Reexamining the excess sensitivity of consumption to income

The role of liquidity constraints

Abstract

The finding that consumption is 'excessively sensitive' to current income is mostly blamed on the presence of liquidity constraints. This thesis extends the current literature and examines the relationship between excess sensitivity, household debt and the unemployment rate for a panel of 17 OECD countries over the period 1995-2015. The findings suggest that excess sensitivity is lower with higher levels of debt and lower unemployment rates, and that consumption is also sensitive to debt growth. These results have important implications for fiscal and monetary policy since the effectiveness of both depend on the way consumers react to changes in income and credit supply.

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1. Introduction

One of the most relevant topics in macroeconomics is aggregate consumption and during the last century it has always been a subject of debate among economists. This is not very strange considering the importance of consumption for economic growth. Its contribution to GDP is always somewhere between a half and two-thirds (OECD, 2015). There have been different theoretical trends throughout history concerning consumption. One of the most profound changes in economics has been the introduction of rational expectations in theoretical models. Among its first ''victims'' were the traditional ("'Keynesian") consumption functions which were modelled to fit historical data (Campbell and Mankiw, 1989). Robert Hall (1978) innovated the research on consumption by combining the permanent-income hypothesis with rational expectations. He came to the remarkable result that consumption is unpredictable. Subsequent studies found however that in empirical estimations consumption is positively related to current income. Campbell and Mankiw (1989) argued that only a certain fraction of consumers act according to Hall's model and that another part of the population simply consumes its current income. The idea is that these consumers are not so much irrational but that they are not able to borrow because of imperfect capital markets, therefore they are forced to consume their current income. The last twenty to thirty years researchers have performed studies which aim to prove that this fraction of current-income consumers is influenced by the severity of liquidity constraints such as Japelli and Pagano (1989) and more recently Sarantis & Stewart (2002) or Cho & Rhee (2017).

This thesis aims to extend on the available literature by estimating the fraction of current-income consumers in a OECD panel of 17 countries over the period 1995-2015. The main focus however will be on the relationship between this fraction and the severity of liquidity constraints which will be modelled by using the household debt ratio and unemployment rate as proxies. The unemployment rate has frequently been used in studies on liquidity constraints (Peersman & Pozzi, 2004; de Castro, 2006; Sarantis & Stewart, 2002), however not that many studies have used the household debt ratio as determinant. Cho & Rhee (2017) actually used household debt, however their empirical method has not been employed in earlier research and they do not check their results for robustness. The methodology for this research is more in line with traditional literature which is an instrumental variables approach. Another difference is that the unemployment rate is used as additional variable and that debt also enters directly into the consumption equation, as in Bachetta and Gerlach (1997).

Examining the relationship between consumption and income under different degrees of liquidity constraints is especially relevant for fiscal and monetary policy debates. Blanchard and Leigh (2013) found that growth rates were lower than forecasted during the fiscal consolidation years during and after the crisis and they relate this to a underestimation of fiscal multipliers. One could argue that consumption is more sensitive to changes in disposable income during recessions when liquidity constraints are higher, a point which has been proven in many studies (McKiernan, 1996 and Peersman & Pozzi, 2008 for example). This implies that the effects of fiscal policy differ according to the state of the business cycle or the severity of liquidity constraints in general. And if liquidity constraints are important then monetary policy can be adjusted to either increase or decrease borrowing constraints, thereby affecting consumption not only via traditional channels but also through lower or higher sensitivity to disposable income.

The results of this study show that the fraction of current-income consumers ranges between 0.25 and 0.36 and that this fraction has increased in the post-crisis period. Moreover, the proportion of current-income consumption becomes lower with higher levels of debt or debt growth and it increases with higher

unemployment. The results are somewhat sensitive to the instruments used although the correlation between consumption growth and debt growth remains robust. The remainder of this thesis is as follows: Section 2 gives an overview of the literature on this topic, section 3 discusses the theoretical model and empirical strategy as well as the data. The empirical results are in section 4 as well as the discussion and limitations. Section 5 concludes and brings forward some policy implications.

2. Literature review

Permanent income, current income and consumption

An important contribution in the consumption literature is that by Hall (1978). Combining the permanent income hypothesis with rational expectations, he came to the remarkable conclusion that future consumption is unpredictable, i.e. the change in consumption follows a random walk. This implies that any transitory changes to income should not affect consumption since these deviations from permanent income are either saved or filled up by borrowing on the capital market. The latter requires perfectly functioning capital markets where agents can lend and borrow freely which is unlikely in practice. This may be why many subsequent studies found that consumption is in fact 'excessively sensitive' to current income. Flavin (1984), using postwar US data, found a coefficient of 0.37 in a regression of consumption on disposable income (both differenced), a clear rejection of the random walk. Campbell and Mankiw (1990) found coefficients ranging between 0.3 and 0.7 for the US whereas Campbell and Mankiw (1991) found coefficients between 0.2 for Canada and almost 1.0 for France in a cross country study. More recent studies are for example those by Cho & Ree (2017), Everaert & Pozzi (2014) or Everaert et al. (2016) who also find significant ES coefficients. Campbell and Mankiw (1989, 1990) used the finding that consumption displays excess sensitivity (ES) to income to come up with a framework that allows for this finding as well as supporting the RE-PIH results. They do so by assuming that a fraction of the population consumes their current income ('rule-of-thumb' consumers) while the other part consumes according to the PIH with rational expectations. Many subsequent studies built upon this framework (from now on referred to as the CM model) to estimate the relationship between consumption and current income. The most cited reason why current income is in fact important is because (some) consumers are liquidity constrained, which will be discussed in the next paragraphs.

Excess sensitivity of consumption and liquidity constraints

Among the first to empirically investigate the failure of the perfect capital markets assumption as a source for the rejection of the random walk result was Flavin (1984). He argued that consumers could still be rational and forward looking even if the observed excess sensitivity of consumption to current income is non-zero, if individuals are liquidity constrained. He added the unemployment rate as proxy for liquidity constraints in a regression of consumption to current income. If liquidity constraints do not play a role then the unemployment rate should not have any direct effect on consumption (besides the indirect effect of lowering income). He found a decrease in the coefficient of income which also became insignificant when adding the unemployment rate and a significant negative coefficient for the unemployment rate, suggesting that liquidity constraints are important.

Campbell and Mankiw (1991) employ the CM model in a cross-country setting and find values ranging between 0.2 for Canada and almost 1.0 for France. More importantly, they find that international data on

consumer debt is consistent with the variation in lambda (ES coefficient) between countries, being suggestive of different degrees of liquidity constraints. This is in line with findings by Japelli & Pagano (1989) who find that those countries that exhibit the highest degree of sensitivity of consumption to current income are also the ones with the lowest debt/consumption ratio (and thus the least developed capital markets). This latter relationship is not so much driven by demand factors, they find. Finally, using indicators of constraints on mortgage markets, they show that rationing is more apparent in countries which also display high ES.

Bachetta and Gerlach (1997) take as baseline the model by CM but add variables capturing credit conditions. They argue that it is unlikely that some part of the population cannot borrow at all (which the CM model implies) and, if so, that this fraction remains constant over time. They use the quantity of consumer credit, mortgage credit and the borrowing/lending wedge as credit determinants. If liquidity constraints are to play any serious role, they say, these variables have to be included in the specification. They find that consumption is indeed excessively sensitive to credit variables and that the coefficient of income sensitivity decreases (and sometimes becomes insignificant) when credit variables are included. Another important finding is that except for the US, consumption tends to lag credit which suggest that the relationship between credit and consumption is mostly driven by supply factors.

