertemporal substitution effect and a negative wealth effect of the interest rate, relative to its appreciation effect on the exchange rate which tends to

increase the consumption of (imported) durables. The findings do not support the existence of a strong indirect effect of monetary policy on labor income which would have been expected to influence aggregate consumption and particularly among lower quantiles with higher marginal propensity to consume.

The paper contains four parts. After the introduction and the short literature review in the first section, Section 2 describes the data. The estimation and the results are presented in Section 3, and Section 4 concludes.

2. The Data

The main data source for our analysis is the information gathered in the annual Household Expenditure Survey (HES) conducted by Israel's Central Bureau of Statistics. In addition, we will want to identify the unexpected part of monetary policy in order to identify the exogenous effect of policy on the variables of interest. This section briefly describes these two sets of information.

a. The household expenditure survey and other macroeconomic data

The Israeli CBS conducts a HES annually, covering more than eight thousand households each year.[6] The survey includes detailed information about the income and expenses of the households as well as demographic information, such as region of residence, marital status, and characteristics associated with consumption of housing services—residence in owned or rented accommodations and the number of rooms in the dwelling at issue. The survey does not include information about the assets or debt of the household, except for information about the ownership of a home and whether the household rents or lives in its own home. The time range of our sample is 2003 to 2018. The survey is annual but households are sampled over the entire year. Using the date a household was interviewed, we partition the sample into quarterly data. Investigating the effect of monetary policy, we feel it is essential to analyze the response of households using quarterly frequency. In addition, the very short sample – only 16 years – does not allow to conduct the analysis on an annual basis.[7,8]

[6] Until 2011 the survey included about five thousand households.
[7] Although the quarterly sample is not a representative sample, and the distribution of sampling over the year is not uniform, the quarterly data does incorporate important information about consumption and income in the sampled period.
[8] Cloyne and Sorico (2017) and Mumtaz and Theophilopoulou (2017) also assign households to different quarters within the annual survey, based on the date of survey interview.

Our classification of expenditure on durables includes furniture, (electric) appliances, TV, DVDs and computer products. Cars are not included in the base definition for the full sample because in the past the HES included only the implied expenditure on car services rather than the value of the car itself. Data for car purchases is available only from 2007. We define an alternative measure for durables' expenditure for a sub-sample starting in 2007 which includes car purchases.

We analyze the response of households to monetary shocks by income quantiles. We also look at households' response to monetary shocks according to the tenure status – whether the household owns an apartment and whether the household is repaying a loan. We do not have information about the level of debt of the household, but we do know whether its expenses include loan repayments. We will also investigate the effect of belonging to a specific age group – older[9] (head of) household relative to others.

We present some statistics that describe the main characteristics of the data. Table 1 provides several insights. The first is that the share of consumption out of disposable income, as measured from the HES, is high, exceeding 1, in the lowest quantile,[10] and declining in the higher quantiles. Another point is that according to our definition, durables expenditure is only a small fraction of disposable income, about 4 percent; including car purchases, durable expenditure is relatively stable among the quantiles at about 7 percent.[11]

Table 1: Share of consumption (excluding housing) and durables expenditure in disposable income, by quantile, 2003–2018 (%)

	Consumption (excl. housing)	Durables expenditure*	Durables expenditure** 2007–2018
1	1.20	0.047	0.064
2	0.96	0.044	0.073
3	0.83	0.037	0.071
4	0.76	0.034	0.071
5	0.66	0.031	0.072
Total	0.88	0.039	0.070

* Excluding car purchases, ** including car purchases

Looking at the development of consumption (in real terms, deflated by own prices), by quantiles over the sample years (Figures 1a–1c), expenditure on durables is more volatile

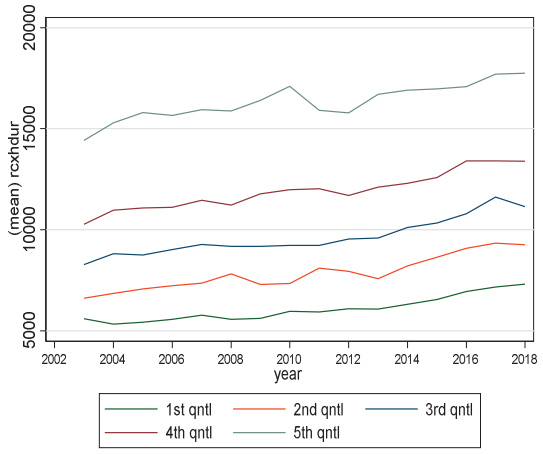
[9] We define older households as those that the age of head of household is aged 50 or more.
[10] This is a known phenomenon in Israeli data. It may reflect the existence of unreported income.
[11] The average share of durables in consumption (excluding housing) is similar across quantiles and is about 4 percent. This is consistent with the magnitude in the National Accounts data, excluding car purchases, as is the definition of durables here.

than the other components of consumption. This higher volatility may reflect higher sensitivity to shocks, and in particular monetary policy shocks.

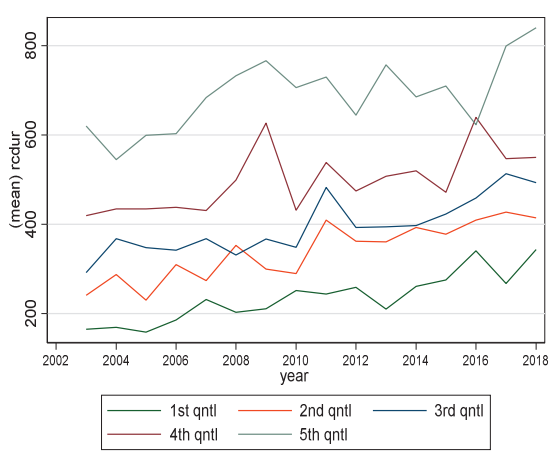
In an alternative partition of the household sample we will want to refer to the tenure status – whether the household owns an apartment and whether it reports loan payments.

Figure 1: Consumption by quantiles, 2003–2018

a: Total consumption excluding dwellings and durables



b: Expenditure on durables



c: Expenditure on durables, including car purchases, 2007–2018

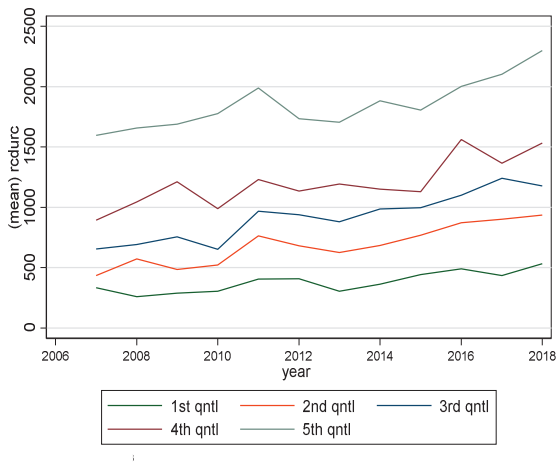


Table 2: Share of apartment ownership and loan payments by quantile, 2003–2018 (%)

Quantile	Ownership	Loan payments
1	49.4	14.8
2	68.0	29.5
3	74.7	37.4
4	81.3	40.0
5	85.7	36.2
Total	72.0	31.7

Ownership rate increases, as expected, in higher income quantiles. While the average ownership ratio is 72 percent, in the lowest quantile only about half of the households own a home, while in the upper quantile the rate is more than 85 percent (Table 2). Of the third of the households that repay loans, their share in the upper quantiles is higher than that in the lower two quantiles. While most of loan payers are home owners (not shown), more than a half of home owners do not have loan repayment expenditures (when sampled).

Looking at the age distribution – differentiating between older households (older than 50 years) and younger households, we find older households tend to be in higher quantiles and to own a home (Tables 3 and 4).

Table 3: Share of older households by quantile, 2003–2018 (%)

Quantiles	50 years old or older
1	29.7
2	37.0
3	37.9
4	41.4
5	50.3
Total	39.3

Table 4: Share of older households by home ownership, 2003–2018 (%)

Ownership	50 years old or older
Own	44.8
Do not own	25.4
Total	39.3

b. Interest rate surprises

In accordance with the literature, we identify the effect of monetary policy by examining the impulse response of various economic measures to a shock (surprise) to monetary policy. We measure the unexpected element of monetary policy as the difference between the expected value for the policy rate on the eve of the monetary decision and the actual rate decided on. The expected rate may be approximated by market-derived expectations or may be based on forecasts published by professional forecasters. Short term market instruments that hedge against changes in the policy rate exist in Israel only from 2007, and may be considered reliable only since around 2010, when the Telbor (inter-bank) market became institutional. This dramatically shortens the available sample period, and therefore we prefer to use, at least for now, the deviation of the actual interest rate from the professional forecasts. Forecasters publish their projections on various dates during the month; in order

to obtain monetary surprises we compute the difference between the actual interest rate on the day of declaration and the average forecasts for it, as they existed the day before, and apply this surprise to the period that follows, until the next decision. In order to create a quarterly indicator for monetary surprises we follow Gertler and Karadi (2015), and imply a method similar to that used by Sandstrom (2018) in order to create a measure of the intensity of the surprise, taking into account the timing of the interest rate decision within the quarter. We do this by first accumulating the surprises over the full sample. The cumulative shock for the series of surprises starting from day t=1 until date d will be:

$$(1) \quad cum\_shock_t = \sum_{i=1}^{d} surprise_i$$

We assume the relevant surprises at each point of time are those accumulated in the previous 90 days.

$$(2) \quad dcum\_shock_t = cumshock_t - cumshock_{t-90}$$

As our analysis relates to consumption during the quarter, the relevant measure is the average of $dcum\_shock_t$ over the quarter.

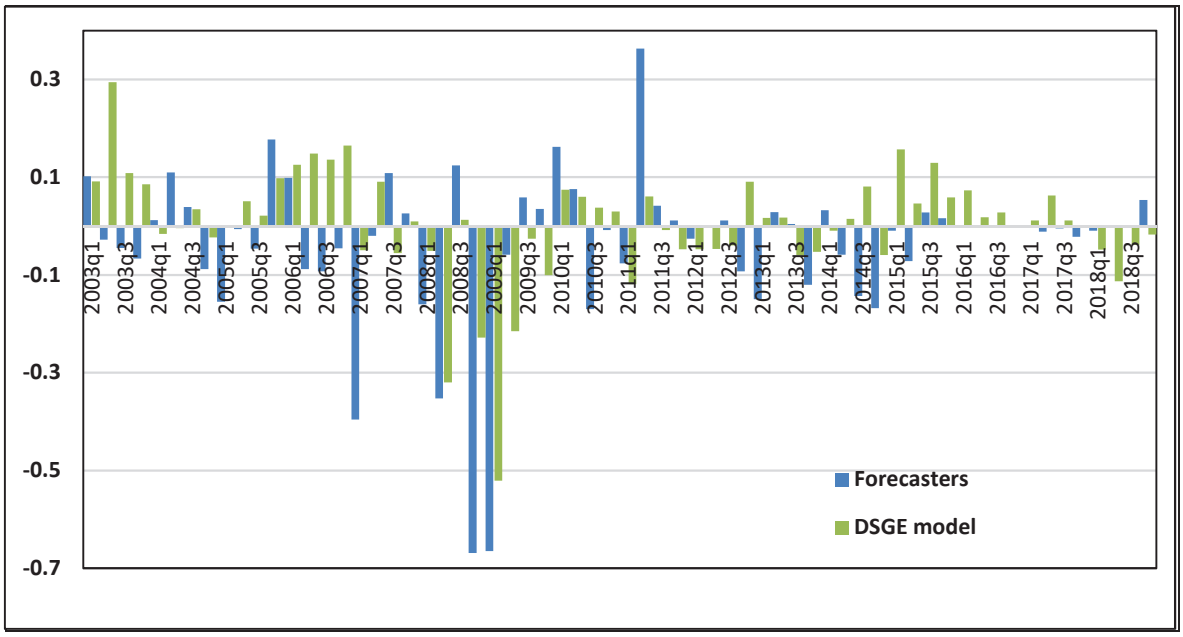
Generally, surprises have been both positive and negative during the sample period, with some bias towards negative surprises, mostly evident during the beginning of the GFC. It is also notable that in the last few years surprises have been practically zero, given the close-to-zero actual interest rate (0.1% since 2015 and 0.25% in the last quarter of 2018), given the anticipation that the Bank will not implement negative interest rates.

