the review of income and wealth

Review of Income and Wealth
Series 62, Number 3, September 2016
DOI: 10.1111/roiw.12182

CONSUMPTION, INCOME, AND WEALTH: EVIDENCE FROM AGE, COHORT, AND PERIOD ELASTICITIES

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This paper examines the relationship between non-durable consumption, income, and wealth (housing and financial) allowing *explicitly* for generational heterogeneity. A framework is proposed to disentangle cohort, age, and period effects and the empirical analysis is based on the U.S. Consumer Expenditure Survey data. We find that there are significant generational differences and the results highlight the range of elasticities *implicit* in results presented, thus far, by age groups. Moreover, we find supporting evidence of humped shaped age profiles for the elasticity of consumption with respect to income and the importance of financial wealth for those aged 60+. The framework also allows us to generate cohort profiles which draw attention to the negative role of housing wealth for generation X, and period profiles which reinforce the role of financial wealth for the baby-boom generation.

JEL Codes: C23, D12, E21

Keywords: age-time-cohort effects, consumer expenditure survey data, consumption elasticities

1. INTRODUCTION

The effect of wealth on consumption is an enduring topic for research,[1] and in recent years it has been further motivated by different performances in the stock and housing markets. While there is some evidence to support the existence of a wealth effect on consumption, there is less information on the life-cycle pattern of the relationship between income, wealth, and consumption. Furthermore, empirical results on relationships across ages and across time have been mixed, with respect to the significance of the relationship, the magnitude of the effects, and even the possible explanations for the results.

Life-cycle models of savings[2] and consumption (e.g., Ando and Modigliani, 1963) view differences in preferences, ages, and generations as important determinants of the relationship between income, wealth, and consumption. The contribution of this paper is to provide estimates of the different elasticities to consume out of income, housing wealth, and financial wealth that identify separately the effects across age, time, and generation. The propensities to consume across different cohorts are different at any point in time, and the life-cycle patterns of

Note: The authors would like to thank the Australian Research Council for financial support, and three anonymous referees for extremely helpful comments.

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[1]An incomplete list of research includes Levin (1998) and Bostic *et al.* (2009) for using household data; Case *et al.* (2005) and Zhou and Carroll (2012) for using U.S. state level data; and Bayoumi and Edison (2003), Ludwig and Slok (2002), and Girouard and Blondal (2001) for using country-level data.

[2]There is a separate literature about savings, with overlaps with the literature on consumption. For a review of international studies, see Borsch-Supan (2001) and Jappelli (2001) and references therein.

cohorts are different as well. In other words, the effect of wealth on consumption differs across age, time, and *cohort*. For example, our estimates show that the elasticity of consumption with respect to income for a 40-year old born in1950, is 0.353, while that of a 40-year old born in 1965 is 0.229 (these are statistically different elasticities). The corresponding elasticities of consumption with respect to housing wealth are 0.072 and 0.009, respectively, suggesting that within 15 years, the behavior of the baby-boom generation (i.e., those born between 1946 and 1964) changed from being more likely to increase their consumption when their housing wealth increases to having a consumption behavior which is almost unresponsive to changes in housing wealth.

The empirical problem associated with trying to identify age, time, and cohort effects separately is well-known in the consumption-saving literature (see, e.g., Attanasio, 1998 for a discussion). They cannot be identified separately because they are linked by the identity: age (year) + cohort (birth-year) = period (calendar-year). Hence a model with two of the three qualifiers would imply the third. It has been common to focus on changes in ages because they can be attributable to life-cycle reasons, and to focus on changes across time because they can be explained with reference to changes in the business cycle. By implication, using the identity linking age, cohort (birth-year), and time (calendar-year), one can identify the cohort effect as a combination of age and period effects.

The role of cohorts is implicit in many empirical analyses, but whether the cohort effect is important enough to be identified separately is an empirical question. A priori, it is likely that the shape of consumption over time will be cohort-dependent. The consumption pattern of the post-war generation to different types of wealth is likely to be different from the life-cycle pattern of consumption for a cohort born in the 1970s.

A standard approach to study consumption has been to exploit the repeated cross-section nature of the survey data (typically the Consumer Expenditure Survey (CEX)) to build pseudo-panel data by birth cohorts (usually covering five years) and to assume the same age profile across cohorts (see, e.g., Attanasio *et al*., 2009). But this is not satisfactory as, for example, the age-group 25–30 years includes consumers born at different time periods. If there is any difference among the characteristics of the cohort, such as risk aversion, the reported age-group result will be an averaged effect. The problem of generational heterogeneity will exist even if we do not work with age-groups and work instead with ages that match the frequency of the observations (such as annual data and with 1-year ages like 20, 21, 22 and so on). This is because the category of, say, 30-year olds, in a sample covering numerous years, would also contain 30-year olds born at different times. Aggregating these cohorts could potentially yield misleading results.

In this paper, we propose a model which explicitly allows us to estimate and identify the elasticity of consumption out of housing wealth, financial wealth, and income by *age*, *time*, and *cohort* effects. We achieve this by incorporating age, cohort, and business cycle variables in the regression coefficients. In other words, the period effects include implicitly the age and cohort effects (bound by the identity) as well as explicitly the influence of the business cycle. As noted in Attanasio (1998), identification requires the introduction of extra statistical or structural information. We have opted to use information from the business cycle

to identify the time effect. We show that the business cycle effect is significant, and more importantly, the age and cohort effects are also significant despite the inclusion of the business cycle factor.

Our main contribution to the literature is to highlight heterogeneity in cohorts when estimating the correlation between consumption and housing wealth. We argue that this is one more potential channel that contributes to the different responses of the consumption out of housing wealth, namely the generational characteristics of cohorts born at different time periods. The source of this difference may be from different attributes, such as risk aversion, discount factor, and bequest motives. The important point is that this difference may lead to different conclusions about marginal propensities if we only examine age or time effects. Averaging effects can weaken correlations, which may result in insignificant coefficients.[3]

Anticipating our results, we provide evidence that if we look at averaged results, the elasticities out of housing wealth display a hump-shaped pattern, while those out of financial wealth display a U-shaped pattern. While this is valuable information, aggregating different cohorts to get results by ages masks the range of cohort effects. For example, we find that the averaged elasticity to consume out of housing wealth for a 55-year old is 0.052, but the spread ranges from 0.038 (for cohort born in 1950) to 0.055 (for cohort born in 1935).

The paper is organized as follows. Section 2 contains a brief discussion on related studies. Section 3 describes the data and some stylized facts which provide the motivation for the specification of the econometric model in Section 4. Section 5 presents the empirical results based on the CEX[4] data, and associated mortgage data, for the years from 1988 to 2005. We provide estimates and significance tests of consumption elasticities for different combinations of age, cohort, and period to support the importance of allowing for generational (cohort) differences. Figures illustrating age, period, and cohort profiles are also provided. Section 6 concludes.