Several micro-studies also prove the importance of liquidity constraints. One study by Benito and Mumtaz (2006) focuses on UK households and uses panel survey data from 1992 to 2002. They find that of all households, 20-40% are rule-of-thumb consumers. They also find that those that are in this group are more likely to be young, without liquid assets, ethnic minorities and degree educated. Housing equity also plays an important role, which they argue is either through a buffer effect or a collateral effect in which the latter makes borrowing easier. These findings can be reconciled with the finding that the ES of consumption is caused by liquidity constraints, although it could also be explained with models that use precautionary motives (see next paragraph). Christelis, Georgarokas et al. (2017) use survey responses from a representative sample of Dutch households to find that the MPC[1] out of a unexpected transitory income change ranges between 15 and 25 percentage points. They also find that the MPC out of negative income shocks is larger than that for positive shocks which suggests that liquidity constraints are relevant. Filer & Fisher (2005) studied the link between excess sensitivity and liquidity constraints using household data on bankruptcy files in the US. They find that those that filed for bankruptcy in the last 10 years show excess sensitivity which is likely caused by the bankruptcy flag (liquidity constraints) and not so much by other observed behavior. Another study uses household level data from four different OECD countries to check whether institutional differences and borrowing constraints explain the variation in debt levels between countries (Crook, Hochguertel, 2007). They find that between country differences of debt holdings remain strong and cannot be explained by severable observable factors. Also, there is considerable variation in the probability of being turned down for loans, implying that differences in debt is at least partly driven by borrowing constraints. This last finding supports the use of outstanding debt as measure of the degree of liquidity constraints.

Precautionary motives

[1] Marginal propensity to consume, i.e. the fraction consumed out of additional income

Another plausible reason that consumption reacts 'excessively' to current income is the presence of uncertainty. Theoretically this result arises from following the ''buffer-stock model of saving'' (Carrol, Hall & Zeldes, 1992). According to this model the individual faces a constant trade-off between consuming right now (impatience) and saving (precautionary motive). It is the strength of the precautionary motive that determines how much will be saved. When income uncertainty increases, the individual sets a higher wealth target to insure himself against future adversity, which reduces current consumption and/or raises expected future consumption. Peersman & Pozzi (2004) and Sarantis & Stewart (2002) relate this to the excess sensitivity of consumption since more weight is given to current income when uncertainty increases. Ludvigson (1999) extends the buffer-stock model to allow for liquidity constraints that vary stochastically with changes in income. The advantage of this model is that it not only shows that borrowing constraints are responsible for excess sensitivity, but additionally allows a correlation between consumption growth and credit growth. This correlation was already found by Bachetta & Gerlach (1997) but could not be explained by the CM model since this model assumes that 'rule-of-thumb' consumers are not able to borrow (Ludvigson, 1999). Because both liquidity constraints and precautionary motives increases the weight given to current income it is sometimes hard to distinguish the two. The last paragraphs show that empirical findings can sometimes support both views.

Excess sensitivity and financial deregulation

If liquidity constraints are responsible for the relationship between consumption and current income then this implies that the ES parameter varies not only between countries but also over time since liquidity constraints are also likely to change over time, as noted by Bachetta and Gerlach (1997). Several studies therefore focused on the financial liberalization which began in the 1980s in the US and spread across OECD countries, since these have improved capital markets and eased borrowing constraints. The results are mixed. CM (1991) let the ES coefficient be a function of a linear time trend and of a time dummy but they find no evidence of declining ES over time. Bachetta and Gerlach (1997) use Kalman filtering techniques to estimate a time-varying ES parameter and they find evidence that it evolves over time in the US and UK, though in opposite directions. Peersman & Pozzi (2004) also use Kalman filtering over a state-space model and identify financial liberalization as a one-time shift in the level of the time-varying ES coefficient from the first quarter of 1982 onwards. They find a reduction in the coefficient of on average 0.55-0.59 which is substantial. Pozzi et al. (2004), using the number of credit cards issues as proxy for financial liberalization (and other proxies) find no evidence that the ES is affected by this, although they mention that the time period used (1990-99) may drive this result. De Castro (2006) investigated the case of Portugal which joined the EU in 1986 and had profound reforms in its financial sector during the last 20 years. She adopts an overlapping generation model with the possibly that some individuals are liquidity constrained, which differs from the standard CM model. To allow for time-varying ES parameters step dummies were used as well as a Kalman-filtering process. From using the latter technique, she finds a substantial decrease in the ES from 70% in the 80s to almost 40% during the mid-90s, although it increases again for several years after this period. Bayoumi (1993) studies the effect of financial deregulation on the proportion of current-income consumption using annual panel data for different regions within the UK. He finds that this proportion falls from 60 percent before deregulation to 30 percent by 1987.

Cho & Ree (2017) investigate the role of domestic credit markets in the relationship between consumption and current income using a panel of OECD countries over the period 1995-2014. They use a panel smooth

transition regression (PSTR) model which captures non-linearity in the evolution of the ES parameter. They find a reduction in the ES parameter in advanced economies in the period leading up to the financial crisis, stemming from improvements in credit markets over time. Interestingly, they also find that after the crisis the ES increased again for some countries as credit conditions tightened. Finally, Everaert et al. (2016) checked on the stability of the ES of consumption growth for the US, taking into account other factors such as stickiness, time aggregation bias and measurement error. They conclude that the ES lies around 0.23, which is lower than what most studies found, and that it is stable over time. They criticize other studies that investigated this stability of the ES for imposing beforehand that the parameter is time-varying. By using a Bayesian state-space model they say they overcome some of the problems that these earlier studies did not deal with.

The effects of liquidity constraints and precautionary motives

Besides showing that the relationship between consumption and current income changes over time, other studies have explored what economic variables cause these fluctuations. They generally do this by letting the ES coefficient depend on certain proxies for liquidity constraints and precautionary motives. Sarantis & Stewart (2002) investigate the impact of several variables on the magnitude of the ES coefficient. They first start off by extending Hall's model to allow for current income consumers (as in CM), the durability component of consumption and intertemporal substitution. Then the ES coefficient is estimated for 20 OECD countries, and these estimates are used as dependent variable in a multivariate cross-country model. They include variables to capture liquidity constraints such as the private credit/GDP ratio, the savings rate and some demographics as well as variables that capture uncertainty such as the unemployment rate, its difference and the absolute deviation of income. From the cross-country estimation they find the right signs for all variables but only significant ones for the demographics. They blame this on the low number of cross-section units. Then they perform panel analysis and use N3SLS for the estimation method, allowing all parameters to vary with the explanatory variables. They find that the ES parameter varies with the amount of credit, the level and change in unemployment, income growth, population growth and the interest rate.

