Measuring Wealth Effects Using U.S. State Data[*]

Christopher D. Carroll
ccarroll@jhu.edu
JHU

Xia Zhou
xia_zhou@fanniemae.com
Fannie Mae

October 26, 2010

Abstract

This paper describes a new panel dataset of financial wealth for U.S. states constructed from anonymous proprietary account-level records on geographic wealth holdings. The new data set is more comprehensive and representative than existing alternative measures. The paper also constructs significantly improved state-level consumption data, then combines these datasets to provide new estimates of effects on consumption from changes in stock and housing wealth. I find large but sluggish housing wealth effects. The estimated response of consumption to a one dollar change in housing wealth that happened two years ago is above 6 cents. Surprisingly, the data show no evidence for significant stock wealth effects, although large standard errors mean that the differences from housing wealth effects are statistically insignificant.

Keywords: regional data, consumption, housing wealth effect, financial wealth effect

[*]We would also like to thank Prof. Jon Faust, Prof. Laurence Ball, Prof. Louis Maccini, Dr. Michael Palumbo, Dr. Kevin Moore, and seminar participants at the Macro Lunch Seminar of the Economics Department of Johns Hopkins University for their insightful comments and discussions on earlier drafts of the essays in this dissertation. We are also grateful to IXI Corporation for permitting us to create the financial wealth data at the state level and use it for our study in this paper.

1 Introduction

During the second half of the 1990s, a skyrocketing stock market boosted the wealth holdings of American households; at the same time, the personal saving rate dropped from about 8 to 2 percent. This so-called "saving rate puzzle" sparked renewed policy and research interest in the wealth effects on consumption. Figure 1 shows a relatively stylized negative correlation between the saving rate and the net worth to income ratio, which implies a positive correlation between wealth and consumption after controlling for the income effect.

If it is the rise in wealth that is driving down the personal saving rate, we should expect that future variations in wealth will have an impact on consumption. Consequently, wealth effects should be taken into consideration when implementing monetary policy. We should be skeptical, however, about the seemingly obvious relationship between consumption and wealth for a variety of reasons. First, the association we observe in Figure 1 could be mainly the result of simultaneity. For instance, any shock to consumers' optimism or pessimism could have an impact on housing prices, stock prices, and consumption growth in the same direction. Second, endogeneity could also be triggered by a reverse causality of consumption on wealth. Given the presence of heterogeneity, aggregation is another problem, as summing up individuals might not produce a representative consumer. In addition, measurement errors could lead to unreliable associations. To give an example, assume that income Y is measured with error. Through construction then, the personal saving rate, $s = 1 - C/Y$, will also be mis-measured in the same direction as Y. At the same time, the measured wealth-income ratio W/Y will be biased in the opposite direction. The measurement error in income will thus induce a negative correlation between the saving rate and the worth to income ratio.

Most of the current literature on wealth effects employs either aggregate or household-level data. Studies using aggregate data are subject to endogeneity and aggregation problems. On the other hand, studies using household-level data suffer from serious measurement error problems. There is, in fact, a very limited choice of household-level data available for carrying out such studies. For instance, the *Panel Study on Income Dynamics* (PSID) only measures food consumption, while the *Consumer Expenditure Survey* (CEX) has detailed but noisy data on household expenditures and poor financial information. *The Survey of Consumer Finances* (SCF) provides no measure of consumption at all.

An alternative approach, one that potentially avoids some of the problems related to both aggregate and household-level data, is to utilize regional variation. First, aggregation is likely to be less of a problem when less aggregated data is used. Second, if there is sufficient variation across regions, the endogeneity problem might be better controlled. For instance, let us assume a region-specific shock to consumers' confidence, one that might also have a large impact on the consumption behavior of households in the region. However, if a well-integrated stock market exists, this region-specific shock might not have as great an impact on regional stock prices as an aggregate shock would. Therefore, the endogeneity problem is alleviated to some extent. On the other hand, it can be argued that regional data provides more comprehensive and better measures of the relevant variables than household-level data. Furthermore, regional data is more likely to cover a longer time period and therefore allow for richer dynamics.

Case, Quigley, and Shiller (2005) did pioneering work using U.S. state-level data to estimate and compare housing wealth effects and stock wealth effects. This paper extends their work in several aspects. We construct a new panel dataset of financial wealth for U.S. states, using anonymous proprietary account-level records of geographic wealth holdings. The new dataset is more comprehensive and representative than existing alternative measures. This paper also improves upon Case, Quigley, and Shiller (2005), in that we construct a significantly improved state-level proxy for consumption data. These datasets are then combined to provide new estimates of the wealth effects on consumption from changes in stock and housing wealth. The rest of the paper is organized as follows: Section 2 reviews the related literature; Section 3 discusses the limitations of the currently available state-level consumption and stock wealth datasets; Section 4 describes the newly constructed data; Section 5 presents the model specification and regression results; and Section 6 concludes.

2 Recent evidence

The current literature on the marginal propensity to consume (MPC) out of different components of wealth is limited. Davis and Palumbo (2001) compared the stock market wealth effect with the non-stock market wealth effect using U.S. aggregate data. The results, derived from a co-integration analysis, are, however, sensitive to model specifications. Specifically, the long-run effects of both types of wealth are about the same (i.e., 0.06 for stocks and 0.08 for non-stocks) when the level of variables is used. Using logarithms, however, the results show an elasticity for non-stock wealth four times greater than that for stock wealth; this implies that the MPC out of non-stock wealth is at least twice as large as the MPC out of stock wealth. Additionally, using aggregate data (though applying a different method), Carroll, Otsuka, and Slacalek (2006) reported an immediate MPC out of housing wealth of about 1.5 cents and an immediate stock wealth MPC of 0.75. The difference, however, is found to be statistically insignificant from zero.

Levin (1998) appears to be the first study in the U.S. that using household-level data to estimate the differential effect of housing and stock wealth. Using the Retirement History Survey, Levin found that housing wealth has essentially no effect on consumption. Out of eight spending categories, only three reported a statistically significant difference between the respective coefficients for liquid and housing wealth. This finding contradicts the studies using aggregate data summarized above. A possible reason could be the fact that every interviewee in the survey is at least 65 years old. If elderly people tend to view housing wealth more as consumption than as an investment item, their housing wealth effect will be lower than would otherwise be the case. Using the CEX and SCF, Bostic, Gabriel, and Painter (2005) find that, while incorporating all households in their sample, there is no evidence for an important housing wealth effect. Among home owners, however, the housing wealth elasticity is found to be consistently significant and larger than the stock wealth elasticity. Their paper also suggests different consumption behaviors for credit-constrained versus non credit-constrained samples.

Among those who use panel data, Case, Quigley, and Shiller (2005) are probably the most cited in the current literature. Using quarterly U.S. state-level data for 1982 through 1999, the authors found a significant housing wealth elasticity of about 5 percent, but an economically negligible stock wealth elasticity under most model specifications. When using a panel of annual data for 14 developed countries, they found an even larger housing wealth elasticity, in the range of 11 – 15 percent. Nonetheless, under all cases, they found no evidence for an important stock wealth effect. Bayoumi and Edison (2003) used data for 16 industrial countries and found significant wealth effects for most samples and periods. Their estimated housing wealth effect was consistently larger than their estimated equity wealth effect. Ludwig and Sløk (2002) found evidence contrary to the studies cited above. Using annual data from 16 OECD countries, and taking housing prices and stock market prices as proxies for their respective wealth components, the authors reported an estimated stock wealth elasticity twice the estimated housing wealth elasticity. Additionally, both estimates were found to be positive and statistically significant. On the other hand, Girouard and Blöndal (2001) also used OECD data, but were unable to arrive at consistent results when comparing housing wealth with financial wealth. Dvornak and Kohler (2003), using Australian state-level data, found a larger stock wealth effect than housing wealth effect.

