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The Reality of the Real Rate

Kelsey Berro

Department of Economics, Pace University

41 Park Row, 11th Floor, New York, NY 10038
Tel: 212-346-1102 Email: kb50202n@pace.edu

Gregory Colman

Department of Economics, Pace University & National Bureau of Economic Research

41 Park Row, 11th Floor, New York, NY 10038
Tel: 212-346-1102 Email: gcolman@pace.edu

Dhaval Dave (Corresponding Author)

Department of Economics, Bentley University & National Bureau of Economic Research

175 Forest St., AAC 195, Waltham, MA 02452

Tel: 781-891-2268 Email: ddave@bentley.edu

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Abstract

Prevailing economic theory suggests an important distinction between nominal and real values. This concept of purchasing power helps explain the motivation behind basic economic decisions such as whether to invest, save, or consume. Consumers and businesses that make decisions without consideration of purchasing power are assumed to exhibit "money illusion", the failure to adjust nominal values for changes in prices. The standard assumption used for macroeconomic theory and modeling is that consumers and investors lack money illusion, that is, their consumption and investment responds to real variables. This study tests this standard assumption, and examines the effects of nominal and real interest rates on home buying attitudes using micro-data from the University of Michigan: Survey of Consumers. More specifically, the purpose of this research is to compare the impact of various mortgage rates on home buying optimism including the traditional 30-year-fixed rate,

the personal real rate calculated using respondents' one and five-year inflation expectations, and the market real rate calculated from the 30-year TIPS breakeven rate. This is the first study that tests person-specific real rates generated from survey data in addition to market-wide real rates to answer this question. Across all models, results reveal that the nominal rate is more highly influential than real rates in determining home buying optimism. These results have implications for further adjustment to standard macroeconomic modeling.

Keywords: Interest rate, Nominal, real, Money illusion, Housing, Mortgage, Inflation, Expectations

1. Introduction

The Fisher equation describes the relationship between nominal and real variables (Fisher, 1911). The real rate captures the difference between the nominal rate and expected inflation.[1] Holding the nominal rate constant, as inflation increases, the real cost of borrowing decreases, and investment should increase as a result. An example of an investment by consumers that should be affected by the real rate of interest would be home purchases. As the real mortgage rate declines, affordability increases, and therefore we expect to find that home purchases would increase as well. Higher inflation lowers the cost of capital and stimulates credit and spending (Fisher, 1911).

When observing changes in spending, we are observing a trade-off with savings. When individuals can receive a higher real return their propensity to save increases. In times when real returns are very low, they are more likely to spend now and increase their purchases. In the Keynesian aggregate expenditure model, real variables rather than nominal ones dominate the analysis of investment behavior (Keynes, 1936). Market participants are assumed to be aware of the concept of purchasing power and not to exhibit "money illusion" (Fisher 1928). This illusion is that an increase in a consumer's money income automatically means that the consumer can buy more goods and services, ignoring changes in the prices of such goods or services. With respect to interest rates, the illusion is that an increase in the nominal rate of interest automatically increases the cost of borrowing, ignoring the possibility that an increase in the nominal rate reflects an increase in inflation, which will also increase borrowers' incomes. In contrast to popular macroeconomic and financial models, which emphasize the real interest rate, this study assesses the possibility that aggregate expenditure may be influenced by nominal rather than real rates. Therefore if market participants display money illusion, a positive inflation shock will raise the nominal interest rate and have a negative effect on demand. On the other hand, if consumers lack money illusion, a positive inflation shock, holding the nominal rate constant, should increase demand. If consumption and investment appear to rely more heavily on nominal interest rate levels and current household wealth rather than their real counterparts, existing frameworks and paradigms would be better served by incorporating these behavioral responses.

Standard economic theory would suggest that real interest rates will be more determinative in

[1] Technically, the following relationship links the nominal interest rate (i), real rate (r), and expected inflation (π^e): (1+r) = (1+i) / (1+ π^e) or (1+i)=(1+r)(1+ π^e). For small i and π^e, r ≈ i - π^e, that is the real rate is approximately equal to the nominal rate minus expected inflation.

explaining home buying attitudes. In this study we test this assumption and examine the effects of nominal versus real interest rates on home buying attitudes using micro-level data from the University of Michigan: Survey of Consumers. We compare the effects of various mortgage rates on home buying optimism including the traditional 30-year conventional fixed rate mortgage, the "personal real rate" computed using person-specific one and five-year inflation expectations as well as the "market real rate" computed from the 30-year TIPS (Treasury Inflation-Protected Securities) breakeven rate. The results suggest that home buying attitudes are more responsive to nominal interest rates than to real rates, and imply some degree of money illusion exhibited by consumers.