2. Related Studies

Our paper is part of the huge literature over the past 15 years studying the relationship between housing wealth, financial wealth, and consumption, which has been surveyed in Attanasio and Weber (2010) and Paiella (2009). Studies that have documented the link between financial wealth from stock market and consumption include those using aggregate data (see Poterba, 2000 for a survey) and those using micro-level data (see Starr-McCluer, 1998; Dynan and Maki, 2001).

The result that propensities to consume differ across ages is shown in, for example, Campbell and Cocco (2007). They estimated the elasticity of consumption out of housing wealth for old home owners and for young home

[3]Note that this result cannot be easily accounted for using the borrowing constraint argument, since we control for the mortgage level and payment in the analysis.

[4]The CEX data has been used extensively in the study of consumption behavior in the U.S. For studies which explore the relationship between financial wealth and consumption, see Attanasio and Weber (1994), Vissing-Jorgensen (2002), and Brav *et al.* (2002).

renters, and find a large positive elasticity for old home owners and close to zero elasticity for young home renters. They attributed this difference to the different borrowing constraint faced by the old and the young. However, using the same dataset, Attanasio *et al.* (2009) find that the difference is more attributable to different reactions to common macroeconomic factors.

The result that propensities to consume change over the business cycle is shown in Brady and Stimel (2011). More specifically, they show that while the effect of housing wealth on consumption has increased over time, the effect of financial wealth on consumption has decreased over time. Unlike the effect over age (across a person's life-cycle), the period effect is picking up the effect of the macro environment. Propensities to consume estimated in the 1970s would not be the same as propensities in the 2000s.

Our paper is also linked to the literature incorporating consumer attitudes to risk and preferences over the life-cycle, namely the age and cohort effects present in observed aggregate data as the population profile evolves over time. (For statistical studies which show the importance of age, cohort and period effects, see Jappelli, 1999; Gourinchas and Parker, 2002; Fernandez-Villaverde and Krueger, 2007.)

The closest research to our work is by Bostic *et al.* (2009). They studied the relationship between housing wealth, financial wealth, and consumption using CEX and the Survey of Consumer Finance (SCF). We differ in our regression method, however. They use cross-sectional regressions while we use panel regressions. In doing so, they missed potential time-series relationships, which have proven to be critical in the life-cycle models studied by others.

The empirical analysis also separates the wealth effects into that due to housing wealth and that due to financial wealth. While studies about the marginal propensity to consume from income and wealth seem appropriate, the separation of wealth into financial and housing wealth have been prompted by three considerations.

The first consideration comes from the observation associated with the stock market boom during the 1990s, the eventual stock market correction, and the fact that consumption did not fall as predicted by the wealth effect on consumption. This might be because the change in household wealth includes changes in both financial and housing wealth. Between 30 and 60 percent of household wealth is in the form of housing,[5] and housing markets were particularly strong both before and after the financial market correction. Consequently, it was argued that an increase in household housing wealth was offset by a decrease in financial wealth and, as a result, consumption did not change by much. This opened a line of empirical research dedicated to determining the relative magnitudes of the marginal propensities to consume out of various forms of wealth.

A second reason for looking at the effect of housing wealth on consumption is associated with changes in the mortgage refinancing industry. From around the

[5]For example, see Bertaut and Starr-McCluer (2002) and Tracy and Schneider (2001).

mid-1990s, access to home equity became easier; the decline in the cost of collateral may change the role of housing wealth as a source of consumption.[6]

The third consideration, which arises because of the finding that housing wealth is significant, is also important from a theoretical perspective. The Consumption Capital Asset Pricing Model (CCAPM)[7] is often used to explain the relationship between financial wealth and consumption, but the link between housing wealth and consumption is not as clear. It might be argued that all forms of wealth are perfect substitutes and that consumers take them equally into account when making consumption choices. However, this argument disregards the unique features of housing wealth that make the relationship more complicated. One feature is that housing is an indivisible, lumpy purchase. Flavin and Yamashita (2002), Goetzmann (1993), Sheiner (1995), Skinner (1989), and Lustig and Nieuwerburgh (2003, 2004) have shown that this distorts consumer asset allocation. Another feature is that owned housing is also an asset without clear substitutes—the substitute for one owned house is another owned house. Sinai and Souleles (2005) argued that this means there is no real wealth effect from housing price increases. Other features of housing cited in the literature for a difference between the effects of financial and housing wealth are bequest motives, mental accounting, and uncertainty about the wealth increases (Case *et al.*, 2005).

3. Data and Stylized Facts

The argument running through the paper is that it is important to explicitly recognise age, period, and cohort effects when we estimate the elasticities to consume from a pseudo-panel. Like many studies,[8] our pseudo-panel is based on household consumption data in the U.S. Consumer Expenditure Survey produced by the U.S. Bureau of Labor Statistics (CEX). The annual dataset is constructed by summing the quarterly information contained in the CEX. The panel dimension of the data is preserved because we track the progression of a reference person's consumption, income, and wealth year by year. The number of observations in each age-cell each year ranges from 60 to 480; with the youngest age group having the least number of entries. The empirical analysis is based on the average value per cell.

The CEX contains information from three samples. The sample period is from 1988 until 2005.[9] This gives us 18 years of data and 45 age-cells, with the youngest aged 26 and the oldest aged 70 years in 1988. Since we have pooled the three samples, we have a total of $45 \cdot 18 \cdot 3 = 2430$ observations. Our annual panel thus contains a cross-section of 45 ages and a time-dimension of 18 years. The data

[6]We thank a referee for drawing our attention to this point.

[7]This was mostly a result of solving the so-called "equity premium" puzzle pointed out by Mehra and Prescott (1985). See the survey by Campbell (2003) and the references therein.

[8]For more information about the survey and the variables, see the online Appendix and references cited therein.

[9]While the CEX was conducted in earlier years, the earlier surveys are not useable for this study as they lack information on mortgages. To be included in our sample, the household must live permanently in an urban area and not occupy student housing. We exclude from the sample all households with no recorded consumption expenditure on non-durables and services, no recorded consumption of food, and no recorded age because all of these variables are essential to this study.