3 Limitations of existing state-level consumption and stock wealth data

Case, Quigley, and Shiller (2005) have constructed the only measure of quarterly state-level stock wealth for the U.S. for the period 1982 through 1999. They obtained annual information on mutual fund holdings at the state level, which is only available for the years 1986, 1987, 1989, 1991, and 1993. In order to construct stock wealth data, the authors needed to make two restrictive assumptions. First, they assumed that the proportion of mutual funds out of financial assets was constant. However, Figure 2 plots the proportion of mutual funds out of total stock wealth, and shows an evident increase in that proportion over time. Second, they assumed a constant asset distribution across states for those years during which mutual fund data were not available. During those years, then, the stock wealth of each state should, based on the construction, mimic the movement of aggregate stock wealth. Given the limited presence of real wealth distribution across states, the data is not a good proxy for state-level financial wealth growth.

To the best of my knowledge, there exist three distinctive state-level consumption datasets – those used by Asdrubali, Sorensen, and Yosha (1996); Case, Quigley, and Shiller (2005); and Garrett, Hernàndez-Murillo, and Owyang (2004). Of these, only Case, Quigley, and Shiller (2005) utilized the data to examine wealth effects. The consumption data used by Asdrubali, Sorensen, and Yosha (1996), and Case, Quigley, and Shiller (2005) were constructed from retail sales based on different private sector sources. However, in both cases, the quality of the data derived from the private sources is questionable, for a variety of reasons. First, the methodology used in the data construction is never explicitly revealed by either private source. Second, retail sales are presented for states that do not implement sales tax, which constitutes perhaps the single most important source for calculating state retail sales after the Census Bureau ceased reporting monthly retail sales by state, in 1997. Last but not least, both sources vaguely note that important state variables like wage and employment are incorporated into the estimation of retail sales. As a result, the datasets will induce unreliable estimations of the relationship between consumption and any variable that is correlated with wage or employment.

Garrett, Hernàndez-Murillo, and Owyang (2004) computed quarterly retail sales by dividing sales tax revenue by the sales tax rate. The data is potentially a good measure of state retail sales, and thus is generally adopted in this paper. One problem with this, however, is that the sales tax revenues are measured with serious errors; this results in unreasonably large consumption variations and apparent outliers. Therefore, this paper improves upon the data used in Garrett et. al. (2004) by constructing more accurate measures of state retail sales, and by explicitly accounting for outliers.

4 Data description

This paper uses a panel dataset for 44 U.S. states as well as Washington, D.C., at a semi-annual frequency for the period 2001 through 2005. The newly constructed datasets are for stock wealth and consumption at the state level. Other important variables include after-tax labor income and housing wealth. All are expressed in real per capita terms. There is evidence that the new data is more comprehensive and accurate than other existing alternatives. Some important findings will be discussed in the rest of this section. More detailed discussions can be found in Zhou (2010).

4.1 Stock wealth data

The author obtained anonymous account-level records on financial wealth holdings at the ZIP+4 Code level from the IXI Corporation. At the end of each semiannual cycle, IXI collects data from more than 85 leading financial institutions in its network, IXI▶Net™. Reporting institutions include major banks, brokerage firms, insurance companies and mutual fund dealers. Additional information can be found in Chapter 2 of Zhou (2010).

Stock market wealth is defined as the sum of directly and indirectly held (i.e., investments, in the form of IRA and Keogh accounts) stocks and mutual funds. Stock wealth growth is constructed using a consistent method for all 50 states plus the District of Columbia.[1] The geographic distribution of stock wealth growth is plotted in Figure ??. We find similar patterns across states, something to be expected given the fact that the U.S. stock market is so well integrated. However, whether the state heterogeneity manifested in the figure reflects reality cannot be readily answered, as there exists no alternative state-level wealth data with which we might make comparison.

Nevertheless, there are some stylized facts about the U.S. that could help us make a judgment. Florida and Arizona are the two states that have the highest percentage of retired people. As reflected in Figure ??, their seasonal patterns also distinguish them from other states. In order to better illustrate the differences, Figures 3(a) and 3(b) compare the stock wealth growth of Florida and Arizona with the average stock wealth growth of the other states. Both figures indicate that Florida and Arizona have a much higher stock wealth growth rate than the other states during the second half of each year, and a much lower stock wealth growth rate during the first half of each year. This phenomenon might seem strange at first glance, but is actually an outcome of the "snow-bird effect." In the U.S., retired people tend to move to Florida and Arizona during the winter and then move back to their permanent residences once the winter is over. If such individuals update their physical mailing addresses with their financial institutions each time they relocate, they effectively bring their assets along with them.[2] Along with a single measure of population over the course of one year, we should expect that the "snow bird" effect to be fully captured by stock wealth growth at semiannual frequencies. Figures 3(a) and 3(b) therefore provide another piece of evidence that the heterogeneity found in the data corresponds to reality.

A substantial effort was extended to find other potential state-level financial resources with which the new data could be compared. Thus, for instance, Bloomberg reports local stock indices for 22 states, the growth of which is expected to positively but not perfectly

[1]Details on its construction can be found in Chapter 2 of Zhou (2010).

[2]As per the practice of the IXI corporation, the assets are now considered as belonging to the Zip Code +4 of the updated new address.

correlate with local stock wealth growth. Figure 4 presents the correlation between the local stock index and local stock wealth, broken down graphically. Out of the 23 calculated correlations, we find only 2 negative numbers. At the state-specific growth level, defined as state growth minus the U.S. national component, there are still 15 positive correlations. These facts further provide supporting evidence that the data reflects a true distribution of stock market wealth across states.

4.2 Consumption data

Since measures of personal consumption expenditure (PCE) at the state level are not available in the U.S., retail sales are used as a proxy for consumption. In the U.S., national retail sales account for roughly half of PCE, and *The Retail Trade Survey* is probably the single most important source for the national PCE estimation carried out by the Bureau of Economic Analysis (BEA).[3] These considerations provide us with a rationale for using retail sales in place of consumption.

However, even retail sales data is not directly available in the U.S. at the state level. Following Garrett, Hernàndez-Murillo, and Owyang (2004), quarterly state-level general sales tax revenues can be obtained from the *Quarterly Summary of State and Local Government Tax Revenue*, published by the U.S. Census Bureau. Together with general sales tax rates collected from various sources,[4] state-level retail sales are computed by dividing the state general sales tax revenue by the general sales tax rate. One limitation of this method is that it can be applied to 45 states and the District of Columbia. Nevada, however, is dropped in this study because of its discontinued data report and obvious poor data quality.

Strictly speaking, the computed retail sales are only one component of real retail sales, as they exclude items that are either not subject to sales tax or are part of special tax pro-

[3]See Wilcox (1992).

[4]The state general sales tax rate can be found from various sources such as the *State Government Tax Collections*, and the Tax Foundation's *Facts and Figures on Government Finances*.

grams, i.e., liquor and cigarettes. Furthermore, there is serious measurement error problem with the computed retail sales. The author, however, found state-level government-reported (taxable) retail sales for 12 states for the same period during which state-level stock wealth data is available.[5] These measures are more comprehensive than the computed retail sales, as they either include all consumption items (such as when government-reported gross retail sales are used) or at least include those items that are part of special tax programs.[6] Furthermore, these government-reported measures should be more accurate and reliable than the computed ones, since local governments have access to more information regarding their own sales tax system and tax collection practices than other people do.[7]

Ideally, government-reported (taxable) retail sales should be used as a measure of consumption. However, since they are only available for a limited number of states, this paper compiles three sets of consumption data according to the quality of the retail sales data. The first one includes those 12 states that have government-reported retail sales or taxable retail sales; it is categorized as "Best Data". The second set is called "Combined Data,"[8] and includes "Best Data" along with the computed retail sales for the other states. The third set is called "Good Data," which includes "Combined Data" with outliers taken care of. Please refer to the third chapter of Zhou (2010) for a more detailed discussion of the consumption data.

