Review of Economics & Finance
Submitted on 28/08/2014
Article ID: 1923-7529-2014-04-01-17
Ryan R. Brady, Derek Stimel, and Steven Sumner

The Rise of the Housing-Wealth Effect: Counterfactual Impulse Response Analysis

Ryan R. Brady
Department of Economics, United States Naval Academy
589 McNair Road, Stop 10D
Annapolis, MD 21402-5030, U.S.A.
Tel: 410-293-6883 E-mail: rbrady@usna.edu

Derek Stimel (Corresponding author)
Menlo College
1000 El Camino Real, Atherton, CA 94027-4301, U.S.A.
Tel: 650-543-3752 E-mail: dstimel@menlo.edu

Steven Sumner
School of Business Administration, University of San Diego
Olin Hall 213, 5998 Alcala Park, San Diego, CA 92110-2492, U.S.A.
E-mail: sumner@sandiego.edu

Abstract: This paper tests for the *direct* wealth effect versus an *indirect* wealth effect in aggregate data on U.S. households over four distinct sub-periods from 1952 through 2011. We use recent time series techniques to distinguish between the direct wealth effect from indirect channels which may operate through personal disposable income or liabilities. We find evidence of a direct wealth effect for housing wealth, in particular, from 1998 to 2011. The responses of consumption in the 1998 to 2011 period are in contrast to an indirect or "common cause" explanation of the wealth effect. For financial wealth, there is some evidence of a direct wealth effect for the 1998 to 2011 period, but the effect overall is smaller than for tangible wealth. Also, before 1998 the evidence for a direct wealth effect from either housing wealth or financial wealth is weak.

JEL Classifications: E21, C32, R31

Keywords: Wealth effect; Housing; Impulse response function; Consumption; Linear projection

1. Introduction

On average an increase in a household's wealth coincides with an increase in its level of consumption, a phenomenon that has received no shortage of attention among economists. In general, research on the wealth effect finds an effect for both tangible wealth (such as real estate) and financial wealth (*e.g.* a household's equity holdings), with the effect for the former category recently found to be the strongest.[1] However, what may come as a surprise to the casual observer is that even on the heels of the stock market boom in the late 1990s and the housing boom (and bust)

[1] For detailed reviews and evidence on the wealth effect we refer the reader to Paiella (2009), Poterba (2000), Brady and Stimel (2011), Lettau and Ludvigson (2004), Palumbo *et al*. (2006), and Dynan and Maki (2001). Paeilla (2009), in particular, provides a very comprehensive review.

of the 2000s, and despite the numerous studies on the subject, the nature of the wealth effect is uncertain. Researchers have disagreed about the size of the effect for either category of wealth, the effect's economic significance, as well as the mechanism underlying the link between consumption behavior and changes in wealth. Even Arthur Pigou discussion of the wealth effect questioned its magnitude (Colander, 1995, p.177).

The relationship may be *direct*. An increase in wealth leads to a corresponding increase in consumption by way of the household's budget constraint. That is, if a change in wealth is (judged to be) permanent, consumption in every period increases. For a household it is not so much a question of if there is a wealth effect, but when the change in consumption will take place (see Poterba (2000)). In contrast, the relationship may be *indirect*, powered by a common cause such as financial market liberalization[2] or a change in the household's expectations of future income.[3,4] In this case, the observed co-movement of wealth and consumption reflects that common cause. If there is a direct wealth effect, then wealth is a *causal* factor explaining a change in consumption and changes in housing prices should forecast consumption. If the observed wealth effect is an artifact of some common factor then the implication of simultaneous movements in both variables is less clear as will be the implications of, say, the effect of policy on each (see Paiella (2009) and Dynan and Maki (2001)).

In this paper, we seek to provide evidence on the "direct versus indirect" aspect of the wealth effect "debate." We use the recent time-series methodology of Den Haan, Sumner and Yamashiro (2007) to distinguish between a wealth effect operating directly from wealth to consumption, from an effect occurring indirectly through changes in personal disposable income and the level of liabilities. We estimate impulse response functions from a five-variable vector autoregression (VAR) that includes aggregate data for U.S. households on personal consumption, liabilities, tangible assets (primarily housing), financial assets, and disposable income spanning 1952 through 2011. Den Haan *et al*. (2007) provide a unique identification strategy that allows us to isolate the direct wealth effect in the response of consumption to a shock to wealth (both tangible and financial). In particular the direct wealth effect is identified as the difference in the response of consumption to a shock to wealth compared with the response of consumption to a set of counterfactual shocks.[5] We compare and contrast the response of consumption to the shocks over four sub-periods defined by structural breaks in the VAR system.

Our key results provide evidence of a *direct* tangible wealth effect in the response of consumption over a period spanning 1998 to 2011 in contrast to the income-expectations-based explanation espoused in Attanasio *et al.* (2009). Consistent with results in Brady and Stimel (2011) earlier periods show only meager evidence of a wealth effect. Evidence of a *direct* financial wealth effect during the 1998-2011 period is more limited (consistent with various findings that the financial wealth effect in general is minimal). For financial wealth there is evidence of a direct wealth effect prior to the mid-1980s only.

---

[2] See Muellbauer (2007).

[3] See Attanasio *et al*. (2009).

[4] Or, the indirect effect may occur via a specific conduit where an increase in home prices (for whatever reason) only boosts consumption by affecting, say, the level of the household's collateral (see Aoki *et al*. (2001) or our discussion in section 2).

[5] The counterfactual shocks are a series of shocks to disposable income (liabilities) such that the response of disposable income (liabilities) is identical to the response of disposable income (liabilities) to the wealth shock.

The results of this paper and the time series strategy employed should be of interest to those studying the wealth effect or consumption behavior more broadly, especially since time series evidence on the direct wealth effect is scant. The majority of wealth effect studies rely on cross-sectional data (or longitudinal survey data). Aggregate data generally masks demographic differences in consumption behavior researchers have relied on to understand the wealth effect. The evidence for the direct wealth effect we document in this paper provides novel time series evidence on the wealth effect isolating the nature of the wealth effect by wealth category and time period.[6] With respect to the literature, our paper follows the empirical strategy of Brady and Stimel (2011) and offers complementary results to their findings, in particular. Also, our results offer a different perspective on the discussions surrounding the "direct versus indirect" debate and evidence offered by Muellbauer (2007) and Attanasio *et al.* (2009).

2. The Direct Wealth Effect versus Common Causes

Measurement of the wealth effect is a well-covered topic, yet as suggested above agreement on the mechanism that underlies the relationship between wealth and consumption is elusive.[7] The issue centers around whether data reveal a direct wealth effect versus an indirect effect, where some unobserved force results in a coincident change in wealth and consumption (the co-movement of which is mistaken as causal).

