

Heinrichs, Katrin

Conference Paper

German Consumption Inequality. An evaluation with a focus on the financial crisis.

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Inequality in Germany and Europe, No. A06-V2

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Heinrichs, Katrin (2016) : German Consumption Inequality. An evaluation with a focus on the financial crisis., Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Inequality in Germany and Europe, No. A06-V2, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:

<https://hdl.handle.net/10419/145891>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

German Consumption Inequality

An evaluation with a focus on the financial crisis

Draft - Update with more recent data (up to 2014) in progress

Katrin Heinrichs*

September 1, 2016

How did the financial crisis impact on German demand? Are there significant differences in consumption behaviour depending on income? We analyse consumption data from 2005 to 2012/13 and find some indication for divergence of different income categories' consumption after 2009 and for a higher real interest rate sensitivity of higher income earners' consumption. Like studies of income and wealth inequality, we also see a slight upward trend in consumption inequality that might have briefly staggered when the financial crisis hit.

1 Introduction

How did the financial crisis impact on German demand? Are there significant differences in consumption behaviour depending on income? The latter question is important for several reasons. 1. It can help to better explain the impact or transmission of shocks on aggregate consumption. 2. Where wealth data are scarce, it can give some indication as to the wealth inequality (assuming a wealth effect on consumption). 3. It can inform the decision about stabilising/welfare policies after extreme events.

This study complements analyses of the impact of the 2008 financial crisis on employment, income and welfare distribution by Grabka and Frick (2012); Grabka (2015). They find German employment to remain relatively unaffected by the crisis, which they explain by a reduction in overtime and various state programs.¹

Nevertheless, Grabka and Frick (2012) mention that the Great Recession led to a temporary decline in aggregate real gross financial assets of around 4%, which they assume to have impacted most on the "very rich". Looking at our consumption data, that include household incomes up to 18,000 euros per month, it appears that the lower income earners were affected more than the upper categories within our sample, whose post 2008 consumption increases faster than those of

*katrin.heinrichs@fernuni-hagen.de

¹ Hoffmann and Lemieux (2016) offer further explanations for relatively constant employment in Germany: large scale labour market reforms and relatively constant GDP growth with only a short-run dip due to shrinking exports.

the lower income groups. Comparable pre-crisis consumption series are short but point to a more homogenous consumption growth across different income categories.

Grabka (2015) does not find significant distributional changes due to the Great Recession but a short-term reduction in dynamics with respect to income. Comparable data on wealth are in limited supply. Grabka expects that stronger effects on inequality might become apparent later, based on publications by the Federal Statistical Office on a rise in poverty risk.² Our analysis of consumption also points to a brief halt in the movement in inequality (measured by coefficient of variation or GINI). However, inequality seems to be generally on the increase with respect to consumption data.

In their study of average consumption in the EU-27 and its individual member countries, Gerstberger and Yaneva (2013) find that average consumption reacted very differently to the financial crisis. The Baltic countries and Greece suffered the largest loss of individual consumption from 12% to 15% (in terms of volume) between 2008 and 2011. Germany's consumption increase over the period from 2008 to 2011 is quite similar to that of Austria and Belgium at around 3%, while the highest increases are observed for Sweden and Poland with an expansion of average consumption by 5 to 8%.

Now the question is whether a split of the German population by income might present a similarly diverse picture. There seems to be no obvious link between average income and consumption change after the crisis on the European level from a cursory look at the numbers. Countries like Denmark and the Netherlands, for example, faced losses in average consumption while the Czech republic and Poland saw a rise in average consumption.

While the higher income categories in Germany show an increasing trend in consumption after 2008, consumption at the lower half of the considered incomes seems to be fairly constant, if not decreasing. One possible explanation are unobserved wealth or lifetime earnings expectations.

Another possible explanation is that the very low interest rates observed post 2008 motivate the better off to consume a larger share of their income as saving becomes less attractive while at the lower end of the income scale there might be little to allocate in excess of subsistence consumption and borrowing might be severely constrained when future earning prospects are similar to present ones.

