Responses of Time-use to Shocks in Wealth during the Great Recession

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Abstract

Shocks to income and wealth decrease the household's monetary budget available. As a consequence, households respond by decreasing consumption spending. Income shocks, such as unexpected unemployment and retirement, also increase the time-budget available in addition to decreasing the monetary budget available. Some research has suggested that the additional time available enables households to substitute home production for purchased goods and services, effectively increasing their well-being beyond what a measure of spending would indicate. We aim to expand on this research by using data on time-use with data on categories of spending, which has the potential to be much more informative than data on time-use alone: the combination can show substitutions or complements of time for spending. We use wealth shocks in house values induced by the Great Recession to show the extent to which households adjusted home production in response to those wealth shocks. We found some adjustment in the population age 65 or older, but none in the population age 51-64. This implies that younger households experiencing a wealth shock only find very little opportunity, if any, to buffer the welfare losses resulting from reductions in spending on market-purchased goods by increases in home production. Older households were able to compensate modestly.

Citation

1. Background

The assessment of economic preparation for retirement has relied on measures of income and wealth, and in some cases on measures of consumption. However, people could use time to substitute for purchased goods and services to effectively increase their well-being beyond what a measure of spending would indicate (Aguiar and Hurst, 2005). In this paper we aim to expand on this research by using data on time-use and the wealth declines in the Great Recession to find whether households were able to use time to buffer the welfare losses resulting from reductions in spending on market-purchased goods. Understanding to what extent households engage in home production in order to buffer the welfare losses associated with financial shocks is important for economic modeling and analyses, because most economic analyses omit the time use dimension for lack of data.

2. Theoretical background

The simplest form of the life-cycle model specifies that utility depends on only one good. Laitner and Silverman (2005) extend the utility function to include leisure, including pure entertainment, social activities, and productive hobbies. Furthermore, Laitner and Silverman interact leisure with consumption in the utility function so as to allow for home production of some good or service (food, house cleaning, etc.), and/or complementarity or substitutability between time and that good. However, following retirement, leisure is fixed (assuming that retirement marks a complete and irrevocable termination of work). Thus, this version of the extended model reverts to the simple version. In that set-up, spending will decrease with age because of increasing mortality risk. Indeed in panel data, spending does decline with age at a rate of approximately 2% per year (Hurd and Rohwedder, 2008).

A more general utility function allows for multiple goods and services and multiple uses of time. Purchased goods and time are combined to produce utility. In dynamic equilibrium, an individual maximizes within-period utility by equating marginal utilities to price ratios. Following retirement, as total spending declines, budget shares will change

as predicted by Engel curves. To the extent that some uses of time are complements or substitutes for each type of purchased consumption good, those uses of time will also change. In principle, by studying within-person changes in budget shares and in time use in panel data, one could deduce the degree of complementarity or substitutability between types of purchased goods and time use. However, an additional explanation for the change in budget shares is that the marginal utility of consuming some types of purchased goods depends on health (Börsch-Supan, and Stahl, 1991). Then as health declines with age, the marginal utilities change in addition to any change in marginal utilities induced by a reduction in overall spending. Thus data on changes in budget shares and time use in panel incorporate both changes due to health changes and changes due to a shrinking of the budget (moving down the Engle curve). Relying on the magnitude of the wealth shocks in the Great Recession and on the assumption that those shocks were unforeseen (exogenous), we can use change in time use in panel data to separate out life-cycle and health effects from wealth effects on time-use. Many household experience wealth and income shocks sometime over the lifecycle. Such shocks decrease retirees' monetary budgets, but it might be that people buffer the impact on well-being by substituting home production of some goods and services that with more wealth or income would be bought.

3. Literature

The assessment of economic preparation for retirement has relied on measures of income and wealth (Boskin & Shoven, 1987; Haveman et al., 2006, 2007; Crawford & O'Dea, 2012; Knoef et al., 2013; De Bresser & Knoef, 2014), and in some cases on measures of consumption (Engen et al., 1999; Scholz et al., 2006; Hurd & Rohwedder, 2008b, 2011; Binswanger & Schunk, 2012). The canonical Life-Cycle Hypothesis (LCH) predicts that individuals allocate their resources to smooth the marginal utility of consumption over their lifetime. To obtain smoothing of consumption over lifetime, rational forward-looking individuals will save during the working life to maintain a smooth level of consumption at retirement by dissaving. Using a life-cycle model, Scholz et al. (2006) find that about 80% of Americans are saving sufficiently to smooth their marginal

utility of consumption over the life-cycle. Hurd & Rohwedder (2011) find a similar adequacy of preparation for retirement.

