Household Deleveraging: Evidence from the Consumer Expenditure Survey

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PRELIMINARY AND INCOMPLETE*

Abstract

In the present work I provide evidence in support of household deleveraging using micro data from the Consumer Expenditure Survey for the years 2007-2010. I define deleveraging as a contemporaneous reduction in consumption and debt, paired with an increase in savings and savings rates.

First, I show that the joint dynamics of average consumption expenditures, savings and changes in outstanding balances in my data is supportive of this notion of deleveraging. Moreover sorting households by the debt-to-income ratio with which they enter the survey reveals that cuts in consumption and debt are concentrated among (highly) levered households.

Next, I investigate the interactions between leverage and consumption more directly, in two steps. First, I regress consumption levels on the debt-to-income ratio with which the households enter the survey and find that for 2009 a one standard deviation increase in leverage is associated with a decline in total yearly expenditures of about 1170 dollars, 500 dollars for nondurables. Second I regress log growth rates on the same measure of leverage and find that for 2008 and 2010 higher leverage is associated with lower growth in nondurable consumption, even after controlling for contemporaneous changes in house prices and net-worth.

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1 Introduction

The Great Recession has put American households and their finances under the spotlight as they cut consumption and worked out their debts. In the present work I study and document these patterns in the micro data using individual household records from the Consumer Expenditure Survey for the years 2007-2010.

I define deleveraging as a contemporaneous reduction in consumption and debt, paired with an increase in savings and savings rates. To document deleveraging I first reconstruct households' budget constraints using information on households' income, expenditures, assets, and liabilities. This allows me to derive measures of annual savings and annual debt accumulation, i.e. the change in debt stocks over a year. The joint dynamics of average (and median) consumption expenditures, savings, and debt accumulation supports the idea that household have been deleveraging over the Great Recession.

To better gauge the role of leverage on households' consumption/savings decisions I also compute conditional means (and medians) of consumption, savings, and debt accumulation sorting households by the debt-to-income ratio with which they enter the survey. When I do this, I observe that the deleveraging effort is concentrated among (high) leverage households: people entering the survey with zero leverage do not reduce consumption, nor do they increase their savings substantially.

I scrutinize the interaction between leverage and consumption further in the context of a regression analysis. Regressing consumption levels on the debt-to-income ratio with which households enter the survey, I find that, other things equal, in 2009 a one standard deviation increase in this measure of leverage is associated with a decrease of about 1170 dollars in total consumption expenditures, and of about 500 dollars in nondurable expenditures. Next I show that in 2008 and 2010 the same debt-to-income ratio has predictive power for a household's log growth rate of nondurable consumption between the first and the last interview. Households entering the survey with higher leverage have lower consumption growth between their first and last interview.

The importance of household deleveraging as a source of prolonged economic contractions and liquidity traps has been highlighted by Eggertsson and Krugman (2011) and by Guerrieri and Lorenzoni (2011). Empirical work on household deleveraging is however scarce with the exception of Mian, Rao and Sufi (2011) and Dynan (2012). The present work is a first step towards filling this gap.

The paper is structured as follows. Section 2 focuses on the descriptive evidence and together with providing the results, it describes the framework and the data. Section 3 contains the regression analysis. In section 4 I conclude summarizing the results and discussing what methodolgical issues remain open and how I intend to address them.

2 Descriptive Evidence

The following analysis focuses on the dynamics of household consumption, total savings and debt over the Great Recession. In particular I want to explore how much of the dynamics of savings is due to the

dynamics of debt. In other words I am after household deleveraging. The aim is to provide descriptive evidence and to set the stage for the regression analysis.

To this end I turn to micro data, namely a subsample of households from the Consumer Expenditure Survey (CEX), and collect information on consumption, saving and debt at the individual household level.

2.1 Framework

The organizing framework is easily summarized by the following cash-flow equation

$$c_t + rb_{t-1} = y_t - s_t \tag{CF}$$

where c_t denotes consumption, b_{t-1} denotes the stock of debt carried over from the previous period, r is the interest charged on such debt, y_t is disposable income (including interest income), while s_t denotes savings. Moreover I can decompose saving as follows

$$s_t = (w_t - w_{t-1}) - (b_t - b_{t-1}) \tag{SD}$$

This effectively turns the cash flow constraint into the usual budget constraint of a standard household problem where the agent, endowed with y_t, chooses consumption, debt, and "wealth" holdings, w_t. Whether or not the budget constraint interpretation is warranted depends on how I define wealth. If w_t is just cash on hand then the interpretation stands. Conversely, were I to include the entire wealth portfolio of the household, then I should interpret $w_t - w_{t-1}$ as the change in wealth excluding unrealized capital gains and losses.

I now turn to the micro data and reconstruct the Cash Flow equation (CF) and the savings the composition equation (SD) for each household belonging to a subsample extracted from the CEX (see Data section for details).
Analysis of the cash flow equation (CF) will reveal the joint aggregate and cross sectional patterns of income, consumption, and savings over the recession (it is important to study these three quantities jointly as different household groups may face different income dynamics, or, for the same token, different groups of households may respond in different ways to similar income shocks). Finally, the analysis of the SD equation will highlight the link between the dynamics of savings and the dynamics of debt, completing the picture.

2.2 The Data

The CEX is a household survey that interviews short panels of households on a rotating basis. The tenure is such that for each household one year of data is available. Households are interviewed five times, once every three months. The first interview is a warm up interview, while in the second to fifth interview they report their expenditures and income retrospectively. Each month a group of households enters the survey while another group exits it. The rotation is constructed so that, while a different subsample of people is interviewed every month, on a quarterly basis the sample is representative of

the US population. Households report information on consumption expenditures, mortgages, vehicle loans, vehicles and real estate properties in every interview with reference to the three months prior to the interview. This provides me with a year of data at monthly or quarterly frequency depending on the item. Information on unsecured debt is retrieved in the second and fifth interview with reference to the beginning of the interview month. Information on income taxes and contribution to pensions and social security is gathered retrospectively in the second and fifth interview with reference to the twelve months prior to the interview. Finally data on financial wealth is collected in the fifth interview only. Here households provide information on their stocks of financial wealth as of the beginning of the interview month, as well as the change in said stocks from the same month one year ago.

Given this data collection scheme, for each household I effectively have one year of data at yearly frequency on contemporaneous income, expenditures, assets, and liabilities. Therefore I can reconstruct only one instance of the CF and SD equations for each household and the reference period is a year. So that for example for a household interviewed in April 2008 I know income, expenditure and debts for the period April 2007- March 2008.

Interviews are staggered over months, and so is the timing of the equations. This creates some difficulties regarding time aggregation, which is necessary given the relative small size of the samples available at the monthly frequency. To this end I follow the time aggregation procedure of Attanasio (1994). For concreteness consider the year 2008. I assign to 2008 all households that had their last interview between July 2008 and June 2009. Effectively one household is assinged to 2008 as long as at least six months of its expenditure and income figures refer to that year. Thinking ahead, in interpreting the data one has to keep in mind, that the year 2008 includes data that span from June 2007 till May 2009, but most of the data refer to income and expenditures that took place in the solar year 2008.

I will now describe how I measure the various components of the cash flow equation in the micro data. For convenience I restate the equation below,

$$c_t + rb_t = y_t - s_t.$$

The time unit t corresponds to a year; y_t includes total income minus total taxes. Payroll contributions to social security are counted in as a tax and subtracted from total income (see Attanasio 1994). c_t includes total expenditure, but excludes debt service (both interest and principal payments) and contributions to retirement plans and life insurance policies. rb_t includes all expenditures for interest payments on household debt, but not outlays that go towards principal repayment. s_t is derived here as a residual measure. Notice that under this scheme rental payments are included in consumption, while the expenditure on mortgage payments is split between interest payments and savings.

The information on principal payments and on changes in outstanding balances allows me to decompose savings further, into changes in debt $(b_t - b_{t-1})$ and a residual measure of active wealth accumulation $(w_t - w_{t-1})$. While the CEX contains information regarding this last item (namely changes in financial wealth, contributions to retirement plans, and information on the disposition of real estate properties) its quality is dubious. So for the moment I prefer to treat wealth accumulation

as a residual.