We find some tentative evidence that consumption depends differently on the interest rate between the different consumption groups. Unlike found by Stracca (2010), the real interest rate gap

² See also the report on poverty and wealth by the German Federal Ministry of Labour and Social Affairs that gives three different statistics on poverty risk <http://www.armuts-und-reichtumsbericht.de/DE/Indikatoren/Armut/Einkommensverteilung-Armut/A1-Indikator-Einkommensverteilung-Armut.html> accessed 10 Feb 2016. Two of the series show a slight upward trend in recent years while the third is relatively constant. Atkinson and Morelli (2014) observe an upward trend in poverty well before the financial crisis: The German poverty rate increased from 10 to 15% from 1998 to 2010.

Year	2007	2008	2009	2010
EU 27	4.9%	0.9%	-4.3%	4.3%
Germany	1.1%	2.3%	0.2%	3.1%

Table 1: Consumption increase with respect to the previous year (in nominal terms). Source: Eurostat’s NAMA3-table: Final consumption expenditure of households by consumption purpose in million euro

appears to have the expected negative impact on consumption - when we take the income level into account, e.g. by an interactive dummy variable of the real interest rate gap and the income category. The higher income groups tend to shift their consumption by more when the real interest rate gap changes (although not for all of our specifications). Hence an increase of consumption inequality might well have been supported by lower interest rates. While graphically there is some indication that consumption of different income groups diverges post 2008, we have not been able to confirm this analytically based on the short pre-2008 time-series.

Compared to the European union average, German consumption has suffered far less from the financial crisis (see table 1).

We analyse consumption data from two different data sources, the LWR (*Laufende Wirtschaftssrechnungen - continuous household budget surveys*) and the EVS (*Einkommens- und Verbrauchsstichprobe - survey of income and consumption expenditure*) collected by the German Statistical Office. Both list consumption behaviour per household for different income categories.

The next section describes these and the other considered data and how they were transformed in order to obtain nominal and real consumption per household for five different income categories covering incomes from 0 to 18,000 euros monthly. Readers interested mainly in the analysis can skip the following section and directly move on to section 3.

2 The Data and Their Transformation

This section describes our data and explains how we construct quarterly data for nominal and real consumption for Germany from 2005 to 2012/13 from various data sources.

Several German statistical yearbooks³ provide annual data on household consumption (in euros) by at least five net income categories: below 1300 euros, 1300-2600, 2600-3600, 3600-5000 and 5000-18,000 euros per household per month. When more subcategories are given, they are subcategories of the larger ones, so we aggregate the data to the five larger ones employing household numbers per category as weights.⁴

³ For the most recent years we referred directly to Fachserie 15 for LWR or EVS data instead of the statistical yearbook.

⁴ Where several income categories had to be summarised into one, this was weighed by number of households in each category. For example in 2007 there are more than five bins. The 1300-2600 euros income category consist of about 4,146,000 households in the 1300-1700 euros per months category and 7,943,000 in the 1,700 - 2,600 category. The household numbers are estimates given in the same table as the consumption figures. For our purpose, the averaged consumption figure for the 1300-2600 bin is then weighted by the household numbers of each of its “sub-bins”.

Data are available from 2003 to 2013. Since the underlying measurement methods changed considerably in 2005, we disregard the earlier data. Some later data are also subject to inconsistencies: Every five years consumption data are collected by the EVS, while the data in the intermittent years are obtained from the LWR. In years when the EVS is conducted, the LWR does not take place.

Both surveys include only households with monthly net incomes below 18,000 euros. The LWR surveys about 8000 households annually since 2005, the EVS 2008 included about 60,000 households. The LWR survey excludes farmers and self-employed (main income earners). The EVS sample is hence not only larger but draws a sample from a partly different population. Graphical inspection shows an upwards or downwards kink for most consumption series (fig. 1).