In the years since the GFC, monetary policy in Israel, as is in many other advanced economies, has been characterized by a very low level of nominal interest rates. In addition, due to the limit on further accommodation of monetary policy close to the effective lower bound, central banks have added other instruments such as asset purchases, intervention in the forex market, forward guidance and negative interest rates. In Israel, the Bank of Israel chose to renew foreign market intervention in 2008 – first in fixed amounts and later by discretion, as a supplementary monetary instrument; forward guidance was also used as a monetary policy instrument.[12] In this paper we do not address the possible effects of these components of monetary policy on the dispersion of consumption, and therefore may underestimate the total effect of the policy.

[12] See Chapter 3 in the Bank of Israel Annual Report for various years.

The data we use represents surprises. An alternative approach is to look at structural shocks to monetary policy derived from a structural model. [13] These shocks, if correctly identified, represent unexpected changes in the central bank's rate due only to shocks to policy itself, while the surprises derived according to the professional forecasters or the market, are represented in any deviation of actual interest rate from that expected – including forecasters' errors or shocks to other economic variables (if materialized in the relevant period). As a robustness check, we estimate some of the impulse response functions using the derived shocks from the Bank of Israel DSGE model.[14] Figure 2 presents both the monetary shocks as calculated according to professional forecasters and the shocks derived from the DSGE model. There is some difference between the two indicators, but the correlation between them is fairly high – about 0.58.

Figure 2: Computed Monetary Policy Surprises



c. Inequality indices

First we choose to analyze the effect of (the unexpected component of) monetary policy on aggregate indices of inequality, similar to the approach employed by Coibion, et al. (2017).[15]

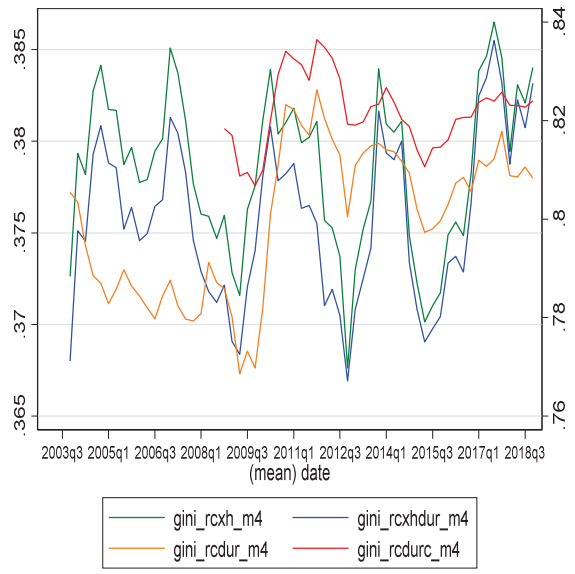
[13] Another possible alternative measure of the unexpected part of monetary policy, that we did not use here, may be approximated using the residual from an estimated Taylor rule.
[14] See Argov, et al. (2012) for an earlier version of the model. I thank the modelling unit in the Bank of Israel's Research Department for their help with this data.
[15] Coibion, et al. (2017) estimate the change in the index rather than its level in future periods.

According to this approach, the left-hand side dependent variable is a macroeconomic measure of inequality, (i. e., the Gini coefficient[16]), and on the right-hand side are, in addition to the variable of interest – the monetary shocks. We include the deviation of the unemployment rate from its Hodrick-Prescott (HP) trend[17] as a macroeconomic control variable. The detailed granular data from the HES is used at this stage only to construct the indices, but not directly for the estimation itself. As seen in Figure 3a, the Gini coefficient we construct is relatively volatile. Inequality for total consumption excluding housing (cxh) and excluding durables (cxhdur) is relatively low compared with the inequality in durable consumption (cdur)[18,] depicted on the RHS y-axis.

Looking at two alternative indices for dispersion – the difference between the 90th and the 10th percentile and the standard deviation of the cross-section log consumption reveals that the dynamics of these indices, and in particular the p90-p10 index, are different from that of the Gini coefficient. This phenomenon – changes in different directions of alternative indicators - may occur when there are changes in the behavior of the middle part of the distribution. (See Appendix 1 for a simple numerical example).

[16] The Gini coefficient is usually defined based on the Lorenz curve, which plots the share of the total income of the population that is cumulatively earned by the bottom x % of the population. The line at 45 degrees thus represents perfect equality of incomes. The Gini coefficient is the ratio of the area that lies between the line of equality and the Lorenz curve, thus ranging from 0 for complete equality to 1 for complete inequality.
[17] We detrend unemployment in order to correct for changes in the natural unemployment rate.
[18] For the partial sample, starting from 2007, we define durables including car purchases (cdurc).

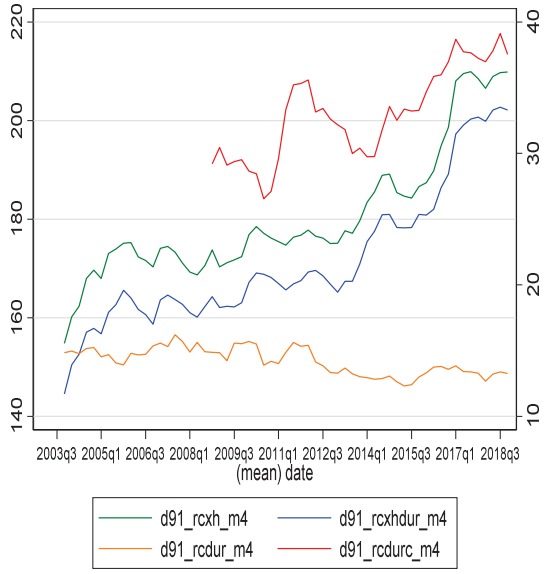
Figure 3a: Gini coefficient for consumption*, 2003–2018



Graph is saved in g_gini

* 4-quarter moving average. Durable expenditure (lrcdur and lrcdurc, including cars, from 2007) on right axis.

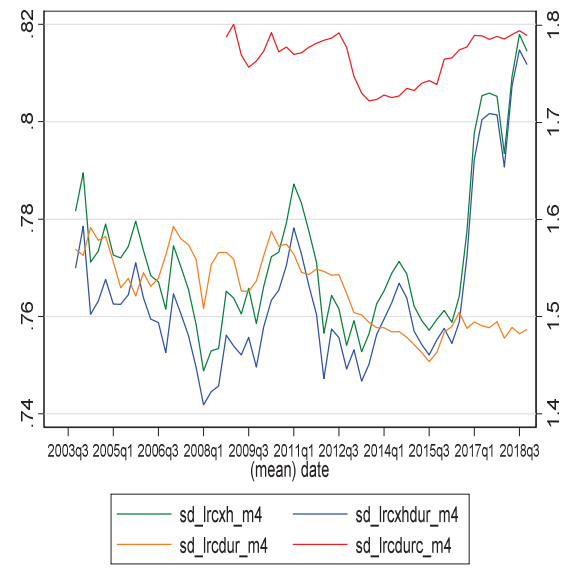
Figure 3b: P90-P10 for consumption, 2003–2018



Graph is saved in g_d91

* 4-quarter moving average. Durable expenditure (lrcdur and lrcdurc, including cars, from 2007) on right axis.

Figure 3c: Cross-section STD for log consumption, 2003–2018*



Graph is saved in g_sd

* 4-quarter moving average. Durable expenditure (lrcdur and lrcdurc, including cars, from 2007) on right axis.

3. The Methodology and Impulse Responses

We investigate the diverse effect of the unexpected component of monetary policy on the consumption of households using three different types of data. The first kind of information is the macroeconomic indicators for inequality – a time series representing a measure of inequality, for example the Gini coefficient. The second type of data is a pseudo-panel we construct, based on shared characteristics of households, for example the income quantile. We will elaborate on this issue later on. The third type of data set is the detailed household data. All these types of data are based on the CBS HES. Optimally, we would have liked to have information from a panel of households, i.e., data for a specific, fixed over time, group of identified households. Unfortunately, the data we have from the HES is for a varying sample of households, meaning we cannot follow a specific household over time. We show in the next section how we deal with this difficulty.

The method we adopt for the analysis is the local projection (LP) methodology introduced by Jorda (2005). As opposed to the standard VAR approach, here we identify the response of the variable of interest rate after k periods independent of a multi-step forecast. The main advantages of this method is that the response functions may be easily estimated by a single equation and they are more robust to misspecification.

a. Preliminary Analysis: Impulse responses for consumption

Before we analyze the effect of (unexpected) monetary policy on inequality, we would like to see whether it has any effect on aggregate consumption. Using the Jorda (2005) methodology, we may specify the equation for aggregate consumption:

$$cons_{t+h} - cons_{t-1} = a^h + b^h m_t + c^h v_t + \varepsilon^h \quad for \quad h = 1, \dots H$$

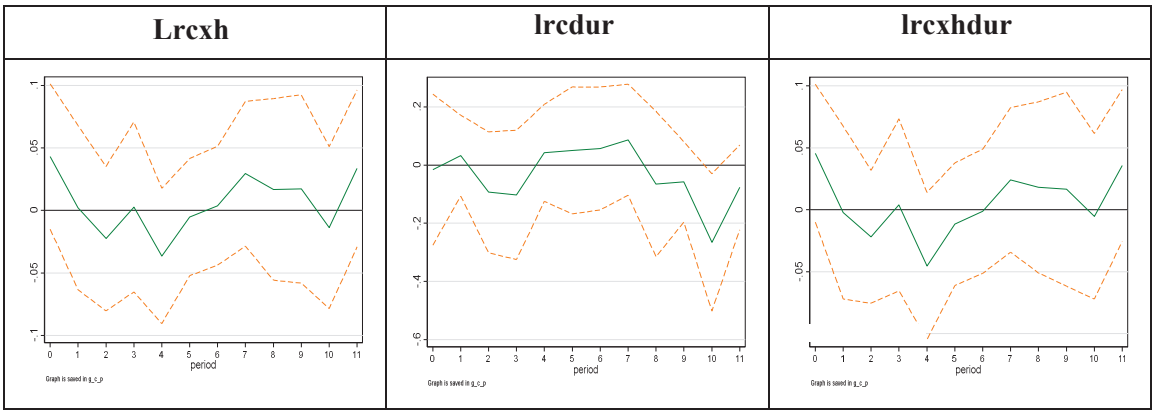
with m_t being the unexpected component of monetary policy, and v_t control variables to adjust for changes in consumption. In our specification these are only the lagged deviation of the unemployment rate from its HP-filter trend, controlling for changes in the macroeconomic environment and seasonal quarterly dummies[19]. We use a robust estimator for the variance-covariance matrix. Using aggregated data from the HES, we use the specification of equation (1) for the log of three consumption aggregates – total consumption

[19] We use the difference of the value of the quarterly dummy between period *t+h* and period *t-1*.

excluding housing (rcxh), durable expenditures (rcdur) and consumption excluding housing and durables (rcxhdur) – all in real terms.