Although S&S use the unemployment rate as measure for uncertainty, other studies (like Flavin (1984)) have used it as proxy for liquidity constraints. Since unemployment raises both liquidity constraints and uncertainty, a positive sign could be reconciled with both views (see paragraph on precautionary motives). Peersman & Pozzi (2004) used both personal wealth and the unemployment rate to capture liquidity constraints. The intuition is that wealth serves as collateral that eases borrowing constraints while the unemployed usually do not have access to credit, increasing liquidity constraints. They do find expected signs for the coefficients but they are not significant. They do find significant business cycle effects, i.e. ES increases during recessions mostly caused by higher ''external premiums'' (see also Japelli and Pagano (1989)). Including the dummy for recessions may be the cause of the insignificant unemployment rate and wealth variables since these variables could capture short-term fluctuations in the ES with the state of the business cycle. Removing the recession dummy did not change the results. Closely related work is that by Peersman & Pozzi (2008) who also investigate the effect of business cycle fluctuations on the ES parameter. They use the change in unemployment rate as their proxy and they show that it is highly correlated with turning points of the business cycle as calculated by the NBER. Contrary to their earlier work in 2004 they now find a significant coefficient for the unemployment rate. The results show that the ES is on average 0.37 during recessions while it is 0.22 during expansions. This effect of the unemployment rate on the ES can be both via liquidity constraints or precautionary motives. De Castro (2006) also used

the unemployment rate as proxy for liquidity constraints and found that the fraction of current income consumers increases with the unemployment rate.Peersman & Pozzi (2004) find that the ES of consumption is positively related to the government debt ratio. According to the authors this can be reconciled with the presence of liquidity constraints. One reason could be that by borrowing more, the government crowds out private borrowing since banks are now less willing to lend to private borrowers and more to the government. This indirectly increases liquidity constraints for consumers and thus makes consumption more sensitive to changes in current income.

McKiernan (1996) used quarterly US data for the period 1952-1994 and estimated the fraction of current income consumers. He used a Kalman filter to allow for a time-varying parameter and found that the time-varying model outperformed the constant parameters model. Then he made a link between credit tightness conditions and excess sensitivity and found that a dummy capturing credit crunches and the unemployment rate were significant with the right signs, concluding that excess sensitivity varies over time with the degree of liquidity constraints. Cho & Ree (2017) used the household debt ratio as proxy for liquidity constraints and they relate this variable to the development of credit markets over time. They model the relationship between consumption growth and income growth as consisting of a linear and a non-linear part where the latter is determined by a transition variable, in this case household debt (as percentage of disposable income). They find ES parameters ranging between 0.16 and 0.38 over time and they show that as household debt rises, the excess sensitivity of consumption to income falls. They also show that the ES decreases towards the global crisis and increases in some countries again after the crisis hit, and they relate this to the rise and fall of household debt (and thus liquidity constraints) in the respective periods. In her work on Portugal, de Castro (2006) used the ratio of assets hold by monetary and financial institutions to GDP as well as nominal interest rates as proxies for financial market liberalization and thus as measures for liquidity constraints. She finds significant results with the expected signs, pointing to a reduction in liquidity constraints with the degree of financial liberalization. Another interesting relationship she points out is the one between consumption smoothing and indebtedness. While the ES decreased substantially until the mid-90s in Portugal, it increased again for a few years after and de Castro blames the high indebtedness and accompanying debt service payments. This suggests there is a non-linear relationship between the debt burden of households and consumption smoothing, as is also pointed out by Benito & Muntaz (2005). They say that low levels of debt are likely to reflect inabilities to access the credit markets and therefore smooth consumption. High levels of debt are also associated with a higher probability of being in the excess sensitivity group which might reflect increased likelihood of facing credit constraints, including self-imposed constraints.

3. Methodology

Theoretical framework

The theoretical foundation for the empirical analysis comes from the permanent income hypothesis with agents that have rational forward looking expectations, as was analyzed by Hall (1978). The framework starts with the consumer choosing consumption so as to maximize (1):

$$E(U) = E_1\left[\sum_{i=1}^{\infty} \beta^i U(C_{t+i})\right] \qquad (1)$$

This intertemporal optimization problem can be solved using the Euler equation for consumption:

$$u'(C_t) = \beta(1+R)E_t[u'(C_{t+1})] \quad (2)$$

Where for simplicity the real interest rate R will be assumed zero and $\beta = 1$ (meaning zero time preference). Hall (1978) shows that with quadratic utility (meaning linear marginal utility) the change in levels of consumption follows a random walk. However, most subsequent studies showed that the same result can be achieved for logs of consumption using constant relative risk aversion (CRRA) utility instead of quadratic utility (see CM (1991) for example):

$$U(C) = \frac{C^{1-\theta}}{1-\theta} \quad (3)$$

The main advantages are that it does not have the counter-intuitive properties of quadratic utility and it supports the fact that consumption and income seem to follow a log-linear instead of a linear relationship (CM, 1991). Deriving marginal utility and substituting this into (2) leads to the following optimum:

$$E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\theta}\right] = 1 \quad (4)$$

If consumption-levels are log-normally distributed, Hansen and Singleton (1983) show that consumption growth cannot be forecasted:

$$\Delta c_t = \alpha + e_t \quad (5)$$

Where small letters denote logs of variables. CM (1991) came up with an alternative model. They allowed a fraction of consumers $(1-\lambda)$ to behave as in (5) and another fraction (λ) to behave as 'rule-of-thumb' consumers who simply consume their current income:

$$\Delta c_t = \lambda_t \Delta y_t + (1-\lambda)\varepsilon_t \quad (6)$$

Where ε_t stands for unanticipated changes in permanent income. In line with earlier studies (e.g. Sarantis & Stewart (2002) and Pozzi. et al (2004)) lambda is allowed to be a function of some variables capturing liquidity constraints and/or precautionary motives, where in this study the household debt ratio and the unemployment rate are the determinants:

$$\lambda_t = \lambda(D_t, UR_t) \quad (7)$$

If lambda increases with liquidity constraints, then the expected sign for the debt ratio is negative since a higher debt ratio suggests that consumers can borrow more easily while an increase in the unemployment rate is likely to increase borrowing constraints (see previous section). The latter variable is expected to appear with a positive sign.

Empirical specification and estimation

First equation (6) will be separately estimated in a panel framework covering 17 OECD countries over the period 1995-2015:

$$\Delta c_{it} = \alpha_i + \lambda_0 \Delta y_{it} + \varepsilon_{it} \quad (8)$$

Where the index *i* refers to the individual OECD countries (i=1,….21) and t refers to the time index (*t*=1995,…2015). All small letters denote logs of the variables. c_{it} is real per capita consumption of non-durables and services, which is commonly used in comparable studies, and y_{it} is real per capita household disposable income. Estimating λ_0 in (8) will only tell us if consumption growth is sensitive to income growth on average across countries and over time. But given the variation of this coefficient across countries (shown by CM, 1991 for example) and over time it is not very useful. If liquidity constraints are the source of between country and within country variation of lambda, then estimating (7) will be more informative. This is done similarly as in Pozzi et al. (2004), who assume a linear specification of (7) and then substitute for lambda in the main equation (8):

$$\Delta c_{it} = \alpha_i + (\beta_0 + \beta_1 D_{it} + \beta_2 UR_{it})\Delta y_{it} + \varepsilon_{it} \quad (9)$$

Where D_{it} stands for the household debt ratio and UR for the unemployment rate. The last paragraphs of this section discusses the data.