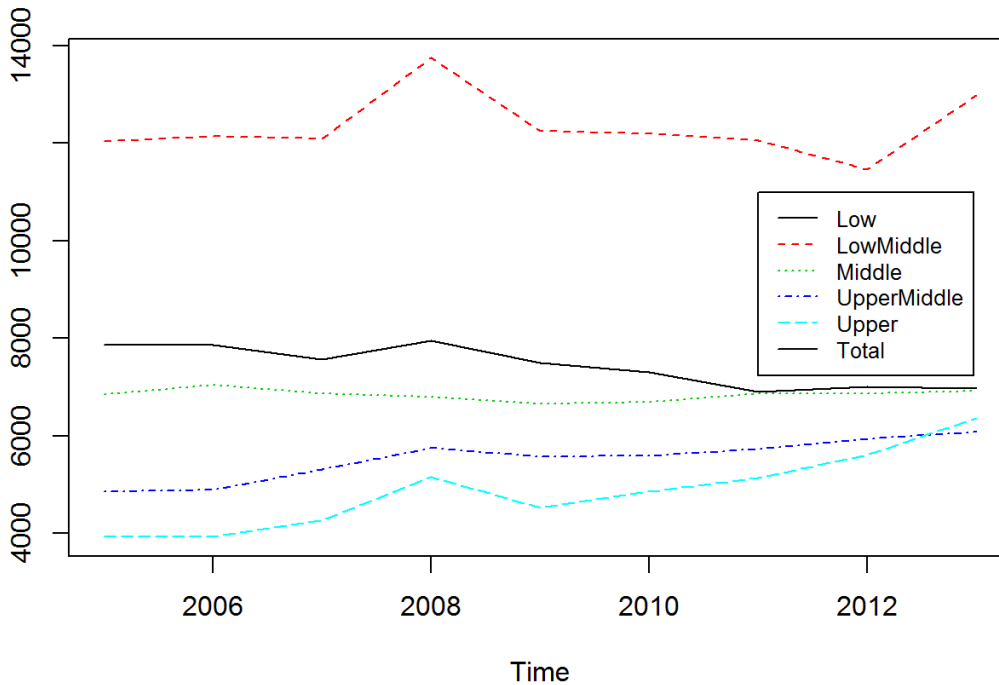


Figure 1: Annual Consumption per Household by Income Category 2003-2013 (in Euro)

The kinks correspond well to the largest increases in population per category. While the increase of households in the 2008 EVS in the LowMiddle (1300-2600 euros net income) and the Upper (5000-18,000 euros net income) income categories is especially large in comparison to the LWR data, there are hardly any additional households in the Middle income group (table 2).

It appears very likely that mean and median income in some groups and hence consumption behaviour of those groups are affected by the shift in the sample. We perform some, mostly graphical but also inequality related (GINI coefficient and coefficient of variation) analyses on

Income	absolute	%
Below 1300 (Low)	420,5	0,059
1300-2600 (LowMiddle)	1572	0,129
2600-3600 (Middle)	41	0,006
3600-5000 (UpperMiddle)	303	0,056
5000-18000 (Upper)	760	0,173
Total	3096,5	0,085

Table 2: Deviation of 2008 EVS household numbers from from the simple 2007-2009 LWR average in absolute figures and in percentages of the average

these annual data, still taking EVS data into account with the inequality analysis as there are no intertemporal dependencies. We omit the EVS data from much of the following analysis, however, when we run regressions on quarterly data.

Even higher frequency data would be preferable as central banks do not change interest rates in line with our quarterly data. However, data by income category are only available at annual frequencies, which we then interpolate and weigh by aggregate quarterly data.

To obtain quarterly data for each income group, we use data on quarterly consumption expenditure from the national accounts. These quarterly data of aggregate German consumption are provided by the German statistical office. The quarterly data are multiplied by the weight of each income group in total consumption to obtain quarterly consumption for the five income groups.⁵ We employ simple linear interpolation to obtain weight-data for the missing three quarters from the annual weights. For 2008 we also employ linear interpolation to substitute the EVS value for most of the analysis. 2008 data can therefore not be interpreted in any meaningful way.

The interpolation procedure likely smoothes over a share of the individual group effects that could otherwise be identified for the intermittent years, but should allow to better identify the general impact of real interest (or other frequently changing variables) on general consumption.

In order to obtain real consumption data, the nominal consumption data are divided by the CPI data from the German Statistical office. The data are available at monthly frequency and hence geometric means over three months give a quarter's CPI.

As it appears plausible that the differing consumption behaviour merits different CPIs⁶, we calculate total "real" consumption per income group from two-digit COICOP level, i.e. we discount twelve subgroups of consumption by their respective CPI for each income group. Each income group's real consumption equals the sum of the real subgroup consumption for that group.

The share of the different consumption categories differs considerably between income groups.

⁵ To obtain the weights we multiply average household consumption in each income group by the household numbers in that income group, which are available from the same table. This aggregate consumption per income group is then divided by total aggregate consumption.