Generally, the effect of unexpected monetary policy that can be identified using aggregated data is weak (Figure 4a). We cannot see any significant effect on total consumption, but there is some insignificant negative effect on durable expenditure, which is in the expected direction.[20]

Figure 4a: The Effect of Monetary Policy on (log) Consumption Aggregates, 2003–2018



* The band represents a 90% confidence interval.

We perform a similar exercise, using the granular data from the HES, to test for the monetary policy effect on (log) consumption.[21] Here we see a significant negative effect on durable expenditure. (Figure 4b). The effect on other consumption is positive, but small in percentage terms.[22]

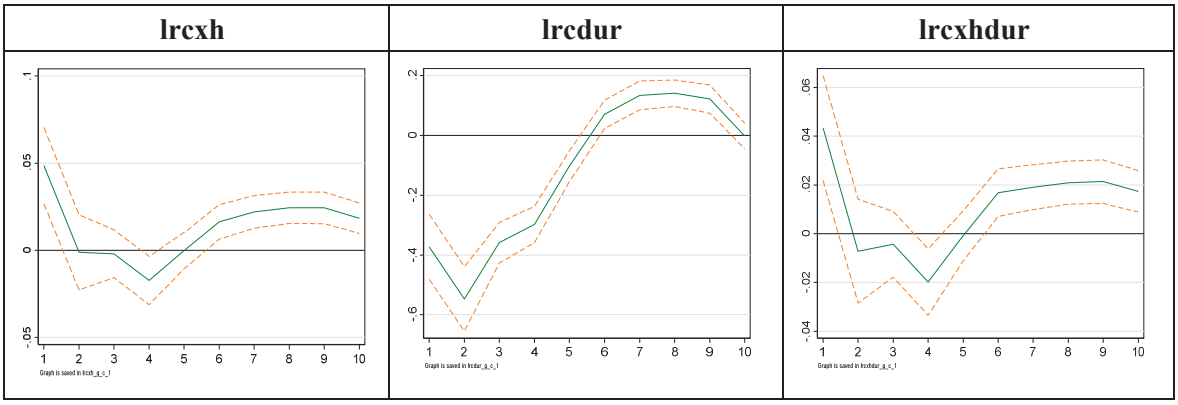
Durable expenditure is generally characterized by large one-time purchases that are indivisible, but that supply consumption services for an extended period of time. Therefore it may be easier to postpone or totally cancel the expenditure. In addition, some of these products are luxury goods with a relatively high price elasticity, which may also be expressed in a stronger reaction to monetary policy. Generally, a stronger effect on durable expenditure is consistent with the higher volatility of this component and its stronger sensitivity to changes in income and wealth, relative to the smoother path of other consumption.

[20] Barak (2017) studying consumption in Israel, does not find a significant negative effect of interest rate, in several specifications on the aggregate consumption function. For some specifications he finds that the effect is positive – a result consistent with a substitution effect larger than the income effect. Kahn and Ribon (2014) find a small negative response of consumption to changes in the 1 year real yield. They also find that the negative effect on durables is larger than that for other consumption.

[21] See a more detailed description of the method used for the granular data in the section below.

[22] Non-durable (excl. housing) consumption is on average more than ten times larger than expenditure on durables. (See Table 1).

Figure 4b: The Effect of Monetary Policy on Consumption Aggregates – Granular data



* The band represents a 90% confidence interval.

The next step is to disentangle the aggregate effect of monetary policy by studying the specific effect on households with various characteristics. This may help us to understand the transmission of monetary policy and its distributional effects better.

b. Impulse responses for inequality indices

Now we turn to our main interest, and using the same methodology we specify the equation for the inequality index ineq:

$$ineq_{t+h} - ineq_{t-1} = a^h + \sum_{j=1}^{J} b_j^h m_t + c^h v_t + \varepsilon^h \qquad for \quad h = 1, \dots H$$

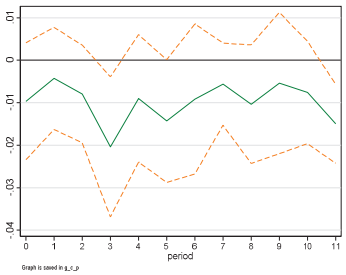
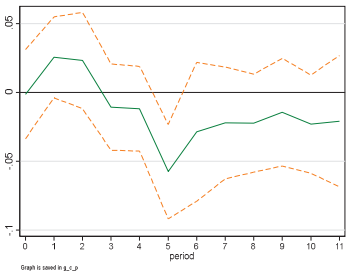
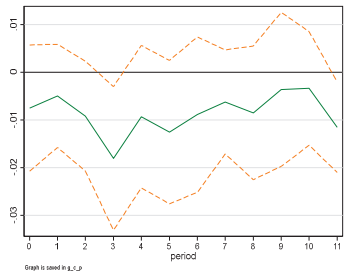
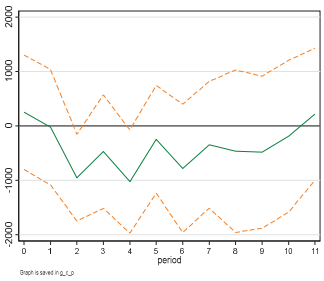
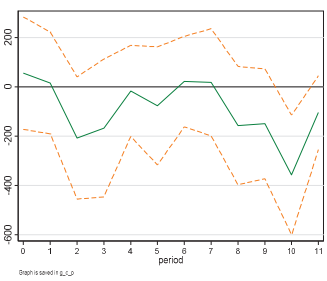
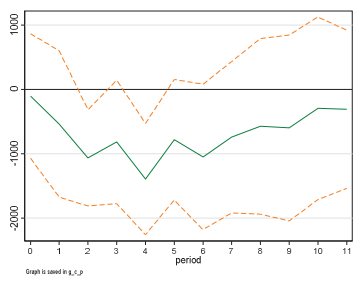
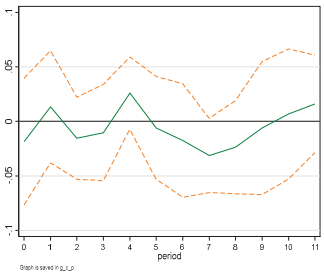
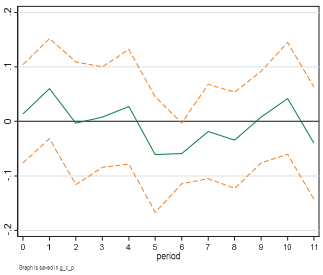
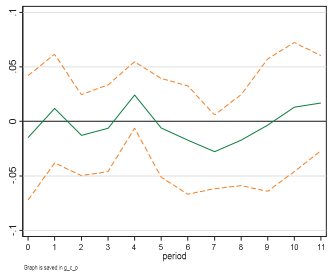
Following Coibion (2017) we examine 3 alternative consumption inequality indices – the Gini coefficient, the cross-section standard deviation of the (log of) consumption, and the

difference between the 90th and the 10th percentiles of consumption.

We study the effect of monetary policy on the inequality indices for the 3 consumption aggregates we analyze – total consumption excluding housing (rcxh), expenditure on durables (rcdur), and consumption excluding housing and durables (rcxhdur). We also investigate the indices for durables including car purchases starting from 2007. As explained above, we use m_t- the unexpected component of monetary policy interest rate as the indicator for monetary policy.

As before, we estimate equation (2) controlling for the lagged (detrended) unemployment rate and seasonal dummies, and using a robust estimator for the variance-covariance matrix.

Figure 5a: <u>The Effect of Monetary Policy Surprises on Inequality Indices</u>

rcxh	rcdur	rcxhdur
Gini coeff.		
		
90-10		
		
sd		
		

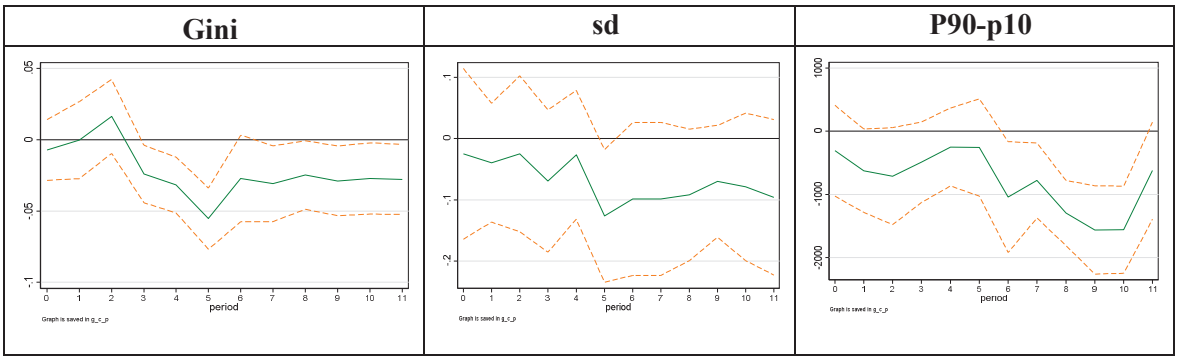
* The band represents a 90% confidence interval.

The results show that a monetary shock tends to somewhat reduce the dispersion in consumption, although the effect is mostly insignificant. (Figure 5a). There is some decline in all three indicators for changes in durable expenditure, while the effect on the dispersion of other consumption is weaker. Generally, there need not be a monotonic mapping between the indices. It may happen that due to a monetary shock that tends to reduce consumption, the dispersion measured by the Gini coefficient will increase, while standard deviation will decline.[23] This may happen, as seen in Appendix 1, when the negative response of the middle-income households is stronger than that in the high or low quantiles.

[23] This is also evident in Figures 1a-1c, where while the durables' expenditure Gini coefficient is rising while the other two statistics are declining over the period examined.

Looking at the sample from 2007, with durables including car purchases, the effect on inequality indices is insignificant for the first periods, but later on both the Gini, the gap between the 90th percentile (p90) and the 10th percentile (p10), and to some extent the standard deviation decline. (Figure 5b).