So what is the *direct* wealth effect? Simply put, when household wealth increases, permanent (non-labor) wealth increases, and, hence, consumption in every period increases. Paiella (2009) notes, "rising asset prices increase household wealth, which in turn increases consumption, via the budget constraint" (p949; see also Maki and Palumbo (2001) for a description). Holding constant the ability to borrow, access wealth, leave bequests to future generations, and other complicating factors, when household wealth increases the consumption of the household will increase. Dynan and Maki (2001) find evidence in favor of a direct wealth effect for stock market wealth. They find that households owning stock increased consumption in response to the rise of stock market wealth in the 1990s, while households with little or no stock market wealth did not (based on information from the Consumer Expenditure Survey). The authors note the latter finding, in particular, rules out indirect (common cause) effects.[8]

Why is the distinction between a common cause and a direct effect important? If there is a direct wealth effect, then wealth is a *causal* factor explaining a change in consumption. If so then changes in housing prices should forecast consumption. However, if driven by a common factor, then the relationship between consumption and housing prices, and the implication of movements in both, is less clear (see Paiella (2009) and Dynan a Maki (2001) for additional discussion). Two particular common causes are the "Credit Effect" and the "Productivity Hypothesis."[9]

---

[6] Most research focuses on stock market wealth (see Dynan and Maki (2001) and Maki and Palumbo (2001)). Case et al. (2003) and Ludwig and Sløk (2004) find evidence of the direct wealth effect. Our impulse response analysis for the 1998 to 2011 period, in particular, is a complement to those earlier studies.

[7] *See* the references cited in the introduction.

[8] Maki and Palumbo (2001) also find evidence for a direct effect based on similar evidence.

[9] Muellbauer (2007) and Brady and Stimel (2011) discuss the credit effect as a separate and distinct topic from the common cause hypothesis, with the latter focusing on income expectations. However, in this paper we suggest that any credit "channel" explaining the wealth effect is more clearly categorized as a "common cause" rather than as separate category.

The credit effect occurs since financial liberalization of credit markets provides impetus for both the demand for housing and consumption to increase simultaneously, which will affect both homeowners and renters. First, looser credit markets mean homeowners (typically assumed in the literature to be "older" households) can refinance a mortgage at a lower interest rate, pay lower refinancing costs, and get more out of a given (or increasing) value of equity (Aoki *et al*. (2001, 2002) provide detailed discussion on collateral effects). If credit markets are tight, the observed rise in consumption associated with a rise in housing wealth will still be positive but not as large as under looser credit conditions (see Muellbauer *et al*. (1990) for an early discussion, and Muellbauer (2007) for cross-country evidence of this sort of credit channel between wealth and consumption).

For renters (typically assumed to be "young" households in the literature) financial liberalization unburdens renters from saving as much for a down-payment (Muellbauer (2007) provides detailed discussion). All else equal, in response to home price appreciation, young households will save more in anticipation of higher rents or a higher down payment on home purchase (see Sheiner (1995) and Engelhardt (1996) for evidence that high home prices force renters to save more). If credit constraints should "loosen," however, the same young household will have an easier time obtaining credit freeing them to borrow more, consume more, and save less. Similar to homeowners, liberalization spurs both home purchase and increases in consumption for renters. And of course, following liberalization, consumption may also increase for reasons independent of housing wealth (*e.g.* lower interest rates spur consumer durables). Hence, we view liberalization as a "common cause" of the observed increase in housing wealth and consumption.[10]

In addition to the credit effect, the common cause driving wealth and consumption may be due to broader real forces that lead to an increase in productivity. Attanasio *et al.* (2009) identify this effect as the "Productivity Hypothesis" since a boost to productivity leads households to revise their income expectations, which then translates to a change in the demand for housing and consumption. Hence, Attanasio *et al.* (2009) argue that the apparent wealth effect observed in the data is actually the response of both consumption and housing wealth generated by such a change in productivity (see also Attanasio and Weber (1994)).

The "productivity hypothesis" means that the consumption of young households and older households will both increase with appreciating housing prices. However, the increase for the young will be larger since the young should benefit more from an expected increase in lifetime income. With data on U.K. households Attanasio *et al.* (2009) find in favor of the productivity hypothesis. Attanasio and Weber (1994), too, conclude that the "consumption boom" of the 1980s was driven by productivity induced revisions to expectations. The authors are able to explain much of the increase in consumption of older households' with regional housing prices, but not younger households' (whose consumption increase during that boom was more pronounced). Attanasio *et al.* (2009) argue that similar to the 1980s, the consumption of younger households was the primary factor in explaining rise of consumption in late 1990s and early 2000s.[11]

---

[10] Aoki *et al*. (2001) state that "house prices may have a direct impact on consumption via credit market effects"(p460). In this paper we use *direct* to define the specific link between a change in wealth and consumption in terms of the budget constraint, holding constant any change in credit markets. That is, a change in home prices leads to a change in consumption independent of whether or not a homeowner wishes to draw on the increase in equity or refinance a mortgage. The latter decision may lead to an increase in consumption even if a household's net worth is left unchanged. Campbell and Cocco (2007) make a related point discussing the loosening of credit constraints.

[11] Related to the "common cause" idea, Poterba and Samwick (1995) find that the empirical link between stock market fluctuations and consumption appears to be due to the former's role as a leading indicator for consumption, rather than as evidence of a direct wealth effect.

Many studies using both cross-section and time series data find that housing wealth has a greater effect on consumption than stock market wealth (for examples, see Benjamin *et al.*, (2004), Catte *et al.* (2004), Muellbauer (2007), Donihue and Avramenko (2007), Campbell and Cocco (2007), Case *et al.* (2005), and Carroll *et al.* (2011)). Brady and Stimel (2011) document that the effects from housing and financial wealth have both changed over time, where the tangible wealth effect is stronger than the financial wealth effect in data for the United States across four sub-periods dating back to 1952. The tangible wealth effect is strongest in their 1998 to 2009 sample, yet still evident back to approximately the mid-1970s. While a financial wealth effect is also evident in each sub-period, they find the housing wealth effect is even larger during the period that included the equities boom of the late 1990s.

3. Testing for the Direct Wealth Effect

To test for a direct wealth effect we use the general strategy of VAR-based estimation found in Brady and Stimel (2011) and then build on that with the Den Haan *et al.* (2007) methodology. We estimate a five-variable VAR that includes monthly real per-capita consumption of non-durables plus services, real per capita disposable income, real liabilities of households, and two measures of wealth: financial assets of households and tangible assets of households. All variables are defined as log-levels, seasonally adjusted and in 2005 constant dollars. To construct our per-capita variables, we use population measured as the civilian non-institutional population over 16 (provided the Bureau of Labor Statistics (BLS)). The consumption and income series are available from the Bureau of Economic Activity (BEA). Non-durables and services consumption is used in keeping with standard practice with the permanent income hypothesis literature.

The wealth data are from the Flow of Funds provided by the Federal Reserve Board, with wealth measured as the net worth from the balance sheets of households and non-profit organizations. Since we are interested in the effects of different types of wealth, we decompose net worth into its component parts: liabilities; tangible assets, which include real estate, equipment owned by non-profits, and durable goods; and financial assets, which include bank accounts, equities, debt holdings, and life insurance. All data are converted to real terms using the personal consumption expenditure deflator.[12]

We applied the Qu and Perron (2003) method to our VAR model for the 1951 to 2011 time period. The methodology tests for unknown (*a priori*) structural breaks in a system of equations. Brady and Stimel (2011) applied the method and found structural breaks in their VAR system in third quarter of 1973, the first quarter of 1985, and the second quarter of 1998 (with fairly precise confidence intervals, see Table 6 in their paper). They use the break dates to define four sub-samples over which they estimate and compare impulse response functions for the system variables. For our slightly longer sample period, we find the same structural breaks in the second quarter of 1998 and the third quarter of 1973. However, we find a slightly later break for the 1980s, in the third quarter of 1986.[13] Hence, for the estimation that follows, we estimate over four sub-samples delineated by those break dates The dates are established on a pure statistical basis but bear some correspondence the first oil price shock of the 1970s, the volatility reduction of macroeconomic variables in the mid-1980s and the technology bubble of the late 1990s.

