

Determinants of Saving Rate in the US: The Role of Mortgage Payments

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Abstract

The US saving rate has experienced dramatic decreases over the last three decades. This paper attempts to address the main determinants of the personal and private saving rates in the US with a special focus on the role of mortgage payments. Mortgage payments are important when studying the saving behavior because mortgage payments provide households a framework to accumulate home equity in a disciplined manner. The results show that mortgage payment rate (mortgage payments as a percentage of GDP) has negative impact on both personal and private saving rates while the effect is larger for the private saving rate. Furthermore, including mortgage payment rate as an explanatory variable leads to clear changes in the impact of some of the other variables on the two saving rates. We also find that the two saving rates show strong inertia, public saving rate displays robust partial crowding out effect, and the interest rate and the terms of trade are significant determinants of personal and private saving rates in the US.

1 Introduction

The US saving rate has experienced a dramatic decrease for three decades. Figure 1 shows the annual personal, private (i.e. personal and corporate), government, and aggregate saving rates at quarterly frequency between 1987Q1 to 2013Q3. Personal saving rate decreased from about 8 percent to almost 2 percent from 1987 to 2007. Despite the upward trend after the 2008 financial crisis, personal saving rate was at slightly over 3.5 percent levels as of the third quarter of 2013. Private saving rate, which is the sum of personal and corporate saving rates, shows a similar pattern over the same period except for a distinctively stronger increase after 2007, rising from 3.6 percent to 8.7 percent. The US government saving rate, on the other hand, has almost always been well below zero except for the mid-1998 to mid-2001 period. The aggregate saving rate has also decreased over time and reached negative levels during the financial crisis.

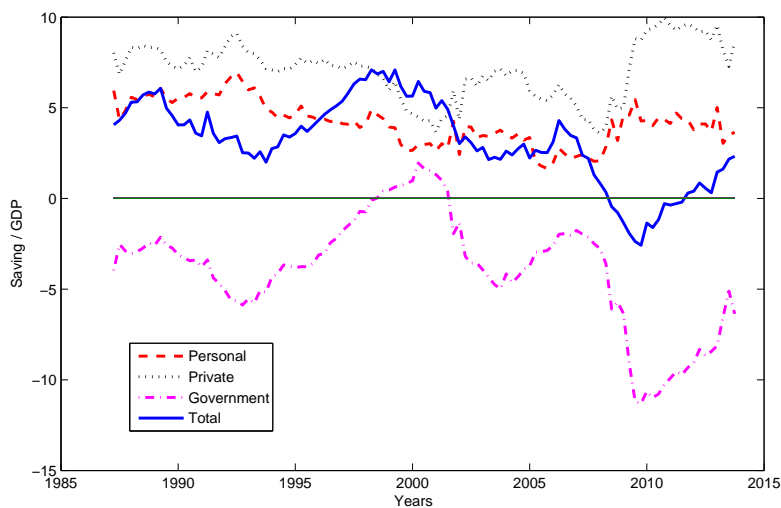


Figure 1: US Saving Rates (1987-2013), Source: BEA

In this study we analyze potential determinants of both personal and private saving rates in the US between 1987Q1 to 2013Q3 period, with a special emphasize on the role of household mortgage payments on these two savings rates. More specifically, we investigate whether an increase in mortgage payments lead to a rise or a drop in personal and private saving rates.

Mortgage obligation is potentially an important determinant of the personal saving rate as mort-

gage payments would serve as a disciplining device for the borrower to accumulate home equity on a monthly basis. Having access to a mortgage loan would also induce young households to save for the initial deposit. However, mortgage payments could also lead households to lower their savings. Consider an agent who wants to be homeowner. In the absence of a mortgage loan, she will have to put aside some amount every month in order to save towards the purchase price. Since she will have to save for the entire purchase price, hence since she will not be able to make the purchase for years to come, she faces an uncertain purchase price. If, on the other hand, she has access to a mortgage loan, she can purchase the house as soon as she has enough saved for a down-payment. Once she has the down-payment and finds a house to purchase, the purchase price and the monthly mortgage payments are determined.¹ Thus, purchasing the house with a mortgage loan reduces the uncertainty that the agent faces regarding how much to save each month in order to be able to own a house. In the spirit of Aiyagari (1994), this reduced uncertainty about future cash flows leads to lower monthly savings for the purpose of buying a house.² In addition, the ability of the homeowners in the US to take out home equity loans enables them to cash in on the equity that they saved up through their mortgage payments.