Figure 5b: The Effect of Monetary Policy Surprises on durable expenditure, 2007–2017



* The band represents a 90% confidence interval.

c. Pseudo-panel

An alternative customary approach, when data does not allow a panel analysis, is to aggregate the granular household data into categories typified by certain relevant characteristics, yielding homogeneous cells with regard to these characteristics, to which we may relate as though they were panel observations with the same "representative average household" over time. This makes it possible to specify an estimation according to the conventional forward-looking local projection method of Jorda (2005), as specified in equation (1) above. Following this method, we may, of course, alternatively aggregate the data on the basis of different characteristics, yielding different panels.

In order to attain homogenous cells, characterized by attributes that minimize the variance within the cell, it is desirable to define the cells by as many attributes as possible. In contrast, due to a limited number of observations for each time period (quarter), ensuring a minimal number of observations per cell limits the number of dimensions by which the data may be categorized. First, we choose to partition our cells by net income quantile.[24]

For each cell k=1,..K in the pseudo-panel, and for each period h, we estimate:

$$y_{k,t-1+h} - y_{k,t-1} = a^h + \sum_{k=1}^{K} b_k^h D_k m_t + c^h z_{k,t-1} + \varepsilon^h$$

[24] Another option, which we investigate later in the paper, is a partition by home ownership with or without conditioning on loan payments, and partition by age group.

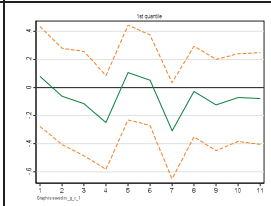
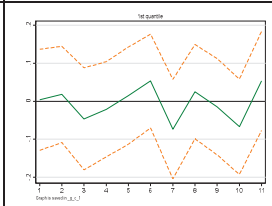
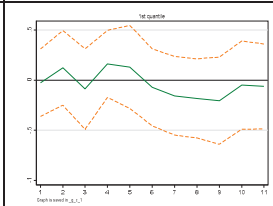
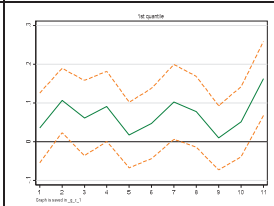
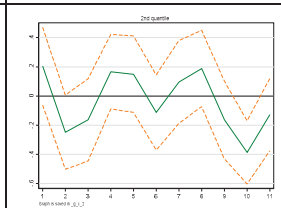
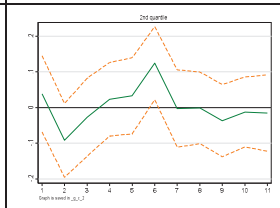
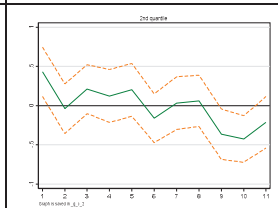
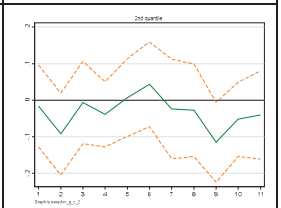
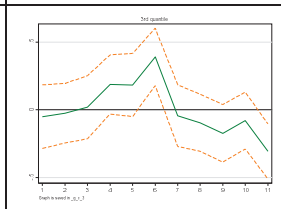
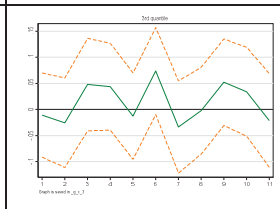
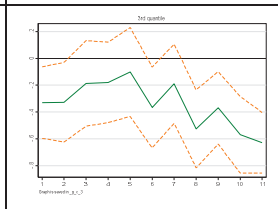
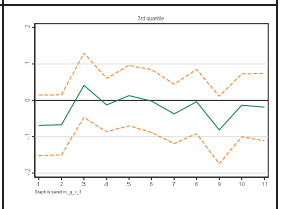
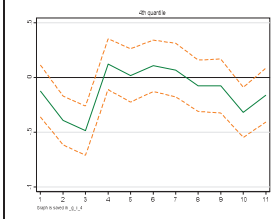
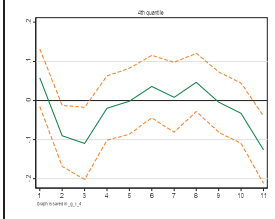
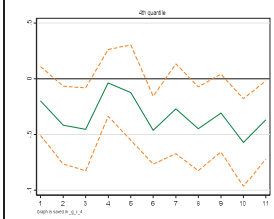
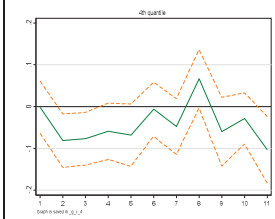
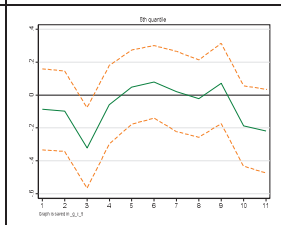
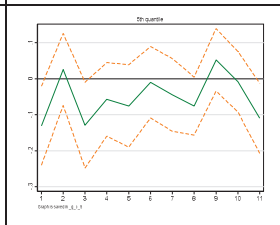
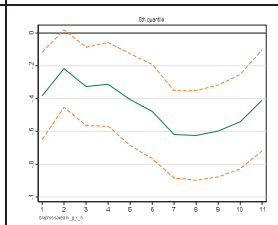
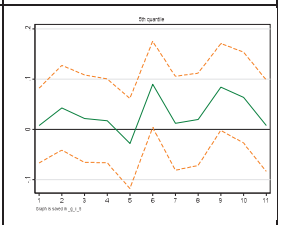
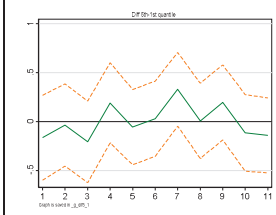
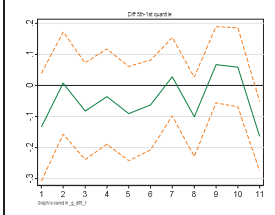
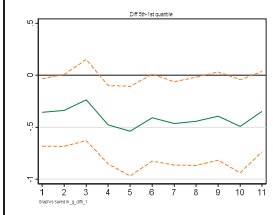
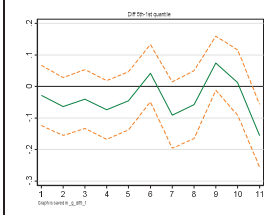
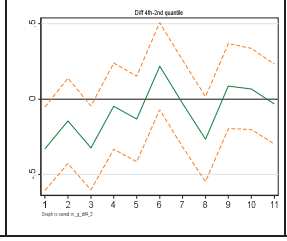
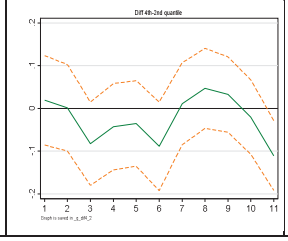
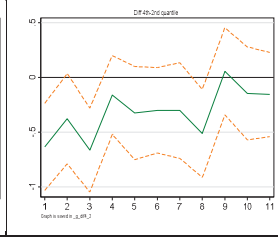
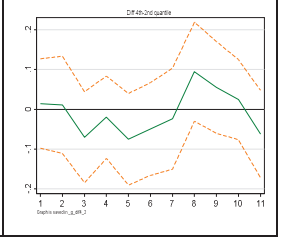
where y is a measure of the household's consumption, m_t is the unexpected component of monetary policy at time t, z_t is a vector of control variables known at time t, which in our case includes the detrended unemployment (lagged one period) and the difference in the seasonal dummy between time $t\text{-}1+h$ and $t\text{-}1$. In addition, we include (exogenous) demographic control variables to take into account the changes in the composition of the pseudo-panel cells, which were partitioned according to income quantiles. We include the average household head's age in the cell, average of dummy variables for older and younger households, for marital status, for new immigrants, number of rooms, size of household, and social rank of municipality in time $t\text{-}1+h$ – all which we assume are exogenous to the monetary shock. ε_h is an idiosyncratic error term and D_k is an indicator variable for households belonging to cell k (e.g., income quantile). Therefore b_k^h is the response of households belonging to group k after h periods. The difference between the $b_j^{k\prime}s$ of the different population groups defines the differential effect of monetary policy shocks on the variable in concern. We use an iterated GLS estimator, allowing for a heteroskedastic and correlated error structure and using a panel-specific AR1 autocorrelation structure.[25]

Figure 6 presents the results of this exercise for durable expenditure – excluding cars for the complete sample, and including car purchases from 2007, and for other consumption (excluding housing). The results of this exercise show that it is durable expenditure that reacts to monetary policy, while the effect on total consumption is generally insignificant. This effect is more pronounced for the shorter period (including car purchases) and is seen more clearly in the higher quantiles. This is consistent with a negative wealth effect due to, for example, a decline in stock prices or home prices, which upper quantiles tend to hold more than the lower quantiles. It may also be that initially the expenditure of lower quantiles on durables is smaller, concentrated in products that are generally more essential, and therefore their expenditure elasticity with regard to changes in the level of interest rate is lower. Looking at the difference in the reaction of upper quantiles relative to lower quantiles, presented in the last two rows of the table, the stronger negative effect on durable consumption (including cars) may be seen. Generally, the negative effect on the consumption of higher quantiles tends to be larger, but the difference is generally insignificant. As a result, inequality in the consumption of durables will tend to decline in the event of a contractionary shock to monetary policy. This is consistent with the effect of policy surprises on the inequality indices shown above (Figures 5a and 5b). It is hard to say

[25] We use the xtgls procedure in STATA16 with the options igls corr(psar1) panels(cor).

anything conclusive from this analysis on the inequality in total consumption, as was the picture for the inequality indices above.

Figure 6: Impulse responses for pseudo-panel by quantiles

Q	lrcdur 2003-2018	lrcxhdur 2003-2018	lrcdurc* 2007-2018	lrcxhdurc* 2007-2018
1				
2				
3				
4				
5				
Dif. 5-1				
Dif. 4-2				

* Including car purchases.

d. Granular Household data

We describe again the Jorda (2005) Local Projections method with some modifications in order to accommodate for the limitations of the granular data that, as mentioned above, is not a panel of a given sample of households, but rather a recurring cross-section sample of changing households.

Ideally we would have liked to specify for each household *n* and period *h* ahead an equation of the following type:

$$(1) \qquad y_{n,t-1+h} - y_{n,t-1} = a^h + \sum_{j=1}^{J} b_j^h D_j m_t + c^h z_{n,t-1} + \varepsilon^h$$
$$for \quad h = 1, \dots H; n = 1, .., N$$

where y is a measure of the household's consumption, mt is the monetary policy shock at time t, z_t is a vector of control variables known at time *t*, and ε_h is an idiosyncratic error term. b_j^h is the response of households belonging to group j (e.g., income quantile, home owner yes/no), to a monetary policy shock after *h* periods. D_j is an indicator variable for group j. Therefore the difference between the $b_j^{h\prime}s$ of the different population groups defines the effect of monetary policy shocks on inequality regarding the variable in concern.