⁶ Following a similar assumption, Breuer and Mehrhoff (2009) calculate inflation indicators for 13 different income categories surveyed in the EVS 2003, find that the highest mean deviation of a subgroup inflation from the aggregate inflation is 0.3%.

Income	2009	2012
Below 1300 (Low)	1.2	1.1
1300-2600 (LowMiddle)	1.7	1.6
2600-3600 (Middle)	2.2	2.1
3600-5000 (UpperMiddle)	2.7	2.6
5000-18000 (Upper)	3.1	2.9

Table 3: Average household size per income category, 2009 vs 2012

The three lower income levels consume proportionately more food than the average household, while the highest income earners consume proportionately less food. The upper middle income earners are quite close to average behaviour. The reverse holds for transportation, for example. Here the high earners spent proportionately more than the average household while the three lowest income groups spend less. The upper middle income households are again quite close to average (with a little upward shift being visible after the introduction of the car scrappage bonus in 2009 that rewarded people for buying a new car if they had the old one scrapped).

The mean deviation when aggregate CPI discounting and subgroup discounting are compared is around -0.1% for the three lowest incomes and around 0.2% for the highest income group with the second highest income group being close to zero mean deviation (each normalised by first period consumption - see figure 2).

We note that employing the aggregate CPI appears to slightly understate real consumption of the highest income group while slightly overstating real consumption of the lower income groups, especially the three lowest income categories. Compared to the amplitude of consumption oscillations, the deviation is small.

In 2010, an overstatement of nominal (=real as our CPI has a 2010 base) consumption by 0.1% amounts to 1 euro per month per household for the lowest income group, 1.6 euros for the lower middle income group and 2.4 for the middle income group, while understating the income of the highest income group by 0.2% means that we understate it by 8 euros.

Having constructed a quarterly dataset of real consumption data per sector, we proceed to calculate a per household quarterly real consumption series since this is the cleaner measure of consumption behaviour over time. Ideally, we would calculate consumption per capita. However, household sizes are given only from 2009 onwards for the different income groups. Compared with the differences of household size between income categories, the changes in household size appear small (table 3). The average high income household consists of more than twice as many people than the average low income household. Nevertheless, average household size shrank from 2.12 people per household in 2005 to 2.02 to the end of our sample (Mikrozensus).

For each household category, we also have average income (at least for the LWR data), which

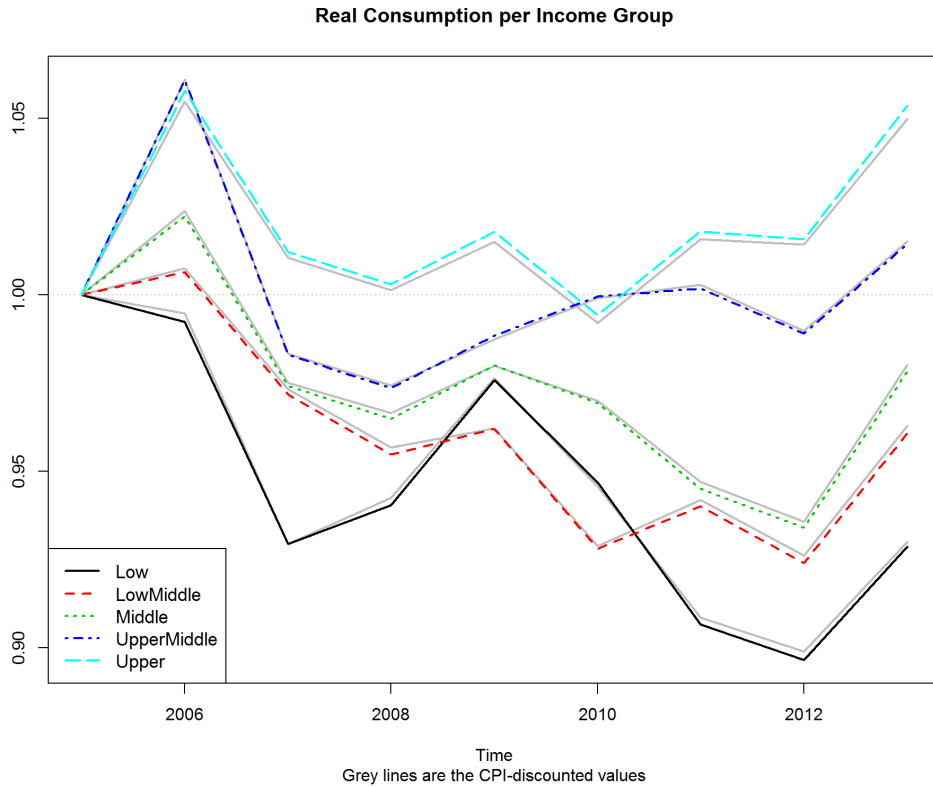


Figure 2: Total consumption per household 2005-2013 discounted by aggregate CPI (grey lines) or 12 COICOP groups' CPIs before aggregation