[12] Brady and Stimel (2011) provide a detailed discussion on the choice of variables used in the literature for testing the permanent income hypothesis and the wealth effect.

[13] The confidence intervals produced by the Qu and Perron (2007) procedure are precise, within one to two quarters of the respective break dates. Detailed results are available upon request. See Brady and Stimel (2011) for an explanation of the method. Gauss code for the break procedure is publically available from Pierre Perron.

We estimate our VAR in log-levels, which is common in impulse response analysis (see Brady and Stimel (2011) for an example, and Hoover and Jordà (2001), and Stock and Watson (2001) for reviews). Ashley and Verbrugge (2009) show that even in the presence of non-stationarity and cointegration, estimating a VAR in levels provides impulse response functions that are robust to those specification issues (see also Naka and Tufte (1997) for related evidence). As such, given well-documented uncertainty in the literature about the appropriateness of estimating wealth effects from a vector error correction framework, uncertainty over the stability of the cointegrating relationships between consumption, income and wealth, and the structural breaks in the system, we estimate our VAR log-levels.[14]

We again follow common practice and identify structural impulse functions using recursive identification (through the Cholesky decomposition). The recursive order dictates that consumption responds to all system variables in time *t*, while income only responds to a shock to itself in time *t* and the rest of the variables with a lag. Also, the wealth categories respond to income and liabilities, but not to consumption in period *t*. Our ordering is based on justifications found in Brady and Stimel (2011).[15] The system is estimated with two lags.[16]

3.1 Baseline Impulse Response Functions

We first discuss the baseline impulse response functions that show the evolution of the wealth effect for both tangible and financial wealth over the four periods delineated by the estimated break dates. In this section, we replicate the procedure of Brady and Stimel (2011) and estimate the impulse response functions from our VAR system with the local projection method Jordà (2005, 2009). The baseline estimation allows us to establish the statistical significance of the impulse response functions in the relatively short sub-periods of interest in this paper. Moreover, the baseline results allow us to compare and contrast our results to previous work and motivate the counterfactual estimation in the next section.

Jordà (2005) shows that impulse response functions calculated from one-step-ahead forecasts by linear projection are less likely to suffer from misspecification than impulse response functions generated from a "traditional" VAR. With respect to the latter method, impulse response functions from VARs are calculated for long horizons, yet VARs are optimally designed for one-period ahead forecasting (as explained by Jordà (2005)). As a result the forecast error can be magnified as horizon increases. However, local projections provide a complement to VAR-estimated impulse response functions if the VAR is a good approximation to the true data generating process. In that case, impulse response functions estimated recursively from a VAR or directly from the local projections will be similar (as will be evident below).

Moreover, Jordà (2009) provides "conditional confidence bands" by exploiting the temporal ordering of impulse response functions. As discussed in Brady and Stimel (2011), Jordà (2009) provides Monte Carlo evidence that his conditional confidence bands have superior power in smaller samples compared to typical VAR-generated confidence intervals. Many studies using

[14] Brady and Stimel (2011) provide a detailed discussion on, and motivation for, the use of impulse response functions for measuring the wealth effect. Brady and Stimel (2011) also provide both a review of the time series properties of the data from 1952 through 2009, and a review of what the consumption-wealth literature has found with respect to said properties.

[15] See Brady and Stimel (2011), Section 3.3, for explanation of the timing of the relationships reflected in the Cholesky order. The IRFs reported in this section are robust to different orderings.

[16] The adjusted-AIC chose one lag for our sample. However, in many VARs estimated with quarterly data, at least two lags are often chosen by lag length procedures. We follow Brady and Stimel (2011) in imposing two lags instead of one at the expense of including redundant variables.

VAR-generated impulse response functions are forced to report confidence intervals for the impulse response function based on one standard error, rather than two (see Brady and Stimel (2011) for references, and Chang and Killian (2000) for a discussion on the pitfalls of estimating impulse response confidence intervals estimated for VAR systems).[17] Brady and Stimel (2011) demonstrate that Jorda's (2005, 2009) methodology provides for statistically significant estimates of impulse response functions over relatively short sub-samples. We refer the reader to Jordà (2005) and Jordà (2009) for further details of the local projection method. Hence, the local projections and conditional standard error bands provide a measure of statistical significance. With that evidence in hand we can later turn our attention to the counterfactual estimation.

First, we focus our analysis on the response of consumption to shocks to the respective wealth categories. Figure 1 on the next page displays the response of the system variables to shocks to tangible wealth and Figure 2 on the next pages shows the responses to the financial wealth shock.[18] The dotted lines show the plus and minus two-standard error bands as calculated using the method of Jordà (2009). We discuss the results displayed in Figure 1 first. All shocks are one-standard deviation.

In response to the shock to tangible wealth, the wealth effect is most evident in Figure 1 for the 1998 to 2011 period (the bottom row of responses). Consumption increases following the shock to tangible wealth for about fifteen quarters, or almost four years after the shock, and remains positive for up to about 18 quarters (the response becomes negative thereafter. The response is statistically significant for the duration of the horizon. The response of consumption to tangible wealth is similar to the case in Brady and Stimel (2011). In our case with the longer sample period, however, the response persists to its peak longer and remains above zero for longer (the magnitudes are about the same at around 0.6 percent).

The first three rows of Figure 1 display the earlier time periods. The wealth effect is not evident in the first two periods, prior to the end of 1986. A small increase in consumption after the tangible wealth shock is evident in the 1986 to 1998 period, though the statistical significance of the response is short-lived. These results are generally consistent to those found in Brady and Stimel (2011)—the tangible wealth effect does not really appear until after 1986.