4.3 Data from other sources

Other important variables used in this paper include quarterly after-tax labor income and housing wealth. After-tax labor income is calculated following Lettau and Ludvigson (2001). The formula used to construct state-level housing wealth is similar to the one adopted by

[5]Data are obtained from the websites of the respective state tax administrations.

[6]Special tax programs notably constitute roughly 25 percent of total sales tax revenue.

[7]They are either calculated by local governments (as in Virginia), or are derived directly from the reports on dealers' returns (as in Iowa).

[8]This paper also examined the wealth effects using another set of dataset that only incorporates the computed taxable retail sales. Please refer to Table 3 for discussions of the results.

Case, Quigley, and Shiller (2005), and is given as follows:

$$w^h_{i,t} = (HO_{i,t} * HH_{i,t}) * HPI_{i,t} * HV_i,$$

where w^h_i is the value of the owner occupied housing wealth for state i; HO is the home ownership rate, taken from the Census Bureau; HPI is the weighted repeat sales housing price index, taken from the Federal Housing Finance Agency (FHFA); and HV is the average home price for 1999, taken from the 2000 Census.

4.4 Data issues

One important data issue arises here. As mentioned above, all variables except the stock market wealth are available at quarterly frequencies. To make them analogous to the stock market wealth, this paper takes their means over the quarters for each half-year, thus converting them into semiannual frequencies.

The dataset, however, features evident and sizable seasonal patterns at the semiannual frequency, especially for the constructed consumption data. The author has made a considerable effort at removing them in a consistent fashion, but was unable to do so at the semiannual frequency. This is largely because of the heterogeneity of seasonal patterns across states and the relatively short time horizon. Nevertheless, many state governments recommend using longer time spans for more reliable trends. It should be recognized that measures of taxable sales (or revenue) at higher frequencies could be misrepresentative for the purpose of comparison. This is because of timing errors over the year-long period. The above consideration recommends using annual growth rates so as to eliminate seasonal effects, at the cost of fewer observations and thus a reduced regression power.

Additionally, to avoid a time aggregation problem, annual averages are not used to calculate growth rates. Instead, $\Delta c_{i,t}$ is computed as the log difference between consumptions for the first half of year t and for year $t-1$. The first half was chosen in consideration of the fact that the state fiscal year ends on June 30. It is arguable that data collected towards the end of a fiscal year is more accurate than data collected at any other time of year.

4.5 Another look at the new data

Since this paper relies heavily on the two newly constructed datasets, before examining the wealth effects, the data is again examined closely by estimating the following equation:

$$\Delta c_{i,t} = \alpha_t + \beta_1 \Delta y_{i,t} + \beta_2 \Delta w_{i,t}^f + \beta_3 \Delta w_{i,t}^h + \varepsilon_{i,t}, \tag{1}$$

where Δ denotes the growth rate of a variable, i.e., the log difference of the variable in real per capita terms. Equation 1 is a simple description of the data without taking into consideration simultaneity and aggregation problems. Table 1 reports the results for all three datasets. It shows that income growth is the one variable that consistently has the largest and most significant coefficient. Perhaps the most interesting finding is that there is evidence that consumption positively correlates with the growth rates of both housing wealth and stock wealth when they are regressed separately. Conversely, whenever income growth is included, their respective coefficients become much less significant, in connection with the reduced sizes. The data archive that can produce all results in this study is available from Johns Hopkins library, at URL: http://jhir.library.jhu.edu/handle/1774.2/34267.[9]

5 Regressions

5.1 Wealth effect estimations

Most studies in the current literature, particularly those that focus on the immediate response of consumption to wealth, adopt regressions similar to those used in Equation 1.[10]

[9] Instructions on how to obtain the new data of financial wealth growth rate for U.S. states can be found in the read me file for the data archive.

[10] Cointegration analysis is another standard method used in the current literature to study long-term MPCs. Nevertheless, given the relatively short time horizon, the data used in this paper does not allow for

However, such regressions do not yield straightforward wealth effects, since they only report the contemporaneous percentage correlation between consumption and wealth. Worse, tests of equal stock and housing wealth effects do not produce transparent results.[11] In order to solve this problem, this paper adopts an approach similar to that employed by Carroll, Otsuka, and Slacalek (2006), wherein they use the ratio of the change in each variable relative to an initial level of after-tax labor income. Put another way, if we define

$$\Delta\tilde{c}_{i,t} = \frac{C_{i,t} - C_{i,t-1}}{Y_{i,0}}$$
$$\Delta\tilde{y}_{i,t} = \frac{Y_{i,t} - Y_{i,t-1}}{Y_{i,0}}$$
$$\Delta\tilde{w}^h_{i,t} = \frac{W^h_{i,t} - W^h_{i,t-1}}{Y_{i,0}}$$
$$\Delta\tilde{w}^f_{i,t} = \frac{(W^f_{i,t} - W^f_{i,t-1})}{Y_{i,0}},$$

where $Y_{i,0}$ is the state after-tax labor income at 2000h1, then the following regression

$$\Delta\tilde{c}_{i,t} = \alpha_t + \beta_1\Delta\tilde{y}_{i,t} + \beta_2\Delta\tilde{w}^f_{i,t} + \beta_3\Delta\tilde{w}^h_{i,t} + \Delta\tilde{\varepsilon}_t, \qquad (2)$$

will potentially produce direct measures of the MPC out of the changes in housing wealth and stock wealth.

As with Equation 1, Equation 2 is subject to serious endogeneity problems, and thus is considered as simply another data description. Table 2 indicates that under this model specification, income change is still the most correlated variable with respect to consumption.

such an analysis. Additionally, cointegration analysis is intrinsically problematic. The most relevant problem with respect to income and wealth effect analysis is the requirement that the cointegrating vectors remain stable, which in turn requires a stable saving rate. This requirement, however, obviously runs contrary to what the data tells us, as illustrated in Figure 1.

[11] One benefit of such estimations is that they produce certain results comparable to those in the current literature. For the sake of comparison, the results of similar estimations are included in the appendix of this paper.

In order to resolve the endogeneity and simultaneity problem that Equation 2 is subject to, we briefly revisit classic consumption theory. The relationship between consumption and wealth/income can be described by the Life-Cycle/Permanent Income Hypothesis. Specifically, a consumer wants to

$$\text{MAX } E_t[\sum_{s=t}^{\infty} \beta_{s-t} u(c_s)]$$

subject to the budget constraint, where β is the time preference, and $u(c_t)$ is the utility function. If the utility function takes a quadratic form as assumed in Hall (1978), it can be easily shown that, under certain conditions, consumption will follow a random walk, i.e.,

$$\Delta c_{t+1} = \epsilon_{t+1},$$
$$E_t[\epsilon_{t+n}] = 0 \ \forall n > 0$$

Thus, the theory implies that consumption responds to unexpected shocks only. In other words, information known to consumers at the time when consumption choices are made cannot have any predictive power for consumption changes in any future periods.