All variables are expressed in January 2012 dollars. I deflate the various components of consumption expenditure using the detailed price indexes provided by the BLS.[1] All income and tax entries are deflated using a twelve month moving average of the all-items monthly CPI, based on the month and year in which the interview took place. All debt and wealth stocks are deflated using the all-items monthly CPI of the month prior to the interview in which household were asked about said stocks. Finally I use nominal values to construct the changes in debt balances ($b_t - b_{t-1}$), and deflate them only afterwards with the same moving average of the all-items monthly CPI used for income. This is done to measure the flow of money appropriately and not attribute additional debt reduction to inflation.

In addition to the variables featuring in the CF and SD equations I recover standard demographic information,[2] and I construct yearly and quarterly measures of expenditure on nondurables, $nondu$, services, $serv$, and durables, du. These quarterly expenditure measures allow me to construct log growth rates for each household, measured as differences in the logarith of the relevant expediture between the first and last interview. The yearly totals for c, $nondu$, $serv$, du and the corresponding mean quarterly log growth rates, $dl2\_n$ $dl2\_s$, $dl2\_du$, are the dependent variables in the regression analysis.

Last but not least I reconstruct portfolio variables which are the key independent variables of the regression analysis. As mentioned before, households are asked about their outstanding balances on mortgage and vehicle loans in each interview. In the second interview they are also asked about their unsecured debt and their income in the previous year. I combine this information into a debt-to-income ratio, $d2i$, by summing the stock of debts and dividing them by income before taxes in the previous year, and multiplying the resulting ratio by 100. This measure allows me to gauge the leverage with which a given household **enters** the survey, so it is a **lagged variable** with respect to the expenditure, income and debt repayment figures that I observe. The whole point of the regression analysis is to asses the dynamic correlation of this measure of leverage with the level of consumption and its predictive power with respect to consumption growth over the period 2007-2010. Along the same lines I construct ratios of financial wealth to income, fw_rat, of total net worth and home equity to income, net_rat and $home\_req$. These variables allow me measure both the size and the composition of household portfolios. The measurement however is somewhat crude given the non pristine quality of the data on financial wealth.

Some final words on sample selection. I am focusing on households interviewed in the last 4 waves of the survey (2007-2010), excluding those who did not complete all four interviews and those with imputed income figures. Moreover, since the survey tracks the residential location and not the people living in it, I exclude households where the age of the reference person changes by more than a year over the course of the interviews, as well as households that experience changes in their housing tenure. The resulting sample contains 8841, or equivalently 35364 household-quarter pairs.

Top-coding of income is an issue for the proper calculation of savings as a residual measure. So

[1] Details upon request.

[2] Age, sex, race, and educational attainment of the household head; family size; household composition; State and MSA of residence when available.

I exclude household with top-coded disposable income records, and the sample shrinks to 8167 and 32668.

Finally for some household the information on the debt-to-income ratio is missing, restricting the sample to 7370 households and 29480 household-quarter pairs. This will be the sample I consider when I look at the descriptive evidence on deleveraging. In the regression analysis I will have to restrict the sample size even further to 4298 households and 17192 as I discard households with missing records on their state of residence and the asset side of their portfolios. The descriptive evidence for this smaller sample is available upon request.[3]

At this point I am not controlling for default behavior of households, as it is not directly available from the CEX interviews, their unemployment or occupational status and I do not use survey weights.

2.3 Results

Figure 1 summarizes the main results on deleveraging for my subsample by plotting the average and median values of the variables in the CF and SD equations, namely $y_t, c_t, rb_t, s_t, (b_t - b_{t-1})$, and the residual wealth measure $(w_t - w_{t-1})$. Averages are in blue and medians are in red.[4]

Over the period we can see a decline of about 2000 dollars (i.e. a 4.9% drop) in average consumption expenditure, paired with a sharp decline in average debt accumulation of about 4000 dollars (i.e. a 130% drop). At the same time average savings go up by about 30% between 2008 and 2009 and stay high in 2010 in the face of an unfavorable income dynamics. Income is flat over 2007-2009 and declines in 2010 by 2000 dollars. It is worth noting that consumption starts falling before income does, and that by 2009 households switch from accumulating debt to rolling over existing debt and move on to actively reduce debts in 2010. Further support for the deleveraging hypothesis comes from the fraction of household in the population that reduce their debts. This goes up from about 46% in 2007-2008 to about 48% in 2009-2010, and form about 66.5% to about 70.5% among households entering the survey with positive amounts of debt.[5] Also the dynamics of interest payments rb_t, which fall by 16% over the period, is consistent with a picture of declining outstanding balances to the extent that debt service payments are proportional to the stock of debt. Finally the residual measure of average wealth accumulation declines over the period suggesting that on average additional savings are predominantly directed towards, or equivalently originate from, debt reduction. This last pattern does not hold for the medians of household with debt suggesting that active debt reductions plays a larger role at the tails of the distribution of savings and debt accumulation $(b_t - b_{t-1})$. If one plots the quantiles of the distribution of $(b_t - b_{t-1})$ against time,[6] one can see that the tails of the distribution shift down, and most notably the upper tail. This suggests that a large fraction of the increase in average savings comes from households not taking up large additional debt, rather than actually paying them down at

[3] In the growth rate regressions I include these households with missing state information back in the sample by replacing the blank state code with a "NA" indicator.

[4] The median for $(b_t - b_{t-1})$ only refers to households that enter the survey with positive amounts of debt: the median for the whole population is effectively zero due to the fairly large proportion of households (about 30%) that enter the survey with no debts and stick to this.

[5] The fraction of households entering the survey with non zero debt is essentially constant at about 70%.in 2007-2009 and drops to 69.21% in 2010.

[6] Results available upon request.