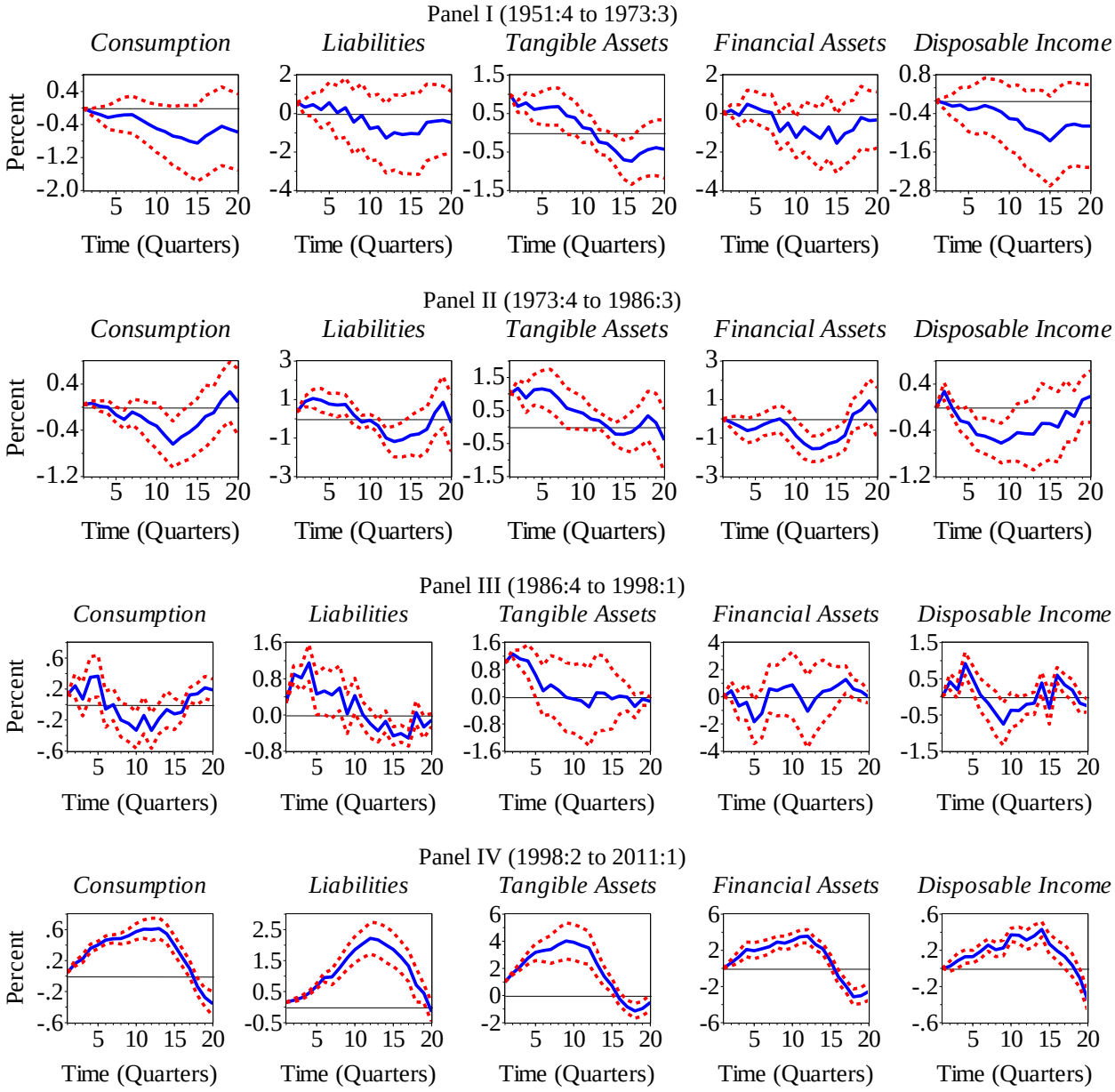
In Figure 2 the response of consumption to the financial wealth shock in the 1998 to 2011 period is positive and statistically significant for approximately six quarters after the shock; thereafter the response turns negative. The response is similar in magnitude and duration to the result reported in Brady and Stimel (2011) and, similar to that paper, the wealth effect evident from financial wealth is smaller than for tangible wealth. For the earlier periods, the financial wealth effect varies. From 1986 to 1998 there is little suggestion of the effect. Only before 1986 does the effect appear, with the strongest and most sustained positive response of consumption occurring in the 1951 to 1973 sample.

Overall, the baseline estimation of the impulse response functions corroborates the results of Brady and Stimel (2011) using a longer sample. In particular the tangible wealth effect is most evident in the 1998 to 2011 period and is larger in magnitude and persistence than the response of

[17] Jordà (2009) provides the insight that the typical standard error bands (i.e., ±1.96×standard error) reported along with VAR-generated impulse response functions may be misleading. These standard error bands assume that individual coefficients that make up the impulse response function are uncorrelated. In fact, as Jordà (2009) notes, the coefficients have a natural temporal ordering with the period *t*'s realization dependent on the realization of the function up to that point.

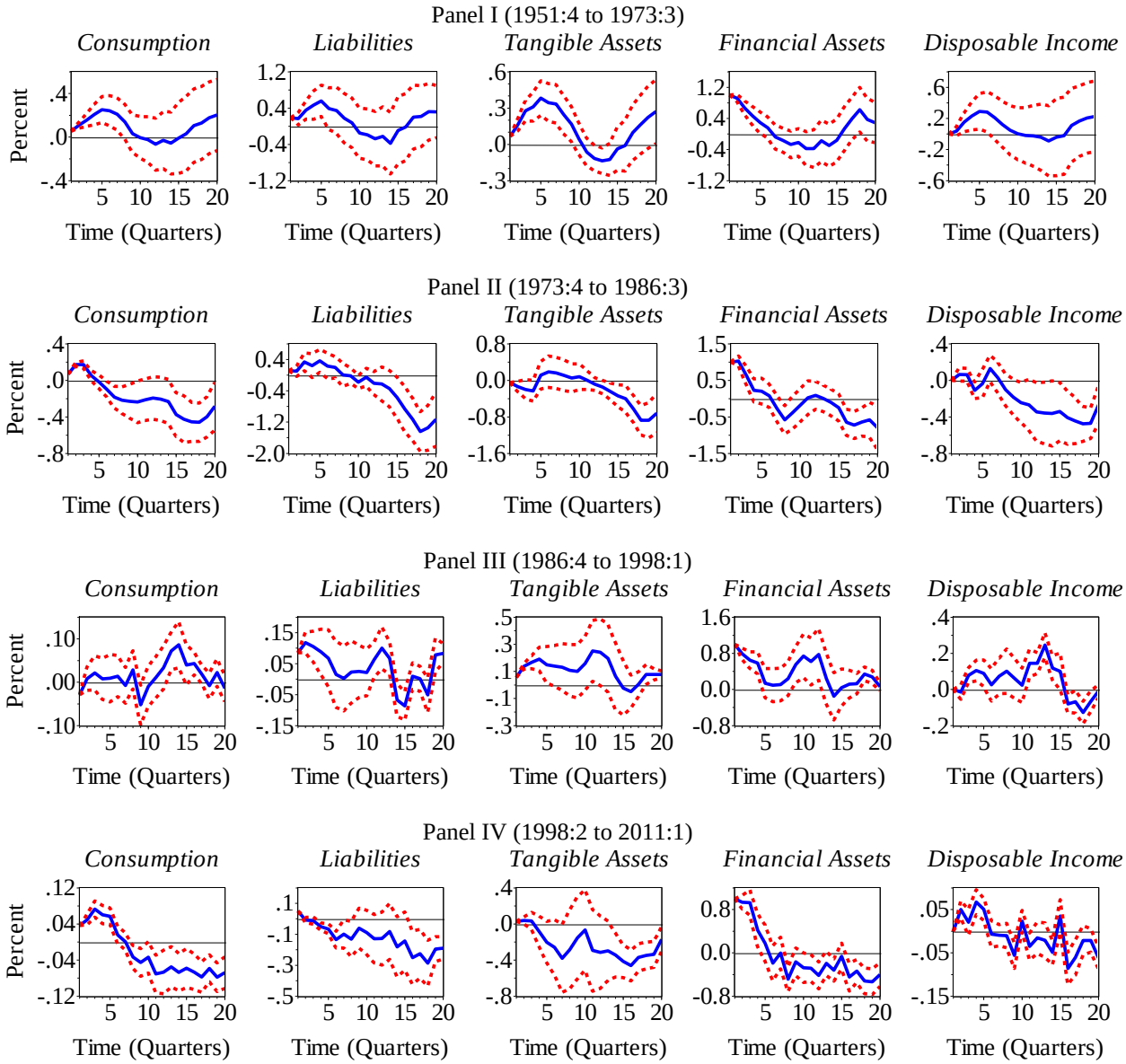
[18] For brevity in this section we eschew displaying responses following shocks to the other variables in the system. However, these results are available by request. We do discuss shocks to income and liabilities later in Section 3.3.

consumption to financial wealth. Also, the tangible wealth effect is generally larger than the financial wealth effect in each sub-period, and the financial wealth effect appears to diminish in each subsequent period. What we seek in the next section is an understanding of whether the effect as captured by the impulse response function of consumption—in periods when the wealth effect is evident—is explained by a common cause or represents a direct wealth effect.