we include in the empirical analysis as income is a common determinant of demand. Although the baseline regression is one without income, based on the New Keynesian IS curve, which represents demand on the aggregate level and contains only real consumption and the real interest rate gap.

We assume the real interest rate gap to possibly proxy the run up to and outbreak of the financial crisis. Hence, the impact of the real interest rate gap on consumption might in this case be interpreted at least partly as the impact of the financial crisis.

We test different constructs of the real interest rate gap (including growth rates and different measures of inflation), all of which have to remain ad hoc as the equilibrium real interest rate is impossible to measure. The measure we employ in the presented econometric modelling is the deviation of the actual real interest rate, i.e. the nominal interest rate set by the ECB minus inflation (aggregated to quarterly data where the nominal interest rate changed more often) minus an approximate equilibrium rate that is an average of the preceding four years "actual real rate" and the following years real rate.

However, to begin with, we perform a simple descriptive analysis of the consumption data, before proceeding to some regression analyses. Considering that the original annual data series are relatively short for reliable test statistics, a graphical analysis appears at least as important.

3 The Analysis

For an initial overview, we present some graphical and numerical analyses of consumption per income group and deducted inequality measures (GINI-coefficient, coefficient of variation) of the annual data in section 3.1. It appears that there is a slight upward trend in inequality. In the wake of the financial crisis, a gap between the consumption of the three lower income groups and the two higher income groups seems to open (figure 2). The econometric analysis follows in section 3.3.

3.1 Graphics and Income Distribution Analytics

Overall, the higher the income group, the faster the growth of per household consumption of that group. While the (very short) data series before the occurrence of the financial crisis give tentative evidence for growth in all but the poorest category (compare figure 2 in the last section), post 2008 data point to a reduction even in nominal consumption for the lowest group and at no real growth for all income groups below 3600 euros per month.

Considering the share in total consumption, a considerable increase for the highest income group from almost 21% to close to 28% appears, while all incomes below 3600 euro per month consume a shrinking share of the total.

As the number of households in each group changes somewhat over time, these trends do not necessarily point to increasing inequality in consumption. Indeed, the number of households in the highest income share has increased slightly over the sample while the number of households in the lowest income group decreased.⁷

Constructing a consumption GINI index from the sample,⁸ we find that the consumption inequality is on the rise over the sample (table 4). The values are very similar to those found by Fuchs-Schündeln *et al.* (2010) judging from their figure 16. They analyse somewhat earlier EVS based consumption data, ending in 2003. Their overall consumption GINI appears to be slightly on the rise, but for the last five years of their sample.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
GINI	0.23	0.24	0.24	0.25	0.24	0.25	0.25	0.26	0.25

Table 4: Consumption GINI based on LWR and EVS data. EVS years are in grey.

The 2008 and 2013 values should be interpreted separately as they derive from the EVS data. The rise in inequality is not necessarily related to the financial crisis. A general upward trend can be observed from the beginning of the series. On the other hand, omitting the EVS data, the

⁷ As the income groups are defined in nominal terms, it is likely that especially the lower categories become poorer over time in real terms.

⁸ Unlike with the standard GINI index, we do not have constant population intervals but take the data's fixed income intervals, otherwise the calculations are identical to the GINI index.

financial crisis possibly caused a short-term reduction of inequality. The reduction is very slight as it is noticeable only in the third decimal. The upward trend continues from 2010 onwards, however.

The coefficient of variation⁹ presents a similar picture

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
Coeff of Var	0.42	0.44	0.44	0.45	0.44	0.44	0.46	0.46	0.46

Table 5: Consumption coefficient of variation based on LWR and EVS data. EVS years are marked grey.