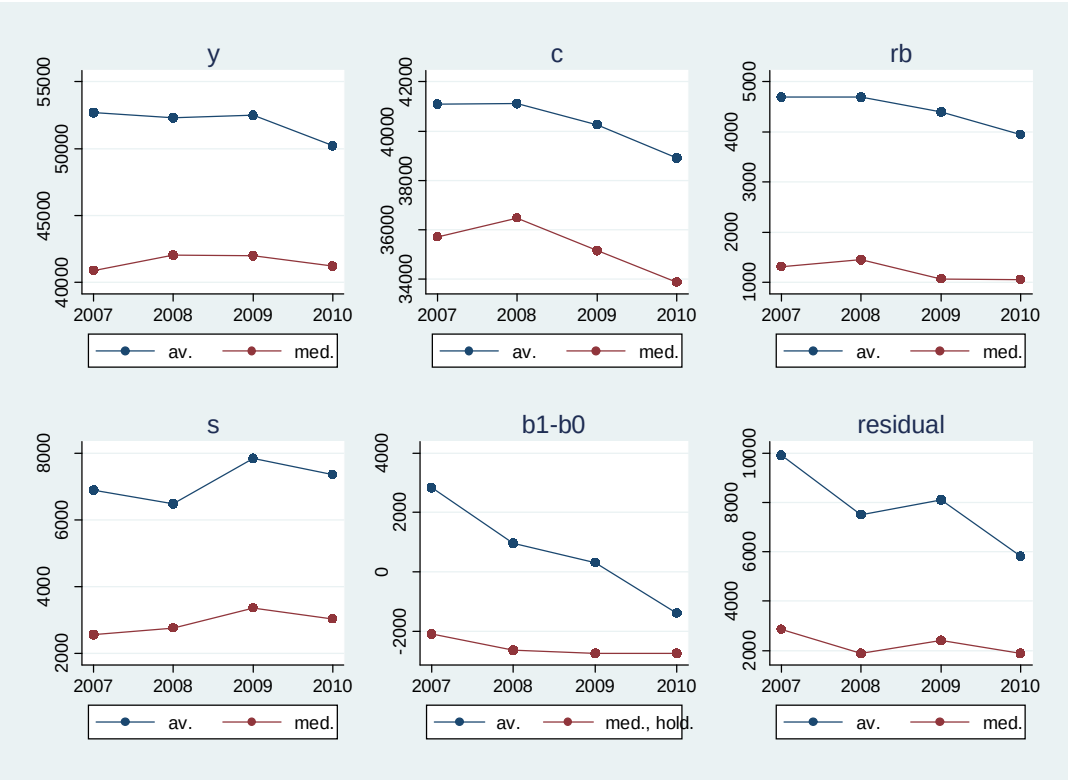

Figure 1: Deleveraging in the Population

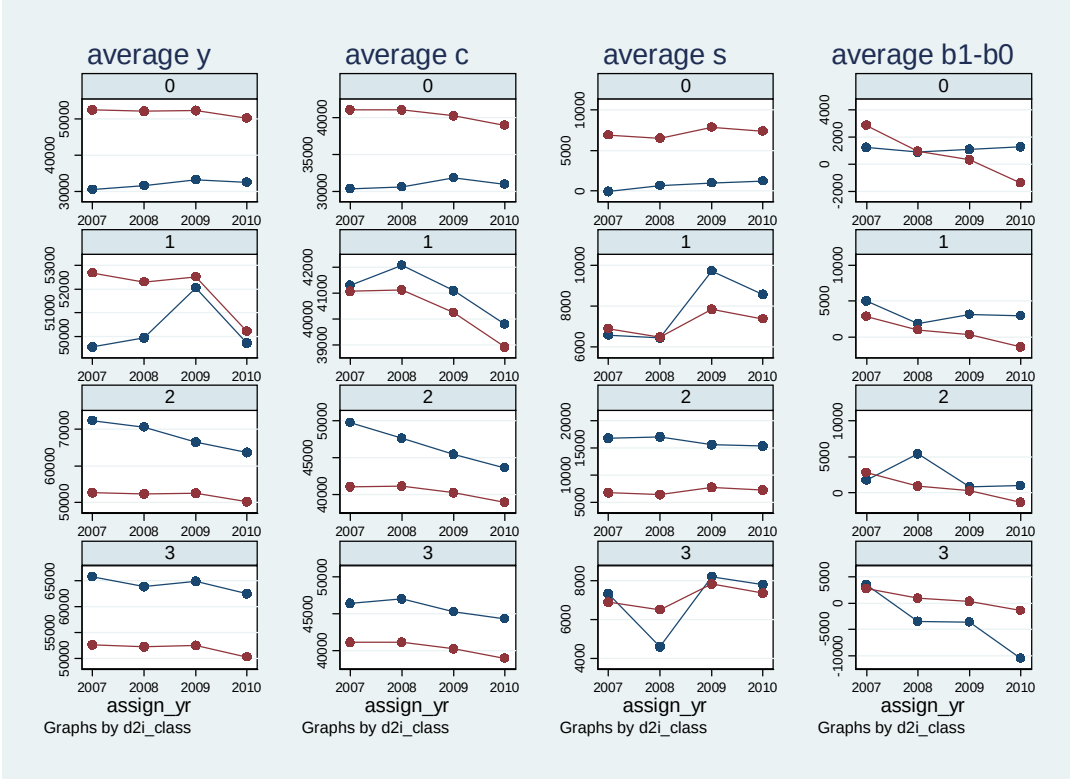

Figure 2: Deleveraging by debt-to-income ratio: Averages

a higher rate.

Conversely, the dynamics of average income, consumption and savings, is confirmed also by the respective median values.

Figure 2 replicates the same exercise for selected variables y_t, c_t, s_t, and $(b_t - b_{t-1})$, this time conditioning on the debt-to-income ratio with which households enter the survey. To this end I group households in bins depending on the value of their debt-to-income ratio $d2i$. I devise four groups $0, 1, 2, 3$. Households in group 0 enter the survey with zero leverage. Households in group 1 have a positive $d2i$ of at most 50%. Group 2 has leverage ranging from 50% to 150%, and group 3 includes households with leverage above 150% . Leverage in the sample never exceeds 2000%. While these groups are based on absolute values, they roughly correspond to meaningful quantiles of the distribution of $d2i$. About one third of the population has zero leverage while the 150% threshold corresponds to the 75th percentile. Finally the rest of the population is roughly equally divided between group 1 and 2.

Figure 2 reports the average values of the conditional means in blue and the unconditional mean in red to ease comparisons across groups. A similar figure reporting conditional and unconditional medians is relegated to the Appendix. The first pattern emerging form Figure 2 refers to the static differences between the various leverage classes. We can see that income and consumption are proportional to leverage for the groups $0, 1,$ and 2 . This monotonicity does not carry over to group 3 which has consumption levels comparable to group 2 but lower income, with the result that groups 3 has a much

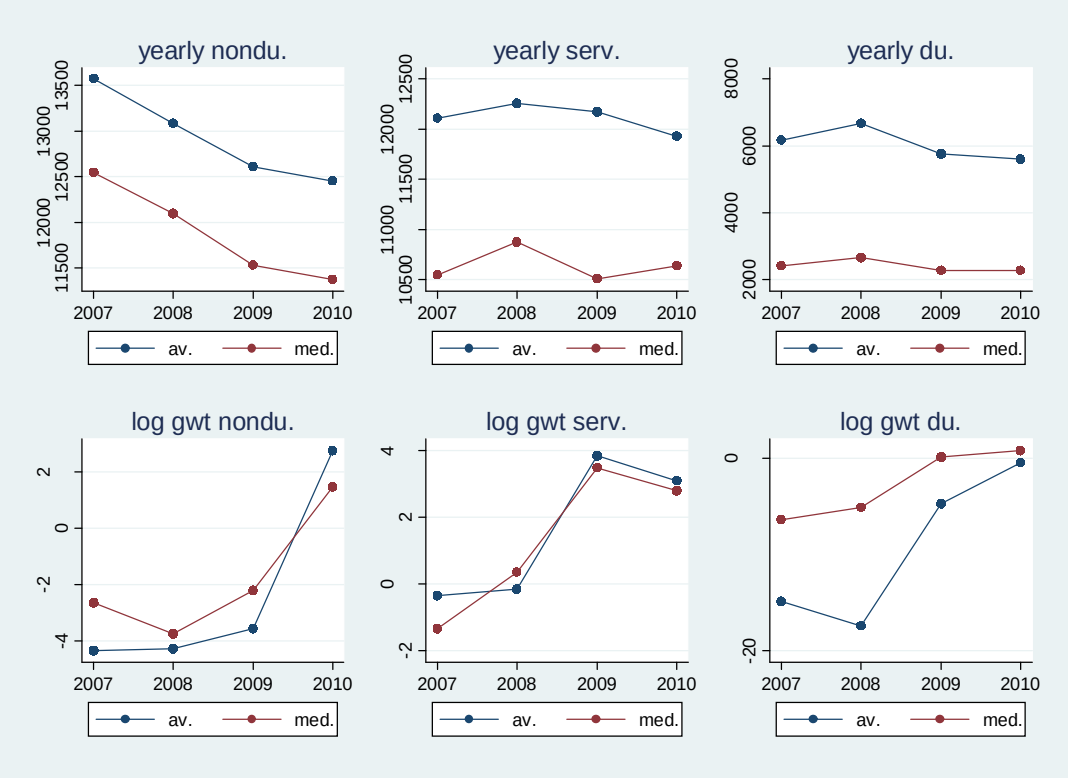

Figure 3: Conusmption by type: levels and mean log growth rates.

lower savings rate on average than group 1 and 2.

As for the dynamics we can see that groups 2 and 3, but group 2 in particular, reduce consumption more sharply than in the aggregate. However part of this can be attributed to a worse income dynamics especially for 2. Only group 3 reduces debt substantially. Conversely group 0 does not reduce its consumption nor its debts. Finally high leverage households face a worse income dynamics. Unfortunately this differentiated patterns for income muddle the picture for the dynamics of savings. Therefore the take away from the picture is that the reduction in consumption is closely related to positive leverage, while active debt reduction is concentrated among high leverage households. These patterns are confirmed for conditional medians.

Figure 3 reports average and median levels of *nondu*, *serv*, *du* and their respective log growth rates. This figure is included to provide some intuition for the regressions as well as to break down the reduction in c_t into its main components.