Unfortunately, as mentioned above, we do not have a panel setting – each household is only observed once. But, we may assume that each household, even when not in our sample, witnessed the shocks to monetary policy in all past periods. So, for each household observed in period *t*, we may rewrite equation (1), lagging *h-1* periods, and have:

$$(2) \qquad y_{n,t} - y_{n,t-h} = \tilde{a}^h + \sum_{j=1}^{J} \tilde{b}_j^h D_j m_{t-h+1} + \tilde{c}^h z_{n,t-h+1} + \tilde{\varepsilon}^h$$
$$for \quad h = 1, \dots H; n = 1, .., N$$

Let us label this modified specification "augmented local projection". As noted above, $y_{n,t-h}$ and $z_{n,t-h}$ for households in period t's sample are unobservable. Therefore, in order to estimate (6), and following Verbeek (2007),[26] we first estimate the value of $y_{n,t-h}$ using information about the y values of other households sampled in t-h. We assume that predetermined (head of) household's characteristics such as date of birth, region of residence, marital status, religion, and so on do not change or change very slowly within our sample, and therefore we may assume that these characteristics in period t are similar to

[26] I thank Itamar Caspi for referring me to this literature.

those that existed in t-h for a given household. In addition, macroeconomic conditions that may have affected the households' behavior in t-h may also assist in controlling for $y_{n,t-h}$.

We therefore estimate the first stage:

$$\hat{y}_{n,t-h} = d_0 + d_1\, z_{n,t-h} + d_2 q_{t-h} \quad for \;\; n = 1,..,N$$

Where, as before, z is a vector of fixed or almost-fixed household specific attributes and q is a vector of macroeconomic variables that affect $y_{n,t-h}$. Based on (6) we can assess the specific household's behavior in t-h, which is unobservable. Having estimated $\hat{y}_{n,t-h}$ we now may return to equation (5) and write:

$$y_{n,t} - \hat{y}_{n,t-h} + \hat{a}^h + \sum_{j=1}^{J} \hat{b}_j^h D_j m_{t-h} + \tilde{\varepsilon}^h \quad for \;\; h = 1,...H;\; n = 1,..,N$$

Given that $\hat{y}_{n,t-h}$ is estimated using $z_{n,t}$ the information contained in these variables is already encompassed in $\hat{y}_{n,t-h}$ and it is excluded from the estimation in the second stage. We do add the seasonal dummy for period t to control for seasonal effects and the deviation of unemployment in t-h from its trend to control for additional macroeconomic effects on the consumption in t-h.

We can now estimate, using (7) the effect of monetary policy shocks over-time, by only observing the level of $y_{n,t}$.

Impulse responses for granular household data

As described above, we estimate the effect of monetary surprises on consumption using a two-stage procedure. First we estimate the expected level of consumption according to equation (6), and in the second stage we apply the expected consumption to the second stage equation (equation (7)) in order to evaluate the effect of monetary policy surprises on consumption of each of the quantiles we defined.

First stage equation

As we observe each household only once, we cannot follow its characteristics over time, and have to assume that they remain unchanged. The specific household consumption in any period t may be approximated by the personal characteristics, and by the quantile the

household belongs to (assuming most households do not move between quantiles in the short run). We also include the one-quarter-lagged unemployment rate as an indicator for the macroeconomic conditions, which is uncorrelated with the consumption of a specific household.

In order to control for household characteristics that affect its level of consumption we include in the first stage estimation of consumption (details below), specific household attributes such as the age (of head of household), region of residence, marital status, size of household, number of earners in the household, number of rooms in residence, dummy for new immigrants and for socioeconomic rank of residence area. We also include the unemployment rate as a macroeconomic control variable and quarterly dummies to control for seasonality.

We find that household specific attributes affect consumption. Unemployment tends to lower consumption, but contrary to the expected, we estimate a positive effect, albeit economically very small, of unemployment on durable consumption. We find that households that belong to higher income quantiles are expected to consume about 20-30 percent more than the quantile below. See Appendix 2 for the detailed estimation results.

Second Stage: Impulse responses

Using the expected level of household consumption in time t-h as estimated in the first stage, we estimate the effect of a surprise to monetary policy in t-h on the consumption in time t.

Figure 7 presents the impulse responses for the consumption aggregates – durables and other consumption excluding durables, based on the granular data. It is easy to see the negative effect on durable expenditures, and a small positive effect on other consumption, for the upper quantiles, only occasionally significant. Looking more closely at the difference in the response between higher and lower quantiles (in the last two rows of the table), the negative effect on durables is somewhat stronger in the upper quantiles, at least for the first periods after the shock. This leads to a decline in the dispersion of durable expenditure between quantiles in response to a positive (tightening) monetary surprise. This result is in line with Coibion, et al. (2017) who also find that the responses of consumption by high net-worth households are larger than that of low net-worth households.[27]

[27] We do not have information on the net wealth of households, but only concerning the household's income.

Figure 7: Impulse responses for granular data

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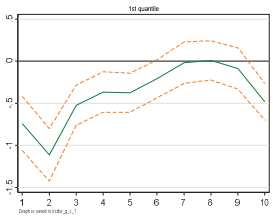
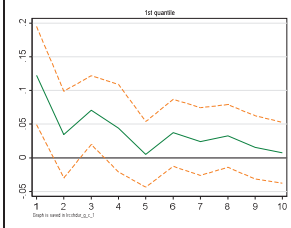
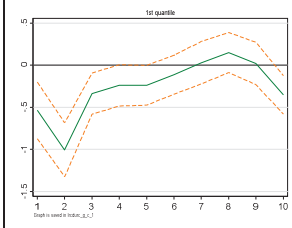
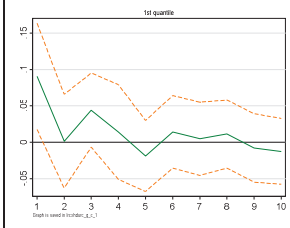
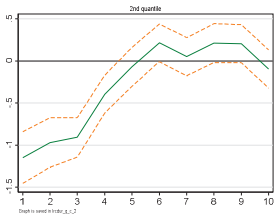
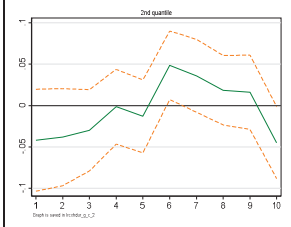
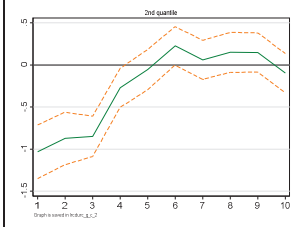
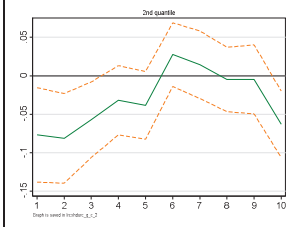
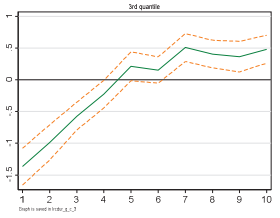
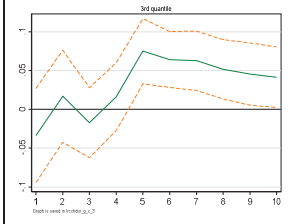
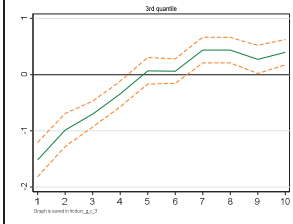
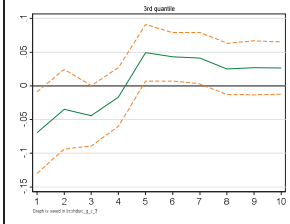
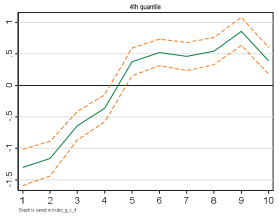
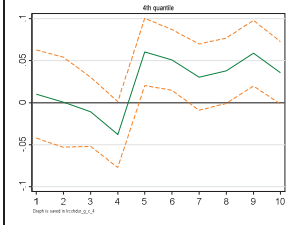
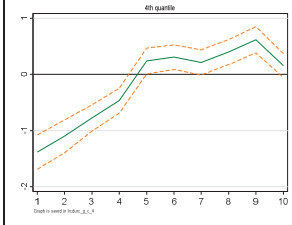
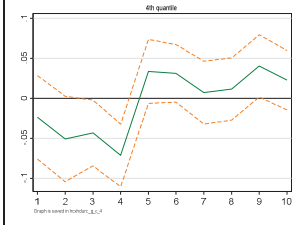
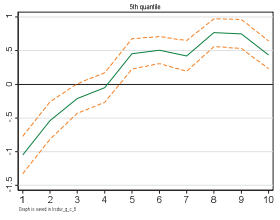
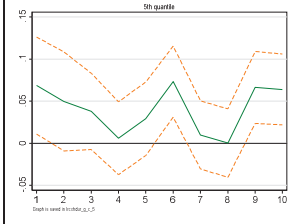
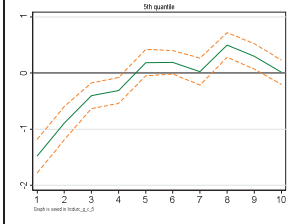
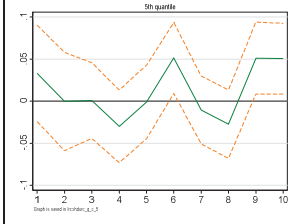
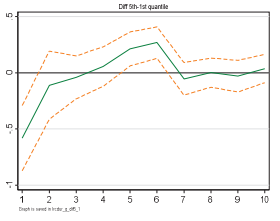
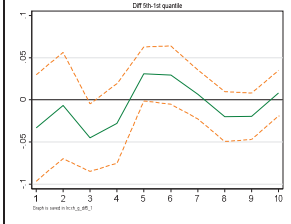
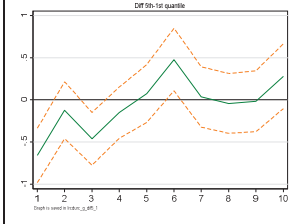
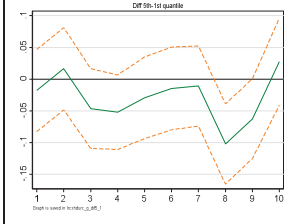
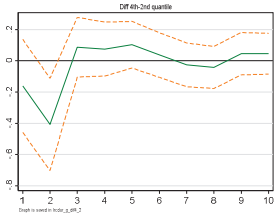
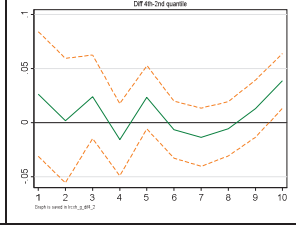
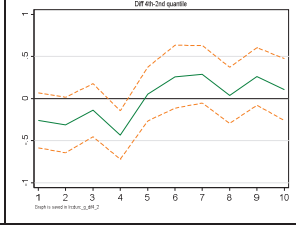
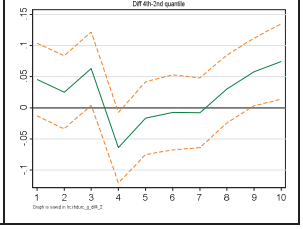
1				
2				
3				
4				
5				
Dif. 5-1				
Dif. 4-2				