Grabka (2015) interprets two values of the SOEP (socio-economic panel), that were measured in five year intervals as not showing an increase in inequality due to the financial crisis. Had we only considered the EVS values of the GINI, we might have arrived at a similar conclusion. Considering the two measures of inequality, we might confirm Grabka’s observations that the financial crisis briefly froze the status quo. Generally, however, inequality appears to follow a slight upward trend and graphical inspection indicates a gap in trend arising between the three lowest income groups and the two highest groups from 2009 onwards.

We use interpolated data in the following because for the econometric analysis we have explanatory variables at higher frequencies and hence at least links between these can be partly modelled. Besides, the annual time series are quite short for statistical procedures.

3.2 Econometrics

Again, we consider consumption per household as our variable of interest. Now, however, we employ the quarterly series obtained by interpolating the quarterly aggregate consumption series by linearly interpolated annual weights obtained from the five income categories’ consumption series. Unless otherwise mentioned EVS years are substituted by interpolation.

The correlation between total consumption of an income group and per household consumption are affected by the transformation from the annual to the quarterly series. However, in most cases the changes are not large.

While the correlation between different categories ranges from 0.69 to 0.96 for consumption per household, the correlation ranges from -0.58 to 0.97 for total consumption per group. Some correlations are very close to zero in this case. Directly adjacent income groups come with positive correlation in both cases, however (see table 6).¹⁰

A household in the lowest group income remains the one with the lowest correlation to its neighbouring income group after transformation (compare table 7). From these data we might

⁹ Coefficient of Variation = $\frac{\sqrt{Var(Cons)}}{Mean(Cons)}$, where *Cons* includes the per household consumption of the five income groups.

¹⁰ These values have been obtained from the series including LWR and EVS data. Removing the EVS data from the series reduces all except the last value for “Group Total” considerably (0.16, 0.1, 0.48, 0.98). The correlation for the first two “Per Household” values is likewise noticeably lower (0.27, 0.69, 0.9, 0.92).

Correlation:	Low & Low Middle	Low Middle & Middle	Middle & Upper Middle	Upper Middle & Upper
Per Household	0.69	0.93	0.92	0.96
Group Total	0.30	0.26	0.70	0.97

Table 6: Correlation between consumption series of adjacent income groups

expect this group to show the most different behaviour from all other groups.

Correlation:	Low & Low Middle	Low Middle & Middle	Middle & Upper Middle	Upper Middle & Upper
Per Household	0.71	0.92	0.83	0.94
Group Total	0.64	0.43	0.35	0.97

Table 7: Correlation between consumption series of adjacent income groups for the interpolated data

As compared to consumption data per income category, income data are much more closely linked (see table 8). For all income groups real incomes per household decrease steadily from 2005 to 2012, reaching values between 10 and 11% below the starting point of the series, which basically tracks the behaviour of the CPI.¹¹

Correlation:	Low & Low Middle	Low Middle & Middle	Middle & Upper Middle	Upper Middle & Upper
Per HH Annual	0.98	0.99	1	0.98
Per HH Quarterly	0.99	0.99	0.99	0.98

Table 8: Correlation between income series of adjacent income groups (per household)

When we want to consider the effect of the financial crisis on consumption behaviour (or distribution), it appears sensible to include variables that are commonly assumed to influence demand, like income and prices and possibly some variable that describes the impact of the financial crisis.

Prices are indirectly included by employing “real” variables: consumption and income are divided by the CPI. One further variable that influences demand behaviour over time in many models is the interest rate.

The interest rate could also partly be seen be a proxy variable for “occurrence of financial crisis”. The nominal interest rate drops uncommonly fast after 2008.

As the deviation of the actual real interest rate from its equilibrium value in the absence of shocks is a vital influence on demand in DSGE-models, we construct a variable that approximates this real interest rate gap.¹²

¹¹ A decrease in average real income is not surprising as income categories are - unfortunately - given in nominal terms. In nominal terms incomes in 2012 are around the same level or slightly below 2005 values for the low and the middle income group, while the upper middle incomes increased by about 2% and low middle and high incomes by about 1% in comparison to 2005 values

¹² The equilibrium real interest rate is extremely difficult to measure and since no published data for the required period have been sighted, we approximate it in a relatively ad hoc fashion. The actual real interest rate is simply the nominal interest rate minus inflation. The real interest rate is the mean over five years of these data. One year ahead and four years past the considered time. This way, we can include a forward-looking element, but do not place too much weight on expectations. The length of the period is taken to allow for abrupt changes to have an impact, but not too quickly, thereby on the one

Our hypothesis is that the low interest rate contributes to a relatively stronger increase in consumption in the higher income range, because low income earners might not be willing or able to borrow.