The picture shows that the bulk of the reduction comes from nondurables and durables. The decline in nondurables is striking for its size and persistence. Nonetheless the decline in expenditures was broad-based as the decline in average service expenditure testifies. The picture for average log growth rates is consistent with the one painted for levels: negative growth rates are concentrated in nondurables and durables, and the ones for durables are twice as large and show higher persistence. One should be cautious however in drawing conclusions from growth rates of durable expenditure based

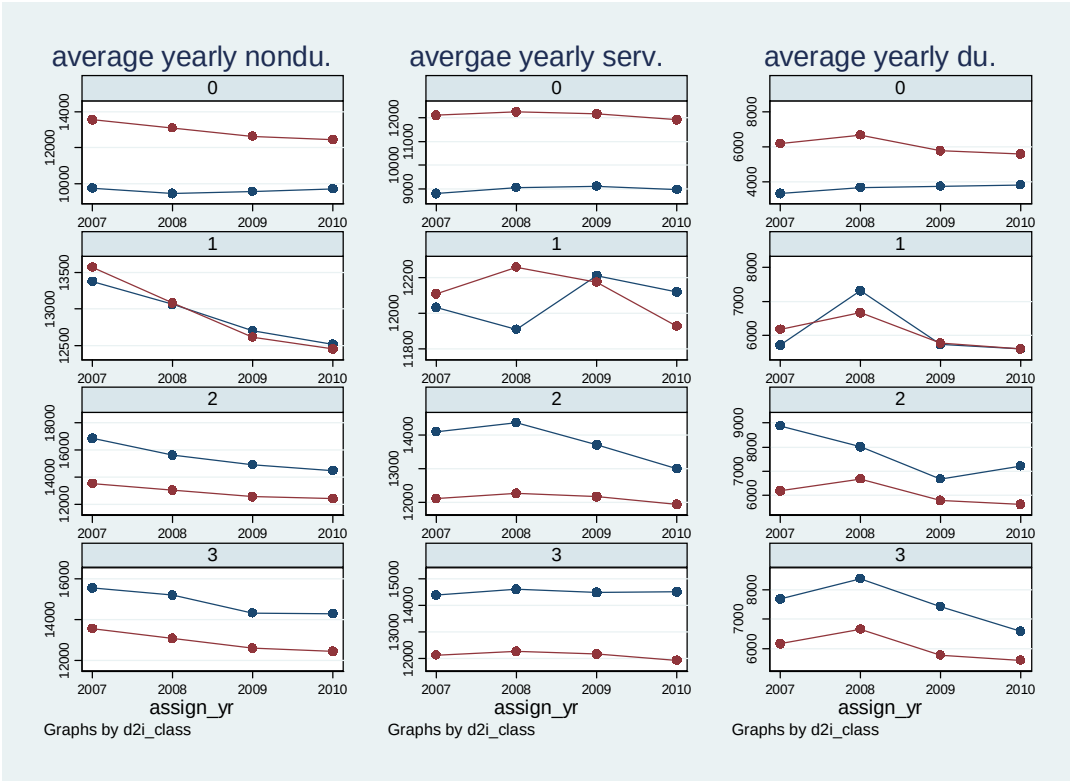

Figure 4: Conusmption by type: average levels by debt-to-income ratio.

only on one year of observation per household, precisely because durable purchases are lumpy in nature.

Figure 4 reports the average levels of *nondu*, *serv*, *du* by leverage, while Figure 5 reports average conditional mean growth rates.[7] Figure 4 shows larger absolute reductions in the levels of nondurable and durable expenditures for high leverage households. The pattern for services is less clear. Similarly Figure 5 shows that high leverage household have systematically lower growth rates for nondurable and services, but not for durables. The same caveat in interpreting log growth rates for durables applies.

To sum up, the descriptive evidence is supporting of deleveraging, defined as a contemporaneous reduction in consumption and debt paired with an increase in savings and savings rates, in my sample as a whole. When I condition on the debt-to-income ratio with which the household enter the survey I observe that the deleveraging effort is concentrated among (high) leverage households: People entering the survey with zero leverage do not reduce consumption, nor do they increase their savings substantially. Finally the reduction of nondurable expenditure is at the core of the reduction in total consumption.

[7] Median values are availabe upon request.

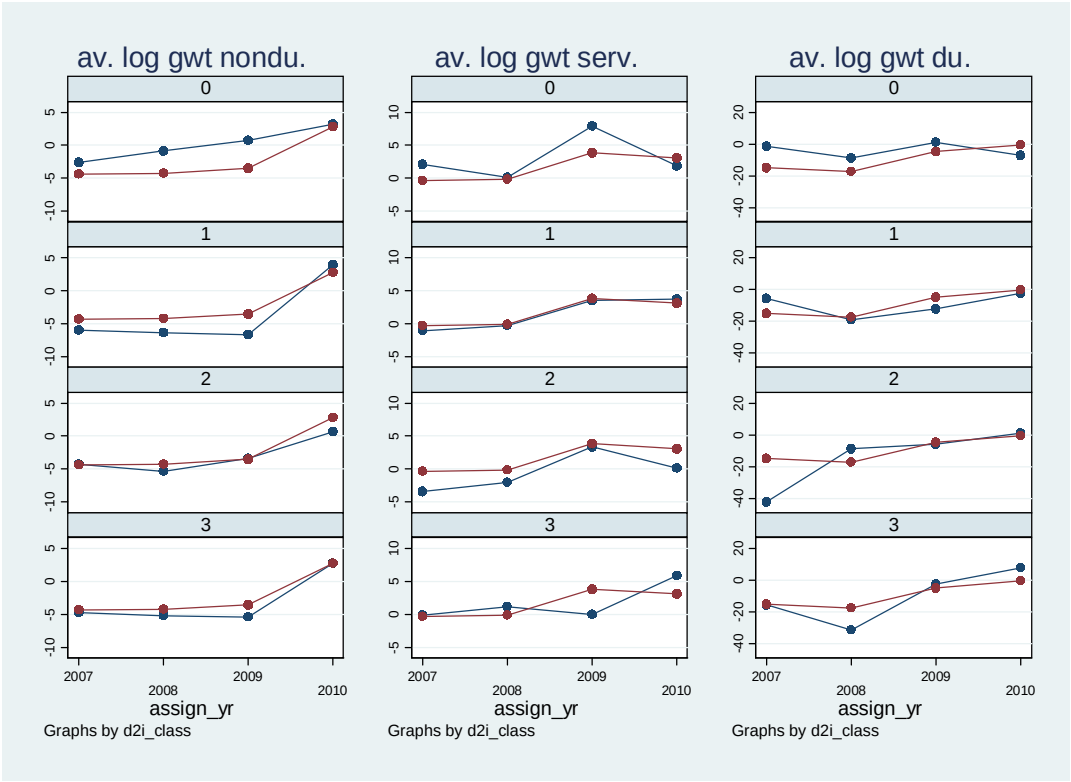

Figure 5: Conusmption by type: average log growth rates by debt-to-income ratio

3 Regression Analysis

One key take-away from the descriptive analysis is that cuts to consumption are concentrated into high leverage households. At the same time high leverage households enjoy high levels of income and consumption. This suggest that portfolio composition and not just portfolio size, as measured by total net worth, is informative with respect to households' consumption/saving decisions over the Great Recession. For this reason the following regression analysis has two objectives. On the one hand to provide a first step towards an investigation of this statement, that is that portfolio composition matters. On the other hand to verify the association between high leverage and the reduction in consumption that emerged from the one dimensional sorts of the previous section.
I first consider consumption levels and then I move on to the log difference of expenditures between the second and fifth interview. In what follows I will refer to theses log differences as log growth rates

The empirical specification for the analysis of consumption levels is as follows,

$$\begin{aligned} \exp_{it}^{c} &= \alpha_c + f(age_{it}^{c}) + \gamma' \mathbf{z}_{it}^{c} + \sum_{s \in T} \mathbf{1}(s=t)\{\delta_s + \beta_{0s} edu_{is}^{c} \\ &+ \beta_{1s} d2i_{is}^{c} + \beta_{2s} \left(d2i_{is}^{c}\right)^2 + \beta_{3s} fw\_rat_{is}^{c} + \beta_{4s} \left(fw\_rat_{is}^{c}\right)^2 \\ &+ \beta_{5s} \hom e\_req_{is}^{c} + \beta_{6s} \left(\hom e\_req_{is}^{c}\right)^2 \} + u_{it}^{c} \end{aligned} \tag{1}$$

where $\exp_{it}^{c}$ denotes the expenditure in year t of household i belonging to cohort c. I consider four different types of expenditure; total consumption, nondurables, services, and durables. The data I am using is a repeated cross section. Therefore I follow the literature and construct synthetic cohorts based on the decade of birth. The first part of the equation is just a standard age profile $\alpha_c + f(age_{it}^{c})$ augmented with demographic and state of residence information collected in the vector $\mathbf{z}_{it}^{c}$. The second part of the equation includes a year dummy δ_s together with the interactions of this year dummy with a dummy for educational attainment edu_{is}^{c},proxying for permanent income, and with the portfolio variables. These are the debt-to-income ratio, $d2i$, the financial wealth to income ratio, fw_rat, and the home equity to income ratio, $\hom e\_req$, which is a proxy for net-worth.[8] The quadratic terms are included to capture non linearities.