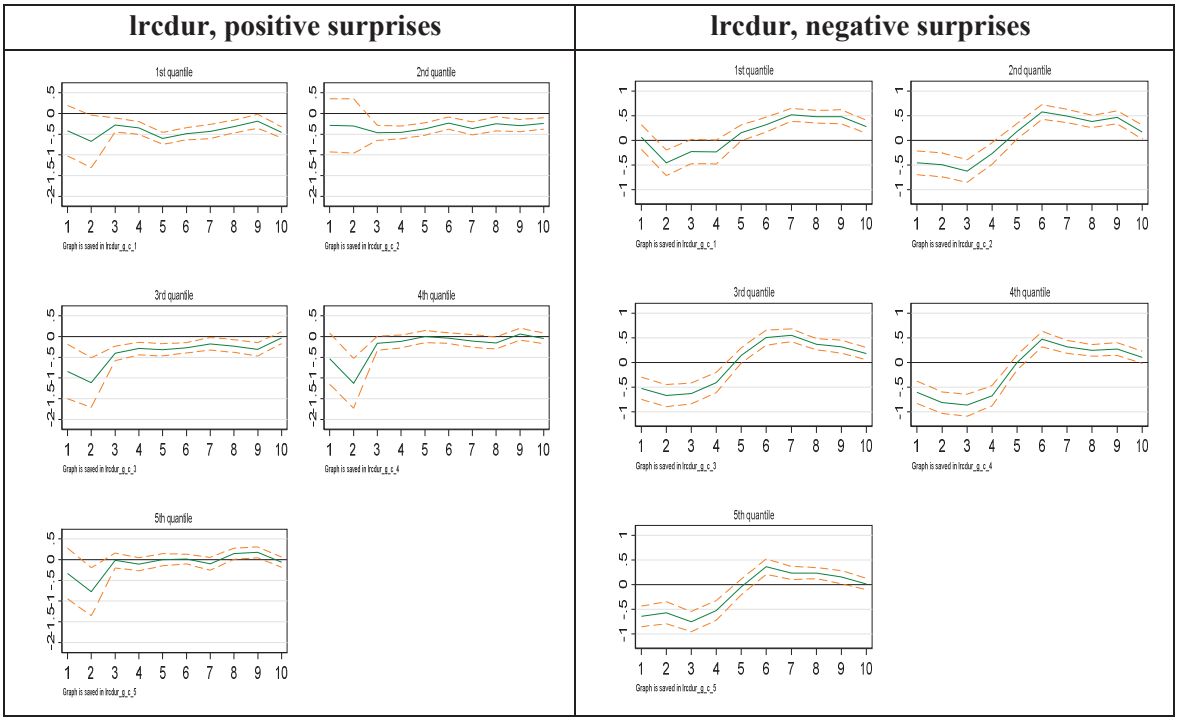
* Including car purchases

A positive effect of higher interest rates on consumption is consistent with an income effect that is stronger than a substitution effect – although as households in lower quantiles are usually borrowers rather than lenders, this interpretation is less reasonable for lower quantiles. Another possible explanation may relate to the effect of interest rates on the exchange rate. Higher local interest rates tend to strengthen local currency appreciation, directly reducing the price of tradable goods, and therefore increasing demand for consumption.[28] This exchange rate channel may effect consumption in the opposite direction, especially in the short-run, and therefore may offset, at least partly, the substitution effect of higher interest rates.

Distinguishing between positive and negative monetary surprises

We test for differences in the effect of positive (tightening) and negative (accommodative) monetary surprises on durable expenditure and find that lowering interest rates has a stronger (in absolute value) effect on durable expenditures relative to an increase in the monetary interest rate. (Figure 8).

Figure 8: Impulse responses for granular data, positive and negative surprises, by quantile



[28] We should comment that one could have expected this effect to be stronger for durables, for which the weight of tradables is much larger than in non-durable consumption.

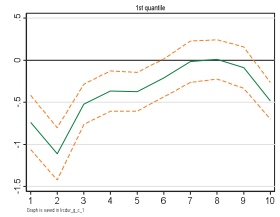
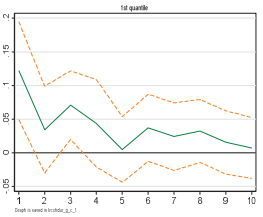
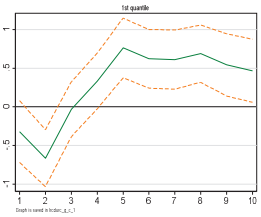
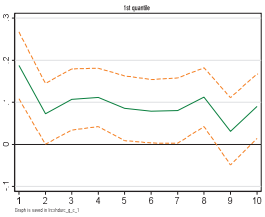
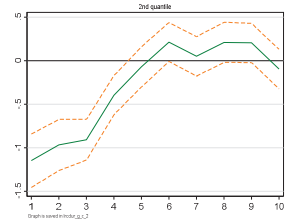
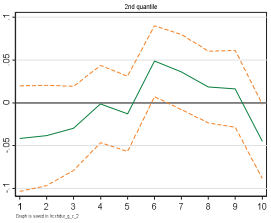
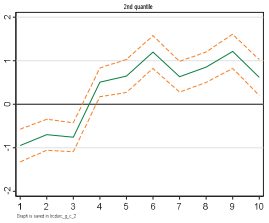
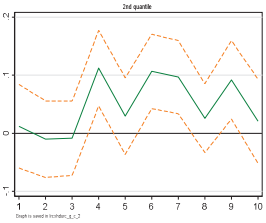
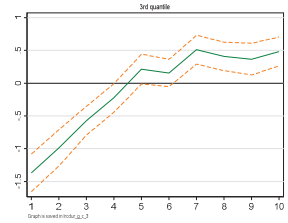
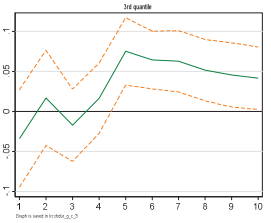
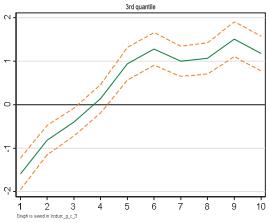
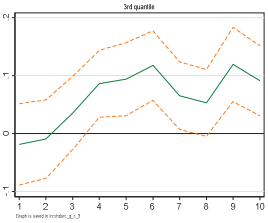
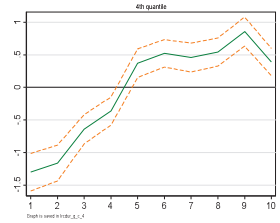
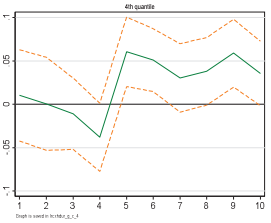
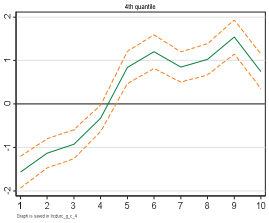
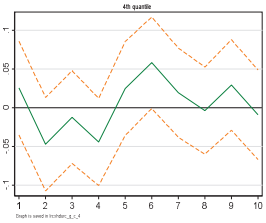
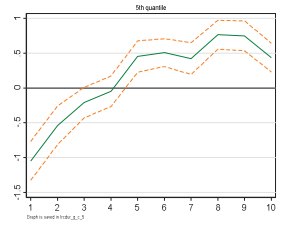
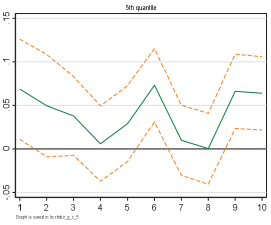
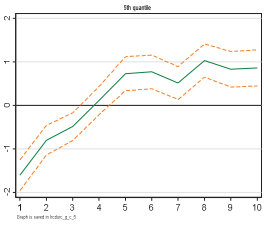
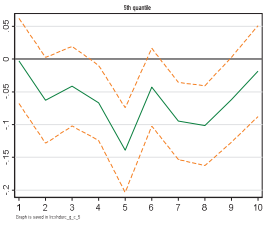
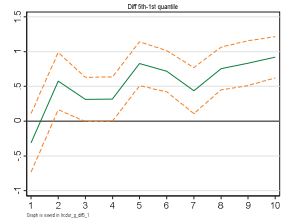
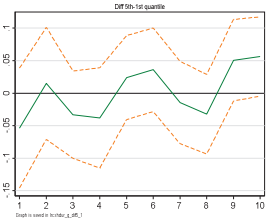
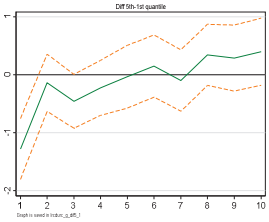
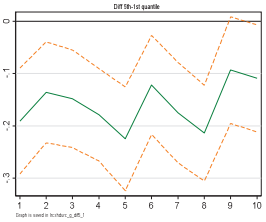
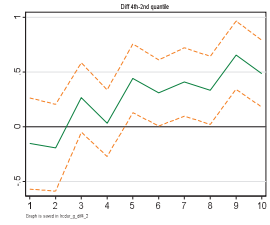
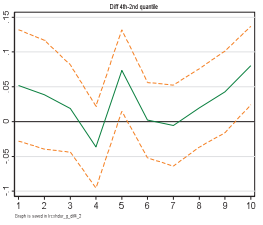
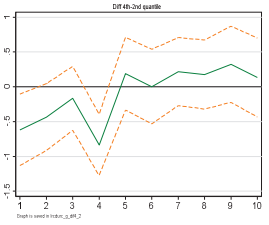
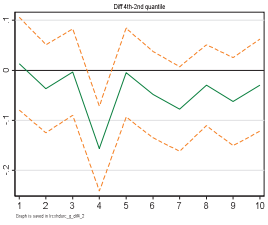
In both cases, and as in the general case, the response of the lower quantiles is somewhat weaker. So, when interest rates go up, lower quantiles reduce by less (in percentage, and therefore also in absolute terms) their expenditures on durables, and therefore the dispersion in consumption is reduced. When monetary policy becomes more accommodative, higher income quantiles react more strongly (in percentage change and therefore also in absolute terms) and increase durable expenditure more, contributing to a larger dispersion in consumption between quantiles.

Impulse responses for household data using structural DSGE monetary shocks

Generally, the results using the DSGE shocks are similar to those obtained with the surprises derived from the professional forecasters' data. (Figure 9). Durables are effected negatively and significantly, while other consumption does not react economically significantly to the shock.[29] Nevertheless, the response of the expenditure on durables is stronger for higher quantiles only in the shorter sample, including cars, but shows the opposite result for the full sample.

[29] The impulse response is statistically positive, but its magnitude is 10 times smaller than that of durable expenditure.