The random walk proposition, therefore, can help us alleviate the endogeneity and simultaneity problem, as it suggests that current consumption growth would not react to any lagged wealth growth. Nevertheless, time aggregation and measurement error could cause current consumption changes to correlate with once lagged income and wealth changes, even if the PIH holds true. Aggregation also matters when the PIH holds in continuous time, and the measures of consumption are based on time averages. Under this situation, changes in time-averaged consumption will have nonzero first order serial correlations; this will lead to nonzero correlations between changes in consumption and once-lagged variables. It is also easy to prove that measurement errors in the consumption level could cause measured consumption changes that correlate with once-lagged explanatory variables.[12] Given the above considerations, the following equation is employed to address the question of wealth effects[13]:

$$\Delta\tilde{c}_{i,t} = \alpha_t + \beta_1\Delta\tilde{y}_{i,t-2} + \beta_2\Delta\tilde{w}^{f}_{i,t-2} + \beta_3\Delta\tilde{w}^{h}_{i,t-2} + \Delta\tilde{\varepsilon}_t. \quad (3)$$

Equation 3 employs twice-lagged independent variables, and thus reports MPCs out of changes in housing wealth and stock wealth that occurred two periods prior.

There are, however, two minor modifications that need to be made. First, what $C_{i,t}$ captures here is not the real personal consumption for state i, but the state's taxable retail sales. Thus, using $C_{i,t}$, the estimation of Equation 3 actually yields the effect of changes in wealth on taxable retail sales. To gauge the approximate change in real consumption, it is assumed that initial state consumption can be determined by $C^*_{i,0} = Y_{i,0} * \frac{C^*_0}{Y_0}$, where C^*_0 and Y_0 are aggregate personal consumption expenditure and after-tax labor income, respectively. In addition, we assume that the ratio of retail sales to real consumption holds constant over time, i.e., $\frac{C_{i,t}}{C^*_{i,t}} = \frac{C_{i,0}}{C^*_{i,0}}$. Therefore, changes in state consumptions can be measured roughly by

$$\begin{aligned}(C^*_{i,t} - C^*_{i,t-1}) &= (C_{i,t} - C_{i,t-1}) * (\frac{C^*_{i,0}}{C_{i,0}}) \\ &= (C_{i,t} - C_{i,t-1}) * (\frac{C^*_0}{Y_0}\frac{Y_{i,0}}{C_{i,0}}).\end{aligned}$$

The same problem arises when measuring stock wealth. Thus, it is assumed for all states and time periods that $\frac{W^f_{i,t}}{W^{f*}_{i,t}} = \frac{W^f_{IXI,0}}{W^f_{FFA,0}}$, where $W^{f*}_{i,t}$ denotes the real state stock wealth at time t.

[12]Let us assume that $c_t = c_{t-1} + \varepsilon_t$ and $c_t = c^*_t + \upsilon_t$, where c_t is real consumption, c^*_t is the measured consumption, and υ_t is the measurement error. Although real consumption growth follows a random walk, the measured consumption growth, $\Delta c^*_t = \varepsilon_t - (\upsilon_t - \upsilon_{t-1})$, is correlated with the once-lagged information.

[13]IV regression is another commonly used method to solve endogeneity problems. However, variables lagged by two years have weak explanatory power, especially for income and stock wealth growth. Thus, it would lead us to another econometric issue – weak instruments.

Therefore, if we redefine

$$\Delta\tilde{c}_{i,t} = \frac{C_{i,t} - C_{i,t-1}}{Y_{i,0}} * (\frac{C_0^*}{Y_0}\frac{Y_{i,0}}{C_{i,0}}) \tag{4}$$

$$\Delta\tilde{w}_{i,t}^f = \frac{(W_{i,t}^f - W_{i,t-1}^f)}{Y_{i,0}} * \frac{W_{FFA,0}^f}{W_{IXI,0}^f}, \tag{5}$$

the regression of Equation 3 ends up reporting approximate estimates of the MPC out of changes in housing wealth and stock wealth.

Table 3 summarizes the results of our estimations using Equation 3. It indicates that all three datasets report similar results, with the exception that none of the estimations from "Best Data" is statistically significant. It is, however, well expected, given the small sample size of "Best Data."

Table 3 shows that the coefficients of income changes are all positive and large. Furthermore, they are statistically significant by using both "Combined Data" and "Good Data". It therefore implies that income changes have a fairly big impact on consumption, despite the two-year lag. This, however, contradicts the random walk theory as predicted by the Permanent Income Hypothesis.

The wealth effect caused by changes in financial wealth, on the other hand, is found to be both significant and negligible. This finding is consistent with Dynan and Maki (2001), who found that the impact of stock wealth on consumption very quickly becomes apparent, and any lagged changes in stock wealth beyond 9 months does not have any significant effect on consumption.

However, we observe highly significant and large coefficients for housing wealth in two out of the three datasets. Additionally, all three datasets indicate that an MPC out of housing wealth changes occurs two years prior around the neighborhood of 6 cents. The main reasons why the response to housing wealth shocks may be slower than the response to financial wealth shocks are: Unlike stock prices that can be easily tracked daily online or in newspapers, house prices cannot be accurately and regularly observed. Actually, homeowners might be less aware of short-run changes in house prices and it might take a homeowner a while to realize that his/her house price has changed. Additionally, the cost of realizing capital gains on housing wealth is lumpy. As a result, the response to housing wealth growth is not likely to be spontaneous.

What is more interesting is that the difference between the housing wealth effect and the stock wealth effect is found to be statistically significant for "Good Data," and on the verge of being significant for "Combined Data." Therefore, in the presence of the consistently larger point estimates for the housing wealth effect, when implementing policies and making macroeconomic forecasts, monetary policymakers should be alert to the different impacts on consumption generated by movements in the housing and stock markets respectively.

5.2 A habit formation test

The above estimations only report the relatively immediate impact of wealth changes on consumption. In place of a cointegration analysis, this paper applies a method proposed by Carroll, Otsuka, and Slacalek (2006) for deriving "long term" wealth effects. The basic idea is, if there is evidence of habit formation, consumption growth will be serially correlated. Thus, any impact that wealth changes have on consumption could be delivered over the very long run through a serial correlation of consumption growth. The long run wealth effect then can be derived by dividing the short run wealth effect by one minus the habit formation coefficient. Following the relevant literature, the following equation is employed as a habit formation test:

$$\Delta\tilde{c}_{i,t} = \alpha_t + \lambda E_{t-2}\Delta\tilde{c}_{i,t-1}. \tag{6}$$

Table 4 reports the estimations using Equation 6. Using currently available state-level instruments, the results provide no evidence of habit formation.[14] This could be because of the short time horizon of the data. Consequently, the estimation for habit formation remains as an interesting topic for future research.

6 Conclusion

This paper describes a new panel dataset of financial wealth for U.S. states, constructed from anonymous proprietary account-level records of geographic wealth holdings. The new dataset is more comprehensive and representative than existing alternative measures. The paper also constructs significantly improved state-level consumption data, and then combines these datasets to provide new estimates of the effects of changes in stock wealth and housing wealth on consumption. Consistent and strong evidence is found for large but sluggish housing wealth effects. Based on the results from our new approach, two out of the three datasets indicate that the MPC out of a one dollar change in two-year lagged housing wealth is about 6 cents. In addition, the twice-lagged income change is also found to have large impact on current consumption. Both findings lead to the rejection of the random walk theory. Furthermore, a statistically insignificant and economically small stock wealth effect is found for almost all specifications. Additionally, there is evidence that the housing wealth effect is significantly larger than the stock wealth effect. These results could, nonetheless, help explain the strength of consumption following the stock market bubble burst at the end of the 1990s. With respect to monetary policies then, these results suggest that it is necessary to take into consideration the potentially substantial difference between consumers' respective reactions to fluctuations in the housing markets and stock markets.

[14] Many other IV sets were tested but also failed to demonstrate a positive and significant habit formation coefficient with reasonable first stage results.

References

ANTONIEWICZ, R. L. (2000): "A Comparison of the Household Sector from the Flow of Funds Accounts and the Survey of," Discussion paper, Federal Reserve Board.

ANTONIO, C., AND R. E. HALL (1996): "Productivity and the Density of Economic Activity," *The American Economic Review*, 86(1), 54–70.