TABLE 1
DESCRIPTIVE STATISTICS

Variable	Sample Mean ($)	S.D. Ages (26–70 years)	S.D. Cohorts (birth-years: 1918–79)	S.D. Periods (1988–2005)
Consumption	2,474.8	326.1	287.4	98.3
Income	7,514.7	1,452.6	1,565.6	1,011.9
Financial wealth	16,809.4	8,009.4	7,413.9	5,160.5
Housing wealth	46,130.9	15,293.3	14,743.0	9,455.7
No. of groups		45	62	18

are also identified by cohorts, and the birth-years are from 1918 to 1979. The use of annual data rather than 5-year cohorts ensures that each observation is unambiguously identified by age and cohort at each period in time.

The four key variables are defined as follows. *Consumption* is real expenditure on non-durables and services;[10] *real total income* is pre-tax income; *financial wealth* is the sum of savings account, checking account, U.S. savings bond, and securities holdings; while *housing wealth* is defined as the current market value of housing less the outstanding mortgage debt. Each observation can be associated with a particular age, cohort (birth-year) and period.

Before proceeding to the estimation, it is convenient to note some stylized facts, when the data are grouped by age, cohort, and period. The 2430 observations can be grouped into 45 ages (26–70 years), 62 cohorts (birth-years 1918–79), or 18 years (1988–2005). Since the data are identified by three qualifiers (age, cohort, or period), grouping them according to one qualifier must imply averaging over the other two qualifiers. Thus an observation by age must necessarily be averaged over cohorts and periods, an observation by cohort be averaged over ages and periods, and an observation by period averaged over ages and cohorts. Table 1 provides some descriptive statistics (means and standard deviations) of these constructed averaged variables.

The data show an average consumption of non-durables and services of $2474.8 (per household per quarter) that is supported by a before tax income of $7514.7, financial wealth of $16,809.4, and housing wealth of $46,130.9. The sample mean age is 48 years old, the averaged cohort birth-year is mid-1948, and the mid-point of the sample period is mid-1996.[11]

Figure 1a provides profiles of the averaged variables—consumption, income, financial, and housing wealth—over different ages. The profile of consumption and income over the ages is hump-shaped, while both financial and housing wealth increases with age. These are well-known stylized facts. Figure 1b plots the variables for reference persons aged 48 years (the average age of the sample) but

[10]For this study we have assumed that consumer preferences for non-durables and services are separable. Also, we acknowledge that mortgage debt has a dual role. On the one hand, the funds acquired through mortgage finance potentially expand a household's consumption opportunities, but on the other hand the acquisition of mortgage debt carries with it the obligation to repay the debt through periodic mortgage payments, thus reducing a household's consumption opportunities. These effects have been netted out.

[11]These values are similar to those reported in Attanasio and Weber (2010).

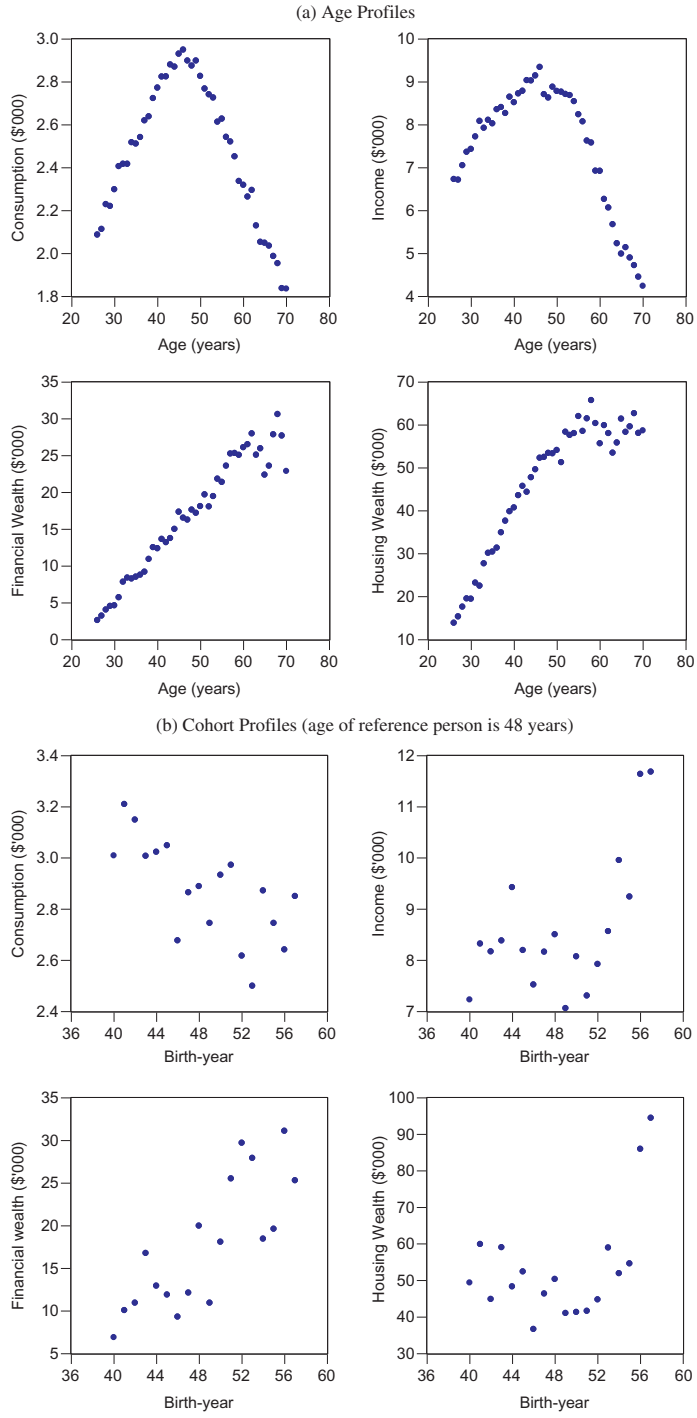

Figure 1. Stylized Facts Consumption, Income, and Wealth (financial and housing)