Figure 9: Impulse responses for granular data, using DSGE shocks

Q	lrcdur 2003-2018	lrcxhdur 2003-2018	lrcdurc* 2007-2018	lrcxhdurc* 2007-2018
1				
2				
3				
4				
5				
Dif. 5-1				
Dif. 4-2				

* Including car purchases

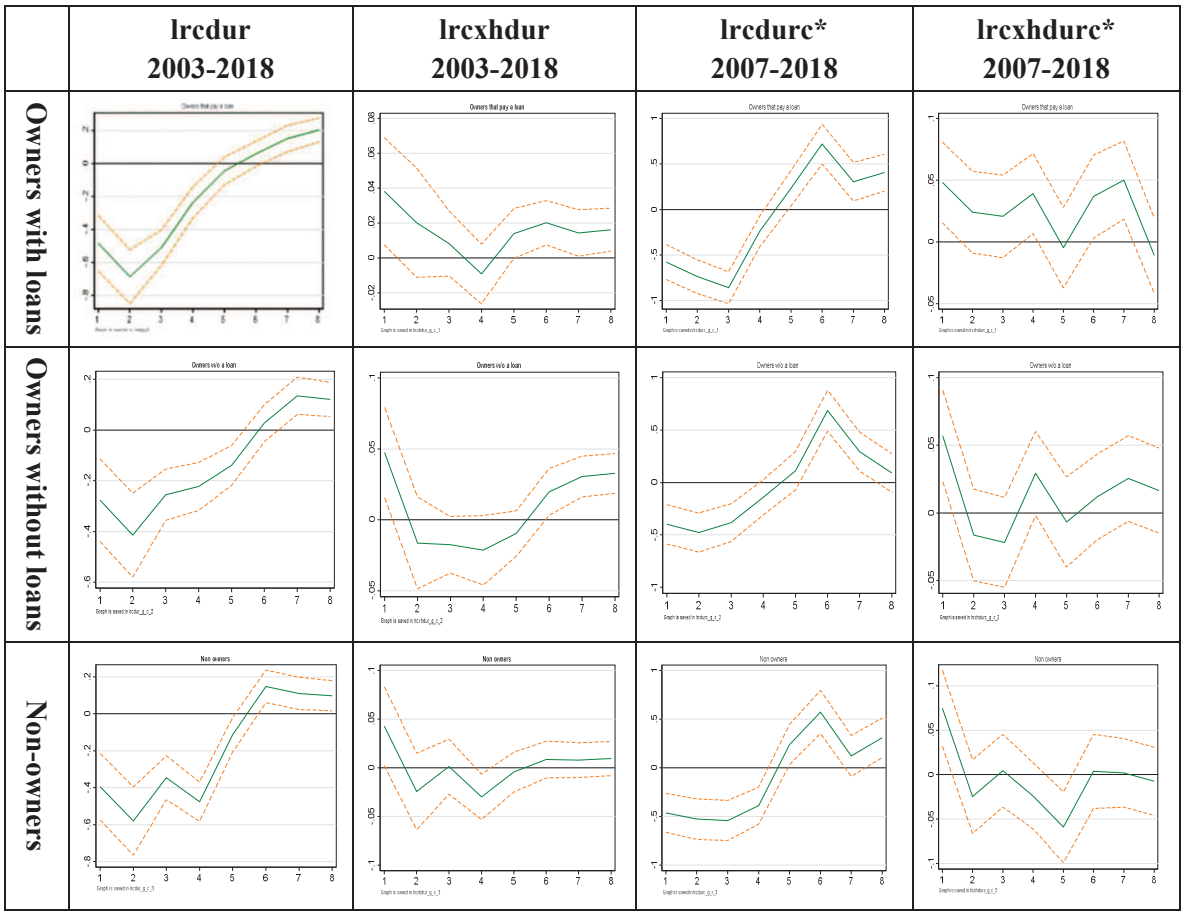
Impulse responses for household data by ownership and loan status (granular data)

We distinguish between three groups of households – those that own their own home (one or more) and declared that they have mortgage expenses,[30] households that own a home but do not have mortgage expenses, and households that do not own a home.[31]

Looking at the response of households according to their tenure status, we do not see any difference between the three groups. All households reduce expenditure on durables in response to a positive monetary shock, and generally do not change other consumption components. Although a change in the interest rates affects mortgage expenditures and may be expected to act to reduce consumption for households that hold mortgage debt, the response of home owners with or without a mortgage is similar. This may be due to the fact that we do not have information about the level of the household's debt (we only know whether the household pays back home loans but not the current or historic level of debt). Interest rate shocks are also expected to affect the value of homes and therefore the (perception of) wealth by households. Even so we do not find any difference in the response of home owners relative to other households.[32] (Figure 10).

[30] We do not have information about the debt status of the households.
[31] Of those, the share of households that have mortgage payments is very small. See Table 2.
[32] This result holds also in an alternative partition where we only distinguish between two groups – home owners and others.

Figure 10: Impulse responses for granular data, by tenure and loan status



* Durables include cars.

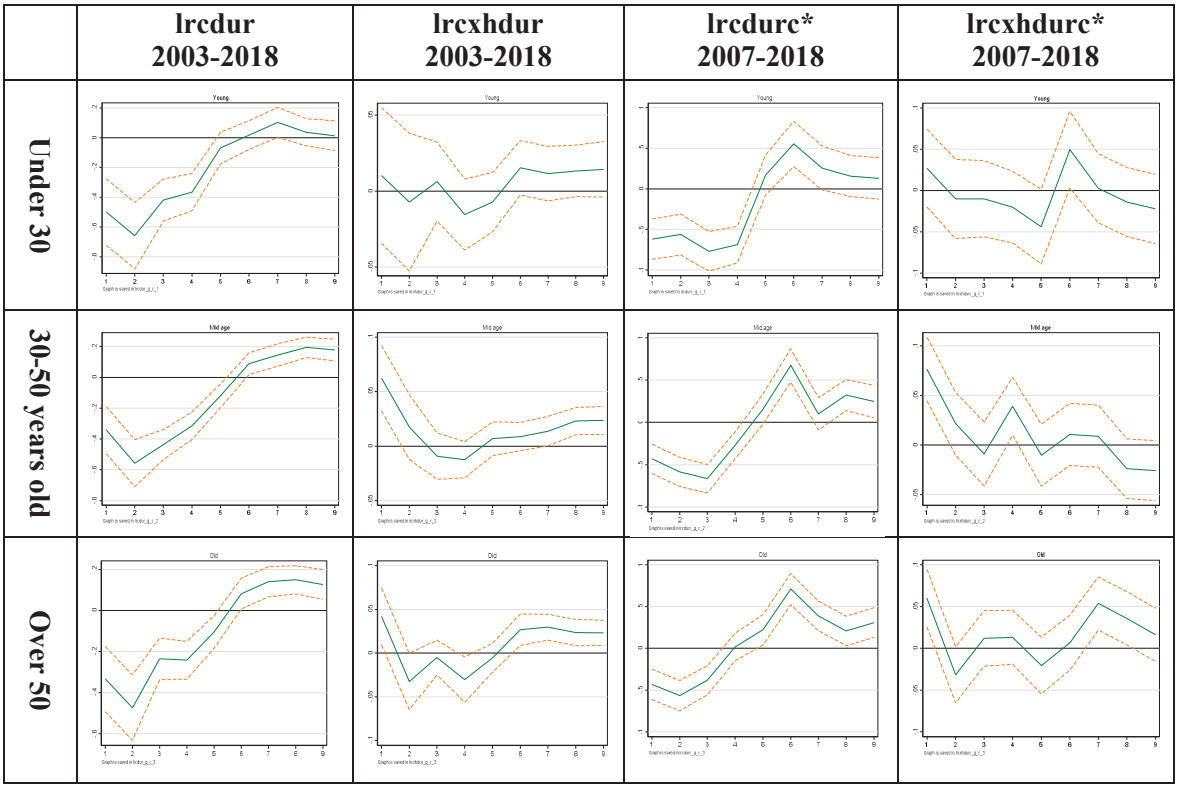
Cloyne, Ferreira and Surico (2018) estimate the effect of monetary surprises on consumption for UK and US data by clustering households by groups of tenure status to get three pseudo cohorts of mortgage borrowers, house owners without a mortgage, and renters. They find that in response to an unexpected expansionary monetary shock, mortgage borrowers significantly increase their consumption, while other home owners do not react, and renters do increase consumption, but at a smaller rate relative to mortgage borrowers. Loukoianova, et al. (2019) also find that Australian households with a high level of debt respond more than other households to monetary policy shocks and contract their total consumption and expenditure on durables.

Impulse responses for household data by age group (granular data)

We checked for differential effects of monetary policy shocks on different age groups – young (heads of) households, under 30 years old, senior-citizen households, over 50 years old and households between 30-50 years old. Table 3 shows that there is a positive

correlation between age and quantile – higher quantiles are characterized by a larger share of older people. The qualitative results are similar to the alternative classifications by quantile or home ownership. (Figure 11). The effect on durable expenditure (in percentage) is negative and significant, and larger than that on other consumption. The differences between the groups are relatively minor, with a slightly weaker response of durable expenditures of younger households. This result is in line with our result that the response of lower quantiles, in which the share of young households is larger, is somewhat weaker than that of households on the upper quantiles. (See Figure 7). Bunn, Pugh and Yeates (2018) examine the effect of monetary policy on income and wealth, and similar to the results here, do not find substantial differences in the effect of monetary policy according to age groups. They find that while accommodative monetary policy supported more the incomes of the young indirectly due to lower unemployment and higher wages, the older and wealthier benefited directly from the increase of asset prices, so that overall, most households benefited from the expansionary policy. Berg et al. (2019) also find that older households' consumption responds more than younger households to monetary policy shocks, and among them the response is increasing in income – evidence of a wealth effect.

Figure 11: <u>Impulse responses for granular data, by age group</u>



* Durables include cars.

4. Concluding Remarks

We investigate the effect of monetary policy on the dispersion of consumption, using data from the Household Expenditure Survey for Israel from 2003 to 2017. We employ the Local Projection proposed by Jorda (2005) on three alternative transformations of the data. We examine the effect on aggregate inequality indices, we use a pseudo-panel technique to overcome the fact that we do not see the same households over time (we do not have panel data), and we also analyze the granular data with a two stage procedure to overcome the same difficulty.

We find that unexpected monetary policy affects the expenditure on durables, but does not have a clear or significant effect on total consumption (excluding housing expenditures). A positive (meaning, contractionary) unexpected change in the Bank of Israel's rate will tend to increase the Gini coefficient for durable expenditure but will be manifested in reducing the dispersion measured by the 90-10 difference or the standard deviation of the log of this expenditure. This outcome is consistent with results we get from analyzing the behavior of households according to their income quantile. The effect of monetary policy on durable expenditure is evident mostly in the middle and higher quantiles and less in the lower quantiles. We find some evidence that home owners react to contractionary monetary policy while for renters we do not see any significant effect. We may conclude that monetary policy contributed only marginally to a decline in the inequality in total consumption. It is worth noting, that in Israel, as a small open economy, a large share of durables is actually imported, and therefore even if there is some effect on the demand for durable expenditure its effect on local output will be much smaller.

A positive (contractionary) surprise to monetary policy will tend to appreciate the local currency. This appreciation lowers the local price of imported goods, and in particular the local price of durables. Theoretically, the combined effect of this surprise is a reduction in expenditure on durables due to the rise in interest rate, but on the other hand an increase in expenditure because of the decline in their relative price. A stronger negative reaction of higher quantiles may reflect the larger negative direct effect of the rise in interest rate relative to the positive effect of the appreciation caused by it in these quantiles, while the opposite is true for lower quantiles.

