ASYMMETRIC EFFECTS OF INTEREST RATE CHANGES: THE ROLE OF THE CONSUMPTION-WEALTH CHANNEL

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Abstract

This paper examines the role of the consumption-wealth channel in explaining asymmetric effects of monetary policy changes. Towards this end, we draw upon available literature on the consumption function and behavioural finance to construct a framework for asymmetric effects of monetary policy caused by the impact of wealth changes on aggregate consumption. We then employ data from the UK to examine the validity of the proposed framework. In the context of a liberalized economy with easy access to consumer credit, wealth reduction due to monetary tightening is expected to have weaker impact on spending than increase in wealth. Our results validate the above hypothesis.

Asymmetric Effects of Interest Rate Changes: The Role of the Consumption-Wealth Channel

1. Introduction

There is overwhelming evidence to show that monetary policy exerts significant influence on national output through aggregate demand (Bernanke and Blinder, 1992; Christiano et al., 1996). It is also well known in the theoretical literature that the transmission channels of monetary policy are the credit channel, the interest rate channel, the exchange rate channel and the wealth channel. While the first three channels have been extensively examined, empirical research on the wealth channel has remained restricted to the impact of monetary policy on asset prices. What has not received adequate attention is the entire pass-through of monetary policy changes on consumption expenditure through movement in asset prices and household wealth. On the other hand, the theoretical roots of this consumption-wealth channel can be traced back to as early as works by Modigliani (1963) and Ando and Modigliani (1963). Their life-cycle theory of consumption emphasizes the role played by household wealth in planning for life-time consumption. However this theory and subsequent work on the permanent income hypothesis by Friedman (1957) postulate that households are consumption smoothers and plan for an entire life-time consumption pattern. In such a framework, there can be little role of monetary policy in so far as the impact of interest rate shocks would be muted. This would be more so in developed financial systems where easy access to consumer credit would allow households to smoothen their consumption patterns.

However, recent work has raised concerns about the strong co-movement exhibited by asset prices and consumption (Dynan and Maki, 2001; Lustig and Van Nieuwerburgh, 2005). Such correlation has strong bearings on the conduct of monetary policy to the extent that monetary policy shocks impact asset prices and thereby household wealth. While this sensitivity of consumption to wealth changes does not appear to be consistent with the traditional views on consumption, policy makers have been taking increasing cognizance of the importance of this phenomenon (Borio et al., 2003). The explanation for this apparent puzzle could lie in the easy access to mortgage equity withdrawals, mortgage re-finance and cheap trading in shares that are possible in developed financial systems. Such easy access to funds whenever required means that any changes in asset prices can be readily translated into liquidity which can then be used for spending on durable or non-durable goods and services. Thus, developed countries could have a section of such 'impatient' consumers whose transitory component of total consumption is significant and easily affected by asset price changes. This would imply the existence of a consumption-wealth channel of monetary policy transmission in such economies.

A recent strand of the monetary policy literature examines asymmetric effects of policy changes. However, as Florio (2004) points out, most of the work related to asymmetric effects of monetary policy has been empirical in nature and the theoretical underpinnings of this phenomenon have been less discussed. In a survey of the asymmetry literature, Florio (2004) documents the following as available explanations: expectations (about future business outlook or inflation), asymmetric price adjustment and credit market imperfections. In this context, the purpose of the present work is to examine the role of

the consumption-wealth channel as a possible factor in explaining asymmetric effects of monetary policy changes. Towards this end, we draw upon available literature on the consumption function and behavioural finance to construct a framework of asymmetric effects of monetary policy caused by the consumption-wealth channel. We then employ data from the UK to examine the validity of the proposed framework. In the context of a liberalized economy with easy access to consumer credit, wealth reduction due to monetary tightening is expected to have weaker impact on spending than increase in wealth. Our results provide empirical support for this argument.