3.3 The Model

From graphical inspection, we observe an upward trend in all quarterly group consumption series. The unit root tests are not decisive. Simple Regressions of the individual series including a trend, an AR-term or a first difference (as the dependent variable) graphically and from a White-test (for which our sample of eight years of quarterly values is probably too small) seem to come with homoscedastic residuals.

To make use of the correlation of the consumption series, we construct a panel to analyse a model of the type

$$\log(C_{i,t}) = \rho \cdot \log(C_{i,t-1}) + \beta \cdot r_{gap_t} (+\alpha + \gamma \cdot x_{(i),t(-2,-3,-4)}) \quad (1)$$

where $x_{(i),t(-2,-3,-4)}$ might include a constant, average group income $_i$, seasonal dummies, income group dummies and interactive dummies of the income group and the interest rate gap as well as further lags of consumption. The index i denotes the income group. Consumption and income are taken in log-form not only because it is a convenient convention to obtain elasticities, but also because a lognormal distribution is a common assumption for the income distribution (Singh and Maddala (1976)), which makes it a likely candidate for consumption distribution as well.

When ρ equals one, i.e. there is a unit root in the data and we have the first difference of log-consumption on the left of equation (1). We usually obtain values above 0.9 for the ordinary AR-process. However, the R^2 values were usually quite high. We discuss results of both the unit-root and the VAR random effects panel analysis results here as it appears difficult to decide for one or the other.

3.3.1 UR-process

A first regression without seasonal dummies presents a very low R^2 and a coefficient on the interest rate gap which appears highly significant (in a not very significant regression) and is of the wrong sign.

Introduction of the dummy variables removes the significance from the interest rate, but it is now of the correct sign. Stracca (2010) claims that New Keynesian IS regressions have difficulties

hand allowing for the theoretical possibility of the equilibrium rate to change quickly, while on the other hand following the customary method of approximating the equilibrium real rate by a trend. Some other potential variables have been constructed and seem to reflect similar behaviour to our choice. Compare figure ?? in the appendix.

$\log(C_{i,t})$ $-\log(C_{i,t-1})$	r_{gap_t}	Seas. dummies (2,3,4)	adj. R^2
1	4.79 (<0.001)		0.0042945
1	-0.26947 (0.34)	43.27689, -15.83652, 3.79811 (< 0.001)	0.58479

Table 9: Unit root baseline regression (p-values in brackets)

introducing the correct sign without additional asset price inclusion.

When introducing interactive dummies of income group and real interest rate gap, these become negative with a positive real interest rate gap coefficient, however. Neither the interest rate nor the interactive dummies are significant at the 10% level. The adjusted R-squared rises above 0.7 for all tested specifications involving interactive income category dummy variables or average income levels.

The model specifications with interactive dummies added leads to the conclusion that the upper middle income group requires the real interest gap to reach 2.5 percent for its impact to turn negative, the other groups requiring interest rate gaps of at least 5% with 21% for the low middle income group.

Overall, the results from the unit root regression are so far supportive of the fact, that adding interactive income-interest rate dummies improves the model fit. The resulting parameters are not always in line with the expected values and not significant individually.

The results from the VAR-analysis are closer to what we expected.

3.3.2 VAR-regression

The baseline VAR-specification result is similar to the baseline UR-specification. We present only the regression including seasonal dummies here (10). While quantitatively different, the result is qualitatively similar, i.e. the coefficients are of the same sign and similar relative sizes.

$\log(C_{i,t})$	$\log(C_{i,t-1})$	r_{gap_t}	Seas. dummies (2,3,4) (2,3,4)	adjusted R^2
1	0.9871258 (<0.001)	-0.0366723 (0.3992)	10.4724899, -18.4166970, 9.2642084 (<0.001)	0.9546

Table 10: VAR regression (p-values in brackets)

Introducing interactive dummies across incomes causes the real interest rate gap coefficient to approach zero from below while only the interactive coefficient for upper middle income is negative.