ARON, J., J. V. DUCA, J. MUELLBAUER, K. MURATA, AND A. MURPHY (2010): "Credit, Housing Collateral and Consumption: Evidence from the UK, Japan and the US," Working Paper 1002, Federal Reserve Bank of Dallas.

ARON, J., AND J. MUELLBAUER (2006): "Housing Wealth, Credit Conditions and Consumption," Centre for the Study of African Economies Series WPS 2006-08, University of Oxford.

ASDRUBALI, P., B. SORENSEN, AND O. YOSHA (1996): "Channels of interstate risksharing: United States 1963-1990," *Quarterly Journal of Economics*, 111, 1081–1110.

BAYOUMI, T., AND H. EDISON (2003): "Is Wealth Increasingly Driving Consumption," DNB Staff Reports (discontinued) 101, Netherlands Central Bank.

BERTAUT, C. (2002): "Equity Prices, Household Wealth, and Consumption Growth in Foreign Industrial Countries: Wealth Effects in the 1990s," International Finance Discussion Papers 724, Board of Governors of the Federal Reserve System.

BOSTIC, R., S. GABRIEL, AND G. PAINTER (2005): "Housing Wealth, Financial Wealth, and Consumption: New Evidence from Micro Data," manuscript, University of Southern California.

BYRNE, J. P., AND E. P. DAVIS (2003): "Disaggregate Wealth and Aggregate Consumption: an Investigation of Empirical Relationships for the G7," *Oxford Bulletin of Economics and Statistics*, 65(2), 197–220.

Campbell, J. Y., and J. F. Cocco (2006): "How Do House Prices Affect Consumption? Evidence From Micro Data," *Journal of Monetary Economics*, forthcoming.

Campbell, J. Y., and G. N. Mankiw (1989): "Consumption, Income and Interest Rates: Reinterpreting the Time Series Evidence," in *NBER macroeconomics annual*, ed. by O. J. Blanchard, and S. Fischer, pp. 185–216. MIT Press, Cambridge, MA.

Cardarelli, R., D. Igan, and A. Rebucci (2008): "The Changing Housing Cycle and the Implications for Monetary Policy," in *World Economic Outlook*, chap. 3. Washington: International Monetary Fund.

Carroll, C. D., M. Otsuka, and J. Slacalek (2006): "How Large Is the Housing Wealth Effect? A New Approach," Working paper no. 535, Johns Hopkins University, www.econ.jhu.edu/pdf/papers/wp535carroll.pdf.

Case, K. E., J. M. Quigley, and R. J. Shiller (2005): "Comparing Wealth Effects: The Stock Market versus The Housing Market," *Advances in Macroeconomics*, 5(1), 1–34.

Ciccone, A. (2002): "Agglomeration effects in Europe," *European Economic Review*, 46(2), 213–227.

Davis, M., and M. G. Palumbo (2001): "Does Stock Market Wealth Matter for Consumption?," Finance and Economics Discussion Series 2001-23. Washington: Board of Governors of the Federal Reserve System.

Del Negro, M. (1998): "Aggregate Risk Sharing Across US States and Across European Countries," Ph.D. thesis, Yale University.

Disney, R., A. Henley, and D. Jevons (2003): "House Price Shocks, Negative Equity and Household Consumption in the UK in the 1990s," memo, University of Nottingham.

Dvornak, N., and M. Kohler (2003): "Housing Wealth Stock Market Wealth and Consumption: A Panel Analysis for Australia," RBA Research Discussion Papers rdp2003-07, Reserve Bank of Australia.

Dynan, K. E., and D. M. Maki (2001): "A Primer on the Economics and Time Series Econometrics of Wealth Effects," Finance and Economics Discussion Series 2001-9. Washington: Board of Governors of the Federal Reserve System.

Edelstein, R. H., and S. K. Lum (2004): "House prices, wealth effects, and the Singapore macroeconomy," *Journal of Housing Economics*, 13, 342–367.

Garrett, T. A., R. Hernàndez-Murillo, and M. T. Owyang (2004): "Does Consumer Sentiment Predict Regional Consumption?," *Federal Reserve Bank of St. Louis Review*, 87(2), 123–35.

Girouard, N., and S. Blöndal (2001): "House Prices and Economic Activity," OECD Economics Department Working Papers 279, OECD Economics Department.

Glaeser, E. L., H. D. Kallal, J. A. Scheinkman, and A. Shleifer (1992): "Growth in Cities," *Journal of Political Economy*, 100(6), 1126–52.

Hall, R. E. (1978): "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence," *Journal of Political Economy*, 86(6), 971–87.

Kennickell, A. B. (2003): "A Rolling Tide: Changes in the Distribution of Wealth in the U.S., 1989-2001," Discussion paper, Federal Reserve Board, http://www.federalreserve.gov/pubs/oss/oss2/papers/concentration.2004.5.pdf.

Lettau, M., and S. Ludvigson (2001): "Consumption, Aggregate Wealth and Expected Stock Returns," *Journal of Finance*, LVI(3), 815–849.

——— (2004): "Understanding Trend and Cycle in Asset Values: Reevaluating the Wealth Effect on Consumption," *American Economic Review*, 94(1), 279–299.

Levin, L. (1998): "Are assets fungible? Testing the behavioral theory of life-cycle savings," *Journal of Economic Organization and Behavior*,, 36, 59–83.

Lopez, M. A. G., and I. M. Olivera (2005): “The Spatial Effect of Intra-Metropolitan Agglomeration Economies,” Working Papers 0513, Department of Applied Economics at Universitat Autonoma of Barcelona.

Ludwig, A., and T. Sløk (2002): “The Impact of Changes in Stock Prices and House Prices on Consumption in OECD Countries,” Working Paper 02/1 International Monetary Fund.

Shiller, R. J. (2004): “Household Reaction to Chagnes in Housing Wealth,” Discussion paper, Cowles Foundation for Research in Economics, Yale University, Discussion Paper NO. 1459.

Thaler, R. H. (1990): “Anomalies: Saving, Fungibility, and Mental Accounts,” *Journal of Economic Perspectives*, 4(1), 193–205.

Wilcox, D. W. (1992): “The Construction of U.S. Consumption Data: Some Facts and Their Implications for Empirical Work,” *The American Economic Review*, 82(4), 922–941.

Zhou, X. (2010): “Essays On U.S. State-Level Financial Wealth Data and Consumption Data,” Ph.D. thesis, Johns Hopkins University, http://jhir.library.jhu.edu/handle/1774.2/34267.