Notes: The impulse response functions and accompanying standard error bands are calculated using the local projection (LP) method of Jordà (2005, 2009). See the text further explanation and data sources.

Figure 1. Baseline Impulse Responses for shocks to Tangible Wealth



Notes: The impulse response functions and accompanying standard error bands are calculated using the local projection (LP) method of Jordà (2005, 2009). See the text further explanation and data sources.

Figure 2. Baseline Impulse Responses for shocks to Financial Wealth

3.2 Impulse Response Analysis with the Den Haan *et al*. (2007) Method

To separate the effect of wealth on consumption relative to income and liabilities, we use the method of Den Haan *et al*. (2007). One of the challenges of analysis with impulse response functions is isolating the effect of *just* wealth on consumption versus the effect of, say, *just* income on consumption. With respect to income, the impulse response function of consumption to a shock to tangible wealth captures the direct response of consumption to the increase in wealth, *and* the indirect effect of the increase in consumption that occurs from the increase in income that results

from the boost in wealth.[19] The latter is a feedback effect that occurs through the five-variable system. For example, the estimate for consumption at $t + 1$ will be a function of the value of the increase in tangible wealth at time t plus from the increase in income at time $t + 1$. The latter occurs since in the system tangible wealth at time t is a function of income at time t and that relationship will feed back into the equation where consumption is a function of both tangible wealth and income at time t.

Den Haan *et al.* (2007) provide a "counterfactual" method to isolate the component of the impulse response function one is interested in observing. The method is best understood by explanation of their particular application. Den Haan *et al.* (2007) estimate a monetary-VAR where they are interested in the effect of a shock to the federal funds rate (representing monetary policy) on aggregate loans from commercial banks. Theirs is a test of the "loan-supply" effect of the monetary transmission mechanism, which captures the reaction of commercial banks in cutting their supply of loans after a rise in the interest rate independent of the demand for loans. In the VAR-setting, one will observe a decline in loans after the increase in the interest rate. However, this decline will encompass both the loan-supply effect—the supply side effect—and the decline in lending due to a fall in the demand for loans. The latter occurs through the feedback from the decline in income within the system that results from the contractionary policy shock. For those interested in uncovering the loan-supply effect, observing the impulse response of the loans to the policy shock alone does not suffice. One needs more information from the system or some clever strategy for identification in order to understand how much of the decline in loans is from the supply side versus the demand side.[20]

Den Haan *et al.* (2007) isolate the former effect from the latter in a two-step process. First, Den Haan *et al.* (2007) estimate a monetary–VAR and calculate typical impulse response functions showing the effect of the shock to the federal funds rate on the system variables including the loans from commercial banks and real disposable income. In the second step, they re-estimate the impulse response functions following a set of income shocks that are defined to generate the same impulse response of disposable income that occurred in response to the monetary shock. The sequence of income-shocks then define a "non-monetary" shock and one can then trace out the impulse response functions of the other variables in the system. Hence, in Den Haan *et al.*'s (2007) application the non-monetary shock isolates the effect of the real shock on lending. Then, one can compare the first set of impulse response functions to the second set and the difference can be interpreted as a unique effect of the policy change on loan supply.[21]

We apply this logic to our wealth-income-consumption relationships. First, we are concerned with distinguishing between the effect of income and wealth on consumption (we consider the indirect effect of credit later). We compare the response of consumption to the tangible wealth

[19] Hoover and Jordà (2001) explain this succinctly: "Each shock to the VAR system has several effects: (i) a direct effect on the current value of the dependent variable in its own equation; (ii) an effect mediated through that variable on any equation lower in the causal order; and (iii) an infinite sequence of effects on the future values of both variables, since the values of today become the lagged values of tomorrow. The impulse-response function [for a system of equations] captures the net result of all three effects"(page 118).

[20] The monetary policy literature is replete with attempts to identify the loan-supply effect. Brady (2011) compares the response of sub-categories of consumer loans to do so, Den Haan *et al.* (2007) compare real estate, consumer and commercial and industrial loans. See both papers for reviews of the loan-supply effect literature.

[21] See Den Haan *et al.* (2007) page 909 for their explanation of the method and the associated Figures 1 and 2 on pages 911 and 912, respectively.

shock with the case of an income shock, where, as in Den Haan *et al.* (2007), we define the income shock as a sequence of shocks that lead to the same impulse response function of disposable income that occurs in response to the tangible wealth shock. We refer to this as the counterfactual income shock. Then we compare the response of consumption to the wealth shock with the response of consumption to the counterfactual income shock.

Hence, we posit the difference in the consumption responses will reveal the extent to which the direct wealth effect explains the response of consumption.[22] Empirically, it is difficult to identify the specific linkages characterizing either the direct effect or a common cause discussed in Section 2. For example, the direct effect assumes that the change in non-labor income (wealth) explains the increase in consumption. However, a shock to wealth may coincide with or spur a change in labor income as well, leading to a separate income effect on consumption. The Den Haan *et al*. (2007) counterfactual shock allows us to separate those effects. While we cannot observe that a revision to income expectations has occurred (in the manner of the productivity hypothesis of Attanasio *et al.* (2009)), we can at least isolate the effect of wealth on consumption from the coincident effect of income. Then separately, we consider the same sort of counterfactual isolating the feedback through liabilities (see sub-section 3.4).

If a direct wealth effect is evident we expect to observe the following in our two counterfactual exercises:

1. The response of consumption to the tangible wealth effect will be larger (and positive) than the effect of the counterfactual income shock on consumption. We define the difference between the two responses as the magnitude of the direct wealth effect relative to income.

2. The response of consumption to the tangible wealth effect will be larger than the effect of a counterfactual liabilities shock on consumption. The difference between the two responses defines the magnitude of the direct wealth effect relative to liabilities.