2. Consumption-wealth channel and asymmetry

The consumption-wealth channel of monetary policy traces the impact of interest rate changes on aggregate consumption through change in market value of assets. Modigliani (1971) is one of the earliest works to demonstrate that consumer spending plays a critical role in transmitting the effects of monetary policy changes to the real economy through the wealth channel. In reality, the changes in wealth could arise due to changes in value of either financial assets or housing. Consequently, consumption may be affected by housing wealth and housing wealth holdings directly rather than indirectly, say through company pension funds. Interest rate shocks can affect consumption through the wealth channel in three ways. First, lower interest rates would lead to higher house prices which increases the asset wealth of existing house owners. Such households can then convert these capital gains from their property into liquid spending power through mortgage equity withdrawal, i.e. extracting equity from the higher value of houses by borrowing

more.[1] This enhanced liquidity can then be used for financing consumption of durables or non-durables. Second, lower interest rates lead to rise in value of housing collateral which implies increase in the households' capacity to borrow and willingness of banks to lend. Third, lower interest rates can also boost the market value of financial assets (e.g. market price of shares and bonds are sums of future income streams discounted by what is now a lower interest rate). Thus higher financial wealth can also reduce the need to save and hence release liquidity for consumption spending.

However recent empirical research has provided only weak support for the existence of the consumption-wealth channel of monetary policy transmission. Ludvigson et al. (2002) employed US data from 1966 to 2000 to study the monetary policy transmission to consumption. Their results reveal only a weak role for the wealth channel in transmitting the Federal Reserve's monetary policy changes to consumption spending. Siokis (2005) investigated the consumption-wealth channel of monetary policy transmission in the Euro area by examining data from 1977 to 2002. The results indicate that the wealth channel does not play an important role in transmission of interest rate changes to consumption. Both these papers employed the structural vector auto regression (SVAR) methodology to isolate the impact of endogenous wealth changes on consumption. We intend to revisit the issue of consumption-wealth channel of monetary policy transmission by examining data from the UK through a similar SVAR model and then examine asymmetry in the transmission channel through a set of estimations of the consumption function.

[1] For older house owners, equity release is another channel of extracting equity from higher house prices to finance current consumption.

Kahneman and Tversky (1979) in their influential work on what has come to be known as behavioural finance offered the concept of prospect theory. According to this theory, individuals loath losses more than they like gains. This is manifested in a utility function that is concave in gains but convex in the region of losses. It is reasonable to expect that such preferences would suggest consumption behaviour of the Duesenberry (1949) type where the consumption function is steeper for increases in wealth but flatter for wealth reductions. This is the well known Ratchet effect in consumption. Following from these rationales, it is reasonable to expect that increase in wealth may lead to higher consumption but a fall in wealth may lead to a smaller reduction in consumption in absolute terms. Consumers may take recourse to past savings or other sources of credit (primarily unsecured, e.g. credit cards) to mitigate the adverse impact of wealth reduction on consumption.

Thus, this argument introduces the possibility of asymmetry in the consumption-wealth channel of monetary transmission. In other words, the pass-through is now as follows. Lower interest rates lead to higher wealth which can be used by households to finance higher consumption through equity withdrawals, higher mortgage or increased willingness to spend in general. On the other hand, higher interest rates lead to lower wealth which may not proportionately reduce consumption due to the prospect theory and ratchet effect arguments. In sum, interest rate changes inversely affect asset value which may have asymmetric effects on consumption at least in the short to medium term. Clearly, we are dealing with two issues here. First, does the consumption wealth channel

work? Second, can the consumption-wealth channel explain the asymmetric effects of interest rate changes?

Previous studies have explored asymmetries in the response of household consumption to changes in financial and non-financial wealth. Apergis and Miller (2004) found that positive stock market wealth shocks affect consumption more than negative shocks. Disney et al. (2002) found that impact of house prices on consumption in the UK is stronger when house prices are rising rather than falling. However our objective is to examine asymmetries in the impact of monetary policy shocks on aggregate wealth and consumption. In other words, we intend to study the monetary transmission channel through aggregate wealth, its impact on consumption expenditure, and examine the presence of asymmetries therein.