Figure 1: The saving rate versus the net worth - income ratio

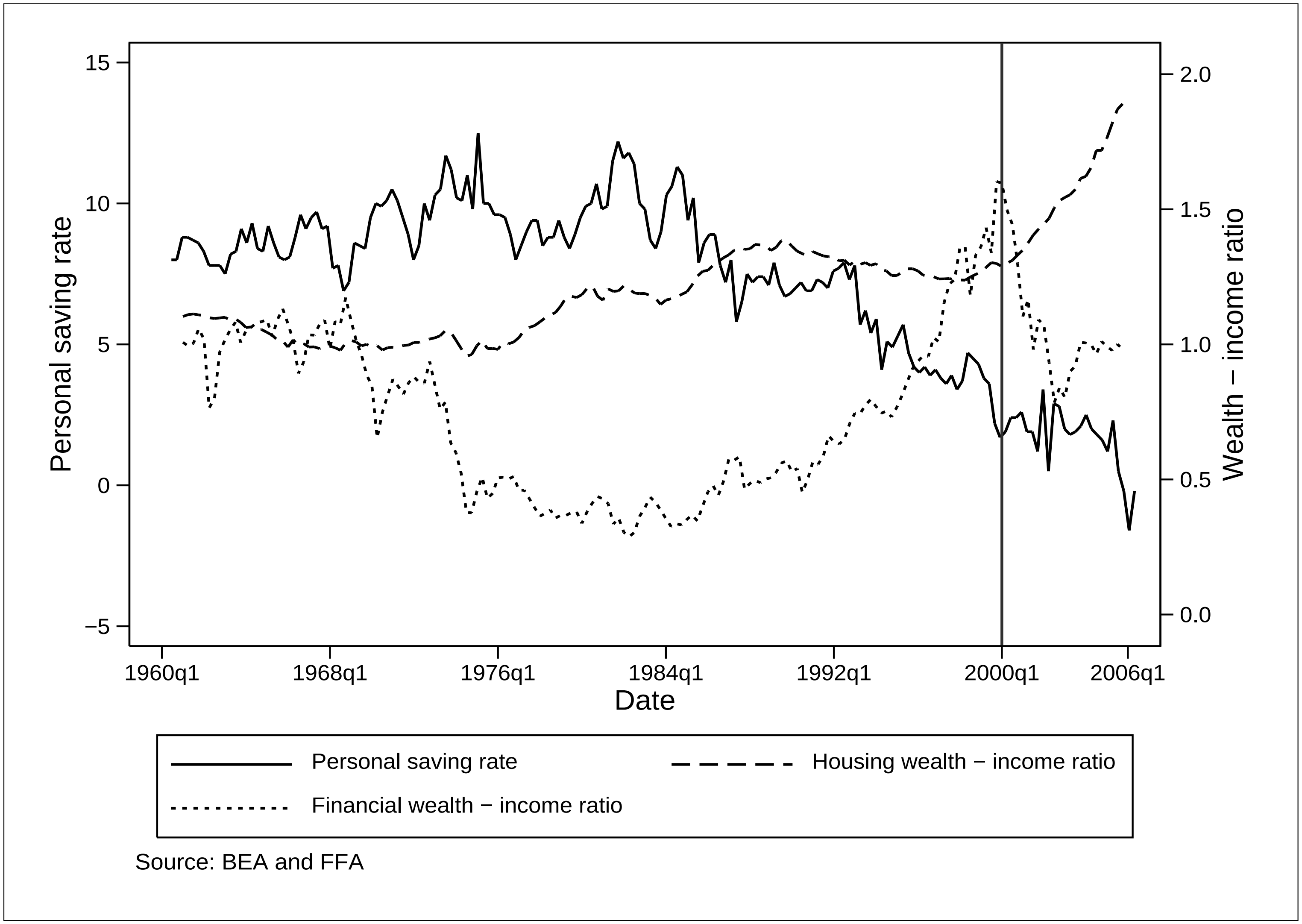


Figure 2: Mutual funds versus total stock wealth

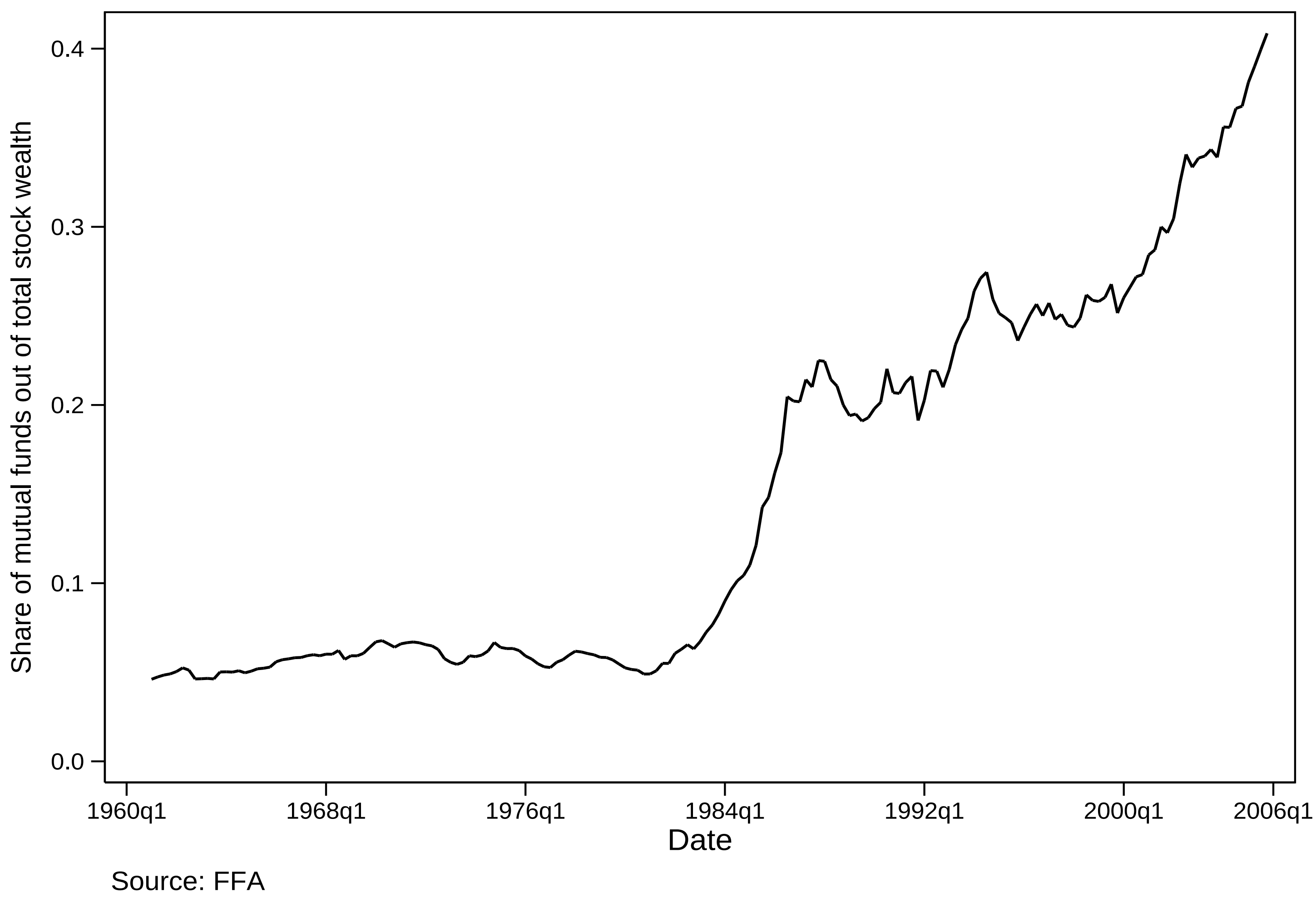
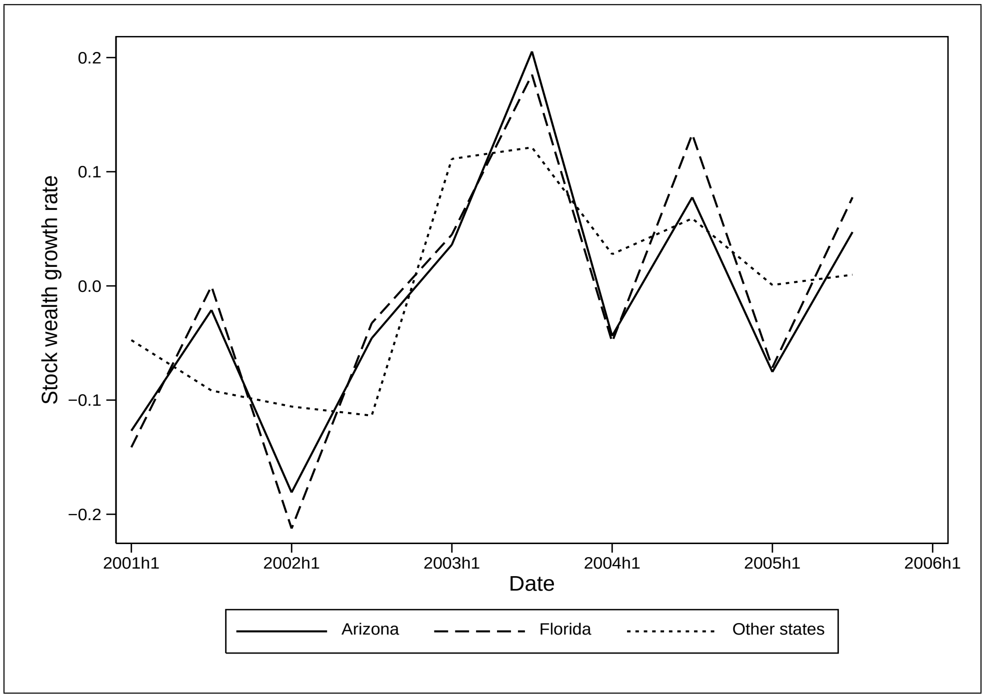
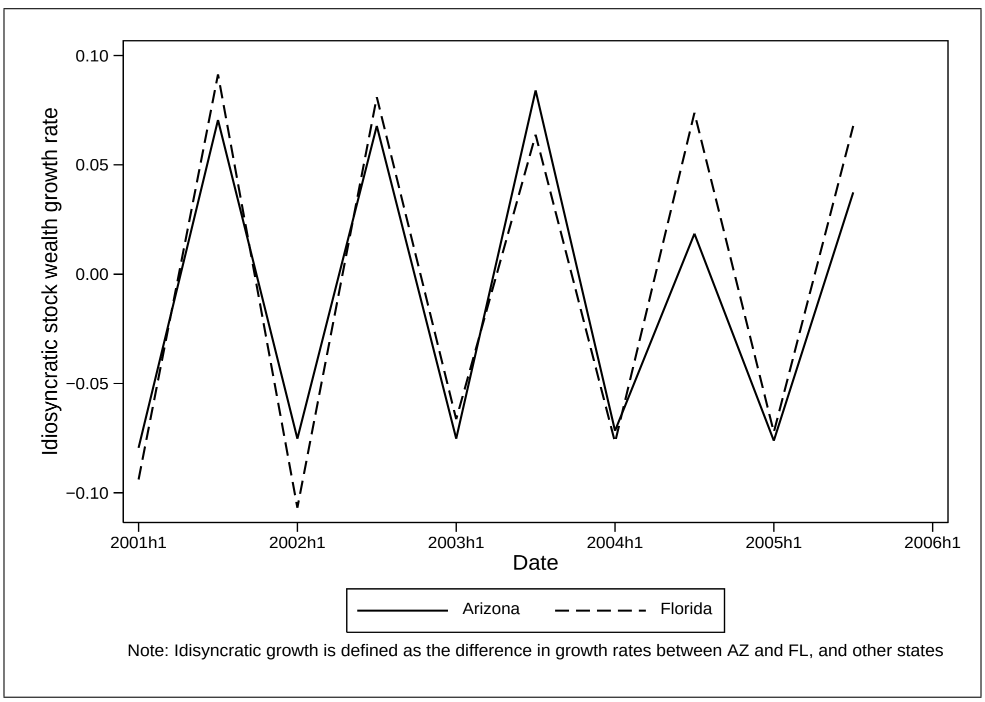