While none of these studies consider home production in their assessments, a couple of strands of related literature have raised the issue and showed that home production plays a role when people experience a change in their work status. The first literature is concerned with changes in spending and time use around retirement and the second is concerned with changes in spending and time use in response to unemployment. A number of studies have noted and investigated a sizeable drop in household spending at retirement. This phenomenon of sharply declining consumption at retirement has been called the retirement consumption puzzle as it is in contrast with the predictions of the LCH. Such drops in consumption expenditures at retirement are found by, among others, Mariger (1987); Robb & Burbidge (1989); Banks et al. (1998); Bernheim et al. (2001); Miniaci et al. (2003); Battistin et al. (2009). Other studies argue that the drop in consumption expenditures at retirement is not in contrast with the LCH. Hurd & Rohwedder (2003, 2006); Ameriks et al. (2007); Borella et al. (2011); Hurd & Rohwedder (2013) argue that the drop in consumption is anticipated and therefore not inconsistent with rational forward-looking individuals per se. Alternatively, retirement may be due to an unanticipated shock (a health shock or layoff) as suggested by Smith (2006); Haider & Stephens (2007); Barrett & Brzozowski (2012). Such unexpected retirement may explain the observed drop in consumption in a manner consistent with the LCH. For excellent overviews of the literature regarding the reconciliation of consumption drops within the LCH, see Hurst (2008) and Attanasio & Weber (2010).

One of the main conclusions of Hurst (2008) is that there is a large heterogeneity in spending changes at retirement across different categories of consumption. Food expenditures in particular are found to fall sharply relative to other consumption components (Aguila et al., 2011; Hurd & Rohwedder, 2013; Velarde & Herrmann, 2014). Aguiar & Hurst (2005) explain this phenomenon by showing that retired persons use their additionally available time to maintain well-being by substituting home production (e.g., cooking) for purchased goods and services (e.g., dining out). Hence, it is crucial to differentiate between expenditures and consumption and to augment the standard life-

cycle model with home production in order to explain that the expenditure drops observed at retirement are not inconsistent with the LCH (Hurst, 2008).

The idea of introducing home-produced goods in the utility function was introduced by Becker (1965) and further developed by Gronau (1977). In dynamic equilibrium, an individual maximizes within-period utility by equating marginal utilities to price ratios, where the price of time depends on labor market opportunities. Following retirement, as total spending declines, budget shares will change as predicted by Engel curves; to the extent that some uses of time are complements or substitutes for each type of purchased consumption good, those uses of time will also change.

The subsequent literature has pursued the implications of home production further. Baxter & Jermann (1999); Apps & Rees (2005); Aguiar & Hurst (2005); Dotsey et al. (2010); Rogerson & Wallenius (2013) incorporate home production in a standard life-cycle model in which the home-produced goods are substitutable with market goods. Dotsey et al. (2010) show that this model can account for the observed patterns in consumption and time-use over the life-cycle. According to the model, households allocate more time to home production and leisure as they reduce working hours toward retirement. This is because the opportunity cost of home production and leisure declines in retirement, because there is no longer a tradeoff with working hours. As a consequence, home production of goods substitutes for consumption of market goods; this explains the drop in expenditures observed at retirement.

Taking into account the willingness to substitute home production for market consumption also improves explanation of the aggregate fluctuations observed at the macro level (Benhabib et al., 1991; Greenwood & Hercowitz, 1991). The time households devote to home production fluctuates over the business cycle, implying that households may shift away from market work to home production in recessional times. Unemployed workers choose lower levels of market goods consumption than they would if employed, but they can keep well-being constant as they have more time to produce at home (Hall, 2009; Karabarbounis, 2014). Ahn et al. (2008) find that home production is higher in households with unemployed individuals than in those with employed individuals. Similarly, Brzozowski & Lu (2006), explicitly focusing on food

consumption and production, find that home production is higher in households with retired individuals.

Although these results are an indication of substitution effects between market consumption and time-use, they cannot be interpreted as being causal; Ahn et al. (2008) and Brzozowski & Lu (2006) are only able to analyze time-use in a cross-sectional setting. However, using longitudinal data, Velarde & Herrmann (2014) find substantial substitution effects between food expenditures and food-related time-use at retirement. This result extends to individuals who are non-working (not in the labor force) or unemployed. Burda & Hamermesh (2010) find evidence that individuals generally offset market hours with home production during times of high cyclical unemployment. Aguiar et al. (2013) show that individuals who lost working hours during the Great Recession reallocated a substantial part of their available time to home production and/or increased leisure time. They find that about 30% of lost working hours were absorbed by home production during the Great Recession. Such substitution between market work and home production may mitigate the effects of recessions on well-being, the drop in which may not be as large as the drop in market hours. However, Aguiar et al. (2013) do not study the substitution effects between market consumption and home production as they do not have data on spending (Burda & Hamermesh, 2010; Aguiar et al., 2013). Analyzing the effect of the Great Recession, Griffith et al. (2014) find that households lowered food spending by increased shopping effort. They, however, do not have any explicit information about time-use.

We expand on the research discussed above by using data that has information on both time-use and spending. This combination has the potential to be much more informative than data on time-use alone since it can show the degree to which spending can be substituted for home production. Furthermore, the data used are longitudinal with information on more than one respondent in the household. These data allow us to examine several specific topics more thoroughly than has previously been possible. First, we investigate the importance of home production and the variation in home production over various background characteristics. Secondly, we use wealth shocks caused by the

Great Recession to estimate how unexpected changes in wealth affect home production and other activities. Finally, we analyze the scope to which households are able to substitute market-purchased goods for home production.