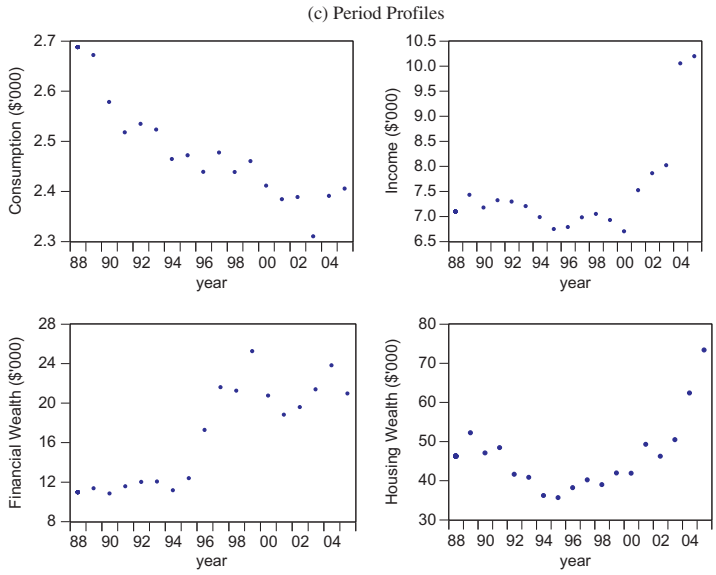

Figure 1. Continued

with different birth years. This figure illustrates the cohort effect. Consumption of the 48-year olds born in the post-war years was clearly lower than in those of the same age but born in the pre-war years. In contrast, income and wealth of the cohorts born in the 1950s were higher than those of earlier cohorts. Figure 1c plots the variables organized by period (calendar year). Consumption over the years fell because the average age is younger for the more recent years, but note that the decline is quite small. The period profile for income shows a slight increase. In general, average household consumption and income have been relatively stable in this sample (1988–2005), even though there are have been economic booms and mild recessions during the sample period. The coefficient of variation for consumption and income is 4.0 and 13.5 percent, respectively. In contrast, both housing and financial wealth exhibit trends and cyclicality. The most significant feature in this figure is the sharp increase of housing wealth and financial wealth starting from 1995. The dot-com collapse in 2001 appeared to have caused a drop in financial wealth without a similar effect on housing wealth.

In this paper, we propose working with a model that acknowledges that the data are identified by three qualifiers: age, cohort (birth-year), and period. Our sample is the full 2430 observations.

4. Econometric Model

The empirical model is constructed from two specifications commonly used in the literature. In the literature concerned with applying statistical methods, consumption is generally decomposed into its age and cohort components as follows:

$$c_{ijt} = \beta^0_{ijt} + \beta^a_{ijt} A + \beta^b_{ijt} B + \varepsilon_{ijt}, \quad \varepsilon_{ijt} \sim N(0, \sigma^2); \quad t = 1988, \ldots, 2005,$$

where A and B are age and cohort dummies and the period effect is identified by default from the linear relationship: cohort (birth-year) + age = period (calendar-year).[12] What is missing from this specification is the explanatory variables of consumption. In contrast, in the literature concerned with explaining economic relationships, the main interest is to estimate the propensities to consume, say from explanatory variable X (usually income and wealth):

$$c_{ijt} = \beta^x_{ij} X_{ijt} + \varepsilon_{ijt}, \quad \varepsilon_{ijt} \sim N(0, \sigma^2); \quad t = 1988, \ldots, 2005.$$

Age, cohort, and period effects can then be augmented in an ad hoc manner, as additional dummies or even more sophistically as a polynomial in age (see Attanasio *et al*., 2009).

The econometric model estimated here is a combination and generalization of the two specifications. The model (based on a pooled dataset) for estimating elasticities of consumption from income, financial, and housing wealth, allowing for cohort and age effects is as follows:[13]

$$c_{ijt} = \beta^o_{ijt} + \beta^y_{ijt} y_{ijt} + \beta^f_{ijt} f_{ijt} + \beta^h_{ijt} h_{ijt} + \varepsilon_{ijt}, \quad \varepsilon_{ijt} \sim N(0, \sigma^2); \quad t = 1988, \ldots, 2005$$

$$\text{where } \beta^w_{ijt} = \delta^w_0 + \delta^w_1 A_{it} + \delta^w_2 B_{jt} + \delta^w_3 A_{it} B_{jt} + \delta^w_4 A^2_{it} + \delta^w_5 B^2_{jt} + \delta^w_6 x_t; \quad w = o, y, f, h$$

$$A_{it} = \begin{cases} i & \text{if } c_{ijt} \text{ is age } i,\ i = 26, \ldots, 70 \\ 0 & \text{otherwise} \end{cases}$$

$$B_{jt} = \begin{cases} j & \text{if } c_{ijt} \text{ is cohort } j,\ j = \text{birth year } 1918, \ldots, 1979 \\ 0 & \text{otherwise} \end{cases}$$

where c, y, f, h are the logarithms of consumption, income, financial wealth, and housing wealth, respectively. The subscript t is a time index, i denotes the age, and j denotes the birth-year of the cohort. Since $A_i + B_j = t$ (e.g., $t = 1988$ for a reference person, age 18, born in 1970), it follows that it would not be possible to identify the period effect separately unless additional statistical or structural information is introduced. Since the purpose of the period effects is to pick up business cycle influences, we have introduced a macro variable x (like growth in GDP) to identify the period effects over and above that which would come about due to age and cohort.[14]

[12]Since age, cohort, and period are linked by the linear relationship: cohort (birth-year) + age = period (calendar-year), modeling two of the three effects is sufficient to cover all three effects.

[13]Control variables to allow for demographic characteristics (such as educational status) can also be introduced. In this paper, we find that these variables are generally insignificant, perhaps because we have explicit age and cohort effects.

[14]We thank a referee for drawing attention to McKenzie (2006) and Schulhofer-Wohl (2013) for alternative approaches to addressing this problem. These alternative approaches consider age, time, and cohort effects in an additive manner, whereas our model allows for (non-linear) interactions between age, cohort, and period effects. It would be interesting, albeit a non-trivial task, to generalize these other methods.

The parameters β_{ijt}^{0}, β_{ijt}^{y}, β_{ijt}^{f}, β_{ijt}^{h} are elasticities and they capture the marginal effects of the variables. We assume that the parameters are functions of age and cohort influences to allow for common economic histories as well as life-cycle effects. The idea that elasticities change over the ages follows naturally from the fact that income typically increases with age (until retirement) and the proportion saved increases with income. Adding a business cycle variable explicitly also allows us to capture time effects, over and above that derived from adding age and cohort effects, on the elasticities.