The intuition behind this specification is as follows: 1) use age cohort dummies, age profile, demographic and state dummies, to fit the average level of consumption of the various members of a cohort across years; 2) use time dummies, education dummies, portfolio compositions, total net worth, and their interactions to capture the dynamics of the level of consumption (within a group); 3) include leverage and financial wealth measure and not just net worth to show that it is portfolio composition and not just portfolio size that matters for the dynamics. The interpretation of β_{1s}, the coefficient of the debt to income ratio, is as follows (the interpretation for the other portfolio coefficients is analogous). β_{1s} measures the impact of (lagged) leverage on the level of consumption of two otherwise identical households in a given year. Therefore, since I showed in the previous section that highly leveraged

[8] I include this proxie and not total net worth to income, since this latter is highly collinear with fw_rat.

households reduce consumption more than others in the years of the crisis, I expect this coefficient to be negative for the years 2009 and 2010. I also test this implication more directly by looking at the impact of (lagged) leverage on log growth rates, using a similar specification

$$\begin{aligned} dl\_\exp_{it}^c &= \alpha_c + f(age_{it}^c) + \gamma' \mathbf{z}_{it}^c + \sum_{s \in T} \mathbf{1}(s=t)\{\delta_s + \beta_{0s} edu_{is}^c \\ &\quad + \beta_{1s} d2i_{is}^c + \beta_{3s} fw\_rat_{is}^c + \beta_{5s} \hom e\_req_{is}^c + \beta_{6s} \Delta w_{it}^c\} + u_{it}^c. \end{aligned} \tag{2}$$

Observe that equation (2) does **not** follow from equation (1). The intuition is basically the same as the one for equation (1). Use the first part of the equation $\alpha_c + f(age_{it}^c) + \gamma' \mathbf{z}_{it}^c$, to isolate deterministic aspects of log growth rates that relate to age, demographics, (and possibly state of residence), and use the second part to uncover the dynamics within a group. Here I omit the second order terms to reduce standard errors on the the first order coefficients of portfolio variables.

\$\$\$The last term Δw_{it}^c is a shorthand for exogenous changes in wealth that I will control for. Specifically I will control both for log changes in reported prices of the main residence and other real estate, Δprice, as well as percentage changes in net-worth to income, Δnw/y, where net worth refers to the difference between the value of all real estate minus the value of all debt secured against it. \$\$\$

The results for equation (1) are presented in Table 1 and the ones for equation (2) on Tables 2 to 7, all in the Appendix. As evident from Table 1 the coefficients on the main and interactions of $d2i$ all have the expected signs: positive on the mains since high leverage household start with higher level of consumption, and negative for the interactions. The coefficients are also quite large. The ones on the main are significant across all expenditure categories, while among the interactions only the ones for 2009 are significant, and only for total expenditure and nondurables. To have a sense of their economic significance notice that a one standard deviation increase in $d2i$ should decrease total consumption expenditure in 2009 by about 1500 dollars (by 1170 dollars considering second order terms).[9] As for the other portfolio variables in general only the main effects are significant and have the expected positive sings as high net worth household consume more. Most interactions however are not significant. Interestingly many of these interactions have a negative sign, as they probably capture negative wealth effects for stock-holders and home-owners.

Moving on to growth rates the picture is quite similar for nondurables where the coefficients for $d2i$ have the expected sign. Not so for services and durable goods. I will now turn todescribe the results on Table 2 in some detail.

Table 2 reports the estimates of equation (2) having the log growth rate of nondurables between the second and the fifth interview as the dependent variable. Column 1 considers a version of equation (2) where $d2i$ is the only portfolio variable included. Column 2 includes all portfolio variables, while in

[9] Assuming joint significance of the main and the interaction we have

$$(15.51 - 23.06) * 197.9254 = -1494.34,$$

considering also the second order terms we have

$$(15.51 - 23.06) * 197.9254 + (0.0271 - 0.0188) * 197.9254^2 = -1169.19.$$

addition in column 3 and 4 I control for changes in reported house prices and changes net worth to income, respectively. I exclude all households that report changes in expenditure, prices and net worth that are below the 1% and above the 99% of their respective distributions. The results in Column 2 are consistent with those reported in Table 1 for the levels of nondurables. The signs on the main are positive while the interactions are all negative, and significant at the 5% level for 2008 and 2010. Comparing columns 1 and 2 we can see that the effect of leverage is robust to the inclusion the other portfolio variables, which in turn do not seem to matter much as in the case of levels. *These results support the notion that ceteris paribus more levered households cut consumption more during the crisis (2008 and 2009) and increased it less in the aftermath (2010).* Column 4 adds the log change in reported values of the home and other real estate. We can see that the coefficients on all portfolio variables hardly change. The coefficients on the log change of reported house prices are relatively high but not precisely estimated, especially at the main. The message however is clear even when exposed to a similar shock to value of real estate highly levered household respond by cutting consumption more or by increasing it less. One can get some intuition for these results (especially for the interaction with the year 2008) by looking at the summary statistics reported in Table 8. In Panel A) I show that my debt to income measure is way higher for households that hold a mortgage, and relatively low for renters and homeowners without a mortgage. Panel B) shows that the median shock to real estate values as reported by the household themselves is fairly homogeneous. *Simple accounting suggests that this homogenous price shock translates into a differentiated shock to net-worth depending on whether or not the household holds a mortgage*. As we can see in Panel C) households with a mortgage suffer much larger median losses to their net-worth. We should be surprised then to observe weaker consumption growth by household the suffer large adverse wealth losses. *This accounting argument suggests that while debt plays a role the dynamics of consumption over the crisis, these do not depart much from a standard permanent income framework. To address this more directly in Column 4 of Table 2 I control for the change in net worth. Estimates do not change much from those of column 3 suggesting that a simple wealth effect may not be the entire story.*

One possible source of concern is that the results may be muddled by the inclusion of renters in the sample. Going back to Table 8 we can see that the changes in prices and net worth are effectively normalized to zero due to the fact that renters by definition do not own their main residence and only a minority of them holds other real estate. To address this in Table 3 I report the same estimates of table 2 having restricted the sample to homeowners only. Results for Columns 1 to 3 are comparable except for the fact that the value of the coefficient of the interaction between $d2i$ and 2008 drops quite a bit (by about 20%). The accounting argument seems to have more bite here as we can see that the same interaction is no longer significant once I control for changes in net worth. Nonetheless the coefficients of the interaction between $d2i$ and 2010 are still negative, significant and essentially unchanged. Once more, while not conclusive, these results hint at forces that go beyond a standard wealth effect.

Tables 4 and 5 repeat the same exercise for services while the Tables 6 and 7 focus on durables. Here as for the case of levels leverage does not seem to play a role.[10]

In closing it would be tempting, given the predetermined nature of my portfolio variables to give

[10] Only in the case of durables I can document a significant effect of leverage: the interaction of $d2i$ and 2009 is significant across all specification. However it comes with an unexpected positve sign and I do not have a good explanation for this.

a causal interpretation to the estimates, but I refrain from doing so, because of some obvious caveats. Namely the possible endogeneity of my leverage measure, as well as the effects of omitted variables. I discuss these in turn in the next section, along with measurement error issues.

4 Concluding remarks

In the present work I reconstructed households budget constraints using data from the CEX for the years 2007-2010, and showed that the joint dynamics of average (and median) consumption expenditures, savings, and debt accumulation supports the notion of household deleveraging. Deleveraging is defined as a contemporaneous reduction in consumption and debt, paired with an increase in savings and savings rates.