Introducing the log of income as an interactive variable with the real interest rate gap instead of interactive income category dummies, the real interest gap coefficient becomes significant at the 5% level as well as the interactive variable. The coefficient on the gap is -0.19 while the coefficient on interest rate gap times log of category income is positive but small at 0.002.

A regression involving four lags of log consumption and the real interest rate gap as independent variables comes with an R^2 of 0.91411 and a negative (but not significant) coefficient on the interest rate gap of -0.047. The first lag is positive, the second negative and the last two positive with decreasing values, all below one (and summing to below one).

Overall, there is some indication that the responsiveness of consumption to the interest rate gap changes across income levels. While a somewhat indifferent coefficient for very low income groups might be justified by the inability to obtain credit (or save) at any interest rate, the highest income groups is possibly already at some satiation level of consumption already and as such might react differently from our expectations. Another possible explanation is that this group was hit most severely by the losses on financial markets and as hence the negative impact from the wealth channel outweighs the positive impact from lower interest rates.

4 Conclusion

Graphically we find some indication of increasing consumption inequality after 2009. From the GINI-coefficient, we can only deduct a small but relatively constant increase over time that is confirmed by the coefficient of variation. An increase after 2009 is not visible here.

From a panel data analysis we can glean that consumption growth is faster for higher income groups when we introduce dummies, but due to data limitations, it is difficult to detect a structural break here. The interest rate effects per income category require some further research. Some analyses point to the strongest negative impact of the interest rate gap on the consumption of the second highest income group. Having a small but positive interactive term for the highest income group appears surprising at first but might be due to financial losses in the wake of the crisis, which reduce consumption and outweigh the possible positive effect of low interest rates. For very low incomes insignificant coefficients on the interactive dummy are not surprising as these are likely to be credit (and saving) constrained.

One weakness of this analysis is the coarseness of the real interest rate gap measure, which is difficult to fully avoid, since the true equilibrium real interest rate is impossible to measure (Kiley (2015)). Some additional regressions with different variables should be run here.

A second aspect that will be tackled in the near future is the addition of a variable representing

the savings rate per income group, that might at least approximate the involvement in financial markets.

Appendix

Potential measures of the real interest rate gap

RealIntDiff1	the employed variable $r_{gap} = r_t - \bar{r}_t$ with $r_t = i_t - \pi_t$, \bar{r}_t is a five year moving average, starting at $t - 1$
RealIntDiff2	very similar concept, $r_t = i_t - \pi_{t-1}$
RealGrowthDiff1	GDP-growth
RealGrowthDiff2	Net National income growth, deviation from five year average

References

- Atkinson, A. B. and Morelli, S. (2014) Chartbook of economic inequality, Working Paper 324, ECINEQ Society for the Study of Economic Inequality.
- Breuer, C. C. and Mehrhoff, J. (2009) Inflationsmessung nach Einkommensgruppen - Wer ist wie stark betroffen?, *Statistisches Bundesamt. Wirtschaft und Statistik*, **10**.
- Fuchs-Schündeln, N., Krueger, D. and Sommer, M. (2010) Inequality trends for Germany in the last two decades: A tale of two countries, *Review of Economic Dynamics*, **13**, 103 – 132, special issue: Cross-Sectional Facts for Macroeconomists.
- Gerstberger, C. and Yaneva, D. (2013) Household consumption expenditure - national accounts. Analysis of EU-27 household final consumption expenditure - Baltic countries and Greece still suffering most from the economic and financial crisis, *Statistics in focus*.
- Grabka, M. M. (2015) Income and Wealth Inequality after the Financial Crisis: The Case of Germany., *Empirica*, **42**, 371 – 390.
- Grabka, M. M. and Frick, R. (2012) *The Great Recession and the Distribution of Household Income*, Oxford, chap. Country case study- Germany, pp. 90–112.
- Hoffmann, F. and Lemieux, T. (2016) Unemployment in the Great Recession: A Comparison of Germany, Canada, and the United States, *Journal of Labor Economics*, **34**, S95–S139.
- Kiley, M. T. (2015) What Can the Data Tell US About the Equilibrium Real Interest Rate?, Finance and economics discussion paper, Board of Governors of the Federal Reserve System.
- Singh, S. K. and Maddala, G. S. (1976) A Function for Size Distribution of Incomes, *Econometrica*, **44**, 963–970.
- Stracca, L. (2010) Is the New Keynesian IS Curve Structural?, Working Paper 1236, ECB.