The estimating model is obtained by expanding each of the β_{ijt}^{w}, β_{ijt}^{w}, $w = o$, y, f, h

$$\begin{aligned} c_{ijt} = {} & (\delta_0^o + \delta_1^o A_{it} + \delta_2^o B_{jt} + \delta_3^o A_{it} B_{jt} + \delta_4^o A_{it}^2 + \delta_5^o B_{jt}^2 + \delta_6^o x_t) \\ & + (\delta_0^y + \delta_1^y A_{it} + \delta_2^y B_{jt} + \delta_3^y A_{it} B_{jt} + \delta_4^y A_{it}^2 + \delta_5^y B_{jt}^2 + \delta_6^y x_t) y_{ijt} \\ & + (\delta_0^f + \delta_1^f A_{it} + \delta_2^f B_{jt} + \delta_3^f A_{it} B_{jt} + \delta_4^f A_{it}^2 + \delta_5^f B_{jt}^2 + \delta_6^f x_t) f_{ijt} \\ & + (\delta_0^h + \delta_1^h A_{it} + \delta_2^h B_{jt} + \delta_3^h A_{it} B_{jt} + \delta_4^h A_{it}^2 + \delta_5^h B_{jt}^2 + \delta_6^h x_t) h_{ijt} + \varepsilon_{ijt} \end{aligned}$$

The dependent variable is c_{ijt} (all variables are in log terms) and there are 28 coefficients (δ_i^w; $w = 0$, y, f, h; $i = 0, \ldots 7$;) corresponding to the 28 regressors. The equation is uniquely identified. Estimates of the elasticities, at time t β_{ijt}^{w}, are computed as a linear combination of the estimated coefficients, and the standard errors of the elasticities are computed correspondingly from the variance–covariance matrix of the regression coefficients.

Since the β_{ijt}^{w} vary across age, cohort, and period, profiles of the elasticities for various combinations of ages and cohorts can be derived. This allows the generation of a more accurate age profile of the estimated elasticities, as cohort and time effects have been specifically included.

A quadratic function has been adopted to allow for the possibility of hump-shaped profiles. In short, the specification permits the generation of a consistent set of age, cohort, and period consumption elasticities with respect to income and wealth. The significance of the coefficients may be used to test a number of hypotheses. For example, there will be no hump-shape age effects if $\delta_3^w = \delta_4^w = \delta_5^w = 0$ and no cohort effects if $\delta_2^w = \delta_3^w = \delta_5^w = 0$.

5. Empirical Analysis

The pooled data is tested for stationarity using two panel unit root tests (see Table 2). All the time series are in logarithms. These tests show that all the variables are panel stationary, ensuring the use of standard inference in the empirical analysis.

Table 3 contains the results for the regression model. The best fitting model was selected on the basis of the likelihood and the significance of the coefficients δ_s. As shown, all the coefficients are significant.

The elasticities in our model are influenced by age–cohort–period effects as well as by business cycle effects (the common factor). The significance of δ_6 shows that the common factor had an important role, *over and above* those of age–cohort–period effects, in explaining the influence of housing wealth on

TABLE 2
PANEL UNIT ROOT TESTS

	c	*y*	*f*	*h*
Levin, Lin, and Chu test Null: unit root (assumes common unit root process)	–25.3631 (0.0001)	–11.2844 (0.0001)	–20.3193 (0.0001)	–15.6983 (0.0001)
Im, Pesaran, and Shin Null: unit root (assumes individual unit root process)	–22.7130 (0.0001)	–9.0764 (0.000)	–19.0146 (0.0001)	–15.0001 (0.0001)

Note: The values in parentheses are the p-values.

TABLE 3
PANEL REGRESSION RESULTS 2013

	$\beta_{ij} = \delta_0 + \delta_1 A_i + \delta_2 B_j + \delta_3 A_i B_j + \delta_4 A_i^2 + \delta_5 B_j^2 + \delta_6 growth$			
	Constant	*y*	*f*	*H*
δ_0	–7.962	3.267	–3.258	1.156
	(0.001)	(0.000)	(0.003)	(0.000)
δ_1	1.749	–0.377	0.638	–0.279
	(0.000)	(0.000)	(0.004)	(0.000)
δ_2	1.892	–0.685	0.692	–0.128
	(0.000)	(0.000)	(0.007)	(0.000)
δ_3	–0.215	0.062	–0.071	0.020
	(0.000)	(0.000)	(0.000)	(0.000)
δ_4			–0.029	0.016
			(0.000)	(0.002)
δ_5		0.031	–0.035	
		(0.000)	(0.000)	
δ_6		–0.006		0.006
		(0.006)		(0.001)

Note: The values in parentheses are the p-values. The standard errors are panel corrected standard errors.

consumption. Our framework provides support for the role of wealth as well as for a common factor (a point noted by Attanasio, 1998).[15]

The full range of results for all combinations of the consumption elasticities β_{ij} with respect to income, housing and financial wealth is shown in Figure 2. Standard errors for each of these coefficients can also be generated, but are not shown here. In Section 5.1, we shall extract slices of information to show how the methodology yields elasticities for different combinations of age, cohort, and period. We shall also generate averaged profiles to demonstrate the shapes of age, cohort, and period profiles. But, before we do that, we shall present some tests to show that the estimated 2-qualifier model is preferable to alternative 1-qualifier models.

[15]Our framework provides further support for the point noted by the referee. We thank the referee for helping us see an important implication of our analysis. We also note that we have tested a range of factors, including the unemployment rate.

