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What Caused the Decline in the US Saving Ratio?

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Abstract

We investigate whether the mortgage equity withdrawal (MEW) mechanism is useful for explaining the large declines in the US personal saving ratio in the last two decades. MEW depends on house price inflation and mortgage rates. In addition stock prices may affect saving ratio. Therefore, we estimate a VEC model with these four variables. The impulse response analysis shows that saving ratio decreases with positive shocks to asset prices and increases with positive shocks to mortgage rates.

Keywords: Saving ratio, MEW, VEC, asset prices, interest rates

JEL: E21, C32

1. Introduction

The average US personal saving rate during 1960-1985 was about 9% but it has declined to 2.5% by 2007. Different explanations are offered for this large reduction; see Guidolin and La Jeunesse (2007). A theory advanced by some practitioners is the mortgage equity withdrawal (MEW) hypothesis of Hatzius (2006). MEW argues that equity extracted from existing houses, via cash-out refinancing, is the main cause for the declining saving pattern. MEW acts as an additional channel, beyond the wealth effect, through which increases in house prices can boost consumer spending. We show that the ratio of MEW to income depends positively on the change in house prices and negatively on mortgage rate.

To examine the role of MEW in the personal saving rate, a VEC model is estimated with the saving rate, the two variables explaining MEW and the stock price index and the results confirm the presence of a significant long-run relationship. Next, we identify the effects of shocks on the saving rate by imposing plausible long-run restrictions on the estimated VEC. The impulse response functions (IRFs) show that saving rate reacts negatively to asset price shocks and positively to mortgage rate shocks.

2. The empirical VEC model

The variables of the empirical VEC analysis are: the house price index inflation (expressed in the year-on-year growth rate) $\Delta_4 p^h$, the Standard and Poor's 500 index (expressed in log) $sp500$, the mortgage rate i^{mg} , and the personal saving ratio sav . For the house price index the source was Standard and Poor's/Case-Shiller, whereas for others the FRED (Federal Reserve Economic Data). We use observations from 1988Q1 to 2010Q1.

The choice of house price inflation and mortgage rate is not *ad hoc*. MEW depends mainly on these two variables. Home equity can be extracted if either of the two following events occur: 1) the value of the house increases; 2) the current mortgage rate goes below the historically contracted one. In such cases the mortgage can be renegotiated, increasing the loan amount or decreasing the service of debt, and then freeing resources.¹ Our view of the MEW mechanism is confirmed by

¹ The literature distinguishes between active and passive MEW. Active MEW consists of cash-out refinancing and home equity borrowing. Passive MEW is the equity released automatically during the housing turnover process. Studies on the link between MEW and consumption showed that housing gains obtained by the housing turnover process are not very important for spending. Therefore, in our analysis, we refer to the active MEW measure. The official measure

DOLS (dynamic OLS) estimation in Table 1. MEW, expressed as a share of disposable income, can be explained with $\Delta_4 p^h$ and i^{mg} .

(Table 1 here)

2.1 Reduced-form model

First, ADF unit roots tests are conducted for the variables before proceeding with the reduced form model specifications. AIC criteria is used in determining the lag orders. The results (available upon request) show that at the 5% level, the unit root null for the variables in levels is not rejected, while the null is rejected for their first differences. Therefore, cointegration between these variables (sav , $sp500$, $\Delta_4 p^h$ and i^{mg}) is possible. The next step is the specification of an unrestricted VAR model for the cointegration tests:

$$y_t = v_0 + \sum_{i=1}^p y_{t-1} + u_t \quad (1)$$

where $y_t = [i^{mg}, \Delta_4 p^h, sp500, sav]'$. All the information criteria (AIC, SIC, HQ) suggest that $\rho = 2$, and a series of diagnostic tests are in Table 2.

(Table 2 here)

We test against autocorrelation, non-normality, and ARCH effects in the VAR(2) residuals. The results are satisfactory, except for some traces of non-normality. To examine whether lack of normality is associated with specific variables, univariate tests are used in Table 3. Normality is rejected because of non-normality in the stock prices and this is due to an excess of kurtosis. An absolute value of unity or less for skewness is acceptable according to Juselius (2006). Since Johansen's maximum likelihood (ML) approach appears robust to excess kurtosis, non-normality is not a serious problem; see Juselius (2001).

of this series is calculated by Greenspan and Kennedy (2008). In 2008, they published a data set on mortgage equity withdrawal that started in 1990 and ended in 2008Q2.