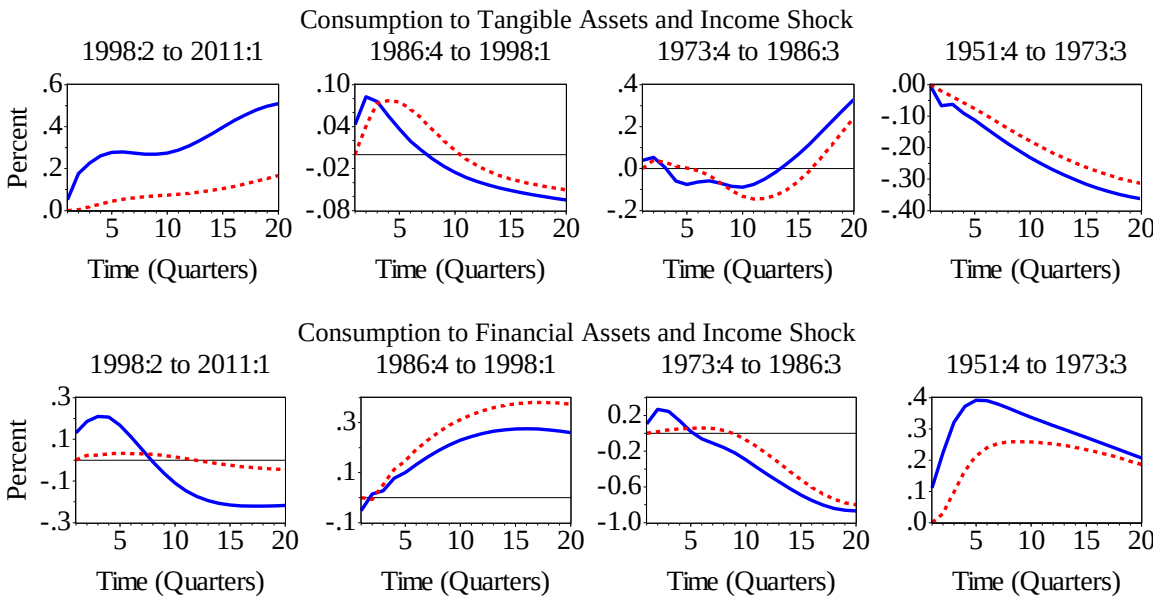
Finally, as alluded to in the preceding discussion, the Den Haan *et al*. (2007) methodology is based on standard VAR estimation (save their unique identification strategy, of course). As noted by Jordà (2005) impulse response function estimates from VARs become less reliable as the forecast horizon increases (as is evident by the increasing standard error bands commonly reported for VAR-produced impulse response estimates). This issue may be especially acute with the relatively short sub-samples we estimate with in this paper (as suggested in section 3.1). Hence, while we report estimates for up to 20 quarters (to be consistent with Figures 1 and 2), we focus our discussion on the first half or so of the horizon displayed in Figures 3 and 4.

3.3 Impulse Response Functions for the Counterfactual Income Shock

Figure 3 displays the impulse response functions of consumption applying the Den Haan *et al*. (2007) counterfactual estimation. For each sub-sample, Figure 3 shows the response of consumption to both a tangible wealth shock and a financial wealth shock, respectively, and to the counterfactual income shock (with the most recent period shown in the left-most column). For each class of asset, the counterfactual income shock is calculated separately. That is, the top panel of Figure 3 displays a sequence of shocks to income consistent with the level of income that occurs for

[22] It is tempting to interpret the "income" shock directly as a shock to income as a result of the change in tangible wealth. However, while the level of income is calculated from that shock in the first VAR, for the purposes of the intellectual experiment, the counterfactual is not limited solely to that definition. Den Haan *et al.* (2007) note that in the second step the exact nature of the income shock is not crucial, only that the income shock represents a change in the economy that is equal to how the real side is affected after the monetary shock (or as in our case, the wealth shock).

each period as a result of the tangible wealth shock. The bottom panel displays a sequence of shocks to income consistent with the level of income in each period of the horizon in response to the financial wealth shock.



Notes: Solid line is response to wealth, dashed line is response to income. Impulse Response functions calculated from a VAR using the methodology of Den Haan et al. (2007). Horizon measured in quarters. The response to the tangible and financial asset shocks are calculated using standard VAR techniques. The response of consumption to the real shock shows how consumption responds to a sequence of shocks to disposable income such that the level of disposable income follows the same path as it did in response to the wealth shock. See text for details.

Figure 3. Response of Consumption to a Wealth Shock and Income Shock

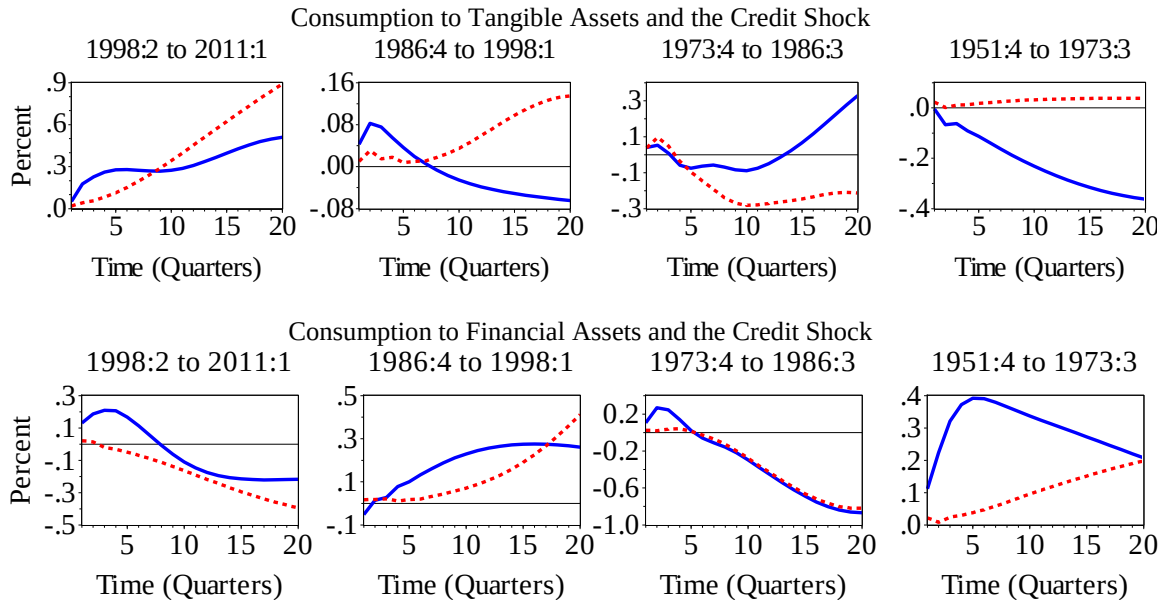
3.3.1 Wealth and income shocks in the 1998 to 2011 period

For the 1998 to 2011 period, the increase in consumption following the tangible wealth shock displayed in Figure 3 is explained almost entirely by tangible wealth. The peak of the response of consumption to the wealth shock reaches about a half a percent and is positive for the entire horizon (similar to the peak for the local projection IRF in Figure 1).[23] However, the response of consumption to the counterfactual income shock is essentially zero for the early part of the horizon with the peak reaching about 0.15 percent. The *direct* tangible wealth effect dominates the response of consumption.

Figure 3 shows some evidence for a direct financial wealth effect as well, though overall the effect of the financial wealth component is more short-lived. The bottom panel of Figure 3 shows an increase of consumption for about six quarters after the financial wealth shock, followed by a general decrease thereafter. As in the case for the local projection-IRFs shown in Figure 1, the initial positive response of financial wealth in Figure 3 is smaller in magnitude than the response to

[23] Notice the response of consumption to tangible wealth shown in Figure 3 is similar, especially for the first half of the horizon, to the response reported in Figure 1, the latter of which is calculated with the local projection technique. As long as the VAR model is a close approximation to the true data generating process for the system, the local projection technique and VAR-based calculation will provide similar impulse response functions, especially at earlier horizons (Jorda (2005)).

tangible wealth. And similar to the case for tangible wealth, the response of consumption to the counterfactual income shock is essentially zero for at least two years after the shock. Here, too, for most of the horizon, the *difference* in the responses reveals the direct wealth effect (albeit relatively small) explains the behavior of consumption.[24]



Notes: Solid line is response to wealth, dashed line is response to liabilities. Impulse Response functions calculated from a VAR using the methodology of Den Haan et al. (2007). Horizon measured in quarters. The response to the tangible and financial asset shocks are calculated using standard VAR techniques. The response of consumption to the credit shock shows how consumption responds to a sequence of shocks to liabilities such that the level of liabilities follows the same path as it did in response to the wealth shock. See text for details.