Why should we be concerned about a low personal saving rate? The primary reason is that a low saving rate constraints the amount of investment that the economy can undertake. There is a very close association between national saving and investment rates (Feldstein and Horioka 1980). To achieve high rates of investment and economic growth, it becomes necessary to rely on foreign capital. However, foreign capital inflows are highly volatile as they respond fairly rapidly to changes in earning opportunities across countries. In addition, assuming positive rates of returns for foreign capital, foreign capital inflows today would eventually mean bigger foreign capital outflows in the future. Low rates of capital formation and heavy borrowing from abroad will have a negative impact on economic growth and inhibit the standard of living over time.

The decline in the US saving rates since 1980s has received substantial attention in the literature.

¹If the borrower takes out an adjustable mortgage loan, she will face uncertainty about the mortgage payments in future years. However, this uncertainty is still less significant than the price uncertainty she would face in the absence of a mortgage loan.

²Aiyagari (1994) reports that for sufficiently high variability and persistency in earnings, aggregate saving rate could be higher by as much as seven to fourteen percentage points.

However, no clear consensus has reached about the main reasons of this decline. An early study by Summers, Carroll, and Blinder (1987) offers an informal discussion of this issue and points out that the primary motivation for saving is the desire to provide for old age and for rainy days, the desire to accumulate for big-ticket item purchases, the desire to leave bequests, and the expected changes in income later in life. Using PSID data Juster, Lupton, Smith, and Stafford (2003) investigate the role of capital gains on personal saving rates and find that part of the decline in the personal saving rates since mid-1980s is due to the significant capital gains in corporate equities. A very similar conclusion is suggested by Lusardi, Skinner, and Venti (2001). According to Bunting (2009), the decline in the personal savings is due to collapsing middle income savings and increasing low income dissavings despite stable high income savings. Guidolin and Jeunesse (2007) take into account the measurement problems about the saving definitions of both NIPA and FRB. The authors conclude that none of the problems of measures currently used fully account for the steep decline in the U.S. saving rate since the mid-90s.

There is also a growing literature on the cross-country determinants of personal and private savings rates. An important study by Loayza, Schmidt-Hebbel, and Serven (2000) using panel data of 69 countries from 1965 through 1994 show that private saving rate exhibit inertia, public saving partially crowds out private saving, and income, inflation, dependency ratio and financial deepness have sizable impact on private saving rate. Similarly Masson, Bayoumi, and Samiel (1998) employ a panel data of both developed and developing countries to analyze the determinants of private saving rate. Their results also suggest partial crowding out of private saving by public saving. They also report that while demographics and growth are important determinants, interest rate and terms of trade have positive but less robust effect on private saving rate. Similar conclusions are reached by Hondroyiannis (2006) for 13 European countries for the 1961-1998 period and by Edwards (1996) for 36 countries for the 1970-1992 period.

Similar results have been obtained in some recent studies that examine the determinants of the saving rate for individual countries. Among these studies are Harris, Loundes, and Webster (2002) for Australia, Paiva and Jahan (2003) for Brazil, Athukorala and Sen (2004) for India, Horioka and Wan (2007) for China, Ozcan, Gunay, and Ertac (2010) for Turkey, and Ang (2011) for Malaysia.

There are two important contributions of this study to the literature. First, to the best of our knowl-

edge, this study is the first attempt to study the determinants of the saving rates in the US using macro data. Although there are some earlier studies on the sources of decline in the saving rate in the US, these studies focus on specific factors such as the role of capital gains (Juster, Lupton, Smith, and Stafford (2003) and Lusardi, Skinner, and Venti (2001)), the role of measurement issues (Guidolin and Jeunesse (2007)) and the role of house price appreciation (Engelhardt (1996b)). We investigate the determinants of personal and private saving rates in the US using macro level determinants that have been widely utilized for other countries. Second, we offer the first study on the role of mortgage payments on personal and private saving rates. As argued above, mortgage payments can be instrumental for saving behavior of households.³

Our results illustrate some interesting effects of mortgage payments on personal and private saving rates. Increasing mortgage payments by one percent leads to contraction in the personal saving rate in the range of 0.47 to 0.91 percent. On the other hand, a similar increase in the mortgage payment rate decreases the private saving rate in the range of 0.88 to 1.24 percent. Furthermore, we find that including mortgage payments in the empirical model leads to significant changes in the impact of some of the other determining of the saving rate, indicating the importance of mortgage payments for saving models. For instance, including mortgage payments in the empirical model leads to sizable decreases in the persistence of both private and personal saving rates. In addition, including it leads to larger crowding out effect of government saving.

The current study has some important policy implications. Following the financial crisis, there is a heated debate in the U.S. over some of the government policies that subsidize mortgage borrowing.