Several methodological issues arise with the estimation of (8) and (9). It is likely that there is correlation between the error term and contemporaneous values of disposable income growth. Everaert et al. (2014) explain that shocks to consumption growth move together with shocks to permanent income growth, and since the latter is correlated to current income growth it induces correlation between income growth and the error term. Using Ordinary Least Square (OLS) will therefore not be appropriate. This issue will be dealt with in a way similar to previous studies, i.e. by using the Instrumental Variables (IV) approach (see CM, 1990, 1991). This comes down to a two-stage process where in the first stage the endogenous variable is regressed on a number of predetermined variables (uncorrelated to the error term). As noted by CM (1991):

"any lagged variables that help to forecast income and growth… are appropriate instruments."

In the second stage the fitted values of the first stage regression are used for estimating (8). Although different instruments can be used, most studies include at least lagged consumption growth, income growth and an error correction term. The latter captures the long-term cointegrating relationship between consumption and income (Everaert & Pozzi, 2014). Different instrument sets will be tested according to their explanatory power and validity. Common in the literature is to test the validity of instruments based on Hansen's J-statistic (see Sarantis & Stewart, 2002) which comes down to testing whether the overidentifying restrictions are valid (where overidentification means that more instruments are used than parameters to be estimated). S&S recommend limiting the amount of instruments used to ensure validity while maintaining explanatory power. Another issue concerns the timing of the variables used. There are several reasons to assume there is an MA(1) process in the error term, which means that there is correlation between the current error term and its lagged value. The most obvious causes are time aggregation bias, measurement error or durability (see Campbell and Mankiw, 1991 for a brief explanation). Assuming a MA(1) term this would mean that using lagged instruments are still correlated to contemporaneous error terms and would give inconsistent estimates. The simple solution is to use at least twice lagged instruments, which will also be employed in this work.

Given the variation of the ES parameter over time and also across countries, this implies heteroskedasticity in the error term. Moreover, Pozzi et al. (2004) pointed out an additional problem with using panel data which is the plausible correlation between country's individual fixed effects and income growth. To solve these problems, they use the generalized method of moments (GMM) to a second-

differenced consumption equation. Sarantis & Stewart (2002) also use the GMM estimator which they say will ensure consistency in the estimation of parameters since this method will make the correlation between each of the instruments and the regression error as close to zero as possible. They deal with overidentification (which simply means having more instruments than parameters to be estimated) by using a weighting matrix which provides HAC estimates. This will also account for an MA(1) process in the error term. Using panel data has the advantage of exploiting the cross-country information in addition to the time series component. One issue with using panel data is the presence of cross-sectional dependence. This implies that the error term is not independent across countries and leads to biased and even inconsistent estimates (Everaert et al., 2014). This is caused by common unobservable shocks that affect all countries at the same time. According to the latter study, this is highly plausible in a time of increasing financial liberalization and business cycle synchronization. One way to deal with this is the inclusion of time-fixed effects in the specification.

Data

Table 1 contains information on the variables used for estimating equation (8) and (9) and their respective sources. Data on these variables are available for 17 OECD countries: Austria, Belgium, Canada, Czech Republic, Germany, Denmark, Finland, France, Great Britain, Hungary, Italy, Japan, the Netherlands, Norway, Portugal, Sweden and the USA. All data was obtained from the OECD database, except for the interest rates for Hungary which were obtained from Eurostat (see table 1). Per capita consumption and disposable income were obtained by dividing total consumption and income by the total population (in millions). Disposable income was obtained in real terms, deflated by final household consumption. Consumption expenditures were deflated using the deflator for private total consumption expenditures. Another (adjusted) disposable income measure was obtained which takes into account in-kind transfers to consumers such as education and health care, which may be a better measure for comparison. For the following countries some adjustments were made to deal with missing data points:

Japan **-** The three month interbank rate data for the period 1995-2002 was missing. Instead I looked at the average difference between the long-term and three month rates over the period 2003-2007. Then I estimated the three month rates for the missing years by subtracting this difference from the long-term rates of these years.

Hungary – For the three month interbank rate data for several years were not available from the OECD database. Instead I extracted data for three month rates from Eurostat which has data for the entire period. There seems to be no significant difference in measurement between these two databases.

Italy – Consumption data was not available for 2015. I used the 2014 values for all types but for services. For services I estimated a linear trend over the period 2009-2014 and extrapolated to 2015.

Netherlands – Consumption data was not available for 2015. I took the 2014 values for semi-durables and durables. For services and non-durables I estimated a linear trend over the period 2009-2014 and extrapolated to 2015.

Table 1

Variable	**Description**	**Source**
Consumption expenditure on non-durable goods and services *(c)*	Measured in millions of national currency, at current prices.	OECD.STAT National accounts – Annual national accounts – Detailed

		tables and simplified accounts – Final consumption expenditure of households
Real net household disposable income (y)	Deflated by household final consumption, in millions of national currency	OECD.Stat National accounts at a glance - Household
Real adjusted net household disposable income (y2)	Additionally takes into account transfers in-kind (e.g. education and health). Deflated by actual individual consumption, in millions of national currency	OECD.Stat National accounts at a glance - Household
Household debt ratio *(D)*	Total of liabilities that require payments of interest or principal by household to creditor. Also includes liabilities of non-profit institutions serving households (NPISHs). As % of net disposable income	OECD (2017), Household debt (indicator). doi: 10.1787/f03b6469-en (Accessed on 06 June 2017)
Harmonized unemployment rate *(UR)*	Measured as % of labor force	OECD (2017), Harmonised unemployment rate (HUR) (indicator). doi: 10.1787/52570002-en (Accessed on 06 June 2017)
Population	Measured in millions	OECD (2017), Population (indicator). doi: 10.1787/d434f82b-en (Accessed on 06 June 2017)
Deflator	Private final consumption expenditure, deflator	OECD.STAT - Economic Outlook No 101 – June 2017 – Prices and Deflators
Inflation	Consumer prices – All items	OECD.STAT – General statistics - Key Short-Term Economic Indicators – Consumer Prices – Annual Inflation
3 month interbank rate	Measured in Levels	OECD.STAT – General statistics – Key short-term indicators For Hungary: Eurostat – Money market rates – Annual data

4. Results

Background information

Table 2 shows some general statistics of the variables in (8) and (9). Although these numbers are very encompassing they have some interesting features. First of all, consumption smoothing is weakly suggested from this table. For instance, income growth was strongly negative at its minimum point while

consumption growth was only half as negative at its lowest. Moreover, the standard deviation of income growth is higher than that of consumption growth which suggests that consumption is less volatile than income. Second, looking at C2 it is almost as volatile as income growth and has a much lower minimum. This may not be very surprising since this measure also entails consumption of durables, which is generally more volatile (see Campbell and Mankiw, 1989). It is also clear that there is wide variance in the amount of household debt, as well as its growth rate. Table 3 looks more closely at the development of both debt and the unemployment rate over time and across countries. It is clear that household debt has steadily risen, from 87 percent of disposable income in 1995 to 145 percent in 2009, while there also is a clear decreasing tendency for the unemployment rate. The effects of the Great Recession are clear: after 2009 overall household debt stayed stable or even decreased, while the mean unemployment rate took a great leap of approximately 2 percentage points since 2008. From these numbers it seems as if unemployment and debt move together, which is interesting in itself. Looking at the overall means of unemployment and debt across country it is clear that there is wide variation in these two variables. On the upper part of the distribution Denmark and the Netherlands stand out with debt ratios far above 200 percent while the Czech Republic and Hungary are at the lower bound with debt levels on average 42 and 46 percent of disposable income. It is worth noting that the latter two countries are relatively underdeveloped and in particular they still have quite small and underdeveloped financial sectors (see Rusek (2005) for a discussion on this topic).