Next I regress consumption levels and consumption growth rates on the debt-to-income ratio with which households enter the survey to investigate the relationship between leverage and consumption in greater detail. I find that, other things equal, for the years 2008 and 2009 higher initial leverage is associated with lower consumption levels and lower consumption growth. While the results on consumption levels are robust, at this point the ones on consumption growth are more tentative.

To the best of my knowledge this is the first work addressing household deleveraging empirically, other than Mian, Rao and Sufi (2011) and Dynan (2012), and the first one to use individual household records from the CEX.

At this point the work is preliminary and there are some open issues that I plan to address in the near future. I discuss them in turn.

First, as I mentioned in the data section, at the present time I am not controlling for the default behavior of households, their unemployment or occupational status, and I am not using survey weights. Unfortunately default information is not reported directly into the CEX. I am currently inquiring with the BLS if it is possible to address this issue through stricter sample section criteria that ensure that the household is not defaulting on its debts at least during its tenure in the sample. As for survey weights I plan to adjust them so as to take my sample selection criteria into account. Finally as for unemployment and occupational status, these are available in individual household member records, which I will soon explore.

Another issue is the extent of measurement error in the data. While the quality of liability data is good (see Johnson and Li (2009)), there is recent evidence that expenditure records in the CEX are subject to severe measurement error. Fortunately some techniques have been developed and I am planning to proceed along these lines.(see Attanasio et a. (2012)).

Third it is unwarranted at this point to draw a causal inference from my regression results. For starters, I cannot exclude that selection biases the estimates of the leverage coefficients. This is because the leverage position of a household is a choice variable. What mitigates this concern, however, is the fact that leverage is predetermined with respect to expenditure outcomes. Recall that $d2i$ is the debt-to-income ration with which households enter the survey. What is more worrisome is presence of some omitted variable, some shock, that affects high leverage households disproportionately and that is relevant for a household's consumption/saving decision. The main shocks I am concerned about are

permanent income shocks and credit shocks I am planning to address these issues from three sides. First, to better control for permanent income shocks, I intend to exploit variation in age in combination with information about industry of occupation and type of pension plan. Second I am planning to exploit the geographic dimension of the data to possibly control for credit shocks. Notice that the inclusion of state dummies is a step in this direction. Finally, I will construct a model of household consumption saving decisions, allowing for heterogenous borrowing constraints. This will allow me to impose more structure on the empirical analysis, especially when it comes to consumption growth rates.

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5 Appendix

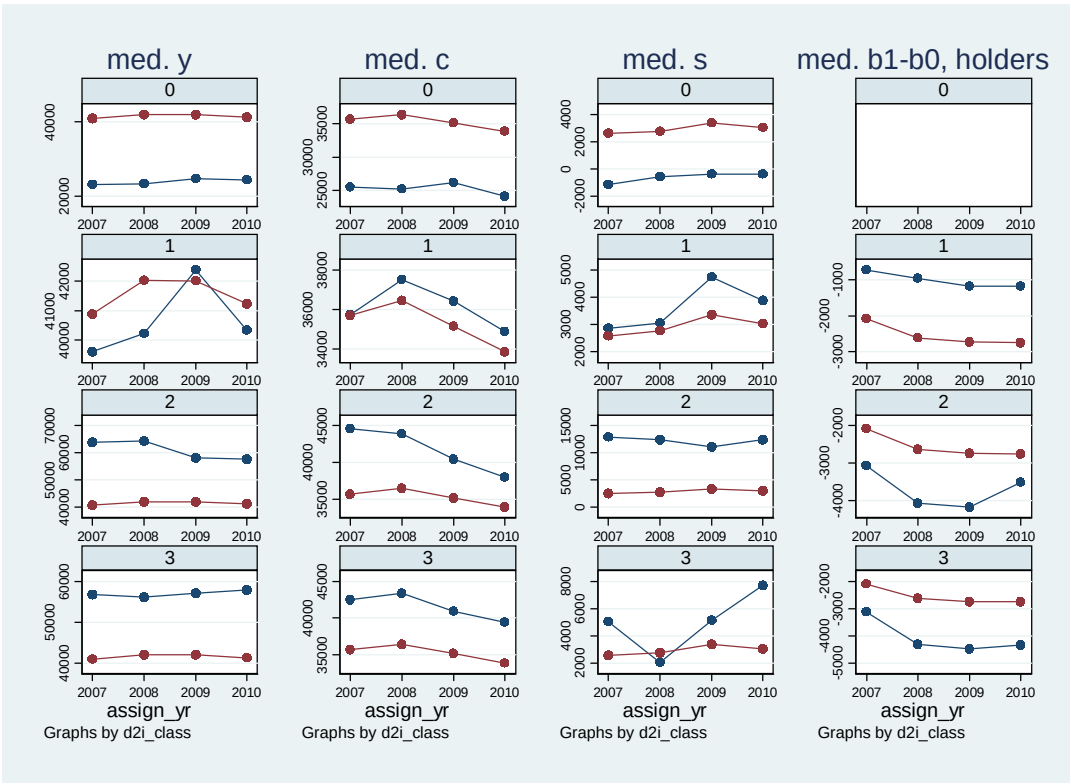

Figure 6: Deleveraging by debt-to-income ratio: Medians

	(1)		(2)		(3)		(4)	
	c		*nondu*		*serv*		*du*	
d2i	15.51**	(7.295)	5.074**	(2.136)	10.97***	(2.360)	7.649**	(3.503)
d2i : 2008	-8.145	(9.223)	-2.115	(2.701)	-1.933	(2.984)	-2.898	(4.428)
d2i : 2009	-23.06**	(9.163)	-7.619***	(2.683)	-4.779	(2.965)	-5.404	(4.400)
d2i : 2010	-8.018	(10.27)	-1.838	(3.007)	-0.405	(3.323)	-4.996	(4.931)
d2i2	-0.0188**	(0.00794)	-0.00708***	(0.00233)	-0.00860***	(0.00257)	-0.00789**	(0.00381)
d2i2 : 2008	0.00841	(0.00957)	0.00453	(0.00280)	0.00185	(0.00310)	0.00169	(0.00459)
d2i2 : 2009	0.0271***	(0.00913)	0.0101***	(0.00267)	0.00567*	(0.00295)	0.00696	(0.00439)
d2i2 : 2010	0.0119	(0.0111)	0.00370	(0.00325)	0.000583	(0.00359)	0.00554	(0.00533)
fw_rat	17.86***	(3.583)	2.867***	(1.049)	5.509***	(1.159)	1.973	(1.720)
fw_rat : 2008	-2.818	(4.957)	-0.754	(1.451)	-1.391	(1.604)	0.640	(2.380)
fw_rat : 2009	2.187	(4.883)	1.716	(1.430)	1.489	(1.580)	0.480	(2.345)
fw_rat : 2010	-8.792**	(4.455)	-2.122	(1.304)	-2.822*	(1.441)	-1.299	(2.139)
fw_rat2	-0.00264***	(0.000700)	-0.000455**	(0.000205)	-0.000904***	(0.000226)	-0.000343	(0.000336)
fw_rat2 : 2008	0.000253	(0.00108)	0.0000257	(0.000317)	0.000157	(0.000350)	0.0000719	(0.000519)
fw_rat2 : 2009	0.000513	(0.000942)	0.0000301	(0.000276)	-0.0000407	(0.000305)	0.0000576	(0.000452)
fw_rat2 : 2010	0.00197**	(0.000786)	0.000421*	(0.000230)	0.000636**	(0.000254)	0.000352	(0.000377)
home_req	1.949	(2.156)	1.277**	(0.631)	2.871***	(0.697)	0.304	(1.035)
home_req : 2008	4.770	(3.000)	0.784	(0.878)	1.692*	(0.970)	0.966	(1.440)
home_req : 2009	-0.802	(2.897)	-0.621	(0.848)	-1.328	(0.937)	0.707	(1.391)
home_req : 2010	2.459	(3.169)	0.345	(0.928)	-0.0370	(1.025)	0.581	(1.522)
home_req2	-0.000335	(0.000429)	-0.000258**	(0.000126)	-0.000333**	(0.000139)	-0.0000935	(0.000206)
home_req2 : 2008	-0.000854	(0.000690)	-0.000105	(0.000202)	-0.000329	(0.000223)	-0.000225	(0.000331)
home_req2 : 2009	0.000232	(0.000589)	0.000138	(0.000173)	0.000294	(0.000191)	-0.000128	(0.000283)
home_req2 : 2010	-0.000836	(0.000737)	-0.0000861	(0.000216)	-0.000215	(0.000238)	-0.0000501	(0.000354)
demog controls	Y		Y		Y		Y	
state dummies	Y		Y		Y		Y	
N	4298		4298		4298		4298	
R^2	0.386		0.431		0.391		0.124	