³There have been some studies that looked at the impact of down-payment requirements on the consumption behavior of households. Japelli and Pagano (1994) and Engelhardt (1996a) show that increasing mortgage down-payment constraints lead to significant increases in saving. Aron, Muellbauer, Murata, and Murphy (2012) offer a comparison of the U.K., U.S. and Japan and show that credit market liberalization and lower down-payment requirements in the U.K. and U.S. has increased the average consumption-to-income ratio. Financial innovations in the U.S. and U.K, such as home equity loans, also led to positive impact by higher home prices on consumption. In Japan, by contrast, there has been no credit market liberalization or financial innovation since the 1970s. As a result, there is no evidence of increasing consumption-to-income ratio and increasing house prices have negative impact on consumer spending. Studies by Muellbauer (2007), Aron., Muellbauer, and Murphy (2006) and Benjamin, Chinloy, and Jud (2004) also investigate housing wealth effects on consumption and how these effects depend on the credit supply conditions.

Examples of these policies include the tax deductibility of mortgage interest payments and implicit government guarantees for mortgages purchased by such government agencies as Freddie Mac and Fannie Mae. The current study highlights an important economic impact of these government policies that have been overlooked by earlier studies. There are various arguments for and against government subsidies in mortgage markets. This study adds another argument and shows that policies designed to encourage mortgage borrowing will have an impact on future economic growth through their impact on the saving rate. Clearly, the impact of increased mortgage debt on the economy will differ from one country to another, depending on the level of saving rate in that country. It is also possible that increased mortgage debt could be associated with improved ability of the borrowers to smooth their consumption over their life cycles. Thus, the current results cannot be used to reach any welfare implications of higher mortgage debt. We simply offer evidence on the impact of mortgage debt on personal and private saving rates, two important components of the national saving rate.

The rest of the paper is organized as follows. In the next section, we discuss the determinants of the saving rate that we use in our analysis. We introduce the econometric model and the data in the third section. Results are presented in the fourth section. We offer some conclusion remarks in the final section.

2 Determinants of Saving

The potential determinants of saving rate have been outlined by both theoretical and empirical studies. Although this is an empirical study on the determinants of saving rate, we need to provide theoretical considerations behind these potential determinants and their possible signs as theory determines the choice variables to be considered in the empirical modeling. However, we will only provide a flavor of theoretical discussion on the determinants of savings and direct curious readers to theoretical and other empirical studies.

The possible determinants of saving rate that we take into account in this analysis are mortgage payment rate (mortgage payments as a percentage of GDP), mortgage-related variables (mortgage debt/total debt, share of mortgage interest payment, mortgage-excluded payments), total personal and private debt, lagged saving rate, income growth rate, government saving rate, macroeconomic

uncertainty, interest rate, financial deepness, terms of trade, return on stock market, and recession dummies.

As the main focus of this study is on the effects of mortgages on saving rate, the effects of the mortgage payment rate is of particular importance. An increase in mortgage payment rate is expected to decrease saving rate in other forms because more households would be able to accumulate home equity which is a type of long-term saving. As households home equity increases, this would encourage them to have less savings in other forms. Hence the net effect is ambiguous *ex ante*.

According to one view, the decrease in personal saving rate in response to an increase in mortgage payment rate would be more than the increase in mortgage payment rate by itself. This is because an increase in mortgage payment rate is similar to increases in home equity, which is a type of long-lasting and a less liquid saving form. This characteristic of home equity would encourage households to rely more on the home equity and decrease personal savings in other forms much more. The presence of home equity loans or reverse mortgages are some supporting examples of this view because housing investment is used as a collateral in these cases in order to obtain new credits. However, according to the opposite views, an increase in mortgage payment rate would not change the personal saving rate because it is same as moving your money from one pocket to the other one. Regarding the private saving rate which is the sum of personal and corporate saving rates, the effect of mortgage payment rate is also ambiguous.

It is empirically found that saving rate shows strong inertia even after controlling for other relevant factors with annual data. Thus we expect to see even stronger inertia in saving rate with quarterly data. This feature of saving rate, which could arise either from consumption habits or consumption smoothing or both is an important explanatory variable that we need to take into account.

The theoretical view on the relationship between income growth and saving rate is not clear as the life-cycle hypothesis and the permanent income hypothesis have different views on the effects of income growth on saving rate. According to the life-cycle hypothesis, aggregate savings would increase in response to an increase in the growth rate of income because it increases savings of younger-age households relative to older-age households. On the other hand, according to the permanent income hypothesis, increases in income growth would imply higher anticipated future income, which would encourage households to save relatively less. Due to this opposite views of income growth on savings,

it is left to the empirical exercise to determine the net effect of income growth on saving rate.