Table 2
Descriptive statistics

	Δc	Δc_2	Δy	D	ΔD
Mean	0.015	0.0137	0.0117	124.4	2.75
Median	0.015	0.0136	0.0121	112.1	2.47
Maximum	0.0935	0.0858	0.075	339.8	31.80
Minimum	-0.038	-0.069	-0.076	15.3	-13.61
Std. Dev.	0.0152	0.0193	0.0209	65.2	5.38

Table 3
Mean unemployment rate and debt ratio (by year and by country)

YEAR	UR	Debt	COUNTRY	UR	Debt
1995	8.13	87.9	AUT	4.83	82.9
1996	8.06	89.8	BEL	8.16	83.6
1997	7.66	92.4	CAN	7.52	139.6
1998	7.28	95.5	CZE	6.61	42.7
1999	6.84	99.8	DEU	8.00	103.9
2000	6.24	103.0	DNK	5.57	272.2

2001	6.06	105.9	FIN	9.41	96.1
2002	6.33	109.9	FRA	9.80	88.9
2003	6.73	114.7	GBR	6.28	138.7
2004	6.89	120.4	HUN	8.21	46.1
2005	6.95	127.8	ITA	9.46	69.2
2006	6.50	134.9	JPN	4.30	134.0
2007	5.88	140.2	NLD	5.39	234.8
2008	5.73	143.2	NOR	3.63	175.1
2009	7.38	145.0	PRT	9.26	120.6
2010	7.75	146.3	SWE	7.50	138.2
2011	7.43	145.0	USA	5.98	116.8
2012	7.76	143.6			
2013	7.94	142.6			
2014	7.47	143.3			
2015	7.11	142.6			

Estimating the fraction of current-income consumers

Table 4 shows the results of estimating (8). All estimations were done using time fixed effects as well as country fixed effects. Both have to be included according to the redundant fixed effect tests (see Appendix). This requires the use of instrumental variables because of the endogeneity of the explanatory variable (see previous section). Since the results may be sensitive to the instrument set used, different sets were used and their diagnostics are also reported (instrument sets are reported below the table). The first row of Table 4 shows the adjusted R-squared of the first stage, i.e. regressing income growth on the instruments including a constant, while the second row shows the F-statistic for joint significance of the instruments. Both rows show positive results with decent explanatory power and no rejections of joint significance. The second row shows the ES coefficients using OLS in the first column and TSLS in the remaining columns. The magnitudes of the coefficients are quite alike, ranging from 0.25 to 0.36 in all estimations, except for the third column which is considerably lower and insignificant. This is caused by the inclusion of an error-correction term in the instrument set. Column 3 and 4 also have this as one of the instruments but they also have other additional variables[2]. There is no sign of autocorrelation (see DW statistic). The p-values of the J-test are all very low which means a rejection of the validity of over identifying restrictions. Hence, these results must be interpreted cautiously. The last two columns split the sample in a pre- and post-crisis period as table 3 already showed that there is a considerable break in

[2] The third instrument set (IV3) is taken from Sarantis & Stewart (2002). While they say they include log levels of lagged consumption and income, I use the difference between these two which comes down to an error-correction term. Adding them separately would be problematic because of non-stationarity issues. The fourth instrument set has the second and third lag of the change in the unemployment rate since these were very significant in the first stage regression, while inflation and real interest rate were left out here because of their insignificance.

the mean debt level and unemployment rate since the crisis[3]. Since the unemployment rate is higher and the debt levels are lower (or stable) after the crisis this suggests more severe liquidity constraints and thus a larger coefficient. The pre-crisis coefficient is indeed quite lower (0.11) than the post-crisis coefficient (0.32) although the former is also insignificant. Although far from certain, these results may suggest that liquidity constraints are important for the relation between consumption and current income, which will be explored further in the next paragraphs.

Table 4

$\Delta c_{it} = \alpha_i + \lambda_0 \Delta y_{it} + \varepsilon_{it}$

	OLS	IV1	IV2	IV3	IV4	Pre-crisis*	Post-crisis
Δy	0.301 [5.543]	0.362 [1.753]	0.104 [0.735]	0.313 [2.636]	0.254 [2.539]	0.114 [1.097]	0.32 [1.738]
First stage R2		0.251	0.279	0.274	0.288		
F-statistic		3.68 (0.00)	4.01 (0.00)	3.74 (0.00)	3.98 (0.00)		
DW	1.6	1.79	1.43	1.67	1.62	1.62	1.7
P(J-stat)		0.01	0.01	0.00	0.00	0.00	0.00
Obs	340	289	289	306	289	170	136

First stage R2 is from the regression of Δy_{it} on the chosen instruments, F-stat (p-value in brackets) gives the statistic from testing joint significance of the instruments. T-statistics for coefficients are between brackets. DW is Durbin-Watson statistic of error autocorrelation. P(J-stat) is the p-value of the J-statistic which tests the validity of over identifying restrictions.

**Pre- and post-crisis estimations were performed using IV3, where the pre-crisis period includes the period 1995-2008 and post-crisis is 2008-2015*

IV1: 2nd and 3rd lags of Δc_{it} and Δy_{it}

IV2: 2nd and 3rd lags of Δc_{it} and Δy_{it} and 2nd lag of $y_{it} - c_{it}$

IV3: 2nd lag of Δc_{it}, Δy_{it}, $y_{it} - c_{it}$, level and change in unemployment rate, inflation and real interest rate

IV4: 2nd and 3rd lags of Δc_{it}, Δy_{it} and ΔUR_{it} and 2nd lag of $y_{it} - c_{it}$

All instrument sets also include a constant

Determinants of excess sensitivity

The results from table 4 show that consumption indeed is sensitive to current income. The next question is whether the magnitude of this relationship varies with the severity of liquidity constraints (or with the amount of uncertainty). Equation (9) therefore implicitly regresses the ES parameter on the household

[3] I took 2008/2009 as transition period although using a year more or less in the pre-crisis period does not change the results very much.

debt (D) and the unemployment rate (UR). The former is expected to appear with a negative sign while the latter should be positively related to ES. Table 5 shows the TSLS estimates of (8), where the same instrument set (IV3) was used for all estimations[4]. All interactions and new variables that enter the equation are also twice lagged to be used as instruments, as in Pozzi et al. (2004). Before (9) is estimated completely, debt and the unemployment rate are first added separately to (8). The first column only has the interaction of debt with income growth as additional variable. Besides a positive and significant ES coefficient the interaction term is significant and has the expected negative sign; a higher debt level reduces the ES coefficient. While this result is promising it could also be that debt itself has a direct effect on consumption and that this is captured by the interaction term. A useful check would be to additionally include the debt variable itself in the equation and see if the interaction term remains intact. The issue is that I cannot include the debt level itself in (9) since it is non-stationary[5]. Therefore the first difference of debt is included. This variable is basically a rough proxy for the amount of credit extended to consumers since it measures the growth in the amount of debt. To keep the results comparable, the interaction term is also included with the first difference instead of the level of debt. Column (2) shows that both the interaction term and the first differenced debt variable are significant and have the expected signs. In the third column consumption growth is regressed on the unemployment rate and its interaction with income growth. Higher unemployment decreases consumption growth (-0.002) and it also increases the magnitude of the ES coefficient (0.182) with both terms being significant. Column (4) has both interactions in the estimation. The signs remain the same but only the interaction with UR is significant (though the other interaction is not far of significance). The ES coefficient itself it now not significantly different from zero. Finally column (5) has both interaction terms as well as first differenced debt and the unemployment rate in its equation. Only the interaction term with UR (0.199) as well as the change in debt (0.001) are significant. The interaction term with debt now has the wrong sign (0.006) but it also is very insignificant. It is worth noting that the p-value for the J-test is always around zero except for column (5), where it suddenly turns remarkably high (0.65). I also replaced the unemployment rate with its first difference but this does not really change the results (results not shown here). The only big difference is that both the interaction of differenced UR with income growth and the first difference of UR itself are significant in (5).