Standard errors in parentheses

$^{*}p < 0.1,\ ^{**}p < 0.05,\ ^{***}p < 0.01$

Table 1: Yearly consumption levels on portfolio variables

	(1)		(2)		(3)		(4)	
	dl2_n		dl2_n		dl2_n		dl2_n	
d2i	0.0165**	(0.044)	0.0152*	(0.069)	0.0146*	(0.082)	0.0143*	(0.087)
d2i : 2008	-0.0230**	(0.033)	-0.0248**	(0.024)	-0.0232**	(0.035)	-0.0226**	(0.039)
d2i : 2009	-0.0152@	(0.130)	-0.0147@	(0.148)	-0.0137	(0.180)	-0.0139	(0.172)
d2i : 2010	-0.0237**	(0.035)	-0.0232**	(0.042)	-0.0226**	(0.049)	-0.0235**	(0.040)
fw_rat			-0.00528@	(0.122)	-0.00523@	(0.126)	-0.00554@	(0.105)
fw_rat : 2008			0.00685@	(0.127)	0.00679@	(0.130)	0.00702@	(0.117)
fw_rat : 2009			-0.00316	(0.514)	-0.00365	(0.452)	-0.00277	(0.567)
fw_rat : 2010			0.00694@	(0.108)	0.00689@	(0.110)	0.00722*	(0.094)
home_req			0.000476	(0.861)	0.000260	(0.924)	-0.000164	(0.952)
home_req : 2008			-0.00350	(0.337)	-0.00254	(0.493)	-0.00247	(0.500)
home_req : 2009			0.00325	(0.321)	0.00391	(0.238)	0.00368	(0.262)
home_req : 2010			0.000675	(0.871)	0.000962	(0.818)	0.00112	(0.787)
Δprice					-0.0458	(0.540)		
Δprice : 2008					0.116	(0.206)		
Δprice : 2009					0.151@	(0.119)		
Δprice: 2010					0.0586	(0.565)		
Δnw/y							-0.0510**	(0.007)
Δnw/y : 2008							0.0825**	(0.002)
Δnw/y: 2009							0.0304	(0.219)
Δnw/y: 2010							0.0294	(0.268)
demog controls	Y		Y		Y		Y	
state dummies	Y		Y		Y		Y	
N	4549		4549		4549		4549	
R^2	0.021		0.036		0.037		0.039	

P-values in parenthesis. Sample includes renters

$^{@}p < 0.15$, $^{*}p < 0.1$, $^{**}p < 0.05$

Table 2: log growth rates on portfolio variables: nondurables, whole sample

	(1)		(2)		(3)		(4)	
	dl2_n		dl2_n		dl2_n		dl2_n	
d2i	0.0173**	(0.047)	0.0153*	(0.085)	0.0148*	(0.099)	0.0130@	(0.144)
d2i : 2008	-0.0191*	(0.094)	-0.0191*	(0.097)	-0.0179@	(0.121)	-0.0150	(0.195)
d2i : 2009	-0.0130	(0.222)	-0.0119	(0.265)	-0.0111	(0.301)	-0.00992	(0.356)
d2i : 2010	-0.0280**	(0.019)	-0.0241**	(0.048)	-0.0236*	(0.054)	-0.0238*	(0.052)
fw_rat			-0.00667*	(0.059)	-0.00662*	(0.061)	-0.00690*	(0.050)
fw_rat : 2008			0.00990**	(0.037)	0.00983**	(0.038)	0.00997**	(0.035)
fw_rat : 2009			-0.00182	(0.710)	-0.00240	(0.624)	-0.00148	(0.762)
fw_rat : 2010			0.00919**	(0.035)	0.00914**	(0.036)	0.00948**	(0.029)
home_req			0.00179	(0.525)	0.00165	(0.563)	0.000791	(0.780)
home_req : 2008			-0.00317	(0.397)	-0.00237	(0.533)	-0.00161	(0.669)
home_req : 2009			0.00319	(0.338)	0.00378	(0.261)	0.00392	(0.241)
home_req : 2010			-0.0000913	(0.983)	0.000123	(0.977)	0.000468	(0.913)
Δprice					-0.0335	(0.643)		
Δprice : 2008					0.0984	(0.265)		
Δprice : 2009					0.145@	(0.121)		
Δprice: 2010					0.0467	(0.634)		
Δnw/y							-0.0500**	(0.006)
Δnw/y : 2008							0.0840**	(0.001)
Δnw/y: 2009							0.0303	(0.205)
Δnw/y: 2010							0.0232	(0.367)
demog controls	Y		Y		Y		Y	
state dummies	Y		Y		Y		Y	
N	3008		3008		3008		3008	
R^2	0.029		0.048		0.050		0.053	

P-values in parenthesis. Sample includes home-owners only

$^{@}p < 0.15$, $^{*}p < 0.1$, $^{**}p < 0.05$

Table 3: log growth rates on portfolio variables: nondurables, home-owners only

	(1) dl2_s		(2) dl2_s		(3) dl2_s		(4) dl2_s	
d2i	-0.00452	(0.634)	-0.0000231	(0.998)	0.00142	(0.884)	0.0000563	(0.995)
d2i : 2008	0.00239	(0.848)	-0.00197	(0.876)	-0.00413	(0.745)	-0.00342	(0.788)
d2i : 2009	-0.00364	(0.757)	-0.00883	(0.458)	-0.0103	(0.387)	-0.00887	(0.457)
d2i : 2010	0.00132	(0.920)	-0.00239	(0.857)	-0.00409	(0.760)	-0.00281	(0.833)
fw_rat			-0.00458	(0.248)	-0.00475	(0.232)	-0.00457	(0.249)
fw_rat : 2008			0.00676	(0.194)	0.00693	(0.183)	0.00678	(0.193)
fw_rat : 2009			0.00748	(0.184)	0.00771	(0.171)	0.00749	(0.184)
fw_rat : 2010			0.00299	(0.551)	0.00316	(0.529)	0.00298	(0.552)
home_req			0.000264	(0.933)	0.000976	(0.760)	0.000259	(0.935)
home_req : 2008			0.00150	(0.719)	0.000246	(0.954)	0.000926	(0.825)
home_req : 2009			0.00105	(0.786)	0.000272	(0.945)	0.000985	(0.800)
home_req : 2010			0.00356	(0.461)	0.00274	(0.573)	0.00348	(0.471)
Δprice					$0.124^{@}$	(0.148)		
Δprice : 2008					-0.180^{*}	(0.089)		
Δprice : 2009					-0.141	(0.206)		
Δprice: 2010					-0.150	(0.204)		
Δnw/y							0.00305	(0.889)
Δnw/y : 2008							-0.0403	(0.193)
Δnw/y: 2009							-0.00600	(0.834)
Δnw/y: 2010							-0.00930	(0.763)
demog controls	Y		Y		Y		Y	
state dummies	Y		Y		Y		Y	
N	4541		4541		4541		4541	
R^2	0.018		0.034		0.034		0.034	