An important determinant of private and personal saving rates is the government savings. According to the Ricardian theory, an increase in government saving rate has no impact on aggregate national saving rate because private saving rate will decrease by an amount equal to an increase in government saving rate. The empirical studies, on the other hand, have found that government saving rate has some crowding out effect on personal and private saving rates. However, based on earlier studies, the crowding out effect is likely to be less than one-to-one, and hence the full Ricardian Equivalence isn't expected to hold.

Saving rate is expected to increase when households and firms perceive increases in macroeconomic uncertainties. In such an environment, agents prefer to hedge against macroeconomic risks by increasing savings. The uncertainty can be captured by exchange market volatility, interest rate volatility, or by inflation rate. For this analysis we use VIX Index as a proxy for macroeconomic uncertainties. We think that it is a better measure of macroeconomic uncertainty than interest rate volatility or inflation rate in the US.

Another potential determinant of saving rate is the real interest rate. At first glance we could assume that higher real interest rate would increase saving rate. However, due to the opposing substitution and income effects the net impact of real interest rate seems to be ex ante ambiguous. An increase in the real interest rate reduces the present value of flow of future incomes and therefore has negative effect on saving rate (i.e. income effect). On the other hand, as the same increase in the interest rate increases the net return on savings, it encourages households to partly postpone today's consumption and increases savings (i.e. substitution effect). However the net effect depends on which one outweighs the other. Earlier studies have found mixed results and hence it is left to empirical exercise to determine the sign and the magnitude of the effect of the real interest rate on saving rate.

We also use the ratio of total debt to GDP as a variable to proxy for the financial deepness economy. This variable can possibly have negative impact on saving rate because households can easily reach credits if financial system is sufficiently deep which would then decrease the motivation for saving. One can think of the mortgage-excluded payments as another proxy for the financial deepness because as financial system becomes deeper and more accessible, more households would use credits and credit cards and hence the mortgage-excluded payments would increase.

When studying the determinants of saving rate and particularly the decline in private and personal saving rates in the US, we need to take into account the capital gains since these gains aren't included in definition of savings in the NIPA. For instance, Garner (2006) and Juster, Lupton, Smith, and Stafford (2003) argue that the decline in saving rate since mid 1980s is largely due to the capital gains on corporate stocks. Therefore we include the growth rate of the Dow Jones Industrial Average Index to capture the capital gains of the stock market investment in the analysis.

We use terms of trade defined as the ratio of nominal export/import to real export/imports to capture the fact that positive terms of trade shocks have positive impact on saving rate through their positive effects on both wealth and income. Finally, we use dummies for recessions in the US for this period.

3 Model and Data

3.1 Data

Our study uses annual US data at quarterly frequency from 1987Q1 to 2013Q3.⁴ Table 1 provides data definitions and their sources. We obtain saving rate data from Bureau of Economic Analysis's Table 5.1 of National Income and Product Account. Saving rate is the ratio of aggregate saving over GDP. Private saving rate is defined as the sum of personal saving rate and the corporate saving rate. Quarterly mortgage payment rate and mortgage-excluded credit payment rate are calculated from the debt service ratios provided by the Federal Reserve. Both personal and private total debt are obtained from Financial Accounts of the United States provided by the Federal Reserve. Mortgage interest payment is calculated by multiplying total mortgage stock with the mortgage interest rate.⁵ Terms of trade variable is calculated as the ratio of nominal export/import to real export/imports. We obtain recession dates from NBER. We use the growth rate of Dow Jones Industrial Average as a proxy for the capital gains that aren't reflected in the saving definition of NIPA.

We apply Augmented Dickey-Fuller test to examine the unit roots in the variables. The results

⁴The analysis cover the period after which the Tax Reform Act became effective.

⁵Mortgage interest rate is the National Average Contract Mortgage Rate provided by Federal Housing Finance Agency (FHFA).

Table 1: Determinants of Saving

Variable	Definition	Source
Personal saving rate	Personal saving / GDP	NIPA
Private saving rate	Private saving / GDP	NIPA
Government saving rate	Government saving / GDP	NIPA
Growth rate of per capita income	Growth rate of per capita income	St. Louis FED
VIX Index	VIX Index	St. Louis FED
Interest rate	Federal funds rate	St. Louis FED
Terms of trade	nominal(exports/imports)/real(exports/imports)	St. Louis FED
Capital gains	Growth rate of Dow Jones Industrial Average	St. Louis FED
Recession dummy	NBER official recession dates	NBER
Mortgage payment rate	Mortgage payments / GDP	FED ¹
Total debt rate	Total debt / GDP	FED
Total mortgage stock rate	Households' Outstanding mortgage debt / GDP	FED
Share of mortgage interest payment rate	Mortgage Interest Payment / Mortgage Payment	FED and FHFA
Mortgage excluded payments rate	Mortgage excluded payments / GDP	FED

¹ This data specifically comes from Household Debt Service and Financial Obligations provided by FED.

of the test presented in Table 2 show that total debt rates, mortgage debt/total debt ratio, the share of mortgage interest payment, and mortgage-excluded payment rate are not stationary. Hence we take the first difference of these variables and take the level of the other variables.