3. Data and Methodology

The data were downloaded from the website of the Office of National Statistics (www.statistics.gov.uk) where recent time-series data on macroeconomic variables and financial wealth were available. The non-financial wealth series was constructed from house prices and private sector dwelling investment data using the methodology outlined by Fernandez-Corugedo et al. (2007). Quarterly data from 1991:Q1 to 2006:Q2 are considered for the following variables: consumption (on non-durables and services), income (household's net labour income), financial wealth (household's net worth) and non-financial wealth (gross housing wealth), inflation and interest rate (Bank of England's official base rate). Consumption, income and wealth data are taken as real and

de-seasonalized whereas inflation and interest rate are nominal and de-seasonalized. In order to have a preliminary understanding of the data, we plot the variables of interest in terms of their levels, logarithms and growth-rates as relevant (see figure 1). From the figure it appears that during the first few years of our sample, interest rate declined and this was accompanied by a rise in wealth and consumption (at levels as well as growth). Subsequent to the year 1994 there was a period of stability before the same phenomenon was repeated several times. However it is interesting to note that interest rate hikes, as observed during 1996 to 1998 and again during 1999 to 2000, were not accompanied by a fall in consumption. Thus, a casual examination of the data suggests that consumption expenditure reacts to interest rate movements, but the response appears to be muted during periods of tight monetary policy. However, whether such responses are statistically substantial and how much of these responses can be attributed to wealth changes are the issues to which we turn next.

(Figure 1 about here)

To test whether interest rate changes have asymmetric effects and whether such asymmetry can be attributed to the consumption-wealth channel, we need to develop an empirical framework to test the above hypotheses. We borrow the macroeconometric framework of Ludvigson et al. (2002) also employed by Siokis (2005). This approach consists of estimating a dynamic structural vector autoregression (SVAR) model with five variables, namely: consumption, income, wealth, interest rate and inflation. This model is employed as a benchmark model to trace the impulse responses of consumption

to an interest rate shock. While this impact on consumption includes the transmission of monetary policy through the wealth channel, a counterfactual can be constructed that shuts down the wealth channel. This experiment provides the direct impact of interest rate on consumption through channels other than the wealth channel. Any difference between the two responses can therefore be attributed to the presence of the wealth channel.

Accordingly, we specify the following SVAR model (Amisano and Gianini, 1997):

$AY_t = C(L)Y_{t-1} + Bu_t$

where: A is an nxn matrix of contemporaneous coefficients relating the simultaneous relationship among the n variables within the same period; Y_t is an nx1 vector of variables; C(L) is a matrix polynomial in lag operator L that describes the dynamic interactions between the variables; u_t is an nx1 vector of structural innovations with covariance matrix Ω and B is an nxn matrix that describers the contemporaneous relationship among the structural shocks. The reduced form of the model is written as:

$Y_t = B(L)\ Y_{t-1} + e_t$

where: $B(L) = A^{-1}C(L)$; and $e_t = A^{-1}Bu_t$; with covariance matrix Σ. The relationship between the structural shocks u_t and the reduced form residuals e_t is therefore:

$Ae_t = Bu_t$

This model, popularly referred to as the AB model, implies the following relationship between the reduced form and structural form covariance matrices:

$\Sigma=A^{-1}\Omega A^{-1'}$

For identifying the structural shocks, it is necessary to recover u_t from e_t by imposing appropriate restrictions on A and B. With the vector Y defined as [Inflation, Income, Consumption, Wealth, Interest rate], we impose the restrictions as follows:

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & 0 \\ a_{41} & a_{42} & 0 & 1 & a_{45} \\ a_{51} & a_{52} & a_{53} & 0 & 1 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

The above restrictions follow the work of Ludvigson et al. (2002) and are based on the following assumptions: interest rate responds contemporaneously to consumption and income, but not the other way round; consumption is contemporaneously affected by wealth, but the opposite is not true; and finally, the interest rate does not contemporaneously respond to changes in wealth.

4. The Consumption-Wealth Channel

At the outset we assess the time-series properties of the variables. The consumption, income and wealth series are first difference stationary as shown by Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests (see Table 1).[2] However Johansen's tests of cointegration suggest that they do not form a cointegrating relationship (see Table 2) thus precluding an analysis of long-run relationship with an error correction model

[2] The only exception is income for which the PP test rejects the null of non-stationarity. However we take income to be non-stationary based on the results from the ADF test and visual inspection of its plot.