P-values in parenthesis. Sample includes renters

$^{@}p < 0.15$, $^{*}p < 0.1$, $^{**}p < 0.05$

Table 4: log growth rates on portfolio variables: services, whole sample

	(1)		(2)		(3)		(4)	
	dl2_s		dl2_s		dl2_s		dl2_s	
d2i	-0.00530	(0.603)	-0.00304	(0.770)	-0.00155	(0.882)	-0.00297	(0.776)
d2i : 2008	-0.000689	(0.959)	0.0000919	(0.995)	-0.00204	(0.880)	-0.00192	(0.887)
d2i : 2009	0.00141	(0.910)	0.000978	(0.938)	-0.000545	(0.966)	0.00104	(0.935)
d2i : 2010	0.00603	(0.665)	0.00819	(0.563)	0.00657	(0.645)	0.00752	(0.599)
fw_rat			-0.00634$^{@}$	(0.125)	-0.00647$^{@}$	(0.117)	-0.00637$^{@}$	(0.123)
fw_rat : 2008			0.00911$^{@}$	(0.102)	0.00924*	(0.097)	0.00918*	(0.099)
fw_rat : 2009			0.00753	(0.188)	0.00769	(0.179)	0.00757	(0.186)
fw_rat : 2010			0.00404	(0.429)	0.00416	(0.416)	0.00408	(0.425)
home_req			-0.0000407	(0.990)	0.000676	(0.839)	-0.0000960	(0.977)
home_req : 2008			0.00117	(0.787)	-0.0000708	(0.987)	0.000404	(0.926)
home_req : 2009			0.00195	(0.623)	0.00121	(0.763)	0.00192	(0.632)
home_req : 2010			0.00436	(0.382)	0.00360	(0.473)	0.00424	(0.398)
Δprice					0.129$^{@}$	(0.123)		
Δprice : 2008					-0.185*	(0.071)		
Δprice : 2009					-0.136	(0.208)		
Δprice: 2010					-0.140	(0.223)		
Δnw/y							0.000342	(0.987)
Δnw/y : 2008							-0.0407	(0.179)
Δnw/y: 2009							-0.00186	(0.947)
Δnw/y: 2010							-0.00947	(0.753)
demog controls	Y		Y		Y		Y	
state dummies	Y		Y		Y		Y	
N	3009		3009		3009		3009	
R^2	0.027		0.048		0.049		0.049	

P-values in parenthesis. Sample includes home-owners only

$^{@}p < 0.15$, $^{*}p < 0.1$, $^{**}p < 0.05$

Table 5: log growth rates on portfolio variables: services, home-owners only

	(1)		(2)		(3)		(4)	
	dl2_du		dl2_du		dl2_du		dl2_du	
d2i	-0.0340	(0.290)	-0.0314	(0.339)	-0.0352	(0.288)	-0.0331	(0.313)
d2i : 2008	0.0128	(0.758)	0.0211	(0.618)	0.0260	(0.540)	0.0252	(0.552)
d2i : 2009	0.0788**	(0.047)	0.0813**	(0.045)	0.0854**	(0.036)	0.0835**	(0.039)
d2i : 2010	0.0656@	(0.141)	0.0570	(0.210)	0.0611	(0.181)	0.0574	(0.208)
fw_rat			-0.0110	(0.372)	-0.0106	(0.388)	-0.0117	(0.343)
fw_rat : 2008			0.0250@	(0.122)	0.0246@	(0.128)	0.0255@	(0.115)
fw_rat : 2009			-0.00417	(0.811)	-0.00475	(0.786)	-0.00275	(0.875)
fw_rat : 2010			0.0131	(0.405)	0.0128	(0.416)	0.0138	(0.382)
home_req			0.00300	(0.760)	0.00140	(0.888)	0.00130	(0.895)
home_req : 2008			-0.0152	(0.249)	-0.0128	(0.342)	-0.0132	(0.319)
home_req : 2009			-0.00803	(0.521)	-0.00619	(0.625)	-0.00766	(0.542)
home_req : 2010			0.00305	(0.854)	0.00497	(0.766)	0.00421	(0.799)
Δprice					-0.282	(0.296)		
Δprice : 2008					0.370	(0.268)		
Δprice : 2009					0.333	(0.348)		
Δprice: 2010					0.341	(0.361)		
Δnw/y							-0.121*	(0.075)
Δnw/y : 2008							0.166*	(0.088)
Δnw/y: 2009							0.0124	(0.890)
Δnw/y: 2010							0.0848	(0.384)
demog controls	Y		Y		Y		Y	
state dummies	Y		Y		Y		Y	
N	4208		4208		4208		4208	
R^2	0.026		0.036		0.036		0.037	

P-values in parenthesis. Sample includes renters

$^{@}p < 0.15$, $^{*}p < 0.1$, $^{**}p < 0.05$

Table 6: log growth rates on portfolio variables: durables, whole sample

	(1)		(2)		(3)		(4)	
	dl2_du		dl2_du		dl2_du		dl2_du	
d2i	-0.0513	(0.163)	-0.0434	(0.248)	-0.0482	(0.202)	-0.0496	(0.188)
d2i : 2008	0.0447	(0.339)	0.0426	(0.369)	0.0481	(0.312)	0.0521	(0.275)
d2i : 2009	0.109**	(0.015)	0.102**	(0.025)	0.107**	(0.019)	0.108**	(0.018)
d2i : 2010	0.0782@	(0.125)	0.0676	(0.195)	0.0731	(0.163)	0.0722	(0.168)
fw_rat			-0.0112	(0.409)	-0.0108	(0.424)	-0.0119	(0.379)
fw_rat : 2008			0.0317*	(0.082)	0.0314*	(0.086)	0.0321*	(0.079)
fw_rat : 2009			-0.00228	(0.903)	-0.00264	(0.888)	-0.000864	(0.963)
fw_rat : 2010			0.0147	(0.386)	0.0144	(0.395)	0.0154	(0.363)
home_req			-0.00117	(0.914)	-0.00317	(0.771)	-0.00415	(0.703)
home_req : 2008			-0.00937	(0.515)	-0.00694	(0.635)	-0.00592	(0.683)
home_req : 2009			0.000177	(0.989)	0.00224	(0.869)	0.00149	(0.912)
home_req : 2010			0.00821	(0.653)	0.0106	(0.563)	0.0102	(0.576)
Δprice					-0.355	(0.202)		
Δprice : 2008					0.402	(0.241)		
Δprice : 2009					0.359	(0.325)		
Δprice: 2010					0.425	(0.267)		
Δnw/y							-0.145**	(0.040)
Δnw/y : 2008							0.194*	(0.052)
Δnw/y: 2009							0.0371	(0.686)
Δnw/y: 2010							0.116	(0.249)
demog controls	Y		Y		Y		Y	
state dummies	Y		Y		Y		Y	
N	2873		2873		2873		2873	
R^2	0.033		0.051		0.052		0.054	

P-values in parenthesis. Sample includes home-owners only

$^{@}p < 0.15$, $^{*}p < 0.1$, $^{**}p < 0.05$

Table 7: log growth rates on portfolio variables: durables, home-owners only

Panel A) d2i

	Mean				Median			
	own w mtge	own no mtge	rent	total	own w mtge	own no mtge	rent	total
2007	195.42	13.27	16.12	99.82	158.73	0.69	0	37.82
2008	196.73	13.44	19.39	100.06	151.11	0	0.36	39.5
2009	215.92	17.25	20.41	104.41	167	0	1.01	31.86
2010	208.61	15.89	19.85	104.77	170.28	0.09	0	33.11

Panel B) Δprice

	Mean				Median			
	own w mtge	own no mtge	rent	total	own w mtge	own no mtge	rent	total
2007	-4.77	-0.28	0.18	-2.23	-3.59	-2.98	0	0
2008	-6.89	-8	0	-4.94	-3.92	-3.92	0	0
2009	-3.67	0.05	-0.2	-1.65	-1.84	-0.87	0	0
2010	-2.95	-0.89	0.03	-1.52	-2.2	-1	0	0

Panel C) Δnw/y

	Mean				Median			
	own w mtge	own no mtge	rent	total	own w mtge	own no mtge	rent	total
2007	7.37	15.3	0.08	6.37	-9.64	-0.51	0	0
2008	-1.94	2.86	0	-0.27	-8.38	-4.52	0	0
2009	1.88	8.98	-0.31	2.53	-6.72	-2.7	0	0
2010	-7.23	12.13	0.67	-0.44	-8.73	0.76	0	0

Panel D) Δn

	Mean				Median			
	own w mtge	own no mtge	rent	total	own w mtge	own no mtge	rent	total
2007	-3.5	-5.37	-5.8	-4.64	-3.29	-2.22	-3.9	-3.25
2008	-5.99	-4.93	-1.8	-4.42	-4.29	-1.38	-3.83	-3.63
2009	-5.96	-6.17	-4.08	-5.32	-4.44	-5.74	-0.47	-3.65
2010	3.29	2.24	2.46	2.79	1.59	2.4	1.63	1.76

The sample is the same as in Table 2

Table 8: Descriptive evidence in support of the accounting argument