[4] Both the instrument set and the main equation contain a constant but it is not reported in table 5

[5] Panel unit-root tests were performed for consumption, income, unemployment rate, debt, inflation and the real interest rate, they can be found in the Appendix.

Table 5

$\Delta c_{it} = \alpha_i + (\beta_0 + \beta_1 D_{it} + \beta_2 UR_{it})\Delta y_{it} + \varepsilon_{it}$

	(1)	(2)	(3)	(4)	(5)
Δy	0.653	0.587	-0.972	-0.055	-0.983
	3.503	4.075	-2.101	-0.154	-1.358
D*Δy	-0.004			-0.003	
	-2.166			-1.256	
ΔD*Δy		-0.038			0.006
		-1.964			0.232
ΔD		0.0010			0.001
		2.596			2.388
UR*Δy			0.182	0.076	0.199
			3.010	2.054	2.200
UR			-0.002		-0.0003
			-2.24		-0.22
DW	1.420	1.977	1.48	1.46	1.63
P(J-stat)	0.001	0.024	0.12	0.00	0.65
Obs	306	306	306	306	306

All estimations were done using TSLS, with IV3 being used as instrument set. Any additional variables and interactions that are not in the original instrument set are included as instruments. t-statistics between brackets.

Robustness

Sensitivity to instrumental variables

The first check will be to play around with different instrument sets for estimating equation (9). Not all equations are separately tested for different sets but the second and fifth column of table 5 are re-estimated with the three remaining instrument sets. The results can be found in the appendix. The equation from column (2) is discussed first. The interaction term with differenced debt has the right sign for two out of three instrument sets but is never significant (although it is not far off significance with IV4, which also is most comparable with IV3). The one with the wrong sign was with using IV1, which excludes the error-correction term. This is also the only equation with a high enough p-value for the J-test of valid instruments. What stands out is that the change in debt remains significant and with more or less the same sign (0.0007) regardless of the instrument set used. This last result also holds when the equation from column (5) is estimated with the three different instrument sets. Furthermore, the interaction between differenced debt and income growth is never significant and only has the right sign with IV2. The

interaction with UR and UR itself always appear with the right sign, but they are never significant (the interaction term comes close in two out of three estimations).

Timing of instruments

All instrument sets have variables that are at least lagged twice to overcome the problem of time aggregation which could induce autocorrelation in the error term (see previous section). The issue with using variables that are lagged two to three years is that they are likely to have quite less explanatory power compared with using one year lags. After all, the autocorrelation issue may not be so problematic after all. For these reasons I experimented with using variables that are lagged one to two years (depending on the instrument set) and re-estimated both (8) and (9). The results can be found in the appendix. For equation (8) the findings are quite interesting since all coefficients are considerably larger than their counterparts of table 4, with magnitudes in the order of 0.39-0.54 (and 1.29 for IV1). One possible explanation is that there is indeed positive autocorrelation which biases upwards the estimates.[6] Strangely enough, the p-value for the Sargan test is very high for IV1 (0.98) which would imply that the instruments are orthogonal. However, once the error correction term is included this result disappears again. The R-squared for the first-stage regression of income growth on the instruments are consistently higher when first lags are used instead of second and third lags, as well as the F-statistic for joint significance. This is not strange since information of one and two year ago generally has better predictive power for current values than information of two or three years ago.

I also re-estimated equation (9) using again IV3 for all estimations but using only first lags instead of second lags[7]. Although there are some differences, some important results are quite robust. The interaction between unemployment rate and income growth always has the same sign and is significant or very close to significance. Debt growth also remains unchanged. It is only the interaction between debt and income growth that is not significant and is wrongly signed. Overall the results seem pretty robust to using first and second lags of instruments instead of second and third lags. There is one interesting difference though. Where in table 5 the p-values of the J-test were quite high for columns (3) and (5) (0.12 and 0.65 respectively) these become approximately zero again when the timing of the instruments is changed. This is quite interesting since the same variables are used as instruments. It could be a sign of autocorrelation issues. If there is indeed a MA(1) term in the error term then one year lagged instruments will be correlated with contemporaneous error values. Since the J-test is in effect a test of the orthogonality of the instruments, the former could be the cause of very low p-values (and thus a rejection of the valid instrument condition). All in all the considerably higher coefficients found for (8) and the rejection of the valid instruments hypothesis in the estimations of (9) suggest that autocorrelation is indeed present. The results with at least second lagged instruments are therefore more trustworthy.

Alternative measures for consumption and income

As another check of robustness total consumption expenditure was used instead of consumption of non-durables and services. This includes consumption of durable goods which leads to a MA(1) term in equations (8) and (9), however this was already taken into account by using at least second lags of instruments. Another check is to include adjusted disposable income, which adjusts for transfers in-kind by government agencies or non-profit institutions serving households e.g. education and health services.

[6] That the autocorrelation is positive can also be found in the work by Campbell and Mankiw (1989).

[7] Since the instrument set already contains a large number of variables, I decided not to include second lags additionaly

According to the OECD database this measure is better to compare across countries. The appendix shows results for both alternative measures. Note that equation 9 is estimated with the differenced unemployment rate instead of levels. The results show no clear difference with the main results; the ES coefficient is somewhat higher (0.414) when using total consumption expenditure, which may be caused by the inclusion of the relatively volatile durable component of consumption.

Discussion

The results from table 4 show that there is a significant departure from the random walk result and that the fraction of current-income consumers lies between 0.25 and 0.36. This magnitude is not strange and in line with what other studies have found. Pozzi et al. (2004) find estimates between 0.24 and 0.40 depending on the variables included and method used and Everaert et al. (2014) find estimates between 0.32 and 0.49. These are panel studies and thus most comparable to this work. Other country studies (e.g. Peersman & Pozzi, 2008; de Castro, 2006 and Everaert et al., 2016) and micro studies (e.g. Benito & Mumtaz, 2006 and Christelis, Georgarokas et al., 2017) also find similar results. This coefficient may still hide a large amount of heterogeneity however and the coefficients could be quite different across countries (see the studies by CM, 1991 and Sarantis & Stewart, 2002 for example). The results do seem to have some sensitivity to the instruments used. Adding an error-correction term to IV1 makes the coefficient much smaller and insignificant. Adding extra terms in IV3 and IV4 gets us to results again comparable with the OLS and IV1 estimates. The pre- and post-crisis estimates suggest that the excess sensitivity has increased after the crisis. At the same time the unemployment rate increased substantially and the overall level of household debt has stalled or decreased (table 3). This brings forward the idea that liquidity or borrowing constraints have increased after the crisis which is why the ES coefficient has increased. The former explanation was also brought forward by Cho & Rhee (2017) who also found that the ES coefficient increased after the crisis after it had fallen gradually towards the crisis.