The rest of the study proceeds as follows. Section 2 provides some background and discusses the relevant literature. Section 3 details the methodology and data assembled for the empirical analyses. Section 4 presents and discusses our key results, and section 5 concludes with some implications for macroeconomic modeling.

2. Literature Review

The assumption that expansionary activity is caused by a reduction in the real rate and an increase in credit is incorporated into many New Keynesian Dynamic Stochastic General Equilibrium (DSGE) models (for instance, Galí and Gertler 2007) used for monetary policy decision making. In these models, positive price shocks with the nominal interest rate held constant are expansionary because the real interest rate has declined. With respect to home purchases, a higher inflation rate should increase home buying optimism by lowering the real cost of the purchase assuming nominal rates are held constant. This increase in the rate of expansionary activity would result in a tighter policy stance for monetary policy and a higher nominal federal funds rate. The popular FRB/US model of the Federal Reserve Board (FRB; 2000) also incorporates strong real interest rate effects.

Monetary transmission mechanisms described by policy makers often invoke the "real interest rate effect". Under the "real interest rate effect", as the Federal Reserve reduces the federal funds rate, with inflation held constant, the real rate is reduced and spending is stimulated (Taylor, 1995). "For the most part, the demand for goods and services is not related to the market interest rates quoted in the financial pages of newspapers, known as nominal rates. Instead, it is related to real interest rates—that is, nominal interest rates minus the expected rate of inflation" (San Francisco FRB, 2003).

The exchange rate channel of monetary policy transmission also depends on real variables. In the short run, according to this transmission mechanism, lower real interest rates in the US will tend to reduce the foreign exchange value of the dollar. This devaluation of the US dollar as compared to other currencies lowers the prices of US exports and raises the prices for imported goods. This relative shift in the price of traded goods leads to a boost in net exports and higher aggregate spending.

In light of these theorized effects, financial market participants also monitor real and nominal rates in conjunction with their analysis of products such as TIPS. This is consistent with neoclassical economics which predicts that real variables are what matters for the real

economy. By emphasizing real variables, the presumption is that businesses and consumers understand and utilize the real rate in their decision-making.

However, there are also costs associated with the determination of accurate and timely forecasts of inflation and thus an opportunity cost associated with determining the real rate, especially for households. These costs have been investigated by a number of economists as well as psychologists studying decision-making. Some behavioral models assume that consumers follow simple heuristics that require relatively little effort or time. For an individual to determine the expected rate of inflation over the term of an investment, one may need to spend considerable time and effort observing a wide variety of variables. An individual may need to travel to various markets and regions. This type of intensive research and analysis may be more cost-effective for a firm than for a household. It may be faster and more efficient for the individual to observe a proxy for inflation – such as gasoline prices – or by analyzing the path of the nominal rate itself in order to determine the most affordable time to borrow. Data suggest that consumers react slowly to persistent changes in the inflation rate (Trehan and Lynch, 2013). However, the price of oil influences inflation expectations strongly. Consumer may therefore utilize highly volatile oil prices in a "rule of thumb" for updating their inflation expectations (Trehan and Lynch, 2013). Decision-makers may often discard potentially relevant and crucial information in order to simplify their decision making (Kahneman & Tversky, 1979). This process has been termed by Kahneman & Tversky (1979) as heuristic editing or framing. In this framework, individuals rule out less important considerations and often focus on the few factors that appear to matter most for the situation at hand. Mankiw and Reis (2002) assume that decision-makers form expectations using "sticky" or stale information, an assumption they justify based on behavioral theory. They assume that all agents act as if they had rational expectations, but most use outdated information. Other empirical research focuses on a market agent's consideration of "fairness" in determining prices such as wages. This consideration of fairness plays an important role in explaining downward nominal wage rigidity (Dickens et al., 2007).