(Table 3 here)

We test for cointegration of the VAR(2) specification with the Johansen (1995) trace and the Saikkonen and Lutkepohl (2000) tests, with only a constant as the deterministic term. Results in Table 4 show that both the multivariate cointegrating tests reject zero cointegrating relations, while the existence of one cointegrating vector is not rejected.

(Table 4 here)

The VECM based on the VAR(2), under the rank restriction $r = 1$, can be specified as:

$$\Delta y_t = \alpha \left[\beta' y_{t-1} + \delta_0 \right] + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + u_t \quad (2)$$

Table 5 shows the Johansen ML estimate of the cointegrating relation, where the exclusion of the insignificant parameters is based on the top-down algorithm (AIC criteria) and it is normalized on the saving ratio. This cointegrating vector is the long run equilibrium relationship between the saving rate, stock price, house price inflation, and the nominal interest rate. All the coefficients are statistically significant and have the expected signs. Also, the estimates of the adjustment coefficients (α) has the correct negative sign and significant at the 1% level.² This is an important evidence that the variables explaining MEW viz., house price inflation and mortgage rate, play an important role in explaining the saving ratio in our sample.

(Table 5)

2.2 Structural identification and impulse response analysis

² DOLS estimates also confirm the existence of a cointegrating equation. These are available upon request and show that the coefficients are similar to the Johansen estimates.

Having specified the reduced-form model, we now examine the structural analysis. In the VEC framework the following restrictions are needed to analyze the effects of structural shocks with the moving average representation of the model:³

$$x_t = \Phi \sum_{i=1}^t \varepsilon_i + \Phi^*(L)\varepsilon_t \quad (3)$$

where the matrix $\Phi = CB$ represents the permanent component of the model, and the matrix polynomial $\Phi^*(L) = C^*(L)B$ the transitory or cyclical component. The vector of the structural shocks is given by $\varepsilon_t = (\varepsilon^i, \varepsilon^{p^h}, \varepsilon^{sp500}, \varepsilon^{sav})'$. We proceed to identify the shocks by imposing restrictions on the long-run impact matrix CB :

$$CB = \begin{bmatrix} * & 0 & 0 & 0 \\ * & * & 0 & 0 \\ * & * & * & 0 \\ * & * & * & 0 \end{bmatrix}$$

We need $\frac{1}{2}K(K-1) = 6$ linearly independent restrictions. Cointegration analysis suggests that the saving ratio is stationary. Accordingly, saving shocks have no long-run impact on the other variables, which correspond to four zeros in the last column of the matrix CB . This reduces the rank of CB , and implies $K^* = 3$ linearly independent restrictions. To identify the $K^* = 3$ permanent shocks, $K^*(K^*-1)/2 = 3$ additional restrictions are necessary. We assume that the long-term interest rate influences asset prices in the long run, but not the opposite. This is because long-term interest rates commove mainly with fed funds in the long period (Mehra, 1996) and the Fed does not target asset prices directly (Bernanke and Gertler 1999). The last assumption is that house prices are more exogenous than stock prices, that is, stock prices respond to house price shocks, but the opposite is not true. This assumption comes from the fact that in the last 20 years the housing market seems to have had a more independent dynamics (Leamer 2008).⁴

³ For a derivation see Lutkepohl and Kratzick (2004).

⁴ However, we have proved that the position can be changed between $sp500$ and $\Delta_4 p^h$ and the results do not change. The results are available upon request.

Figure 1 shows the responses of the saving ratio to a stock price, house price inflation, and mortgage rate shock together with 95% bootstrap confidence intervals based on 2000 replications over a simulation period of 30 quarters. The signs of the dynamic responses are as expected. A positive saving ratio shock has a significant positive impact on itself for about two years. In the long run there is no significant effect, which is in line with the restriction in the long-run matrix. A positive stock price shock, instead, causes an initial positive response of the saving rate, but it is insignificant. The effect on the saving ratio becomes negative and significant only after about four quarters. In the long run this effect remains significant. Similar observations apply to a positive shock to house price inflation. Finally, the saving ratio increases after a shock to the mortgage rate and is significant after about 4 quarters.

(Figure 1 here)

Overall, IRF analysis suggests that: (a) asset prices and mortgage rate shocks have an impact on saving with some delay; (b) MEW shocks have played an important role in saving during the last 20 years.