4. Data Sources

The data for our empirical analyses come from the Health and Retirement Study (HRS), a longitudinal survey that is representative of the U.S. population over the age of 50 and their spouses. The HRS conducts core interviews of about 20,000 persons every two years. In addition the HRS conducts supplementary studies to cover specific topics beyond those covered in the core surveys. The time-use data we use in this paper were collected as part of such a supplementary study, the Consumption and Activities Mail Survey (CAMS).

Health and Retirement Study – Core interviews

The first wave of the HRS was fielded in 1992. It interviewed people born between 1931 and 1941 and their spouses, irrespective of age. The HRS re-interviews respondents every second year. Additional cohorts have been added so that beginning with the 1998-wave the HRS is representative of the entire population over the age of 50. The HRS collects detailed information on the health, labor force participation, economic circumstances, and social well-being of respondents. The survey dedicates considerable time to elicit income and wealth information, providing a complete inventory of the financial situation of households. In this study we use demographic and asset and income data from the HRS core waves spanning the years 2002 through 2010.

Consumption and Activities Mail Survey

The CAMS survey aims to obtain detailed measures of time-use and total annual household spending on a subset of HRS respondents. These measures are merged to the data collected on the same households in the HRS core interviews. The CAMS surveys are conducted in the HRS off-years, that is, in odd-numbered years.

The first wave of CAMS was collected in 2001 and it has been collected every two years since. Questionnaires are sent out in late September or early October. Most questionnaires are returned in October and November. CAMS thus obtains a snap-shot of time-use observed in the fall of the CAMS survey year. In the first wave, 5,000 households were chosen at random from the entire pool of households who participated in the HRS 2000 core interview. Only one person per household was chosen. About 3,800 HRS households responded, so CAMS 2001 was a survey of the time-use of 3,800 respondents and the total household spending of the 3,800 households in which these respondents live. Starting in the third wave of CAMS, both respondents in a couple household were asked to complete the time-use section, so that the number of respondent-level observations on time use in each wave was larger for the waves from 2005 and onward.

Respondents were asked about a total of 31 time-use categories in wave 1; wave 2 added two more categories; wave 4 added 4 additional categories. Thus, since CAMS 2007 the questionnaire elicits 37 time-use categories, as shown in Appendix A. Of particular interest for this study are the CAMS time-use categories related to home production:

- House cleaning
- Washing, ironing, or mending clothes
- Yard work or gardening
- Shopping or running errands
- Preparing meals and cleaning up afterward
- Taking care of finances or investments, such as banking, paying bills, balancing the checkbook, doing taxes, etc.
- Doing home improvements, including painting, redecorating, or making home repairs
- Working on, maintaining, or cleaning your car(s) or vehicle(s)

For most activities respondents are asked how many hours they spent on this activity "last week." For less frequent categories they were asked how many hours they spent

on these activities "last month." Hurd and Rohwedder (2008) provide a detailed overview of the time-use section of CAMS, its design features and structure, and descriptive statistics. A detailed comparison of time-use as recorded in CAMS with that recorded in the American Time Use Survey (ATUS) shows summary statistics that are fairly close across the two surveys, despite a number of differences in design and methodology (Hurd and Rohwedder, 2007).

In this paper we use data from CAMS 2005, 2007, 2009, and 2011, each wave containing between about 5,300 and 6,500 respondent-level observations on time-use that we merge with HRS core data. Combining the data from the HRS core and the CAMS provides us with data that are unique in that we observe demographics, economic status, time-use, and spending for the same individuals and their households in panel.

5. Descriptive analysis

We are interested in how the probability and the extent of participation in various activities varies with characteristics such as health, age, and the state of the economy. As above, we group activities into three categories:

- Market production, or paid work.
- Home production, or house cleaning, laundry, gardening, shopping, cooking, money management, home improvements, and car improvements.
- Leisure, including such activities as watching television, reading, listening to music, sleeping, walking, sports activities, paying visits, communicating with others, using the computer, praying or meditating, maintaining hygiene, playing with pets, physically showing affection, helping others, playing games, making music, and engaging in arts and crafts

In the tables that follow, we consider each of the major categories of activity and how it relates to differences in independent variables of interest. For example, Table 1 shows variation in whether and to what extent people engage in market production, that is, paid work, according to their level of self-perceived health (see Table 1). The

probability that a respondent engages in paid work falls sharply from those in "excellent" health (48%) to those in "poor" health (10%). However, the time spent working (conditional on participation) shows a much less pronounced gradient by self-rated health. Among those working, individuals reporting poor health spend only about 15% less time working than workers in "excellent" health. If work is responsive to a change in health, so would time and money budgets. But we know that health is correlated with age (e.g., Case & Deaton, 2003), so the relations we are seeing in Table 1 may be confounded with age.

Table 1. Descriptive analysis: Paid work and health.