Despite this line research, the assumption that nominal rates play a significant role in determining investment decisions contradicts standard and widely-taught economic theory. However, it is an assumption used in Fairmodel designed by Ray Fair of Yale University. Fair tests the relevance of nominal versus real variables (2003A) and discovers some interesting results using a modification of the Fisher Rule. Fair considers a specification of investment demand that depends on the nominal interest rate and the expected rate of inflation:

$$I_t = \alpha i_t + \beta \dot{p}_t^e \tag{1}$$

where I_t is investment demand at time t, i_t is the nominal interest rate, and $\dot{p}_t^e$ is the expected rate of inflation. If the nominal interest rate determines investment decisions, estimates of β in equation (1) should be zero; if investment depends instead on the real rate, estimates of equation (1) should show that $\alpha = -\beta$. Fair estimates α and β for a number of countries and using a number of different measures of inflation, and is able to reject the real rate specification in almost all models, but is unable to reject the nominal rate specification.

One explanation Fair proposes for the lack of significance of the real rate variable is that in

general inflation expectations are constant. If participants think that the monetary authority is targeting a fixed inflation rate, this might be a reason for inflation expectations to also be held relatively constant. This could be plausible in view of the Federal Reserve's inflation targeting regime since 2012 and the credibility of its price-level stability mandate. Under this added specification to its price-level mandate, the Federal Reserve has stated a goal for inflation of 2% as measured by core personal consumption expenditures (PCE) price index, but has not specified a time frame under which this must be achieved.

There is substantial disagreement among both consumers and professional economists regarding estimates of expected inflation (Mankiw, Reis, Wolfers, 2003). Therefore, even those who attempt to use a comprehensive information set to estimate inflation are rarely able to produce a more accurate forecast. As a result, there may be little benefit of using inflation expectations to calculate a real rate if that estimate consistently diverges from reality. Nominal rates are more easily assessable and observed, and take less time to evaluate when making investment decisions.

Other research has been conducted on the effect of nominal interest rates on real consumer expenditures. Conventional theory suggests that higher after-tax real interest rates lead consumers to save more and spend less. However, during the 1980s, the US experienced historically high real rates while also experiencing a run-up in consumer debt ratios (Wilcox, 1990). Thus standard econometric models tend to under-forecast consumption expenditures and overestimate savings during times of high real interest rates. Wilcox (1990) finds that over the 1950 to 1988 period, nominal interest rates are positively correlated with the personal savings rate; in contrast, over the same period, real after-tax interest rates are negatively correlated the personal savings rate.

Our research will expand upon Ray Fair's and James Wilcox's work by re-evaluating the effect of nominal and real interest rates on investment expenditures. Unlike prior research based on aggregate information, we employ micro-level data and focus specifically on consumers and a component of household investment, namely home purchases. If investment decisions do respond to the nominal rate in lieu of the real rate, then this response would be most likely for households and consumers, who may incur non-trivial costs associated with accurately ascertaining the real rate as suggested by some of the research reviewed above. Thus, our focus on consumers and households is especially salient towards testing this key assumption embedded in standard macroeconomic models. We further utilize a variety of measures of the real rate to test whether real or nominal rates matter most for the consumer's decision, and also to test for sensitivity across different measures of the real rate in order to account for the possibility that households may be obtaining their information regarding the real rate through different means.

3. Data and Methodology

The data are derived from the University of Michigan's Survey of Consumers. Since 1978, the Survey of Consumers has collected a wide range of information on consumers' expectations regarding inflation and home buying attitudes. The Index of Consumer Expectations focuses on three areas: how consumers view prospects regarding their own

financial situation, how they view conditions in the general economy over the near term, and their assessment of longer term economic conditions. Each monthly survey contains approximately 50 core questions, each of which tracks a different aspect of consumer attitudes and expectations. The samples from the Survey of Consumers are statistically designed to be representative of all American households, excluding those in Alaska and Hawaii. Each month, a minimum of 500 interviews are conducted by telephone from the Ann Arbor facility. We employ data from all available waves, spanning 1978-2013, and yielding over 163,000 person-wave observations.

The Survey of Consumers provides our dependent variable and most of our independent variables. Our key outcome captures the consumer's "home buying attitude". Consumers are asked in the survey: "Generally speaking, do you think now is a good time or a bad time to buy a home?" Respondents can respond it is a good time, a bad time, or an okay time where they would have to weigh the pros and cons. We construct a dichotomous indicator that equals 1 if the consumer responds that this is a good time for purchasing a home and 0 otherwise. An important advantage of this outcome measures is that it is attitudinal and is expected to respond in the short term to shifts in the expected costs of home purchases. Another advantage of this measure is that it is not likely to be confounded by any other constraints that the households may face, such as liquidity constraints, since it asks generically about home-buying attitudes. It captures the first-order effect on attitudes, whereas actual home purchases would be a second-order effect. A household may believe that this is a good time to buy a home because of low rates, though may choose not to do so for other reasons such as income/borrowing constraints or other fixed costs associated with purchasing a home and relocation.