Figure 3: Snow bird effect



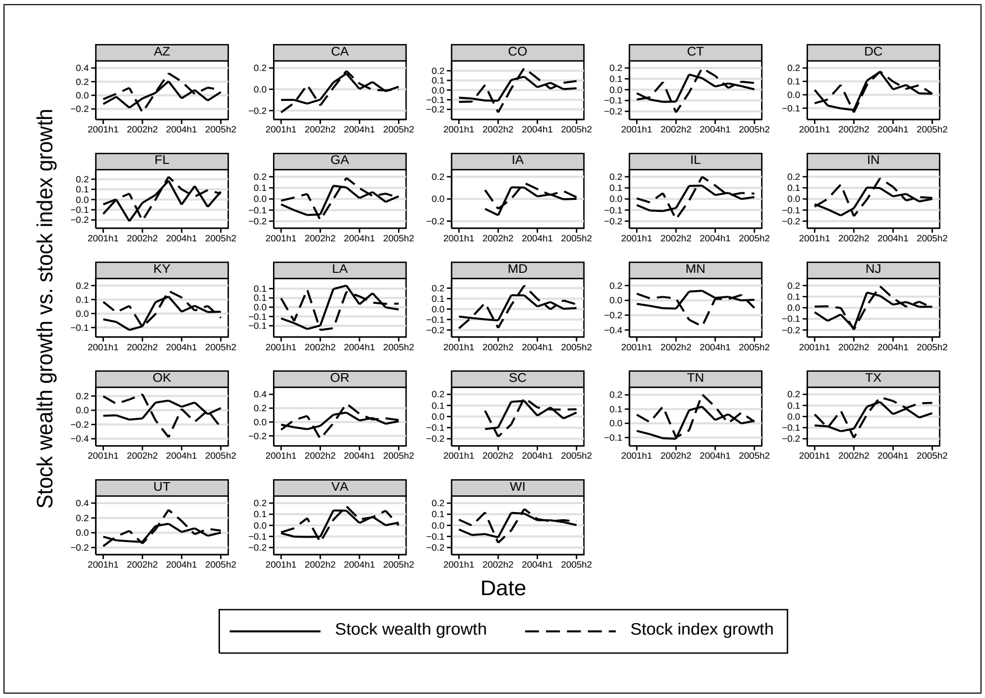
(a) Florida and Arizona versus the average of other states



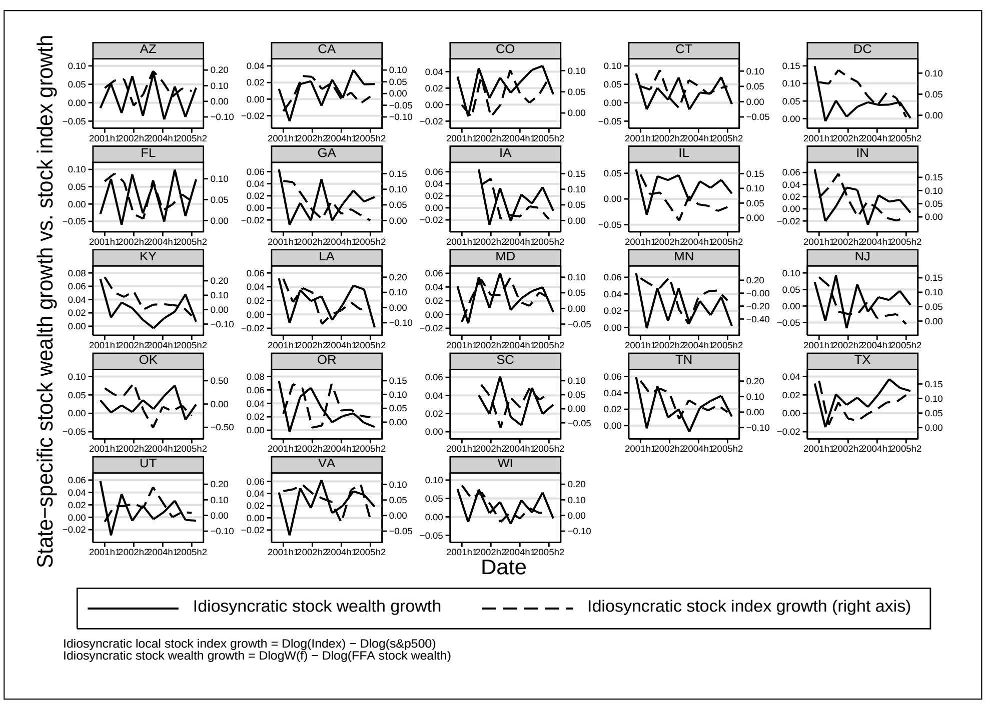
(b) Florida and Arizona versus other states

Note: The sharp seasonal fluctuations in wealth in Florida and Arizona likely reflect a ”snow bird” effect, as wealthy retirees move in and out of these states on a seasonal basis.