(ECM) among these variables of the Campbell and Mankiw (1989) type. Consequently our analysis is of a short-run nature and we construct an SVAR with the growth rates of these three variables with interest rate and inflation in levels.[3] The choice of the appropriate lag structure is based on various information criteria.

(Table 1 about here)

(Table 2 about here)

Figure 2 presents the impulse responses of each variable to a shock in other variables in the estimated SVAR model. One standard error confidence intervals are presented in each graph. Focusing on the response to interest rate shocks, we observe that inflation responds positively, which appears to be a counter-intuitive result. Siokis (2005) obtains a similar result for the Euro area and attributes it to the central bank having superior information on future inflation which allows it to raise interest rates to forestall future inflation. Income does not appear to respond to interest rate shocks while the response of wealth is positive to begin with and then turns negative although the responses are statistically insignificant. The response of consumption to interest rate shocks is negative to begin with and then fluctuates between negative and positive values. Moving on to the responses to wealth shocks we observe that consumption reacts positively and the responses are statistically significant. While this result provides prima-facie evidence of the strength of the consumption-wealth channel we now move on to the counterfactual experiment of shutting down the wealth channel. Accordingly we re-estimate the SVAR

[3] Interest rate and inflation are confirmed by unit root tests to be stationary series.

model by imposing non-responsiveness of consumption to wealth in contemporaneous as well as lagged terms.

(Figure 2 about here)

Finally, we compare the impulse response of consumption to an interest rate shock in this counterfactual experiment with that in the baseline scenario described above. The comparison is presented in figure 3 along with one standard error bands of the base line impulse responses. The impulse responses clearly suggest that interest rate shocks have a muted impact on consumption when the wealth channel is excluded. Clearly, the difference in the two impulse responses can be attributed to the presence of a consumption-wealth channel in the UK during the period under study. In contrast with the results of Ludvigson et al. (2002) and Siokis (2005), which indicate that the above difference is statistically insignificant, we find that the impulse responses of the counterfactual experiment lie outside the standard error bands of the baselines scenario in periods 2 and 3, thereby underscoring the significance of the consumption-wealth channel, at least in the short run. Therefore the existence of the consumption-wealth channel is confirmed by the difference in the above sets of impulse responses and the importance of wealth in driving consumption is evidenced by the significant response of consumption to wealth shocks in the SVAR. Moreover the forecast error variance decomposition of the consumption series shows that around 14% of its variation is explained by the wealth series, as compared to interest rate changes which explain only 6% (see Table 3). Thus the importance of household wealth, whether driven by interest rate changes or

exogenous, leads us to next investigate the nature of the relationships that explain consumption. In other words, we now study the response of consumption to changes in wealth and interest rate and examine any asymmetries that may exist in the relationship.

(Figure 3 about here)

(Table 3 about here)

5. Asymmetric Interest Rate Effects

Table 4 presents a set of estimations for the consumption function. Since we do not have an ECM specification of the Campbell and Mankiw (1989) type, we estimate the relationships in terms of growth rates using the OLS methodology with appropriate diagnostic checks. The estimated models presented here can be thought of as modified versions of the consumption equation of the SVAR model estimated earlier. In the first model presented in Table 4, we estimate the basic consumption function where consumption is simply a function of income and wealth. The estimated model suggests that while consumption is not significantly affected by income, it is significantly impacted by wealth changes. In model 2, we examine the role of monetary policy by introducing interest rate in the consumption function. The results show that in line with expectations, consumption is negatively affected by interest rate changes, while the other results remain unchanged.

(Table 4 here)

In model 3, we introduce two dummy variables, one for interest rate hikes and another for interest rate cuts. The results suggest that while the interest rate increase dummy has an insignificant coefficient, the interest rate decrease dummy has a positive and significant coefficient. Thus this coefficient serves to reduce the negative impact of interest rate on consumption during periods of tight monetary policy. In other words, while consumption responds positively to interest rate cuts, during periods of tight monetary policy consumption does not decline as a response to higher interest rates. Our hypothesis is that part of the explanation for the asymmetric response of consumption to interest rate changes could lie in the consumption-wealth channel. To examine this we estimate model 4 which decomposes the wealth growth series into positive and negative components.