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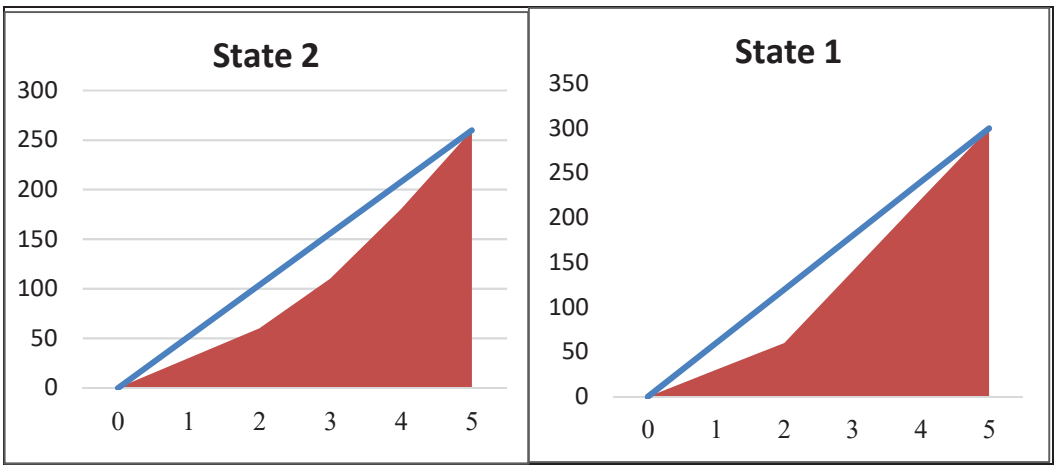
Appendix 1

A simple example for inconsistent changes in different inequality indices

Quantile	State 1	State 2
1	30	30
2	30	30
3	80	50
4	80	70
5	80	80
Gini	0.200	0.215
sd	31.62	26.87
sd/mean	0.527	0.517
sd(ln)	0.481	0.412
sd(ln)/mean(ln)	0.120	0.106
90-10	50.0	40.0
(90-10)/mean	0.833	0.769

With the transition from State 1 to State 2, quantiles 3 and 4 reduce their consumption, (for example), while the lower and upper quantiles do not change their behavior. The Gini coefficient increases in State 2, while the standard deviation of consumption and of log consumption, and the 90-10 difference, in absolute values, and relative to the mean (that has declined), are lower in state 2.



Appendix 2

First Stage Consumption Equations

Consumption excluding housing services

Linear regression

Number of obs	= 107,967
F(29, 107937)	= 3288.80
Prob > F	= 0.0000
R-squared	= 0.5672
Root MSE	= .5129

lrcxh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
unemp_x	-.015636	.0006789	-23.03	0.000	-.0169667	-.0143053
dum_f1	-1.144927	.0086357	-132.58	0.000	-1.161853	-1.128001
dum_f2	-.8173534	.0068007	-120.19	0.000	-.8306828	-.8040241
dum_f3	-.5722144	.0059563	-96.07	0.000	-.5838887	-.5605401
dum_f4	-.3495578	.0055125	-63.41	0.000	-.3603622	-.3387535
dum_f5	0	(omitted)				
downln	-.0422469	.0054707	-7.72	0.000	-.0529694	-.0315245
downxln	-.0040805	.0055854	-0.73	0.465	-.0150277	.0068667
dxown	0	(omitted)				
lage_x	-.2399997	.0134773	-17.81	0.000	-.266415	-.2135844
dum_old	-.058831	.0071816	-8.19	0.000	-.0729069	-.0447552
dum_young	-.1019977	.0086619	-11.78	0.000	-.1189749	-.0850204
dum_mar	.2299295	.004964	46.32	0.000	.2202	.2396589
mefarnes	.0598279	.002481	24.11	0.000	.0549652	.0646906
pernum	.13591	.0017575	77.33	0.000	.1324653	.1393546
olim	-.0730639	.0110185	-6.63	0.000	-.0946599	-.0514679
rooms	.1209027	.0026573	45.50	0.000	.1156946	.1261109
erank3	-.0211105	.0050945	-4.14	0.000	-.0310956	-.0111254
erank4	.0461312	.0060888	7.58	0.000	.0341972	.0580653
dezor1	-.1154495	.0137387	-8.40	0.000	-.1423771	-.0885219
dezor2	-.087915	.0147957	-5.94	0.000	-.1169144	-.0589156
dezor3	-.1297482	.0139849	-9.28	0.000	-.1571583	-.102338
dezor4	-.1754898	.0134254	-13.07	0.000	-.2018033	-.1491762
dezor5	-.1427445	.0131467	-10.86	0.000	-.1685118	-.1169772
dezor6	-.1102632	.0131014	-8.42	0.000	-.1359417	-.0845846
dezor7	-.1024743	.013353	-7.67	0.000	-.128646	-.0763025
dezor8	-.0528213	.0131594	-4.01	0.000	-.0786136	-.027029
dezor9	-.0802122	.0308724	-2.60	0.009	-.1407216	-.0197027
dumq1	-.0252015	.0054549	-4.62	0.000	-.0358929	-.0145101
dumq2	-.018478	.0052204	-3.54	0.000	-.0287099	-.0082461
dumq3	0	(omitted)				
dumq4	.0109025	.0048623	2.24	0.025	.0013724	.0204326
_cons	5.094375	.0543053	93.81	0.000	4.987938	5.200813

Durable expenditures

Linear regression — Number of obs = 107,967; F(29, 107937) = 217.97; Prob > F = 0.0000; R-squared = 0.0654; Root MSE = 1.2709

lrcdur	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
unemp_x	.0039313	.0017542	2.24	0.025	.0004931	.0073696
dum_f1	-.7234725	.0194716	-37.16	0.000	-.7616365	-.6853085
dum_f2	-.5058412	.0164556	-30.74	0.000	-.5380939	-.4735884
dum_f3	-.3821892	.01537	-24.87	0.000	-.4123142	-.3520641
dum_f4	-.2399606	.0151999	-15.79	0.000	-.2697523	-.210169
dum_f5	0	(omitted)				
downln	.0562045	.0136551	4.12	0.000	.0294407	.0829683
downxln	.0154437	.0126964	1.22	0.224	-.009441	.0403284
dxown	0	(omitted)				
lage_x	-.1379893	.0309026	-4.47	0.000	-.1985579	-.0774207
dum_old	-.0946268	.0172119	-5.50	0.000	-.1283619	-.0608917
dum_young	-.0182933	.0239966	-0.76	0.446	-.0653263	.0287396
dum_mar	.1221889	.0111783	10.93	0.000	.1002795	.1440982
mefarnes	.0105533	.0058958	1.79	0.073	-.0010024	.0221091
pernum	.0635416	.0038144	16.66	0.000	.0560654	.0710178
olim	.0176455	.023843	0.74	0.459	-.0290864	.0643774
rooms	.0556458	.0060166	9.25	0.000	.0438534	.0674382
erank3	-.0540281	.0122394	-4.41	0.000	-.0780173	-.030039
erank4	-.0756794	.0153473	-4.93	0.000	-.1057598	-.0455989
dezor1	-.3126911	.032123	-9.73	0.000	-.3756517	-.2497305
dezor2	-.188794	.0351444	-5.37	0.000	-.2576766	-.1199115
dezor3	-.1171833	.0336064	-3.49	0.000	-.1830515	-.0513152
dezor4	-.2257304	.032139	-7.02	0.000	-.2887225	-.1627384
dezor5	-.1476338	.0316617	-4.66	0.000	-.2096903	-.0855774
dezor6	-.0190283	.0316838	-0.60	0.548	-.081128	.0430714
dezor7	-.1359942	.0321781	-4.23	0.000	-.1990629	-.0729255
dezor8	-.0082813	.0316774	-0.26	0.794	-.0703686	.053806
dezor9	.0264495	.0754884	0.35	0.726	-.1215067	.1744057
dumq1	-.0306999	.0133107	-2.31	0.021	-.0567887	-.0046112
dumq2	.0019838	.0126064	0.16	0.875	-.0227245	.0266922
dumq3	0	(omitted)				
dumq4	.0300018	.0117838	2.55	0.011	.0069057	.0530979
_cons	1.142464	.1236417	9.24	0.000	.9001277	1.3848

Consumption excluding durables and housing services

Linear regression — Number of obs = 107,967; F(29, 107937) = 3362.56; Prob > F = 0.0000; R-squared = 0.5708; Root MSE = .50618

lrcxhdur	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
unemp_x	-.0160032	.0007117	-22.48	0.000	-.0173982	-.0146082
dum_f1	-1.127058	.0085313	-132.11	0.000	-1.14378	-1.110337
dum_f2	-.8080335	.006718	-120.28	0.000	-.8212007	-.7948662
dum_f3	-.5644168	.0058991	-95.68	0.000	-.575979	-.5528546
dum_f4	-.3451806	.0054546	-63.28	0.000	-.3558715	-.3344897
dum_f5	0	(omitted)				
downln	-.0481753	.0054012	-8.92	0.000	-.0587617	-.037589
downxln	-.0069113	.0055104	-1.25	0.210	-.0177117	.003889
dxown	0	(omitted)				
lage_x	-.2061393	.0123603	-16.68	0.000	-.2303653	-.1819133
dum_old	-.0604294	.0070104	-8.62	0.000	-.0741697	-.046689
dum_young	-.1016855	.0085395	-11.91	0.000	-.1184229	-.0849482
dum_mar	.2266386	.0049063	46.19	0.000	.2170224	.2362548
mefarnes	.0626139	.0024506	25.55	0.000	.0578108	.067417
pernum	.1357567	.0017422	77.92	0.000	.1323419	.1391714
olim	-.0697569	.0108779	-6.41	0.000	-.0910774	-.0484364
rooms	.1232131	.0026114	47.18	0.000	.1180947	.1283315
erank3	-.0190686	.0050155	-3.80	0.000	-.0288989	-.0092384
erank4	.051836	.0059806	8.67	0.000	.0401141	.0635579
dezor1	-.1058823	.0134488	-7.87	0.000	-.1322418	-.0795227
dezor2	-.0824163	.0144957	-5.69	0.000	-.1108277	-.054005
dezor3	-.1323911	.0136618	-9.69	0.000	-.159168	-.1056142
dezor4	-.1706271	.0131181	-13.01	0.000	-.1963384	-.1449158
dezor5	-.1426729	.012839	-11.11	0.000	-.1678372	-.1175086
dezor6	-.1178855	.0127843	-9.22	0.000	-.1429426	-.0928284
dezor7	-.1011284	.0130418	-7.75	0.000	-.1266902	-.0755667
dezor8	-.0600832	.0128382	-4.68	0.000	-.0852459	-.0349206
dezor9	-.0825761	.0303679	-2.72	0.007	-.1420967	-.0230554
dumq1	-.0247025	.0053881	-4.58	0.000	-.0352631	-.0141419
dumq2	-.0190506	.0051573	-3.69	0.000	-.0291588	-.0089424
dumq3	0	(omitted)				
dumq4	.0106102	.0047863	2.22	0.027	.0012291	.0199913
_cons	4.914965	.0494039	99.49	0.000	4.818134	5.011796