Table 2: Augmented Dickey-Fuller Test

Variable	p-value ¹
Private Saving Rates	0.06 ^a
Personal Saving Rates	0.10 ^a
Growth Rate of Per Capita Real Incomeowth Rate	0.00 ^a
VIX	0.00 ^a
Interest rate	0.00 ^b
Terms of Trade	0.08 ^a
Public Saving Rate	0.09 ^a
Growth Rate of DJIA	0.044 ^a
Mortgage Payments Rate	0.035 ^a
Total Private Debt Rate	0.73 ^a
Total Personal Debt Rate	0.29 ^a
Mortgage Debt / Total Private Debt	0.36 ^a
Mortgage Debt / Total Personal Debt	0.21 ^a
Share of Mortgage Interest Payment	0.27 ^a
Mortgage Excluded Payments Rate	0.23 ^a

¹ Superscript ^a denotes the presence of only intercept in the regression while ^b denotes the presence of both intercept and trend.

3.2 Econometric Analysis

We use two econometric models to study the determinants of saving rate. In the first model, we use commonly utilized variables in the literature. In the second model, we incorporate mortgage payments and other mortgage-related variables into the first model. We perform for both personal and private saving rates separately.

$$PS_t^i = \beta_0 + \beta_1 PS_{t-1}^i + \beta_2 Y_t^g + \beta_3 VIX_t + \beta_4 INT_t + \beta_5 ToT_t + \beta_6 GS_t + \beta_7 REC_t + \varepsilon_t. \quad (1)$$

$$PS_t^i = \beta_0 + \beta_1 PS_{t-1}^i + \beta_2 Y_{t-1}^g + \beta_3 VIX_t + \beta_4 INT_t + \beta_5 ToT_t + \beta_6 GS_t + \beta_7 REC_t + \beta_8 MP_t + \beta_9 \Delta TD_t^i + \beta_{10} \Delta MDTD_t^i + \beta_{11} \Delta MIP_t^i + \beta_{12} \Delta MEP_t + \varepsilon_t \quad (2)$$

We denote the saving rate by PS_t^i where i denotes whether it is personal or private saving rate. For other variables, Y_t^g denotes the growth rate of per capita real income and VIX_t and INT_t stand for VIX index and the real interest rate respectively. The public saving rate and the terms of trade are denoted by GS_t and ToT_t respectively. REC_t is a dummy for the recessions, MP_t^j denotes the mortgage payment rate where j denotes whether it is before-tax mortgage payments or after-tax mortgage payments, $MDTD_t$ denotes the ratio of mortgage payments to total debt. Mortgage interest payment is MIP_t and finally MEP_t denotes mortgage excluded payment rate.

One can argue an endogeneity issue that the independent variable mortgage payment is included in the dependent variable saving rate. However, we believe this could be an issue at micro-level analysis. At aggregate data we dont think that this could be an issue as all savings are sum up at aggregate level. However we subtract after-interest mortgage payments (i.e. home equity payments) from the saving data and perform the same analysis to see if there exist an endogeneity problem. We find that the results are very similar to the results without the subtraction.

4 Results

In this section, we present the results for the personal and private saving rates. Table 3 displays the results for the personal saving rates for both the full sample period 1987-2013 and for the period ended just before the recent financial crisis (1987-2007). In all tables the first columns correspond to the Equation 1 while the other columns corresponds to the second equation.

In the absence of mortgage-related variables, the main determinants of saving rate are lagged saving rate, interest rate, and public saving rate. As expected, personal saving rates show strong inertia. The effect of lagged saving rate is stronger than the effect found in earlier studies with the

coefficients above 0.7. This is mainly due to the fact that we are using quarterly data while earlier studies utilized annual data.

Ex ante the effect of the interest rate on the saving rate is ambiguous because of the substitution and income effects. The results show that real interest rate has positive impact on both saving rates, suggesting that the substitution effect overweighs the income effect. Another important determinant is the government saving rate. As expected, the results indicate that government saving rate has negative impact on personal saving rate. An increase in government saving rate by one percent leads to a decline in the personal saving rate by 0.14 in the full sample and by 0.22 in the sub-sample of pre-crisis period, respectively. As the magnitudes of these declines are not the same to the increase in the government saving rate, the full Ricardian Equivalence does not hold. The effect of VIX index, terms of trade, growth rate of DJIA, per capita income growth rate, and recession dummies are insignificant across both samples in this first analysis.