The results reveal that while wealth increases serve to significantly raise consumption, fall in wealth does not appear to have affected consumption as evidenced by the insignificant coefficient of the wealth reduction series. In other words, an explanation for why interest rate hikes may not lead to fall in consumption expenditure may be found in the consumption-wealth relationship. While increases in wealth lead to higher consumption as expected, reductions in wealth do not affect consumption as households are reluctant to lower their standards of living and expenditure even in the face of adverse interest rate or wealth shocks.

The robustness of our above results were ascertained by a series of diagnostic tests such as those for auto-correlation (Durbin-Watson test), normality (Jarque-Bera test) and conditional heteroscedasticity (ARCH LM test), whose results are reported along with

each estimated model in Table 4. The Durbin-Watson test statistics are close to 2 in each case indicating the absence of auto-correlation. In the case of Model 1 where the test statistic takes the value 1.88, we cross-checked our result with the Q-test and the Breusch-Godfrey test, which confirmed the absence of auto-correlation. In case of each model, the Jarque-Bera and the ARCH LM tests did not reject the null hypotheses of normality and no ARCH effects respectively. To further assess the robustness of our findings, we replaced our measure of consumption with consumption expenditure on non-durable goods alone (i.e. excluding services) and alternatively included semi-durables in the definition. In all these cases, the above results remained qualitatively unchanged.[4] In other words, while households respond to increases in endogenous wealth caused by interest rate cuts, they do not reduce their consumption symmetrically when interest rate rises. This suggests that consumers are able to finance their spending on all forms of consumption by accessing credit. Hence consumption does not fall significantly as a result of adverse changes in wealth due to monetary tightening, at least in the short run.

6. Concluding Remarks

This paper attempts to examine asymmetries in the consumption-wealth channel of monetary policy. Towards this end, we examine macroeconomic data from the UK. Our results suggest that consumption expenditure responds asymmetrically to changes in interest rates, part of which can be attributed to the role of wealth changes in determining consumption. This indicates that the consumption-wealth channel can be a possible reason behind the asymmetric effects of monetary policy. In other words, while interest

[4] The corresponding results, for the SVAR as well as the estimated consumption functions, are not reported to save space, but are available on request from the authors.

rate cuts help to increase wealth and consumption, tighter monetary policy does not appear to symmetrically affect consumption. Our results of weak impact of monetary tightening on consumption growth can be related to Disney et al. (2002) who found that consumption responses to house price shocks are asymmetric in the UK. Their analysis of household survey data revealed that consumption impacts of house price shocks are stronger when house prices are rising. On the other hand, we employ macroeconomic aggregates to show that the response of consumption to wealth and interest rate changes is asymmetric. The above findings have important policy implications. The asymmetry in the consumption-wealth channel suggests that the central bank should take cognizance of the fact that monetary tightening will not reign in consumption growth to the desired extent, which makes it important to re-assess monetary policy measures especially during periods of asset price inflation and rising price inflation. Pre-emptive and progressive interest rate increases may be required to dampen asset price increases and contain future inflation.

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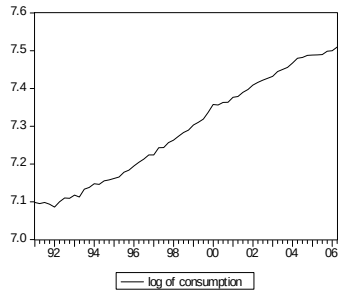
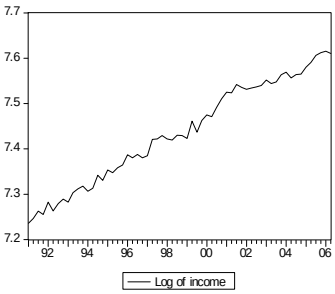
FIGURE 1