Table 5 gives us a closer look at the relationship between liquidity constraints and the excess sensitivity of consumption. It seems that either higher debt or larger increases in the debt ratio lower the ES coefficient. This has been documented before by Sarantis & Stewart (2002) and Cho & Rhee (2017). Using the unemployment rate instead of debt gives similar results: higher unemployment rates lead to higher ES coefficients. This is not very strange since both measures capture more or less the same thing, i.e. variation in liquidity constraints. This may be why debt becomes insignificant as determinant of the ES coefficient when both variables are included in the regression. More unemployed people means there are less people that are able to borrow. The stagnation of decline in debt levels from the crisis onwards could therefore partially be explained by more unemployment. However this is only part of the reason since for a large part banks had to face worsening balance sheets and tighter regulation which most likely made them supply less credit. The fact that both debt and the unemployment rate affect the ES coefficient in the expected way and that the unemployment rate effect stays significant after including debt does signal that liquidity constraints affect the response of consumption to current income. However as already explained in section 2 it could very well be that heightened uncertainty during and after the crisis is (partially) the cause of an increase in the ES of consumption. Higher uncertainty leads to stronger precautionary motives which increases the correlation between consumption and current income so that higher unemployment may reinforce this relationship (Peersman & Pozzi, 2008). Although this may very likely be part of the explanation, the results shows that liquidity constraints are important. This evidence is strengthened by the fact that debt growth comes out significant and with the right sign in all equations. Consumption seems to be ‘excessively sensitive’ to debt growth as well, which was first documented by

Bachetta & Gerlach (1997). It could of course be that the causality is the other way around, that consumption growth affects the growth of debt. However, using Granger tests in their study they find that consumption tends to lag credit. This correlation between consumption growth and debt growth is not explained by the theoretical model in this thesis. But as already noted in section 2, it can well be explained by referring to the model of Ludvisgon (1999). This model supports both the relation between borrowing constraints and the ES of consumption to income, and the correlation between consumption growth and debt growth.

Limitations

As could be seen from the results in table 4 and the robustness checks, the results seem to be somewhat sensitive to the instruments used in the estimation. This makes the result less trustworthy as it is hard to judge what instrument set is best to use. Moreover, most of the instrument sets used do not pass the J-test of valid overidentifying restrictions. This raises concern about the overall validity of the instruments. Even if the instruments do fulfill the exogeneity condition there is some concern about their relevance, especially since twice lagged instruments are used. I have tried to overcome the instrument problem by at least using a couple of different instrument sets and it is good to see that some results stay quite robust. This still does not entirely solve the problem of course.

Another issue concerns the nature of the panel data set. The effective number of years in the estimations is 17 (using IV3 as instrument set which has third lagged variables) which is as high as the number of cross sections. This means only 17 observations per country which is quite low. This statistical weakness should be taken into account when interpreting the estimations. Furthermore, Pozzi et al. (2004) used the GMM method to solve the heterogeneity problem with panel data and the possible correlation between country's unobserved fixed effects and income growth. Although I controlled for heteroskedasticity by using White's (diagonal) coefficient covariance method, I did not employ this relatively more advanced method so statistically the results may be less reliable.

Finally the debt variable is likely to be endogenous. As already mentioned, it is not sure whether debt drives consumption or the other way around and it could also be that a third omitted variable drives both variables. This problem is partly reduced by using TSLS with the inclusion of the second lagged debt variable as instrument, but still it is not sure whether this solves the entire endogeneity problem. The results by Bachetta and Gerlach (1997) that consumption tends to lag credit provide some evidence of the causality direction from debt to consumption.

5. Conclusion & Implications

The key objective of this thesis was to explore how the response of consumption to income depends on the amount of household debt and the unemployment rate. According to theory and previous research a significant fraction of the population consume their current income, which is at contrast with the theoretical predictions by Hall (1978) that consumption growth is unpredictable. Liquidity constraints are the most cited reason for the failure of this result since this prevents individuals from borrowing on the capital market. Household debt and the unemployment rate are often used measures for the degree of liquidity constraints. Using the theoretical framework of Campbell and Mankiw (1989) the fraction of current income consumers can be estimated. Additionally, this fraction can be endogenized to variables capturing liquidity constraints. The results in this thesis show that indeed a significant proportion (0.25-

0.36) of the population consumes out of current income. Moreover, liquidity constraints seem to affect this fraction in the following way: higher levels of household debt or debt growth decrease this fraction while a higher unemployment rate increases the coefficient. Besides that, consumption is shown to be excessively sensitive not only to current income but also to debt growth, a finding similar to that of Bachetta and Gerlach (1997). These findings can be reconciled with the higher fraction of current-income consumers found during and after the crisis since this period showed an overall stagnation of debt levels and increase in the unemployment rate.

These findings have several meaningful implications for fiscal and monetary policy as well as for future economic research. The results imply that during recession, when unemployment rates increase and debt levels generally decrease because of deleveraging, consumption responds stronger to change in disposable income. It is shown that fiscal consolidation during and after the crisis years had larger contractionary effects than forecasted (Blanchard and Leigh, 2013). Countercyclical fiscal policy could therefore be more effective, even though for budgetary reasons it might be tempting to decrease spending during recessions. The expansionary effects of the former on the economy may actually improve government budgets. In these times where European countries are in general reluctant to spend this may be an argument for doing the opposite. The implications for monetary policy are more complex. We are currently in a period where central banks are starting to tighten monetary conditions, which would in theory make borrowing harder and decrease credit supply. This could have a direct effect on consumption growth but also indirectly since consumption becomes more sensitive to changes in current income. On the other hand higher interest rates may be welcomed by banks who face very low margins so that lending may actually increase. Finally these results may be important for calibration of DSGE models (as pointed out by Everaert et al., 2014). These models are frequently employed by centrals banks for example in their economic forecasts and the results of these models depend on parameters such as the response of consumption to current income. Getting a clearer understanding of the latter relationship obviously helps in making more effective forecasts. Finally, the finding that debt has a direct effect on consumption is by my understanding not employed in many consumption models. This might be useful, especially given the relevance of debt and their increasing levels in the developed world nowadays.

Bibliography

Bacchetta, P., & Gerlach, S. (1997). Consumption and credit constraints: International evidence. *Journal of Monetary Economics*, 207-238.

Bayoumi, T. (1993). Financial Deregulation and Consumption in the United Kingdom. *The Review of Economics and Statistics, Vol. 75, No.3*, 536-5539.

Benito, A., & Mumtaz, H. (2006). *Consumption excess sensitivity, liquidity constraints and the collateral role of housing.* Londen: Bank of England.

Blanchard, O., & Leigh, D. (2013). *Growth Forecast Errors and Fiscal Multipliers.* International Monetary Fund.

Campbell, J. Y., & Mankiw, N. G. (1989). Consumption, Income and Interest Rates: Reinterpreting the Time Series Evidence. In O. J. Blanchard, & S. Fischer, *NBER Macroeconomics Annual 1989, Volume 4* (pp. 185-246). MIT Press.

Campbell, J. Y., & Mankiw, N. G. (1990). Permanent Income, Current Income, and Consumption. *Journal of Business & Economic Statistics*, 265-279.

Campbell, J. Y., & Mankiw, N. G. (1991). The response of consumption to income. *European Economic Review*, 723-767.