The second and the fifth columns displays the results when we include mortgage payment rate in the analysis. The statistically significant effect of mortgage payment rate (i.e mortgage payments over GDP) means that an increase in this rate by one percent decreases personal saving rate by 0.47 and 0.68 percent for both 1987-2013 and 1987-2007 periods, respectively. This means that the effect of mortgage payment rate on personal saving rate has become smaller after the recent financial crisis.

The inclusion of the mortgage payment rate has lead to changes the explanatory power of the other variables. The first clear difference is observable from the change in the persistence of the personal saving rate. When we exclude the mortgage payment rate, the persistence is quite high. However, the presence of the mortgage payment rate decreases this persistency. The effect of interest rate and public saving rate has changed as well.

Next, we include some other variables that we think important when analyzing the determinants of saving rate as well as when the role of mortgage payment rate is investigated. These variables are the ratio of total debt to GDP, the ratio of outstanding mortgage debt to total debt, the share of mortgage interest payment to total mortgage payment, and the ratio of mortgage-excluded payment to GDP. The results are displayed in third and the sixth columns of Table 3. In the presence of all explanatory variables, an increase in mortgage payment rate by one percent decreases personal saving rate by 0.86 for the full sample and and 0.80 percent for the sub-sample of 1987-2007.

We find that the share of mortgage interest payment has significant impact on personal saving rate. Personal saving rate decreases by 2.83 percent when the share of mortgage interest payment in total mortgage payment increases by one percent in the full sample case. However the same effect is insignificant for the pre-crisis period. The difference between two cases indicates that after the financial crisis mortgage interest payment has larger negative impact on personal saving rate.

Furthermore, the effect of total debt is significant in both periods but it is positive for the full sample and negative for the sub-sample of pre-crisis period. This shows that for the pre-crisis period, personal saving rate decreases when total debt to GDP ratio increases. However, after the crisis increases in total debt to GDP ratio leads households to save a little more. Finally, the effect of mortgage-excluded payment rate has significantly negative impact on personal saving rate in both samples.

In Table 4, instead of mortgage payment we use after-tax mortgage payment. The negative effect of after-tax mortgage payment rate on personal savings is larger than the negative effect of mortgage payment rate (before tax). In the full model, the effect almost doubled. The comparison with Table 3 show that increases in tax-deduction reduces the effect of mortgage payments on personal saving rate.

In both models, we find that an increase in macroeconomic uncertainty has positive impact on saving rates for the full sample case when mortgage-related variables are included into the analysis. However the same effect is insignificant for the sub-sample of 1987-2007 period. Furthermore, the effect of terms of trade has positive impact on saving rate only for the sub-sample period.

We report the results of the analysis of private saving rate in Table 5 and 6. Private saving rate is the sum of personal and corporate saving rates. Table 5 report the results when we use mortgage payment rate while 6 reports the results when we use after-tax mortgage payments in the analysis.

The effect of mortgage payment rate on private saving rate is statistically significantly negative for both periods and its larger in absolute term than the effect in the case of personal saving rate. An increase in mortgage payment rate by one percent decreases private saving rate in the range of -1.03 to -1.24 for the 1987-2013 period and in the range of -0.88 to -0.92 for the 1987-2007 period.

The other determinants are, by and large, similar to the determinants of personal saving rate with some exceptions. The change in the explanatory power of the variables is larger in private saving model than the personal saving model when mortgage-related variables are included. For instance

the effect of lagged saving rate and public saving rate changes from 0.68 to 0.34 and from -0.27 to -0.42, respectively. Government saving rate has stronger crowding out effect on the private saving rate than on the personal saving rate. This result is intuitive in the sense that corporations respond more promptly to the saving decisions of the government than households. Contrary to personal saving case, the share of mortgage interest payment has no significant influence on private saving rate. The effect of mortgage excluded payments rate is negative in the full sample case and insignificant in the sub-sample case.

Table 6 reports the results when after-tax mortgage payment rate is used instead of mortgage payment rate. Similar to the personal saving analysis, after-tax mortgage payment rate has larger impact on private saving rate than mortgage payment rate. Furthermore, the effect is larger for the full sample analysis than the sub-sample analysis of 1987-2007. The other results are very similar to the results reported in Table 5 where we use mortgage payment rate.

5 Conclusion

The US saving rate has experienced dramatic decreases over the last three decades. This paper attempts to address the main determinants of the personal and private saving rates in the US with a special focus on the role of mortgage payments. Mortgage payments are important when studying the saving behavior because mortgage payments provide households a framework to accumulate home equity in a disciplined manner.