Figure 4. Response of Consumption to a Wealth Shock and Credit Shock

3.3.2 Tangible wealth and income shock

For tangible wealth, we first focus on the 1998 to 2011 period since the wealth effect for housing is most apparent in this latest sub-sample. The shock to tangible wealth has a notably larger effect on consumption than the counterfactual income shock. In terms of the counterfactual experiment, what this reveals is the increase in consumption cannot be explained by the increase in income that is generated by the positive wealth shock. In terms of the direct versus common cause debate, this is consistent with a direct effect. If income was a "common cause" of the increase in consumption, there should be little difference between the responses of consumption after the wealth and counterfactual income shocks. However, here, as posited at the outset of this section, the counterfactual income shock does little to explain the positive boost tangible wealth provides consumption in the 1998 to 2011 period.[25]

[24] Per the Den Haan *et al*. (2007) method, in this section the shocks to tangible and financial wealth are measured in terms of standard deviations. However, if the shocks are scaled to equal one in each sub-period, our qualitative interpretation of the results does not change. The scaled results are available upon request.

[25] *cf.* the result for consumer loans found by Den Haan *et al.* (2007), Figure 2 or 3 pages 912-913. The decline in the loan category the authors find following a contractionary shock to the interest rate

For the 1986 to early 1998 period (shown in the second column of Figure 3), the magnitudes of the responses are smaller than in the post-1998 period (which is consistent with the "diminished" tangible wealth effect found by Brady and Stimel (2011) in their earlier sub-samples). Also, any direct wealth effect only appears initially; thereafter the response to the counterfactual income shock is larger (though the responses are very close over the entire horizon).

For the earlier two periods, spanning 1952 through 1973, the direct wealth effect is also less evident than for the 1998 to 2011 period. In the 1952 to 1973 sample, there is no evidence of a wealth effect for tangible wealth, and the negative response of consumption is barely deeper in magnitude than in response to the counterfactual income shock. Such a decline following the wealth shock is consistent with Brady and Stimel's (2011) results for the same period (see Muellbauer (2007) for the intuition of such a result). And similar to Brady and Stimel (2011), the wealth effect first appears after 1973. Though for the 1973 to 1986 period, there is an initial "blip" of a wealth effect, which then only re-emerges later in the horizon. The effect appears to be of a direct nature, albeit a small one.

3.3.3 Financial wealth and the income shock

For financial wealth, there is some evidence of a direct effect for this 1998-2011 sub-sample, but the effect overall is small (consistent with various findings that the financial wealth effect in general is minimal). The bottom panel of Figure 3 shows mixed evidence for a direct financial wealth effect in the earlier periods. For 1986 to 1998, consumption shows a sustained response following the financial wealth shock and the counterfactual income shock more so than in the post-1998 period (with larger magnitudes than for post-1998). However, the response to the counterfactual income shock is actually larger than the response following the overall financial wealth shock. This suggests that income dominates the response of consumption for this asset class.

For the earlier two sub-samples, the difference in the responses of consumption to the financial wealth shock and the counterfactual income shock suggest a direct wealth effect. For the 1973 to 1986 period the wealth effect is brief and small in magnitude, and then the response becomes negative. A direct financial wealth effect appears more evident from responses of consumption in the 1952 to 1973 period. The difference in the two responses in the bottom panel of Figure 3 implies that most of the increase in consumption in this period is driven by the feedback through income. While of course, the impulse response analysis cannot reveal income expectations, in the least, the response of consumption in this period seems to be explained by the rise in income consistent with the higher values of financial wealth.

3.4 Impulse Response Functions for the Counterfactual Credit Shock

For an alternative perspective, we consider a separate counterfactual—delineating between the effects of a credit shock versus a shock to wealth. Figure 4 displays the impulse response functions of consumption applying the Den Haan *et al*. (2007) counterfactual estimation to liabilities instead of income. The responses are displayed in a manner similar to Figure 3. The counterfactual liabilities shock is defined as a sequence of shocks to liabilities that lead to the same impulse response of liabilities as in the case of the wealth shock.

3.4.1 Tangible wealth and Credit shock in 1998 to 2011 period

For the 1998 to 2011 period, there is still evidence of a direct wealth effect relative to a possible credit effect explanation. The direct wealth effect, however, is shorter in duration than in

cannot be explained simply by the counterfactual income shock (the depressed level of income that occurs in the high-interest rate environment).

the case of the wealth versus income case. Moreover, after about eight quarters the direct wealth effect disappears. That is, more so than in the case with the counterfactual income shock, the response of consumption to tangible wealth for this period appears to be partially explained by the feedback through liabilities.

For a shock to financial wealth, the effect on consumption is similar to the case in Figure 3. There is a small direct wealth effect for about two years. The contrast between the response of consumption to the tangible and financial wealth shocks in the counterfactual shock to liabilities makes sense if a common "credit" cause explains the relationship between consumption and wealth. An increase in tangible wealth is obviously more likely to serve as a catalyst for household borrowing than stock market wealth (see the earlier discussion on the relative wealth effects). That a possible feedback through liabilities is more evident in the tangible wealth scenario shown in Figure 4 could be explained by Muellbauer's (2007) conception of the credit effect.

3.4.2 Wealth and Credit shocks in earlier periods

For the 1986 to early 1998 period, in both the top and bottom panels of Figure 4, there is evidence of a small direct wealth effect. In the least, the response of consumption to either the tangible wealth or financial wealth shock over the early part of the horizon does not appear to be explained by a feedback through liabilities (though in the second half of the forecast horizon the credit effect does become more pronounced in both cases).

For the earlier two periods, the responses of consumption to the counterfactual liabilities shock are similar to the case with the counterfactual income shock. In the 1973 to 1986 sample there is no evidence of a wealth effect for tangible wealth, and consumption falls more after the counterfactual liabilities shock than with the counterfactual income shock. The decline of consumption under the counterfactual liabilities shock for this period may suggest that the feedback through liabilities offsets any potential positive effect from the tangible wealth increase. For financial wealth, there is a small initial effect just as in the case compared to the counterfactual income shock. After a year, however, there is no difference between the wealth effect and the credit effect. For the earliest part of the sample, the relative responses are similar to those displayed in Figure 3, though for both forms of wealth, the direct wealth effect appears more pronounced.

4. Conclusion

While it appears there is a direct wealth effect in the data after 1998 the nature of the wealth effect over time is not consistent, just as evidence for the wealth effect overall is not consistent over time. In the context of the Den Haan *et al*. (2007) counterfactual exercise the response of consumption to a shock to either tangible wealth or financial wealth does not appear to be explained by a feedback through income. However, for the tangible wealth shock there does appear to be a feedback through liabilities but not in the case of the financial wealth shock. Hence, while income does not appear to be a common cause after 1998, there is some evidence of a credit mechanism explaining the increase in consumption after a rise in housing-based wealth.