Macroeconomic variables, UK, 1991:Q1 to 2006:Q2

Log of consumption

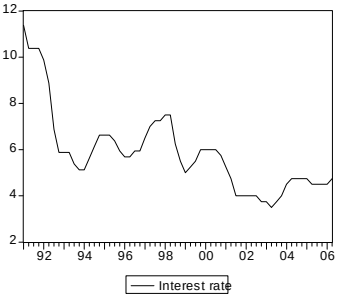


Log of income

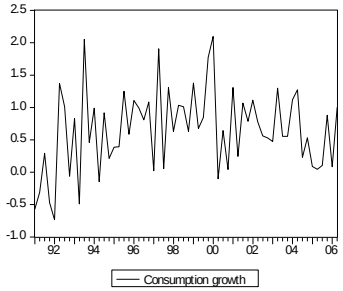


Log of wealth

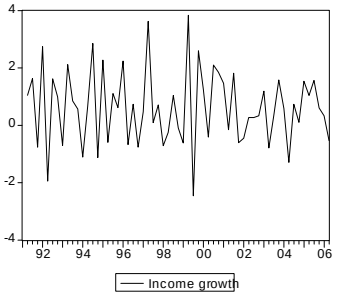
Interest rate



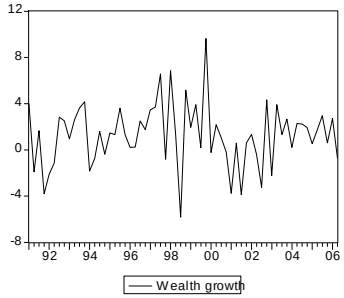
Consumption growth



Income growth



Wealth growth



Inflation

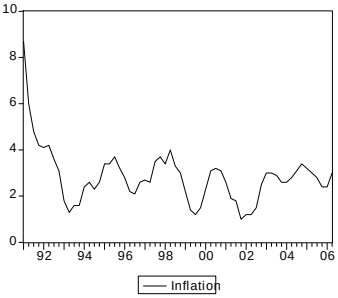
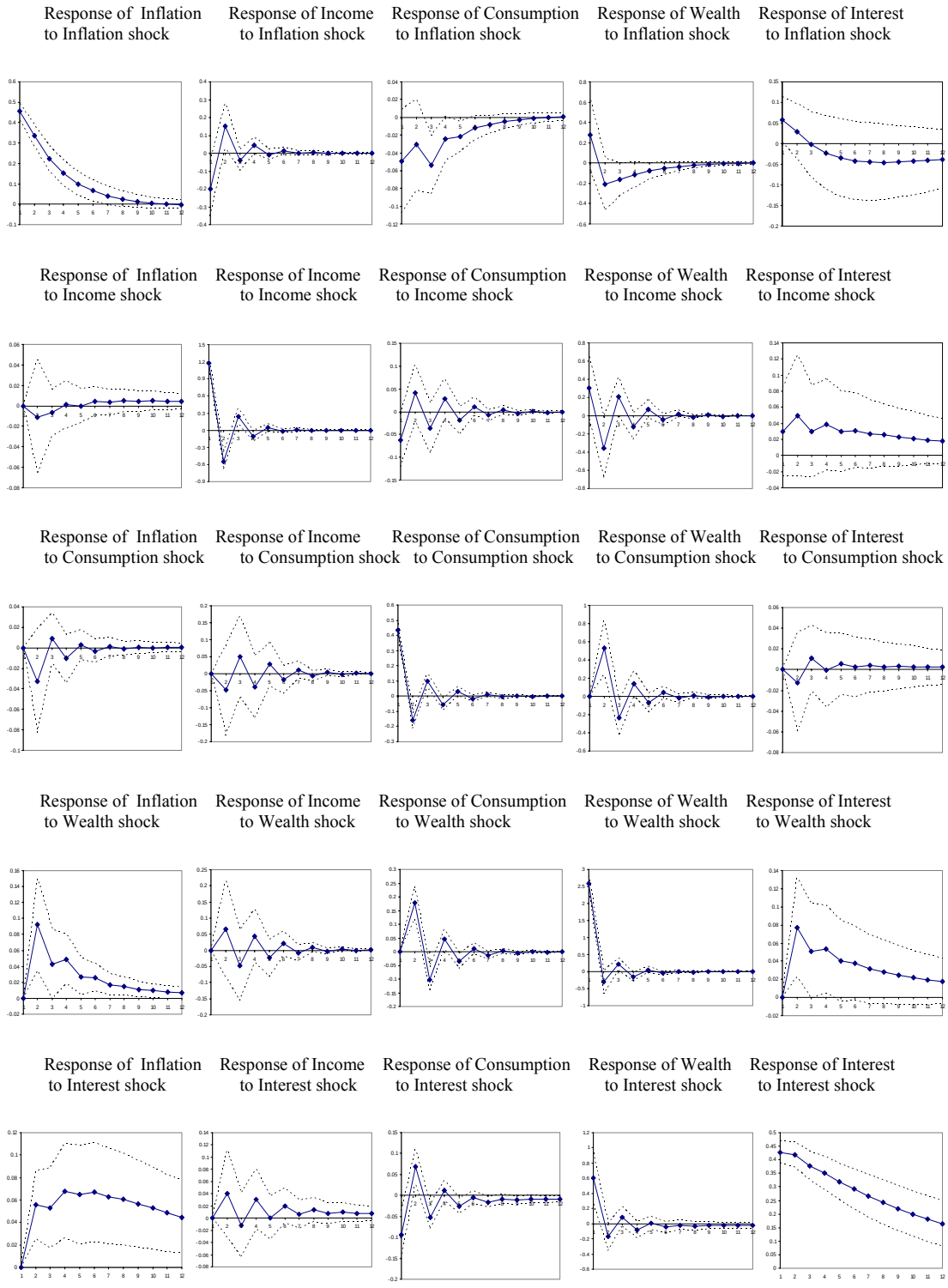