Carroll, C. D., Hall, R. E., & Zeldes, S. P. (1992). The Buffer-Stock Theory of Saving: Some Macroeconomic Evidence. *Brookings Papers on Economic Activity*, 61-156.

Cho, D., & Rhee, D.-E. (2017). Non-linear adjustments on the excess sensitivity of consumption with liquidity constraints. *Applied Economics*.

Christellis, D., Georgarakos, D., Japelli, T., Pistaferri, L., & van Rooij, M. (2017). *Asymmetric consumption effects of transitory income shocks.* Amsterdam: De Nederlandsche Bank NV.

Crook, J., & Hochguertel, S. (2007). *US and European Household Debt and Credit Constraints.* Amsterdam: Tinbergen Institute.

de Castro, G. L. (2006). *Consumption, disposable income and liquidity constraints.* Banco de Portugal.

Everaert, G., & Pozzi, L. (2014). The predictability of aggregate consumption growth in OECD countries: a panel data analysis. *Journal of Applied Econometrics*, 431-453.

Everaert, G., Pozzi, L., & Schoonackers, R. (2016). On the stability of the excess sensitivity of aggregate consumption growth in the USA. *Journal of Applied Econometrics*.

Filer, L., & Fisher, J. D. (2005). Do liquidity constraints generate excess sensitivity in consumption? New evidence from a sample of post-bankruptcy households. *Journal of MACROECONOMICS* , 790-805.

Flavin, M. (1984). *Excess sensitivity of consumption to current income: Liquidity constraints or myopia?* Cambridge: National Bureau of Economic Research.

Hansen, Lars Peter and Kenneth J. Singleton, 1983, Stochastic consumption, risk aversion. and the temporal behavior of asset returns, Journal of Political Economy 91, 249-265.

Hall, R. E. (1978). Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence. *Journal of Political Economy*, 971-987.

Japelli, T., & Pagano, M. (1989). Consumption and Capital Market Imperfections: An International Comparison. *The American Economic Review*, 1088-1105.

Ludvgison, S. (1999). Consumption and credit: a model of time-varying liquidity constraints. *The Review of Economics and Statistics*, 434-447.

McKiernan, B. (1996). Consumption and the credit market. *Economics Letters*, 83-88.

Peersman, G., & Pozzi, L. (2004). *Determinants of consumption smoothing.* Gent: Universiteit Gent.

Peersman, G., & Pozzi, L. (2008). Business Cycle Fluctuations and Excess Sensitivity of Private Consumption. *Economica*, 514-523.

Pozzi, L., Heylen, F., & Dossche, M. (2004). Government debt and excess sensitivity of private consumption: estimates from OECD countries. *Economic Inquiry*, 618-633.

Rusek, A. (2005). Financial Integration and the New EU Member Countries: Challenges and Dilemmas. *Prague Economic Papers*, 17-32.

Sarantis, N., & Stewart, C. (2002). Liquidity constraints, precautionary saving and aggregate consumption: an international comparison. *Economic Modelling*, 1151-1173.

Appendix

Table A1
Redundant Fixed Effects Tests
Equation: EQ7_OLS
Test cross-section and period fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.634489	-16,303	0.0007
Cross-section Chi-square	44.28553	16	0.0002
Period F	14.80326	-19,303	0
Period Chi-square	223.2497	19	0
Cross-Section/Period F	8.896646	-35,303	0
Cross-Section/Period Chi-square	240.3409	35	0

Table A2
Panel unit root test: summary

	Δc	Δy	ΔD	UR	Inflation	Real interest rate
Im, Pesaran and Shin W-stat	-4.4982	8.88433	3.72546	-6.0292	5.71876	-2.55909
Levin, Lin & Chu t*	6.33648	9.07296	3.39718	5.85244	6.72021	-2.93985
ADF - Fisher Chi-square	76.9213	138.474	67.3352	100.198	89.6866	61.0118

All tests reject the null of unit root(s)

Table A3
Equation 8 (4) using alternative instrument sets

	IV1	IV2	IV4
Δy	-0.407	-0.646	0.026
	-0.488	-0.822	0.048
ΔD*Δy	0.025	-0.003	0.021
	0.887	-0.117	0.831
ΔD	0.001	0.001	0.001
	2.509	2.589	2.368
UR*Δy	0.150	0.159	0.077
	1.169	1.293	1.087
UR	0.001	0.000	0.001
	0.534	0.195	0.618
DW	1.726	1.745	1.897
P(J-stat)	0.963	0.478	0.532
Obs	289	289	289

Table A4
Equation 8 (2) using alternative instrument sets

	IV1	IV2	IV4
Δy	0.410	0.258	0.382
	2.008	1.520	3.279
ΔD*Δy	0.013	-0.008	-0.023
	0.702	-0.443	-1.559
ΔD	0.0007	0.0007	0.0007
	2.617	2.198	2.202
DW	1.981	1.594	1.725
P(J-stat)	0.239	0.048	0.007
Obs	289	289	289

Table A5
Equation (8) using first (and second) lagged instead of second (and third) lagged instruments

	IV1	IV2	IV3	IV4
Δy	1.285 [2.594]	0.388 [2.923]	0.540 [5.441]	0.471 [3.949]
First stage adjusted-R2	0.258	0.287	0.307	0.301
F-statistic	3.860 (0.00)	4.236 (0.00)	4.321 (0.00)	4.284 (0.00)
DW	2.073	1.792	1.983	1.910
P(J-stat)	0.967	0.000	0.000	0.000
Obs	306	306	323	306

Table A6
Equation (9) using IV3 with first lagged instead of second lagged instruments

	(1)	(2)	(3)	(4)	(5)
Δy	0.447 [2.672]	0.725 [5.045]	-0.154 [-0.584]	0.107 [0.399]	-0.060 [-0.136]
D*Δy	0.001 [0.402]			0.001 [0.365]	
ΔD*Δy		-0.034 [-1.643]			-0.012 [-0.475]
ΔD		0.0009 [2.613]			0.0007 [2.385]
UR*Δy			0.086 [2.612]	0.051 [1.741]	0.085 [1.975]
UR			-0.0013 [-2.071]		-0.0006 [-0.879]
DW	2.019	2.053	1.660	1.849	1.770
P(J-stat)	0.000	0.002	0.000	0.000	0.004
Obs	323	323	323	323	323

Table A7
Alternative measures for consumption and income

	(1)	(2)	(3)	(4)	(5)
Δy	0.414	0.310	0.745	0.144	0.054
	[2.262]	[2.288]	[3.810]	[0.608]	[0.307]
*D*Δy*					
*ΔD*Δy*			-0.059	0.028	0.011
			[-1.925]	[1.014]	[0.491]
ΔD			0.0011	0.0001	0.0004
			[1.649]	[0.905]	[0.831]
*ΔUR*Δy*				0.598	0.349
				[2.957]	[2.547]
ΔUR				-0.017	-0.011
				[-4.310]	[-4.114]
DW	1.464	1.595	1.804	1.950	1.850
P(J-stat)	0.00	0.00	0.00	0.321	0.215
Obs	305	306	305	305	306

(1): equation 7 using total consumption expenditure
(2): equation 7 using adjusted net disposable income
(3) + (4): equation 8 using total consumption expenditure
(5): equation 8 using adjusted net disposable income
All estimations were done using TSLS with the same instruments as used in the estimation of (8) in the main text. T-statistics are between brackets