Health	Observations	Paid work % of persons involved	Hours per week	Conditional hours per week
Excellent	1991	48	16.6	34.7
Very good	5311	38	13.0	33.8
Good	5548	29	10.0	33.9
Fair	3447	20	6.7	33.0
Poor	1278	10	3.1	29.8
Total	17575	31	10.5	33.8

Pooled cross-sections of time use data from CAMS 2005 through 2011.

As it is with health, the probability of engaging in paid work varies substantially by age (Table 2). It is noteworthy that the age gradient in labor force participation is very steep across all age-bands shown, suggesting lower labor force participation well before people reach their normal retirement age of 65 (or 66 for later cohorts). In contrast to the relation between work and health, there is also a substantial age gradient in hours worked, conditional on any work.

Table 2. Descriptive analysis: Paid work and age.

| | Paid work | | | |
Age	Observations	% of persons involved	Hours per week	Conditional hours per week
51-55	2073	68	26.8	39.4
56-60	2585	58	22.3	38.1
61-65	2840	37	12.2	33.0
66-70	3240	25	6.6	26.9
71-75	2778	17	3.9	23.6
76-80	1984	9	1.8	20.2
81-85	1360	4	0.5	14.0
86-90	734	1	0.4	34.8
Total	17594	31	10.5	33.8

Pooled cross-sections of time use data from CAMS 2005 through 2011.

Next we investigate time effects in paid work and home production. The time period covered by the data we use includes the Great Recession, which, according to the National Bureau of Economic Research, extended from December 2007 to June 2009. As shown in Table 3, market production decreased, on average, during the Great Recession, both in terms of the percentage of respondents engaged in paid work and in terms of the time spent working each week, conditional on working. Both measures immediately recover following the recession. At the population level the Great Recession thereby decreased respondents' monetary budget and increased their time budget. When investigating the effect of wealth shocks below, we will want to distinguish pure wealth shocks from shocks related to changes in labor force participation, which are associated with a change in time available for home production.

Table 3. Descriptive analysis: Paid work and date (business cycle).

CAMS wave	Paid work Observations	% of persons involved	Hours per week	Conditional hours per week
2003	3141	29	9.7	33.3
2005	3571	33	11.2	33.8
2007	3491	31	10.5	33.9
2009	3378	28	9.0	32.0
2011	4010	33	11.8	35.2
Total	17594	31	10.5	33.8

Pooled cross-sections of time use data from CAMS 2005 through 2011.

Constructing the same statistics for the sum of all home production activities for the different CAMS years suggests that, even though market production showed a decline, home production did not increase during the Great Recession (Table 4). In fact, hours in home production reached a minimum in 2009 when economic activity had reached its minimum. Thus at a gross level we do not see evidence of a substitution of home production for either wealth loss or unemployment. Of course, there is very little room for the percentage engaging in home production to increase, since it was already close to 100%.

Table 4. Descriptive analysis: Home production and date (business cycle)

CAMS wave	Observations	Home production % of persons involved	Hours per week	Conditional hours per week
2003	3141	98	22.7	23.1
2005	3574	98	21.6	22.1
2007	3491	98	21.4	21.9
2009	3378	97	20.9	21.5
2011	4010	97	21.0	21.6
Total	17594	98	21.5	22.0

Pooled cross-sections of time use data from CAMS 2005 through 2011.

Nevertheless, home production may respond to shocks in health and work. For example, in cross-section the percentage of persons involved in home production among those in poor health is lower compared to those in good health. Similarly, people who report poor health spend less time on average on home production compared to those in good health (see Table 5, first panel). The implication is that health status appears to affect home production, just as it appears to affect market production. The variation in home production across these groups amounts to about 10 to 15 percent at the aggregate level, but it is possible that a small but nontrivial fraction of the population experiences health shocks that result in much larger changes in work and home production.

Home production also varies by whether or not someone is engaged in market production. Table 5, second panel, shows that hours per week are 2.3 less among those employed. In that work hours among those employed are 33.8, the great majority of hours released by labor force withdrawal is given to leisure.

Table 5. Descriptive analysis: Home production and health; home production and work

| Health | Home production | | | |
	Observations	% of persons involved	Hours per week	Conditional hours per week
Excellent	1991	99	21.7	21.8
Very good	5311	99	21.7	22.0
Good	5548	98	22.4	22.9
Fair	3447	96	20.8	21.7
Poor	1278	91	17.6	19.4
Total	17575	98	21.5	22.0

| Work | Home production | | | |
	Observations	% of persons involved	Hours per week	Conditional hours per week
No	11262	96	22.3	23.1
Yes	6325	99	20.0	20.1
Total	17587	98	21.5	22.0

Pooled cross-sections of time use data from CAMS 2005 through 2011.

In summary, virtually every person engages in home production and total hours spent on all home production activities taken together amount to about 22 hours on average.

Our data sources allow us to analyze the single components of home production. Participation rates in each of these activities and average hours spent are as follows:

- On average, the biggest component of home production is cooking (6.4 hours per week, unconditional). About 85% of respondents engage in cooking. However, even this, the biggest component of home production, takes less than an hour per day on average. Heterogeneity is fairly small. Total time used for cooking is relatively small for workers and more highly educated persons. Time spent exhibited little sensitivity to the business cycle.