FIGURE 2

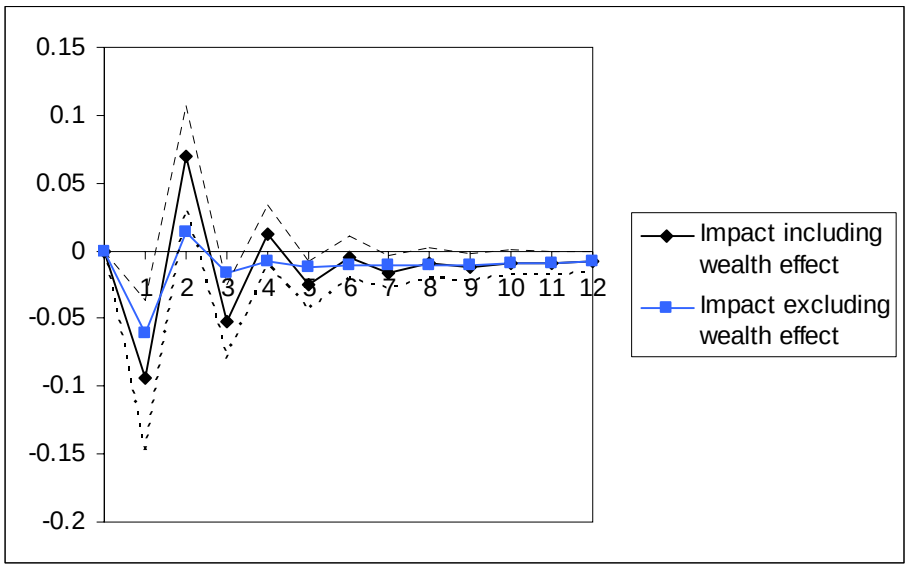
Impulse responses, five-variable SVAR



Note: The dashed lines represent one-standard-error bands.

FIGURE 3

Response of consumption to short-term interest rate shock: baseline and counterfactual scenarios



Note: The dashed lines represent one-standard-error bands.