Prior to 1998 the direct wealth effect is less evident. For tangible wealth there is hardly a wealth effect at all before 1998 (consistent with results in Brady and Stimel (2011)). For financial wealth there is evidence of a direct wealth effect prior to the mid-1980s, but from 1986 to 1998 any evident wealth effect appears mostly consistent with common cause argument made in Attanasio *et al.* (2009).

This paper provides the perspective that not only has the wealth effect changed over time, but the nature of the relationship depends on the category of wealth and the time period under consideration. In addition, this study provides evidence of a direct effect for both housing wealth

and financial wealth, whereas most previous work on the direct wealth effect focused on financial wealth. In light of the rise and fall of housing wealth over the 1998 to 2011 time period, how the *direct* wealth effect may have mattered for the business cycle over this time span would be a useful line of continued research.

Acknowledgements: We thank the editor and the anonymous referees for their helpful comments. All remaining errors are our own.

References

[1] Aoki, Kosuke, Proudman, James, and Gertjan Vlieghe (2001). "Why house prices matter," *Bank of England Quarterly Review*, Winter: 460-468.

[2] Aoki, Kosuke, Proudman, James, and Gertjan Vlieghe (2002). "Houses as Collateral: has the link between house prices and consumption in the U.K. changed?" *Economic Policy Review*, 8(5): 163-177.

[3] Ashley, R. A., and R. J. Verbrugge (2009). "To difference or not to difference: a Monte Carlo investigation of inference in vector autoregression models," *International Journal of Data Analysis Techniques and Strategies*, 1(3): 242-274.

[4] Attanasio, Orazio P., Blow, Laura, Hamilton, Robert, and Andrew Leicester (2009). "Booms and Busts: Consumption, House Prices and Expectations," *Economica*, 76(301): 20-50.

[5] Attanasio, Orazio P., and G. Weber (1994). "The U.K. consumption boom of the late 1980s: aggregate implications of microeconomic evidence," *Economic Journal*, 104(427): 269-302.

[6] Benjamin, John, D., Chinloy, Peter, and G. Donald Jud (2004). "Real Estate Versus Financial Wealth in Consumption," *Journal of Real Estate Finance and Economics*, 29 (3): 341-354.

[7] Brady, Ryan, R. (2011). "Consumer Credit, Liquidity, and the Transmission Mechanism of Monetary Policy, *Economic Inquiry*, 49(1): 246-263.

[8] Brady, Ryan, R., and Derek Stimel (2011). "How the Housing and Financial Wealth Effects have changed over Time," *The B.E. Journal of Macroeconomics*, 11(1), Topics, Article 28.

[9] Campbell, John Y., and Joao F. Cocco (2007). "How do house prices affect consumption? Evidence from micro data," *Journal of Monetary Economics*, 54(3): 591-621.

[10] Carroll, C. D., M. Otsuka, and J. Slacalek (2011). "How Large are the Housing and Financial Wealth Effects? A New Approach," *Journal of Money, Credit and Banking*, 43 (1): 55-79.

[11] Case, Karl, Quigley, John, and Robert Shiller (2005). "Comparing Wealth Effects: The Stock Market versus the Housing Market," *Advances in Macroeconomics*, Berkeley Electronic Press, 5(1), Article 1:1-32.

[12] Catte, P., N. Girouard, R. Price, and C. Andre (2004). "Housing Markets, Wealth, and the Business Cycle", *OECD Economics Department Working Papers*, No. 394, OECD Publishing.

[13] Chang, Pao-Li, and Lutz Killian (2000). "How accurate are confidence intervals for impulse responses in large VAR models?" *Economic Letters*, 69(3): 299-307.

[14] Colander, D. (1995). "The stories we tell: A reconsideration of the AS/AD analysis", *Journal of Economic Perspectives*, 9(3): 169-188.

[15] Den Haan, Wouter J., Sumner, Steven W., and Yamashiro, Guy M. (2007). "Bank loan portfolios and the monetary transmission mechanism," *Journal of Monetary Economics*, 54(3): 904-924.

[16] Donihue, Michael, and Andriy Avramenko (2007). "Decomposing Consumer Wealth Effects: Evidence on the Role of Real Estate Assets Following the Wealth Cycle of 1990-2002," *The B.E. Journal of Macroeconomics*, 7(1): Topics, Article 25.

[17] Dynan, Karen E., and Dean M. Maki (2001). "Does Stock Market Wealth Matter for Consumption?" Washington: Board of Governors of the Federal Reserve System, FEDS Discussion Paper No. 2001-23.

[18] Engelhardt, Gary V. (1996). "House prices and home owner saving behavior," *Regional Science and Urban Economics*, 26(3/4): 313-336.

[19] Hoover, K.D., and O. Jordà (2001). "Measuring Systematic Monetary Policy", *Federal Reserve Bank of St. Louis Review*, 83(4): 113-137.

[20] Jordà, Òscar (2005). "Estimation and Inferences of Impulse Responses by Local Projections," *American Economic Review*, 95(1): 161-182.

[21] Jordà, Òscar (2009). "Simultaneous Confidence Regions for Impulse Responses", *The Review of Economics and Statistics*, 91(3): 629-647.

[22] Lettau, M. and S. Ludvigson (2004). "Understanding Trend and Cycle in Asset Values: Reevaluating the Wealth Effect on Consumption," *American Economic Review*, March, 94(2): 276-299.

[23] Ludwig, Alexander, and Torsten Sløk (2004). "The Relationship between Stock Prices, House Prices and Consumption in OECD Countries," *Topics in Macroeconomics*, 4(1): 1-26.

[24] Muellbauer, John and Anthony Murphy (1990). "Is the UK balance of payments Sustainable?" *Economic Policy*, 5(11): 345-383.

[25] Muellbauer, J. (2007). "Housing, Credit, and Consumer Expenditure," In: *Housing, Housing Finance, and Monetary Policy, A Symposium Sponsored by the Federal Reserve of Kansas City*, Jackson Hole, Wyoming, August-September, 2007, 267-334.

[26] Naka, Atsuyuki, and David Tufte (1997). "Estimating Impulse Response functions in cointegrated systems," *Applied Economics*, 29(12): 1593-1603.

[27] Paiella, Monica (2009). "The Stock Market, Housing and Consumer Spending: A survey of the evidence on wealth effects," *Journal of Economic Surveys*, 23(5): 947-973.

[28] Palumbo, Michael, Rudd, Jeremy, and Karl Whelan (2006). "On the Relationships Between Real Consumption, Income, and Wealth," *Journal of Business and Economic Statistics*, 24(1): 1-11.

[29] Poterba, James, M. (2000). "Stock Market Wealth and Consumption," *Journal of Economic Perspectives*, 14(2): 99-118.

[30] Poterba, James, and Andrew Samwick (1995). "Stock Ownership Patterns, Stock Market Fluctuations, and Consumption," *Brookings Papers on Economic Activity*, 26(2): 295-357.

[31] Qu, Z. and P. Perron (2007) "Estimating and Testing Structural Changes in Multivariate Regressions," *Econometrica*, 75(2): 459-502.

[32] Sheiner, Louise (1995). "Housing Prices and the Savings of Renters," *Journal of Urban Economics*, 38(1): 94-125.

[33] Stock, James, and Mark Watson (2001). "Vector Autoregressions," *Journal of Economic Perspectives*, 15(4): 101-115.