The results show that mortgage payment rate has negative impact on both personal and private saving rates while the effect is larger for the latter. Furthermore, including mortgage payment rate and other mortgage-related variables into analysis leads to clear changes in the impact of some of the other variables on the two saving rates.

We also find that the two saving rates show strong inertia. In addition, public saving rate displays robust partial crowding out effect. Furthermore, our results indicate that while interest rate has robust positive impact on saving rates, the effects of macroeconomic uncertainty, terms of trade, total debt, and share of mortgage interest payments depends on model specifications.

Table 3: Personal Saving Rate (Independent Variable: Mortgage Payments)

	1987-2013			1987-2007		
Lagged Personal Saving Rate	0.713*** (0.062)	0.619*** (0.072)	0.523*** (0.083)	0.727*** (0.064)	0.594*** (0.078)	0.367*** (0.095)
Growth Rate of Per Capita Real Income	0.003 (0.12)	-0.034 (0.118)	-0.001 (0.119)	0.037 (0.133)	-0.016 (0.129)	-0.084 (0.122)
VIX	0.013 (0.008)	0.013* (0.008)	0.024** (0.009)	0.016 (0.01)	0.015 (0.01)	0.014 (0.01)
Interest Rate	0.168*** (0.049)	0.222*** (0.053)	0.282*** (0.057)	0.203*** (0.057)	0.25*** (0.057)	0.294*** (0.076)
Terms of Trade	0.029 (0.029)	0.035 (0.028)	0.026 (0.03)	0.074* (0.037)	0.073** (0.036)	0.134*** (0.037)
Public Saving Rate	-0.139*** (0.042)	-0.193*** (0.047)	-0.226*** (0.051)	-0.219*** (0.058)	-0.298*** (0.063)	-0.387*** (0.064)
Growth Rate of Dow Jones	0 (0.004)	-0.002 (0.004)	-0.004 (0.004)	0.001 (0.004)	0 (0.004)	-0.002 (0.004)
Recession Dummy	0.137 (0.228)	0.288 (0.231)	0.374 (0.254)	0.083 (0.232)	0.176 (0.225)	0.468* (0.237)
Mortgage Payment Rate		-0.471** (0.195)	-0.909*** (0.262)		-0.679*** (0.249)	-0.885*** (0.323)
Total Debt Rate			0.09* (0.048)			-0.153** (0.064)
Mortgag Debt / Total Debt			-0.161 (0.102)			-0.074 (0.109)
Share of Mortgage Int. Payment			-2.828* (1.512)			0.185 (1.901)
Mortgage Excluded Payment Rate			-1.181** (0.523)			-1.042* (0.553)
<i>Adj.R</i> ²	0.799	0.809	0.818	0.875	0.885	0.901
N	106	106	106	83	83	83

Table 4: Personal Saving Rate (Independent Variable: After-tax Mortgage Payments)

	1987-2013			1987-2007		
Lagged Personal Saving Rate	0.713*** (0.062)	0.663*** (0.067)	0.572*** (0.079)	0.727*** (0.064)	0.663*** (0.069)	0.434*** (0.09)
Growth Rate of Per Capita Real Income	0.003 (0.12)	-0.018 (0.119)	-0.002 (0.122)	0.037 (0.133)	0.026 (0.13)	-0.032 (0.121)
VIX	0.013 (0.008)	0.013 (0.008)	0.019** (0.009)	0.016 (0.01)	0.016 (0.01)	0.013 (0.011)
Interest Rate	0.168*** (0.049)	0.207*** (0.053)	0.265*** (0.058)	0.203*** (0.057)	0.248*** (0.059)	0.307*** (0.077)
Terms of Trade	0.029 (0.029)	0.034 (0.028)	0.034 (0.031)	0.074* (0.037)	0.083** (0.037)	0.152*** (0.039)
Public Saving Rate	-0.139*** (0.042)	-0.2*** (0.053)	-0.245*** (0.059)	-0.219*** (0.058)	-0.302*** (0.068)	-0.412*** (0.07)
Growth Rate of Dow Jones	0 (0.004)	-0.002 (0.004)	-0.005 (0.005)	0.001 (0.004)	-0.001 (0.004)	-0.003 (0.004)
Recession Dummy	0.137 (0.228)	0.257 (0.235)	0.424 (0.269)	0.083 (0.232)	0.183 (0.231)	0.512** (0.252)
Mortgage Payment Rate		-0.572* (0.308)	-1.312*** (0.451)		-0.653** (0.298)	-1.031** (0.469)
Total Debt Rate			0.05 (0.045)			-0.167** (0.065)
Mortgag Debt / Total Debt			-0.118 (0.102)			-0.027 (0.108)
Share of Mortgage Int. Payment			-2.627* (1.541)			0.122 (1.999)
Mortgage Excluded Payment Rate			-1.326** (0.58)			-1.049* (0.586)
<i>Adj.R</i> ²	0.799	0.804	0.811	0.875	0.882	0.898
N	106	106	106	83	83	83