- The second biggest component of home production is house cleaning, on which respondents spent 4.6 hours per week on average. About 80% of them engage in this activity. Total time used for house cleaning is relatively small for older age groups and more highly educated persons. Again, heterogeneity over time is very small.

- Shopping takes about 3.7 hours per week on average and about 86% of persons engage in it. Time spent on shopping is especially low for older respondents and those in bad health. Otherwise, heterogeneity of percentage participation and time spent is negligible.

- Doing the laundry is an activity with a relatively high participation rate (72%) but a relatively low average number of hours per week (2.5). The same goes for financial management of the household (83%, <1 hour) and dining out (76%, ~1 hour).

- Gardening is an activity with a fairly low participation rate (49%) but a substantial amount of time spent (2.2 hours unconditional). And, as these numbers indicate, those who do garden spend 4.4 hours per week on it.

- Both home- and car improvements have low participation rates (40%, 48%) as well as little time spent in these activities on average (0.8 hours, 0.3 hours per week). The conditional averages are about twice as high, but still almost negligible on a weekly basis.

Because cooking, house cleaning, and shopping are the categories with relatively high participation rates *and* relatively high time expenditures, they are categories that primarily influence the home production totals. These three categories of home production show minor heterogeneity among work/non-work and health status and virtually none over the business cycle.

There are no substantial differences between the percent of home owners and non-home owners in home production overall (Table 6), but conditional on participating home owners engage in more home production than non-owners

Table 6. Descriptive analysis: Home production and home ownership

| Home ownership | Home production | | | |
	Observations	% of persons involved	Hours per week	Conditional hours per week
No	3797	95	19.5	20.5
Yes	13686	98	22.1	22.4
Total	17483	98	21.5	22.0

Pooled cross-sections of time use data from CAMS 2005 through 2011.

The differences are due to substantial differences in percent participation in gardening and home improvement (Table 7), which give rise to differences in average time expenditures.

Table 7. Descriptive analysis: Gardening and home ownership; home improvements and home ownership

Home ownership	Observations	Gardening % of persons involved	Hours per week	Conditional hours per week
No	3797	24	0.9	4.0
Yes	13686	56	2.5	4.5
Total	17483	49	2.2	4.5
Home ownership	Observations	Home improvements % of persons involved	Hours per week	Conditional hours per week
No	3797	21	0.3	1.5
Yes	13686	45	0.9	1.9
Total	17483	40	0.8	1.9

Pooled cross-sections of time use data from CAMS 2005 through 2011.

The descriptive tables raise the question to what extent there is scope to adjust home production as a response to a shrinking monetary budget due to a shock in housing wealth. To shift from market-purchased to home-produced, people need to have purchased the activity in the market in the first place. In the case of the three most important home production categories, this would primarily imply spending on dining out and home cleaning services. Other categories of spending for which home production may substitute are home repair services, car repair services, and gardening services.

Using simple correlations we indeed find negative relationships between spending on housekeeping services and time spent in housekeeping, as well as between spending

on dining out and time spent cooking (see Table 8). However, we find positive relationships between spending and time-use for gardening services, home repair services, and vehicle maintenance. This suggests that persons who spend more money on gardening services also spend more time on gardening such that spending and time-use are complementary according to their preferences.

Table 8. Correlations between spending and time use, and p-values for significance

Spending categories	Time-use categories					
	Housekeeping	Laundry	Gardening	Home repair	Vehicle maintenance	Cooking
Housekeeping services	-0.05 (0.00)	0.00 (0.55)				
Gardening services			0.01 (0.05)			
Home repair services				0.09 (0.00)		
Vehicle maintenance					0.13 (0.00)	
Dining out						-0.03 (0.00)

The shift from purchased services to home production suggests that wealthy persons may have a greater scope for substituting home production. It is at least possible, therefore, that such substitutions would be more extensive among wealthy persons than among those whose wealth averages to that of the population. However, comparing people in the top 5% of the wealth distribution (financial + housing wealth, distinguished for singles and couples) with the other 95% shows that there is virtually no difference in home production between the two (Table 9).

Table 9. Descriptive analysis: Home production and wealth.

Wealth	Observations	Home production % of persons involved	Hours per week	Conditional hours per week
< p95	16715	97	21.5	22.0
> p95	879	99	21.4	21.6
Total	17594	98	21.5	22.0

Nonetheless, several sub-categories of home services suggest substitution of money for time. Wealthy people spend 1.1 hours (or 23%) less time cleaning house than other people (Table 10). But even among wealthy persons, the total time devoted to house cleaning is substantial, indicating less-than-complete substitution.

Table 10. Descriptive analysis: House cleaning and wealth.

Wealth	Observations	House cleaning % of persons involved	Hours per week	Conditional hours per week
< p95	16715	80	4.7	5.8
> p95	879	78	3.6	4.6
Total	17594	80	4.6	5.7

On the other hand, wealthy persons also tend to devote more time to shopping (Table 11), pointing to a complementarity between time and money in shopping.