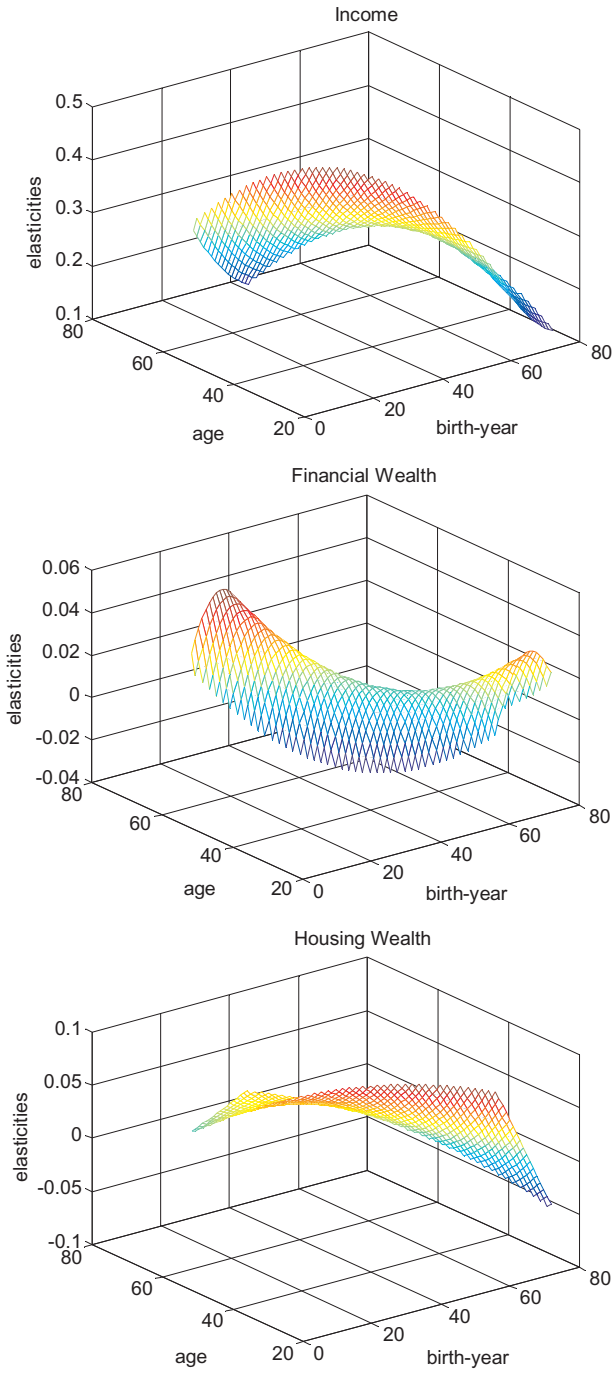

Figure 2. Income and Wealth Elasticities

TABLE 4
TESTS OF HYPOTHESIS

Alternative Models	Log Likelihood	Likelihood ratio test (p-value)
Null: Quadratic model (preferred model)	2643.112	
(a) Model with no age, cohort, or period effects	1666.967	860.806 (0.000)
$\beta_{ijt}^w = \delta_0^w; \quad \delta_1^w = \delta_2^w = \delta_3^w = \delta_4^w = \delta_5^w = \delta_6^w = 0$		
(b) Model with only age effects (i.e., regardless of calendar-year and birth-year, all persons of the same age (A) have the same elasticities of consumption)	2212.709	1341.972 (0.000)
$\beta_{ijt}^w = \delta_0^w + \delta_1^w A_i + \delta_4^w A_i^2; \quad \delta_2^w = \delta_3^w = \delta_5^w = \delta_6^w = 0$		
(c) Model with only cohort effects (i.e., regardless of calendar-year and age, all persons with the same birth-year (B) have the same elasticities of consumption)	1972.126	760.156 (0.000)
$\beta_{ijt}^w = \delta_0^w + \delta_2^w B_j + \delta_5^w B_j^2; \quad \delta_1^w = \delta_3^w = \delta_4^w = \delta_6^w = 0$		
(d) Model with only period-effects (regardless of birth-year and age, all persons in the same calendar year (P) have the same elasticities of consumption)	2263.034	1952.290 (0.000)
$\beta_{ijt}^w = \delta_0^w + \delta_2^w P_k + \delta_5^w P_k^2 + \delta_g^w x_t; \quad (\delta_1^w - \delta_2^w) = (\delta_3^w - 2\delta_5^w) = (\delta_4^w - \delta_3^w + \delta_5^w) = 0$		

5.1. *Tests of Specification*

Since the polynomial specification nests a number of alternatives, we also provide test results for four alternative specifications. Table 4 presents the likelihood ratio tests when the alternatives are: (a) when there are no age, cohort, or period effects; (b) when there are only age effects (meaning that regardless of calendar-year and birth-year, all persons of the same age have the same elasticities of consumption); (c) when there are only cohort effects (meaning that regardless of calendar-year and age, all persons with the same birth-year have the same elasticities of consumption); and (d) when there are only period-effects (meaning that regardless of birth-year and age, all persons in the same calendar-year have the same elasticities of consumption). The likelihood ratio test rejects the case that there are no age, cohort, or period effects. It also rejects the case when there are only age effects, or only cohort effects, or only period effects. The preferred model is one that allows for interaction between two of the three qualifiers.

5.2. *Consumption Elasticities with Respect to Income and Wealth*

The analyses thus far have shown that, overall, age, cohort, and the business cycle variable are significant determinants of the elasticities of consumption. It is also possible to test whether a particular consumption elasticity for a particular age (or cohort or period) is significantly different from another age (or cohort or period) elasticity. For reasons of parsimony, we have not presented this set of

results, instead we will present slices of information to indicate patterns, notwithstanding the possibility that contiguous ages/cohorts/periods may not be statistically different from each other.

Table 5 presents a selection of results, organized by age and cohort (i.e., birth years) at 5-year intervals, namely ages 30, 35, and so on and cohorts born in years 1930, 1935, and so on. The table shows that people of the same age, but born at different times, have different elasticities of consumption out of income, with the older cohort exhibiting higher elasticities. The results for the elasticities of consumption out of wealth, are harder to generalize.

As shown in Table 5, the elasticities of financial wealth, across ages, range from as low as –0.012 (cohort born in 1945 at age 45), to as high as 0.043 (cohort

TABLE 5

Consumption Elasticities (selected ages and cohorts)

	Birth-Year									
Age	1970	1965	1960	1955	1950	1945	1940	1935	1930	Average
Income										
30	0.150*	0.206*	0.265*							0.195
35	0.194*	0.201*	0.257*	0.317*						0.246
40		0.229*	0.237*	0.293*	0.353*					0.282
45			0.249*	0.257*	0.313*	0.374*				0.302
50				0.254*	0.262*	0.319*	0.379*			0.307
55					0.243*	0.252*	0.309*	0.369*		0.297
60						0.217*	0.226*	0.283*	0.344*	0.272
65							0.176*	0.185*	0.242*	0.231
70								0.119*	0.128*	0.174
Average	0.163	0.208	0.250	0.281	0.297	0.297	0.283	0.252	0.251	
Financial Wealth										
30	0.020*	0.020*	0.002							0.012
35	–0.004	0.012*	0.012	–0.006						0.004
40		–0.009	0.007	0.007	–0.011					–0.001
45			–0.011	0.005	0.006	–0.012				–0.002
50				–0.009	0.006	0.007	–0.011			–0.001
55					–0.005	0.011*	0.012*	–0.007		0.003
60						0.003	0.018*	0.019*	0.001	0.011
65							0.014	0.029*	0.030*	0.022
70								0.027*	0.043*	0.036
Average	0.016	0.012	0.004	0.000	–0.001	0.002	0.007	0.016	0.020	
Housing Wealth										
30	0.018*	0.042*	0.072*							0.035
35	–0.005	0.029*	0.048*	0.073*						0.043
40		0.009	0.038*	0.052*	0.072*					0.048
45			0.021	0.044*	0.054*	0.068*				0.051
50				0.031*	0.049*	0.053*	0.063*			0.053
55					0.038*	0.052*	0.051*	0.055*		0.052
60						0.044*	0.052*	0.046*	0.046*	0.048
65							0.047*	0.050*	0.039*	0.043
70								0.048*	0.046*	0.036
Average	0.013	0.034	0.049	0.054	0.056	0.057	0.055	0.051	0.047	

Notes: This table presents the elasticities for different cohorts (indexed by birth-years) at different ages. It also reports the average elasticities over the ages (last column) and over the cohorts (last row). The sub-panels refer to the consumption elasticities out of income, financial, and housing wealth, respectively.