Table 5: Private Saving Rate (Independent Variable: Mortgage Payments)

	1987-2013			1987-2007		
Lagged Personal Saving Rate	0.682*** (0.058)	0.428*** (0.07)	0.335*** (0.081)	0.73*** (0.073)	0.551*** (0.083)	0.447*** (0.098)
Growth Rate of Per Capita Real Income	0.213* (0.115)	0.168 (0.103)	0.118 (0.104)	0.078 (0.145)	0.02 (0.134)	0.026 (0.135)
VIX	0.011 (0.008)	0.012* (0.007)	0.009 (0.007)	0.019* (0.011)	0.016 (0.01)	0.007 (0.011)
Interest Rate	0.155*** (0.039)	0.238*** (0.038)	0.238*** (0.038)	0.14** (0.056)	0.175*** (0.053)	0.245*** (0.079)
Terms of Trade	0.074*** (0.027)	0.074*** (0.024)	0.079*** (0.027)	0.069* (0.039)	0.058 (0.036)	0.069* (0.038)
Public Saving Rate	-0.266*** (0.043)	-0.424*** (0.048)	-0.419*** (0.052)	-0.248*** (0.063)	-0.352*** (0.065)	-0.303*** (0.081)
Growth Rate of Dow Jones	0.001 (0.004)	0.002 (0.004)	0.002 (0.004)	0.003 (0.005)	0.003 (0.004)	0.002 (0.004)
Recession Dummy	0.168 (0.231)	0.16 (0.204)	0.286 (0.222)	0.039 (0.251)	0.012 (0.232)	0.089 (0.244)
Mortgage Payment Rate		-1.034*** (0.195)	-1.236*** (0.255)		-0.923*** (0.247)	-0.876** (0.402)
Total Debt Rate			-0.025 (0.022)			-0.038 (0.031)
Mortgag Debt / Total Debt			-0.004 (0.06)			0.08 (0.116)
Share of Mortgage Int. Payment			0.72 (1.191)			-1.825 (2.106)
Mortgage Excluded Payment Rate			-0.685* (0.412)			-0.633 (0.531)
<i>Adj.R</i> ²	0.891	0.915	0.917	0.855	0.877	0.88
N	106	106	106	83	83	83

Table 6: Private Saving Rate (Independent Variable: After-tax Mortgage Payments)

	1987-2013			1987-2007		
Lagged Personal Saving Rate	0.682*** (0.058)	0.567*** (0.06)	0.487*** (0.072)	0.73*** (0.073)	0.643*** (0.075)	0.518*** (0.091)
Growth Rate of Per Capita Real Income	0.213* (0.115)	0.183* (0.107)	0.132 (0.109)	0.078 (0.145)	0.066 (0.137)	0.069 (0.135)
VIX	0.011 (0.008)	0.011 (0.007)	0.006 (0.008)	0.019* (0.011)	0.018* (0.01)	0.008 (0.011)
Interest Rate	0.155*** (0.039)	0.214*** (0.038)	0.22*** (0.04)	0.14** (0.056)	0.189*** (0.055)	0.266*** (0.079)
Terms of Trade	0.074*** (0.027)	0.077*** (0.025)	0.089*** (0.028)	0.069* (0.039)	0.077** (0.037)	0.088** (0.041)
Public Saving Rate	-0.266*** (0.043)	-0.405*** (0.052)	-0.423*** (0.062)	-0.248*** (0.063)	-0.365*** (0.07)	-0.317*** (0.098)
Growth Rate of Dow Jones	0.001 (0.004)	-0.001 (0.004)	-0.002 (0.004)	0.003 (0.005)	0.001 (0.004)	0 (0.004)
Recession Dummy	0.168 (0.231)	0.263 (0.215)	0.462* (0.248)	0.039 (0.251)	0.108 (0.239)	0.193 (0.275)
Mortgage Payment Rate		-1.177*** (0.285)	-1.659*** (0.467)		-0.952*** (0.303)	-0.95 (0.637)
Total Debt Rate			-0.017 (0.025)			-0.043 (0.033)
Mortgag Debt / Total Debt			-0.037 (0.063)			0.083 (0.12)
Share of Mortgage Int. Payment			0.655 (1.253)			-1.973 (2.254)
Mortgage Excluded Payment Rate			-0.958* (0.532)			-0.711 (0.629)
<i>Adj.R</i> ²	0.891	0.906	0.908	0.855	0.871	0.875
N	106	106	106	83	83	83

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