Table 11. Descriptive analysis: Shopping and wealth.

Wealth	Observations	Shopping % of persons involved	Hours per week	Conditional hours per week
< p95	16715	86	3.7	4.3
> p95	879	93	4.5	4.8
Total	17594	86	3.7	4.3

Percent participation rates and hours spent per week in the other home production subcategories by the wealthy are highly similar to those for people below the top 5% of the wealth distribution. If "wealthy" is defined as those in the top 10 percent, the results of the analysis are similar.

6. Regression analysis

6.1 Methods

To separate out wealth effects on time-use, we need a wealth shock, which the Great Recession provides, and a more formal analysis. We estimate regression models for changes in time-use as follows:

$$\Delta T_{kit} = X_{it}\beta + \varepsilon_{normal}\Delta W_{it} + \varepsilon_{2007}D_{2007}\Delta W_{it} + u_{it}$$

where subscripts *i* and t indicate households and CAMS waves, respectively, and k indexes time spent in a particular type of activity. Our interest lies on how the wave-to-wave change in time spent on an activity relates to the change in household wealth, ΔW_{it}, during "normal" and recession times. Hence, we interact, ΔW_{it} with a binary variable, D_{2007} taking value 1 for wave 2007 to 2009, the waves that span the onset and termination of the recession according to NBER dating. The parameter ε_t is the reaction of time-use to wealth change. We would expect that ε_t would normally be close to zero for most time use categories during "normal" times as there is only a weak association between wealth change and time use on a particular good as households follow their life-cycle paths. However, during recession times (2007-2009), in response to the large changes in house value, ε_t may not be zero, but would have a sign that depends on whether an activity is complementary with, or substitutable for, wealth. The other explanatory variables include, age, change in household structure, change in health, and so forth, as taken up above.

We estimate equation (1) with instrumental variables, where the ΔW_{it} are the change in housing wealth, which we take to be endogenous for several reasons: house value is subject to observation error; housing wealth may be actively saved or dissaved; and ΔW and u may be correlated due to omitted variables. Our instrumental variables are regional housing price changes from the different census regions, which exhibit substantial variation because the decline in house prices in the Great Recession varied substantially depending on the region of residence. We divide the sample according to age less than 65 and age 65 or older because job market effects for which we have imperfect controls undoubtedly affect those groups differently. Furthermore, we only

select those persons whose household owns a house and did not move. In this way, we are certain that people have some housing wealth and that the change in housing wealth is a pure price effect.

6.2 Results

We do not find a significant effect of wealth change between 2007 and 2009 on time spent in home production for the 51-64 year old persons (see Table 12, below, following the "Discussion" section). Neither do we find that a change in health or work status is associated with a change in home production. For people aged 65-80, we find a significant association (at the 10% level) between housing wealth changes and home production over the period of the recession. House value is measured in thousands, so that a decrease in housing wealth of $100,000 is associated with an increase in home production of about 7 hours per week (on a base of about 21 hours) compared "normal times." While such large decreases in housing wealth happened during the Great Recession, only some households with a relatively large amount of housing wealth saw their housing wealth decreasing with this amount. For the average individual, the experienced effect is much smaller.

A detailed decomposition of time-use among the 65-80 year old persons (Table 13) shows that the negative wealth shocks are primarily associated with increased television watching. Health shocks (not reported here) are primarily associated with decreased exercising and increased communication. Stopping with work (not reported here) is primarily associated with home production in the form of increased gardening while it is also associated with more time spent in hobbies such as reading mainly.

The results in Table 13 suggest that the associations between shocks and detailed categories of home production are small. The total of home production categories is affected nonetheless as can be seen in Table 12. The wealth shock of the Great Recession, which in principle only affects the monetary budget, is also found to increase the time spent in watching TV. As Angrisani et al. (2013) show, the wealth shock of the Great Recession led to reduced spending. If some of that reduction is for leisure activities that cost money, there is more time available for non-costly leisure activities such as watching TV. However, we do not explicitly find that the wealth shock led to

significantly fewer hours spent in costly leisure activities (entertainment). But note that entertainment only takes up about 0.3 hours per week on average thereby leaving the scope of changes in in this time-use category negligible.

7. Discussion and Conclusions

We sought relationships between time-use and shocks to wealth, such as occurred during the Great Recession. The hypothesis was that such sudden, dramatic changes in wealth would cause the people experiencing them to attempt to maintain well-being by decreasing the expenditure of money on market-produced goods and substituting the expenditure of time to generate more home-produced goods to buffer against the loss of wealth.

This hypothesis was only partially supported by our analyses. Using regression analyses, we did find associations during the Great Recession between increased home production and shocks to homeowners aged 65 to 80, but not to younger respondents.

Time used for leisure is also associated with wealth and health shocks. In particular, respondents increased the time they spent watching television. This is consistent with the findings of Aguiar et al. (2013) that leisure activities such as watching TV and sleeping absorb about half the total productive time that is lost to an unemployment shock. Note however that this type of shock is different from a wealth shock as a wealth shock only directly affects the monetary budget, while an unemployment shock has a direct effect on both the monetary and time budgets.