*denotes significance at the 5% level.

born in 1930 at age 70). This range encompasses the Bostic *et al*. (2009) result of 0.02, albeit this averaged value masks a wider range of elasticities.

Differences in the range of elasticities are even more pronounced when we look at the consumption elasticities of housing wealth. Age and cohort specific elasticities range from –0.005 (age 35, birth-year 1970) to 0.073 (age 35, birth-year 1955), resulting in averaged age elasticities ranging from about 0.035 to about 0.053, and averaged cohort elasticities ranging from 0.013 to 0.057. These results are consistent with the 0.06 result from Bostic *et al*. (2009), and there is some support for the result in Attanasio *et al*. (2009) using the U.K. Family Expenditure Survey (FES) data, that the consumption elasticity is stronger for younger members of the same cohort.

Overall, the results suggest that consumption elasticities have both age and cohort effects. Since standard errors can also be generated for each of the derived elasticities, we also had a closer look at the significance of each estimated elasticity. There are too many results to present, but the asterisks in Table 5 denote significance at the 5 percent level. Instances when the elasticities were not significantly different from zero include, for example, the elasticities of consumption with respect to financial wealth, aged 40, cohort birth-years 1950, 1955, 1960, and 1965. We also find that the elasticities of some contiguous age/cohort groupings were not significantly different from each other (for example, while each of the elasticities of consumption with respect to income, aged 40, for cohort birth-years 1965 and 1960 were significant, they were not significantly different from each other). On the other hand, the elasticities of consumption with respect to housing wealth for persons aged 40 in cohort birth-years 1965 and 1950 were significantly different from each other.

5.3. *Age, Cohort, and Period Profiles*

To help interpret the results, we also generated averaged profiles. For instance, the implied age profiles can be obtained by averaging over the ($J = 18$) cohorts in each age group $i = 26, \ldots, 70$:

$$\beta_i = \frac{1}{J}\sum_{j}^{J}\beta_{ij}; \quad j = \tau - i; \quad \tau = 1988, \ldots, 2005.$$

The implied cohort profiles for birth-year $j = 1918, \ldots, 1979$ can be calculated as:

$$\beta_j = \frac{1}{T}\sum_{i=26}^{70}\beta_{ij}; \quad i = \tau - j; \quad \tau = 1988, \ldots, 2005;$$

$$T = \begin{cases} j - 1917 & \text{for } j = 1918, \ldots, 1935 \\ 18 & \text{for } j = 1935, \ldots, 1962 \\ 1980 - j & \text{for } j = 1963, \ldots, 1979 \end{cases}$$

Although the range of the cohort j is over all the birth-years in the sample, it should be noted that the cohort born in 1918 appears only once aged 70 in 1988, while those born in 1979 appear only once aged 26 in 2005. We can also generate the implied period profiles since we know the composition of age and cohort at each point in time. For $t = 1988, \ldots, 2005$, averaged over $I = 45$ ages:

$$\beta_{\tau} = \frac{1}{I}\sum_{i}^{I}\beta_{ij}; \quad j = \tau - i; \quad i = 26, \ldots, 70.$$

A selection of the average values is shown in the last row and column in each of the sub-panels in Table 5.

Figure 3 plots the age, cohort, and period profiles of the consumption elasticities with respect to income and wealth. The plot includes only those averaged values that are significantly different from zero (determined by checking each of the estimated elasticities across age, cohort, and period). They present different perspectives on the results. The age profiles for income and housing wealth profiles are hump-shaped and accord with life-cycle models. In particular, these elasticities rise quickly from age 26 to 40 as families are formed, and personal income increases. From age 40 to 60, the elasticities are relatively flat and from age 60+, as income falls with retirement, the consumption elasticity with respect to income drops off while that with respect to housing wealth tapers off. The elasticity of consumption to financial wealth is a shallow U-shape, having a greater effect after age 60+.

The cohort profiles show the influence of generations—the silent generation who lived through the Great Depression (birth-years 1925–45), the baby-boomers (1946–64), and generation X (1965–79)—and they reinforce the results from the age-profiles (because the older generations are also older in age in the sample). The results show the importance of financial wealth to the baby-boomers (the generation widely associated with privilege, as many grew up in a time of affluence) and generation X. But while housing wealth was important for the baby-boomers, housing wealth detracted from consumption for the younger generation X.

The period profiles also give some insight into generational influences as the different waves grow through the sample. Note that the baby-boomers dominate the results in the 1990s, and this explains the higher consumption elasticities with respect to financial wealth over those calendar years. The period profiles also show the influence of the recession in the early 1990s and the early 2000s on consumption. During these years, the elasticity of consumption from income increased while the elasticity of consumption from housing wealth fell. As income and housing wealth would have fallen in those recession years, these results suggest that households relied more on an increase in income than an increase in wealth to sustain their consumption expenditures in recession years.

To highlight the elasticities over different stages of the business cycle, we grouped the estimated results into three sets corresponding to low, moderate, and high economic activity. The scatter graph in Figure 4 shows the range of variation, but more importantly, they also show that the propensities to consume out of income during periods of low growth (which includes the recession years) are not that different from the relationship during periods of high activity (the boom years). In other words, the income–expenditure relationship appears to be quite stable once assets that can shape consumption are taken into account.[16]

[16]We thank a referee for suggesting we group the results to examine whether the income–expenditure relationship is similar across recession and boom times.