TABLE 1

Unit Root Tests at Levels

	Consumption		Income		Wealth	
	Without trend	With trend	Without trend	With trend	Without trend	With trend
ADF test statistic	0.5604	-3.2227	-0.8099	-2.8109	-0.1026	-2.0251
Number of lags	2	2	1	1	0	0
P-value	0.9874	0.0900	0.8090	0.2942	0.9441	0.5760
PP test statistic	1.0567	-3.0865	-0.9864	-4.5646	-0.1408	-2.2870
Bandwidth	2	2	4	4	3	4
P-value	0.9967	0.1188	0.7529	0.0027	0.9397	0.4343

Unit Root Tests at First Differences

	Consumption		Income		Wealth	
	Without trend	With trend	Without trend	With trend	Without trend	With trend
ADF test statistic	-4.2554	-4.2954	-12.4455	-12.3809	-8.4210	-8.3405
Number of lags	1	1	0	0	0	0
P-value	0.0012	0.0061	0.0000	0.0000	0.0000	0.0000
PP test statistic	-9.7820	-10.0144	-13.6785	-13.6388	-8.3881	-8.3183
Bandwidth	3	3	4	4	3	3
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: The lag length for the ADF test is based on SIC criterion. Bandwidth for the PP test is determined by the Newey-West statistic using the Bartlett kernel.

TABLE 2

Trace Test for Cointegration

Hypothesized Rank	Eigen value	Trace Statistic	5% Critical Value	P-value
None	0.2085	24.6024	29.7970	0.1762
At most 1	0.1615	10.5717	15.4947	0.2393
At most 2	0.0001	0.0006	3.8414	0.9818

Note: P-values are based on MacKinnon-Haug-Michelis (1999).

Eigen Value Test for Cointegration

Hypothesized Rank	Eigen value	Maximum Eigen value Statistic	5% Critical Value	P-value
None	0.2085	14.0306	21.1316	0.3625
At most 1	0.1615	10.5711	14.2646	0.1771
At most 2	0.0001	0.0006	3.8414	0.9818

Note: P-values are based on MacKinnon-Haug-Michelis (1999).

TABLE 3

Forecast error variance decomposition of consumption

Period	Inflation	Income	Consumption	Wealth	Interest
1	1.1954	1.9007	84.3481	8.3120	4.2439
2	1.3488	2.1929	77.7007	13.4121	5.3454
3	2.2921	2.5239	75.0414	14.2231	5.9196
4	2.4634	2.7582	74.6657	14.2507	5.8620
5	2.6008	2.8555	74.1844	14.3336	6.0257
6	2.6453	2.8947	74.1208	14.3182	6.0209
7	2.6648	2.9118	74.0049	14.3223	6.0962
8	2.6717	2.9148	73.9769	14.3153	6.1213
9	2.6727	2.9171	73.9330	14.3120	6.1652
10	2.6725	2.9164	73.9110	14.3078	6.1924
11	2.6716	2.9164	73.8865	14.3045	6.2210
12	2.6710	2.9157	73.8692	14.3015	6.2426

TABLE 4

Asymmetry in Consumption-wealth channel

Dependent variable is Consumption								
	Model 1		Model 2		Model 3		Model 4	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Intercept	0.7735	0.0000	1.2252	0.0000	1.1582	0.0000	1.1752	0.0000
Consumption(-1)	-0.3086	0.0116	-0.3492	0.0043	-0.3576	0.0030	-0.3492	0.0041
Income(-1)	-0.0070	0.8854	-0.0015	0.9742	-0.0095	0.8379	-0.0112	0.8131
Wealth(-1)	0.0769	0.0013	0.0726	0.0020	0.0564	0.0192		
Wealth increase(-1)							0.1053	0.0028
Wealth decrease(-1)							0.0084	0.8770
Interest rate(-1)			-0.0730	0.0569	-0.0766	0.0425	-0.0794	0.0393
Interest rate increase dummy(-1)					0.3277	0.0427		
Interest rate decrease dummy(-1)					0.1119	0.4183		
Adjusted R-squared	0.1918		0.2301		0.2612		0.2396	
Akaike info criterion	1.4029		1.3697		1.3582		1.3723	
Schwarz criterion	1.5426		1.5443		1.6025		1.5818	
F-statistic	5.6681	0.0018	5.4083	0.0010	4.4759	0.0010	4.7178	0.0012
Durbin-Watson test stat	1.8783		1.9040		1.9422		1.9544	
Jarque-Bera test stat	0.0116	0.9942	0.1384	0.9331	0.2776	0.8704	0.5505	0.7594
ARCH LM test stat	1.2073	0.3192	0.9275	0.4554	0.9639	0.4353	0.6363	0.6389