Some of the potential substitution towards home production was reinforced or elaborated upon through simple pairwise correlations. For instance, people substitute time spent on housekeeping and food (cooking) for money spent on those activities (cleaning services, dining out). In contrast, gardening and home and vehicle maintenance are complements. That is, persons who spend more money on these activities also devote more time to them.

Generally, home production accounts for significant quantities of people's time—over 20 hours per week, according to our data. And respondents with different characteristics (wealth, health, employment status) or at different times (before or during the Great Recession) varied little in the time they spent on home production. At the same time, many people spent money on market production of food (82% dined out), vehicle maintenance (79%), housekeeping (48%), home maintenance (46%), and gardening (35%). Note, however, that most people have no scope for reduction of housekeeping, home maintenance, and gardening expenditures—no spending to cut back on so as to allow substitution of home production. Consider people who spend money on a particular activity (say, dining out) and people who never do. The difference between them in the time they spend on home production (cooking) is very small. That suggests that the people who spend money in the market (dining out) do not spend much time doing so, compared with the time they spend cooking. So even people who substitute spending on market-purchased goods for home production – people who dine out instead of cooking — are not substituting to any great extent.

Overall, these results suggest that there is no population-wide substitution of home production for spending and that the scope for changing spending in relation to home production is rather small for many households, and the only potentially home production activity with sufficient scope is home cleaning as this takes up about a quarter of all home production and because there is some room for substitution effects according to simple pairwise correlations.

Angrisani et al. (2013) indicate that shocks in wealth significantly reduce consumption. Combined with our results the implication is that shocks primarily decrease consumption (spending) but only increase home production for the older population, and even then only marginally. The limited extent of home production adjustments means that the reduction in well-being of households resulting from a wealth shock is only marginally buffered by home production.

8. Table 12. Estimated regression coefficients for the change in time spent in home production

| | Home-owners, not moving | |
| | Δ Home production | |
	51-64	65-80
Δ House value * 2007-2009	0.05	-0.07*
	(0.05)	(0.04)
Δ House value	0.00	0.03
	(0.00)	(0.02)
Deteriorating health	-0.65	0.47
	(0.61)	(0.51)
Improving health	0.09	0.27
	(0.69)	(0.56)
Stop working	1.36	0.54
	(0.95)	(0.87)
Start working	-0.03	1.18
	(1.44)	(1.19)
Δ Age	-0.80	2.60
	(2.31)	(1.66)
Δ Age squared	0.01	-0.01
	(0.02)	(0.01)
Δ 2003-2005	-1.08	-2.44**
	(1.21)	(1.11)

Δ 2005-2007	-1.61	-5.49**
	(2.30)	(2.20)
Δ 2007-2009	-2.03	-7.99**
	(3.67)	(3.26)
Δ 2009-2011	-2.45	-9.49*
	(4.85)	(4.24)
Observations	2,559	4,676

*= significant at 10%
level

**= significant at 5%
level

9. Table 13. Estimated regression coefficients for the change in time spent in detailed time-use categories

	Home-owners, not moving, age 65-80	
	Δ House value * 2007-2009	Δ House value
Δ Cleaning	-0.02	0.01
	(0.01)	(0.00)
Δ Laundry	0.00	0.00
	(0.00)	(0.00)
Δ Gardening	-0.01	0.00
	(0.01)	(0.00)
Δ Shopping	0.00	0.00
	(0.01)	(0.00)
Δ Cooking	-0.01	0.00
	(0.01)	(0.04)
Δ Fin. Management	0.00	0.00
	(0.00)	(0.00)
Δ Entertainment	0.00	0.00
	(0.00)	(0.00)
Δ Home improvement	0.00	0.00
	(0.00)	(0.00)

Δ Car improvement	0.00	0.00
	(0.00)	(0.00)
Δ Dining out	0.00	0.00
	(0.00)	(0.00)
Δ Watching TV	-0.07**	0.02*
	(0.03)	(0.01)
Δ Read newspapers	-0.01	0.00
	(0.01)	(0.00)
Δ Read books	-0.02	0.00
	(0.01)	(0.00)
Δ Listening music	-0.02	0.01
	(0.01)	(0.01)
Δ Sleeping	-0.03	0.01
	(0.04)	(0.01)
Δ Walking	-0.01	0.01
	(0.02)	(0.01)
Δ Exercising	-0.01	0.00
	(0.01)	(0.00)
Δ Visits	0.03	0.00
	(0.03)	(0.00)
Δ Communicating	-0.02	0.01

	(0.01)	(0.00)
Δ Using PC	-0.03*	0.01
	(0.02)	(0.01)
Δ Praying	0.00	0.00
	(0.01)	(0.00)
Δ Personal hygiene	0.00	0.00
	(0.00)	(0.00)
Δ Pets	0.00	0.00
	(0.00)	(0.00)
Δ Affection	-0.01	0.00
	(0.01)	(0.00)
Δ Helping others	0.00	0.00
	(0.01)	(0.00)
Δ Volunteering	0.00	0.00
	(0.00)	(0.00)
Δ Religious meetings	0.00	0.00
	(0.00)	(0.00)
Δ Club meetings	0.00	0.00
	(0.00)	(0.00)
Δ Health	-0.01	0.00
	(0.01)	(0.00)