3. Conclusions

In this paper we have investigated the dynamics of the personal saving ratio in the US economy for the last two decades, a period of huge declines in the saving ratio. We found that the variables explaining the MEW, viz., house price inflation and mortgage rate, and stock prices enter the long-run relationship of the saving ratio. We have estimated with VEC this long run relationship and a structural form with restrictions on the long-run impact matrix. Impulse responses showed that the saving ratio responds negatively to asset price shocks and positively to mortgage rate shocks and these are consistent with the underlying theories and empirical results.

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Appendix: Tables and figures

Table 1: DOLS estimates of active MEW

$$\text{Model } amew_t / yd_t = MEWRAT_t = \beta_0 + \beta_1 i_t^{mtg} + \beta_2 \Delta_4 p_t^h + \sum_{j=-k}^k \beta_{1,j} \Delta i_{t+j}^{mtg} + \sum_{j=-k}^k \beta_{2,j} \Delta(\Delta_4 p_{t+j}^h) + \varepsilon_t$$

$$\text{Long-run relation } MEWRAT_t = \beta_0 + \beta_1 i_t^{mtg} + \beta_2 \Delta_4 p_t^h + u_t$$

Sample Period	β_0	β_1	β_2
1991q1–2008q2	-3.744*	-0.298***	0.099***
Phillips–Ouliaris test	-4.23***		

Note: *, **, *** represent, respectively, the significance levels of 10%, 5%, and 1%. *amew* and *yd* are expressed in natural logarithm. Leads and lags of DOLS estimations are selected according to HQ criteria. The sample period denotes the range of data before the data points for leads and lags are removed. Newey–West corrected *t*-statistics are applied in regression.

Table 2: Diagnostic tests for VAR(2) specifications

	Q_{16}	Q_{16}^*	LM_5	LJB_4^L	$MARCH_{LM}(5)$
$\rho = 2$	210.7 [0.73]	234.38 [0.30]	95.96 [0.11]	19.82 [0.01]	549.0 [0.06]

Note: *p*-values in brackets. Q_p = multivariate Ljung–Box portmentau test tested up to the ρ^{th} lag; LM_p = LM (Breusch–Godfrey) test for autocorrelation up to the ρ^{th} lag; LJB_p^L = multivariate Lomnicki–Jarque–Bera test for non-normality from Lutkepohl (2004) with *p* variables in the system; $MARCH_{LM}(\rho)$ = multivariate LM test for ARCH up to the ρ^{th} lag.

Table 3: Specification tests for VAR(2) model

Univariate normality test for	<i>sav</i>	<i>sp500</i>	$\Delta_4 p^h$	<i>i</i> ^{mtg}
Norm(2)	0.512 [0.774]	12.919 [0.00]	5.36 [0.069]	4.262 [0.119]
Skewness	0.151	-0.404	-0.215	0.51
Excess kurtosis	3.223	4.706	4.138	3.366

Note: *p*-values in brackets.

Table 4: Multivariate cointegration tests

Johansen cointegration test				
	Test statistics	Critical values		
H₀	$\rho = 2$	90%	95%	99%
r = 0	52.29	50.50	53.94	60.81
r = 1	33.3	32.25	35.07	40.78
r = 2	16.57	17.98	20.16	24.69
r = 3	6.23	7.6	9.14	12.53
Saikkonen and Lutkepohl test				
	Test statistics	Critical values		
H₀	$\rho = 2$	90%	95%	99%
r = 0	40.99	37.04	40.07	46.2
r = 1	20.34	21.76	24.16	29.11
r = 2	9.75	10.47	12.26	16.1
r = 3	0.33	2.98	4.13	6.93

Notes: Deterministic term: constant in the cointegrating relationship.

Table 5: Cointegration vector and loading parameters for VECM with two lagged differences and cointegrating rank $r = 1$

	<i>sp500</i>	$\Delta_4 p^h$	i^{mtg}	<i>sav</i>	<i>constant</i>
β	-1.6 (3.6)	-0.042 (2.1)	0.469 (2.9)	1	11.48 (2.87)
α	-0.014 (1.78)	-0.276 (1.86)	-	-0.404 (5.25)	

Note: t -statistics in parentheses. Top-down subset restrictions exclude loading factor from mortgage rate.

Figure 1: Impulse response analysis