Figure 4: The local stock index versus state stock wealth



(a) State financial wealth growth versus local stock index growth



(b) Idiosyncratic state financial wealth growth versus idiosyncratic local stock index growth

Table 1: Data description: $\Delta c_{i,t} = \alpha_t + \beta_1 \Delta y_{i,t} + \beta_2 \Delta w^f_{i,t} + \beta_3 \Delta w^h_{i,t}$

Best Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta y_{i,t}$	0.766***			0.68***	0.793***		0.704***
	(0.204)			(0.202)	(0.191)		(0.184)
$\Delta w^f_{i,t}$		0.43**		0.352**		0.449***	0.369**
		(0.176)		(0.176)		(0.168)	(0.163)
$\Delta w^h_{i,t}$			0.125*		0.135**	0.134**	0.141**
			(0.064)		(0.059)	(0.063)	(0.059)
Obs.	48	48	48	48	48	48	48
$\bar{R}^2$	0.72	0.701	0.687	0.739	0.743	0.722	0.765
Partial $\bar{R}^2$	0.154	0.095	0.051	0.212	0.222	0.16	0.291

Combined Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta y_{i,t}$	1.945***			1.844**	1.936***		1.851**
	(0.698)			(0.721)	(0.736)		(0.752)
$\Delta w^f_{i,t}$		0.392**		0.293		0.376**	0.294
		(0.19)		(0.249)		(0.189)	(0.248)
$\Delta w^h_{i,t}$			0.107		0.011	0.077	-.008
			(0.078)		(0.087)	(0.074)	(0.081)
Obs.	180	180	180	180	180	180	180
$\bar{R}^2$	0.21	0.126	0.102	0.222	0.206	0.124	0.217
Partial $\bar{R}^2$	0.121	0.027	0.0008	0.135	0.116	0.025	0.13

Good Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta y_{i,t}$	1.945***			1.844**	1.936***		1.851**
	(0.698)			(0.721)	(0.736)		(0.752)
$\Delta w^f_{i,t}$		0.392**		0.293		0.376**	0.294
		(0.19)		(0.249)		(0.189)	(0.248)
$\Delta w^h_{i,t}$			0.107		0.011	0.077	-.008
			(0.078)		(0.087)	(0.074)	(0.081)
Obs.	180	180	180	180	180	180	180
$\bar{R}^2$	0.21	0.126	0.102	0.222	0.206	0.124	0.217
Partial $\bar{R}^2$	0.121	0.027	0.0008	0.135	0.116	0.025	0.13

a. Partial $\bar{R}^2$ refers to the proportion of variance explained by all variables other than the year dummies.
b. Standard errors in parenthesis. {*, **, ***} = significant at the {10%, 5%, 1%} level.

Table 2: $\Delta\tilde{c}_{i,t} = \alpha_t + \beta_1\Delta\tilde{y}_{i,t} + \beta_2\Delta\tilde{w}^f_{i,t} + \beta_3\Delta\tilde{w}^h_{i,t}$

	Best Data	Combined Data	Good Data
$\Delta y_{i,t}$	0.76***	2.509**	1.519***
	(0.25)	(1.095)	(0.537)
$\Delta w^f_{i,t}$	0.073**	0.023	0.042
	(0.029)	(0.059)	(0.043)
$\Delta w^h_{i,t}$	0.016	0.006	0.012
	(0.01)	(0.013)	(0.01)
$\beta_2 = \beta_3$	3.555	0.088	0.473
	(Rejected)	(Accepted)	(Accepted)
OBS	48	180	180
$\bar{R}^2$	0.767	0.201	0.251
Partial $\bar{R}^2$	0.309	0.127	0.111

Table 3: $\Delta\tilde{c}_{i,t} = \alpha_t + \beta_1\Delta\tilde{y}_{i,t-2} + \beta_2\Delta\tilde{w}^f_{i,t-2} + \beta_3\Delta\tilde{w}^h_{i,t-2}$

	Best Data	Combined Data[a]	Good Data
$\Delta y_{i,t-2}$	0.556	1.083**	0.891**
	(0.423)	(0.423)	(0.395)
$\Delta w^f_{i,t-2}$	-.005	-.015	-.021
	(0.04)	(0.035)	(0.029)
$\Delta w^h_{i,t-2}$	0.067	0.058**	0.061***
	(0.048)	(0.025)	(0.022)
$\beta_2 = \beta_3$	1.666	2.688	4.956**
	(Accepted)	(Accepted)	(Rejected)
OBS	24	90	90
$\bar{R}^2$	0.244	0.03	0.061
Partial $\bar{R}^2$	0.037	0.039	0.072

[a] The regression using only the computed taxable retail sales shows a significant and even larger housing wealth effect, and a very small and insignificant financial wealth effect. The results are available from the author upon request.

Table 4: Habit formation: $\Delta\tilde{c}_{i,t} = \alpha_t + \lambda E_{t-2}\Delta\tilde{c}_{i,t-1} + \varepsilon_t$

	Best Data	Combined Data	Good Data
$E_{t-2}\Delta\tilde{c}_{i,t-1}$[a]	0.642	-.004	0.074
	(0.4)	(0.301)	(0.314)
obs	24	90	90
$\bar{R}^2$	0.028	-.018	-.017
First Stage:			
Partial R^2	0.33	0.156	0.139
$P-val$	0.069	0.0005	0.017

[a] IV: $\Delta\tilde{c}_{i,t-2}$, $\Delta\tilde{y}_{i,t-2}$, $\Delta\tilde{w}^f_{i,t-2}$, $\Delta\tilde{w}^h_{i,t-2}$.

APPENDIX: Results using the elasticity method

Many papers in the literature have estimated wealth effects by adopting the elasticity method. Consequently, we then investigate the respective housing wealth and stock wealth effects by estimating the following equation, as with most related studies:

$$\Delta c_{i,t} = \alpha_t + \beta_1 \Delta y_{i,t-2} + \beta_2 \Delta w^f_{i,t-2} + \beta_3 \Delta w^h_{i,t-2} + \varepsilon_{i,t}. \tag{7}$$

Table 5 reports the regression results from Equation 7 for all three sets of consumption data. The findings are roughly consistent across the three datasets.

The most outstanding and robust finding is the large coefficient for lagged housing wealth. The stock wealth effects reported in Table 5 are all statistically insignificant. Furthermore, in 2 of the 3 estimations, the size of the stock wealth effect is economically small. The hypotheses of equal housing wealth and stock wealth coefficients are, however, accepted in 2 out of 3 estimations.

Table 5: Results for the elasticity method

	Best Data	Combined Data	Good Data
$\Delta y_{i,t-2}$	0.338	0.609*	0.405
	(0.321)	(0.312)	(0.286)
$\Delta w^f_{i,t-2}$	0.234	-.022	-.072
	(0.269)	(0.098)	(0.084)
$\Delta w^h_{i,t-2}$	0.411**	0.266**	0.278***
	(0.198)	(0.115)	(0.099)
Test of β_2=β_3	0.243	2.614	5.61**
	(Accepted)	(Accepted)	(Rejected)
obs	24 90	90	
$\bar{R}^2$	0.37	0.015	0.042
Partial $\bar{R}^2$	0.177	0.024	0.052