Δ Games	0.00	0.00
	(0.01)	(0.00)
Δ Making music	0.00	0.00
	(0.00)	(0.00)
Δ Arts and crafts	0.00	0.00
	(0.00)	(0.00)

*= significant at 10% level

**= significant at 5% level

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APPENDIX A

CONSUMPTION AND ACTIVITIES MAIL SURVEY
TIME-USE CATEGORIES ON WHICH DATA ARE COLLECTED

	Variable Names Across Waves (*separate spouse questionnaires)						
Reference period	Category	CAMS 01	CAMS 03	CAMS 05*	CAMS 07*	CAMS 09*	CAMS 11*
Last week	Watching programs or movies/videos on TV	A1	A1	A1	A1	A1	A1
Last week	Reading newspapers or magazines	A2	A2	A2	A2	A2	A2
Last week	Reading books	A3	A3	A3	A3	A3	A3
Last week	Listening to music	A4	A4	A4	A4	A4	A4
Last week	Sleeping and napping (including at night)	A5	A5	A5	A5	A5	A5
Last week	Walking	A6	A6	A6	A6	A6	A6
Last week	Participating in sports or other exercise activities	A7	A7	A7	A7	A7	A7
Last week	Visiting in person with friends, neighbors, or relatives	A8	A8	A8	A8	A8	A8
Last week	Communicating by telephone, letters or e-mail with friends, neighbors, or relatives	A9	A9	A9	A9	A9	A9
Last week	Working for pay	A10	A10	A10	A10	A10	A10
Last week	Using the computer	A11	A11	A11	A11	A11	A11
Last week	Praying or meditating	A12	A12	A12	A12	A12	A12
Last week	House cleaning	A13	A13	A13	A13	A13	A13

Last week	Washing, ironing, or mending clothes	A14	A14	A14	A14	A14	A14
Last week	Yard work or gardening	A15	A15	A15	A15	A15	A15
Last week	Shopping or running errands	A16	A16	A16	A16	A16	A16
Last week	Preparing meals and cleaning up afterwards	A17	A17	A17	A17	A17	A17
Last week	Personal grooming and hygiene, such as bathing and dressing	A18	A18	A18	A18	A18	A18
Last week	Caring for pets	A19	A19	A19	A19	A19	A19
Last week	Physically showing affection for others through hugging, kissing, etc.	A20	A20	A20	A20	A20	A20
Last month	Helping friends, neighbors, or relatives who did not live with you and did not pay you for the help	A21	A21	A21	A21	A21	A21
Last month	Doing volunteer work for religious, educational, health-related, or other charitable organizations	A22	A22	A22	A22	A22	A22
Last month	Attending religious services	A23	A23	A23	A23	A23	A23

Last month	Attending meetings of clubs or religious groups	A24	A24	A24	A24	A24	A24
Last month	Taking care of finances or investments, such as banking, paying bills, balancing the checkbook, doing taxes, etc.	A25	A25	A25	A25	A25	A25
Last month	Treating or managing an existing medical condition of your own	A26	A26	A26	A26	A26	A26
Last month	Playing cards or games, or solving puzzles	A27	A27	A27	A27	A27	A27
Last month	Attending concerts, movies, or lectures, or visiting museums	A28	A28	A28	A28	A28	A28
Last month	Singing or playing a musical instrument	A29	A29	A29	A29	A29	A29
Last month	Doing arts and crafts projects, including knitting, embroidery, or painting	A30	A30	A30	A30	A30	A30
Last month	Doing home improvements, including painting, redecorating, or making home repairs	A31	A31	A31	A31	A31	A31

Last month	Working on, maintaining, or cleaning your car(s) or vehicle(s)	n/a	A32	A32	A32	A32	A32
Last month	Dining or eating outside the home (not related to business or work)	n/a	A33	A33	A33	A33	A33
Last year	Away overnight for business	n/a	A35	A34	A38	A38	A38
Last year	Away overnight for vacation	A32	A34	A35	A39	A39	A39
Daily	Waking hours- mind engaged	A33	A36	A36	A40	A40	A40
Daily	Waking hours- body engaged	A34	A37	A37	A41	A41	A41
Daily	Waking hours- activities w/others	A35	A38	A38	A42	A42	A42
Daily	Waking hours- activities benefit others	A36	A39	A39	A43	A43	A43
n/a	Who completed survey section	A37	A40	A40	A44	A44	A44
n/a	How long did section take	A38	A41	A41	A45	A45	A45
Last week	Eating meals	n/a	n/a	n/a	A34	A34	A34
Past year	Seeing healthcare providers	n/a	n/a	n/a	A35	A35	A35
Last week	Managing medical condition of another	n/a	n/a	n/a	A36	A36	A36
Past year	Managing medical bills/claims	n/a	n/a	n/a	A37	A37	A37