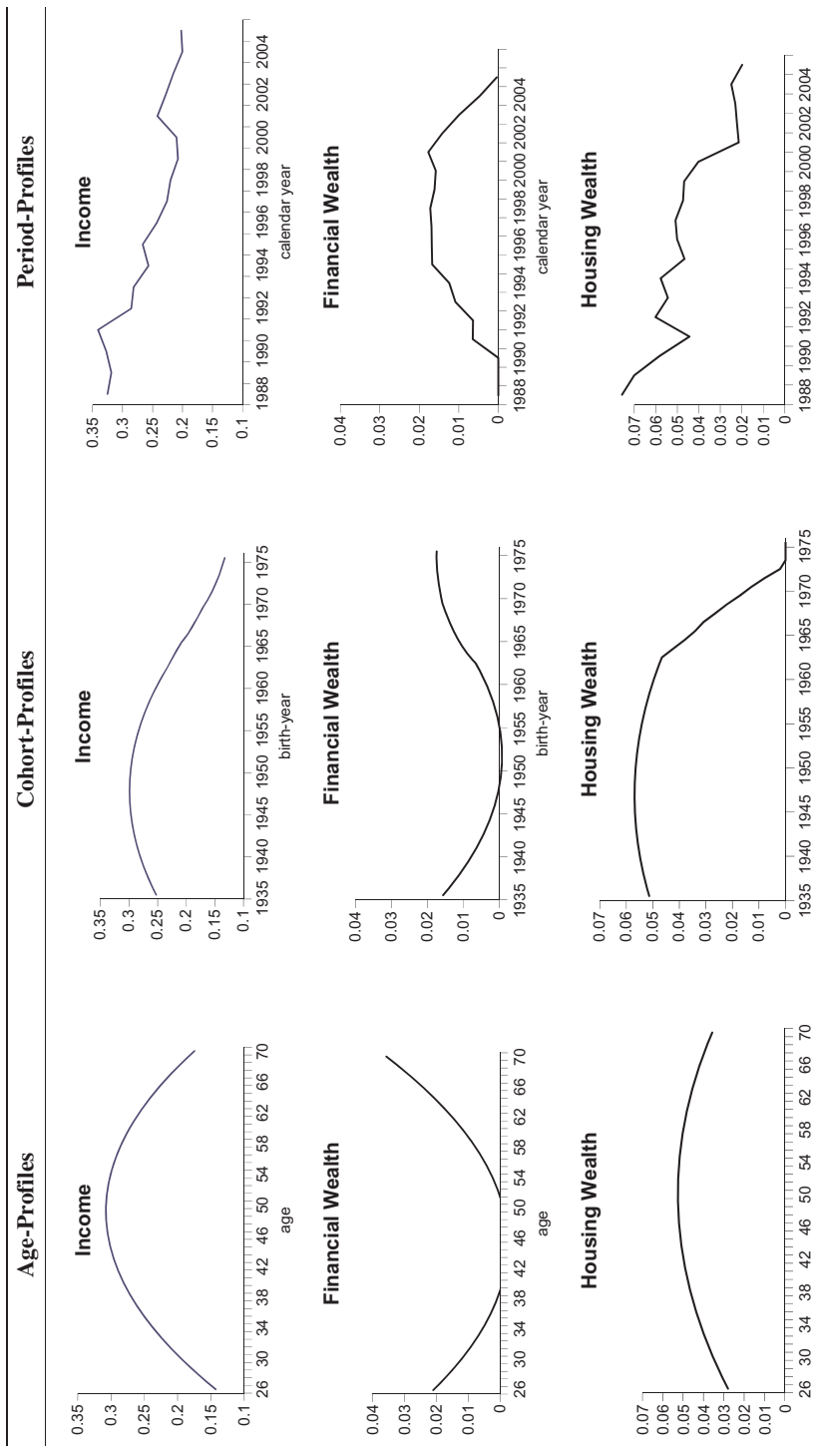

Figure 3. Elasticities of Consumption with Respect to Income and Wealth

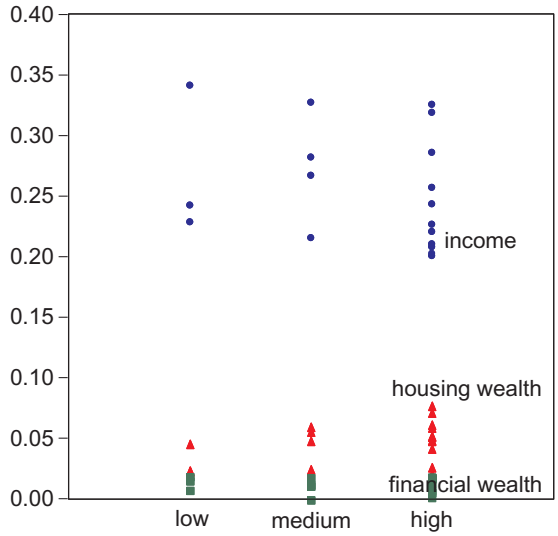

Figure 4. Variations in Elasticities and Economic Activity

The results show that the changes in period elasticities noted by Brady and Stimel (2011) can also be partly attributed to age and cohort effects. Furthermore, the pre-retirement results support Campbell and Cocco (2007) in showing that the effect of housing wealth on consumption increases with age, and also Bostic *et al.* (2009) in showing that the elasticities associated with housing wealth are larger than those associated with financial wealth. This means that the adverse effects of a fall in housing wealth can be more serious than an equivalent fall in share prices. However, post-retirement, financial wealth is more important than housing wealth.

It would be appropriate at this juncture to note an important qualification. The estimated elasticities reported here, relate percentage changes in consumption to percentage changes in income, financial, and housing wealth without specific reference to the nature of the changes in income and/or wealth. However, consumption responses to capital gains (associated with shares and/or house prices) may be different from consumption responses to, say, bonuses. In other words, the nature of the changes in income and wealth may matter. Future research could extend the analysis here to allow for further disaggregation of the sources of income and wealth.

6. Conclusion

This paper estimates elasticities to consume from income, housing wealth, and financial wealth allowing for cohort, age, and period effects. A framework is proposed to disentangle these effects and the empirical analysis is based on the U.S. Consumer Expenditure Survey data from 1988 to 2005. The main advantage of the framework is that it yields estimates which are specific to a particular age and cohort. Thus we provide evidence of the range of elasticities implicit in the results about consumption and wealth, thus far reported in the literature. In particular, we find that there is evidence of generational heterogeneity, and hence

age-only results (averaged over cohorts) typically underestimate the consumption elasticities.

The results generated reinforce the evidence of humped shaped age-profiles for the income elasticity and the importance of financial wealth for those aged 60+. But, by being explicit about cohort effects we also find evidence of the negative role of housing wealth for generation X, and evidence of the positive role of financial wealth for the baby-boom generation.

There are three implications of these results. First, they reinforce the importance of cohort, period, and age effects in the study of intertemporal choices between consumption and savings (and hence financial and housing wealth accumulation). Second, the age profiles have implications for the design of policies for an ageing population and in particular, the importance of financial wealth for those aged 60+. Third, while both housing and financial wealth have significant effects, the elasticity of the former is larger for the pre-retirement ages, suggesting greater adverse effects of a fall in housing wealth compared to a fall in financial wealth. This result is important because a risk-averse consumer can choose to avoid risky holdings of financial assets, but cannot avoid consuming housing services. The paucity of financial data in the CEX database, unfortunately precludes a more detailed study of the influences of different types of financial assets (in the financial wealth portfolio) on consumption.

To conclude, this paper provides evidence of generational heterogeneity in consumption behavior, namely that people of the same age, but born at different times, have different propensities to consume. This means that the range of consumption elasticities is broader than previously reported, but more importantly, the study also identifies the cohorts where economic cycles have been especially important in shaping consumption behavior.

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Supporting Information

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Appendix: Description of the Dataset