Our key independent variables are the nominal and real mortgage interest rates. For the nominal mortgage rate, we use the 30-year conventional mortgage rate, derived at the monthly level from the St. Louis Federal Reserve Economic Data (FRED). The FRED series ID for this variables is MORTG. To calculate the real mortgage rate, we use the Fisher equation

$$r = i - \pi^e$$

where π^e is expected inflation. We use three measures of expected inflation. The first is based on the following question in the Survey of Consumers: "By about what percent do you expect prices to go up, on the average, during the next 12 months?" We calculate our first measure of the real mortgage rate by subtracting the respondent's 12-month expected inflation from the 30-year mortgage rate described above, as follows:

Personal Real Mortgage Rate (1-year)

= 30-year Mortgage Rate – Expected Inflation over the next 12 months

Note that because each respondent has his or her own expected inflation, this measures the perceived real mortgage rate for each respondent.

Our second measure of expected inflation is based on the following question: "By about what

percent per year do you expect prices to go (up/down) on the average, during the next 5 to 10 years?" Using this longer-term measure of inflation expectations, we calculate a second measure of each respondent's real mortgage rate, as follows:

Personal Real Mortgage Rate (5-year)

= 30-year Mortgage Rate – Expected Inflation over the next 5 years

The use of these person-specific real rates is a key innovation and contribution of this study, since they are arguably the most relevant for households' investment decisions; that is, if households do respond to the real rate, then it is presumably their own personal determination of the real rate that should matter.

Finally, we estimate expected inflation using the difference between the 30-year nominal treasury rate (FRED series GS30) and the 30-year real rate from the Treasury Inflation-Protected Securities (TIPS), also from FRED (series FII30). We then subtract this measure of expected inflation from the same 30-year mortgage rate used above. Note that this measure of the real 30-year mortgage rate is the same for all respondents. Specifically,

Expected inflation = 30-year Treasury Rate – 30-year TIPS rate

Market Real Mortgage Rate = 30-year Mortgage – Expected Inflation (30-year Breakeven Rate)

We estimate the following investment demand specification to assess the importance of nominal versus real rates in consumers home purchase decisions.

$$HBA_{it} = \beta_0 + \beta_1 RATE_{it} + X_{it}\Psi + \mu_{it} \quad (2)$$

HBA refers to the home-buying attitude (whether the respondent reports this is currently a good time to purchase a home) for the i^{th} consumer in time period t. *RATE* refers to either the nominal 30-year fixed mortgage rate or the three alternate real rates defined above, and *X* is a vector of individual-specific socio-demographic factors which would also be predicted to affect home-buying decisions. Specifically, we control for age (linear and quadratic) measured in years, gender (a dichotomous indicator for female; reference category is male), number of children under the age of 18 in the household, marital status (dichotomous indicators for divorced and not married; reference category is married), household income adjusted for inflation (measured in thousands of dollars), education level (dichotomous indicators for high school graduate, some college, college degree and graduate education; reference category is less than a high school education), and census regions (dichotomous indicators for the West, Midwest, and South; reference category is the Northeast). These variables are derived from the Survey of Consumers. We also control for the unemployment rate (U-3 rate, which is the total number of unemployed as a percent of the civilian labor force, and is official unemployment rate), obtained from the Bureau of Labor Statistics, in order to capture cyclical factors and general economic and labor market conditions. The models are estimated via ordinary least squares (OLS).[2] Reported standard errors are

[2] Estimates and conclusions are fully robust, in term of direction of the effects, magnitudes, and statistical significance, to estimation via logit or probit regression methods. Results available upon request from the authors.

conservatively adjusted for heteroscedasticity and correlated errors across respondents and over time within the same survey year.

The key parameter of interest is β_1, which captures how the relevant interest rate affect home-buying attitudes. If the standard assumptions underlying macro-modeling hold true, we expect to find that the real rate has a negative effect on home buying attitudes. If, on the other hand, consumers have money illusion, we expect to find that the nominal rate has a negative effect on home buying attitudes. Also, we would also expect that the personal real rate, which incorporates consumers' inflation expectations, would be more highly correlated with home buying attitudes than the investor determined market real rate. If the personal real rate is insignificant, we can further assess whether the reason is that consumers are forecasting inflation inaccurately and thus calculating the real rate incorrectly.

With respect to the other covariates, we hypothesize the following directions of effect. An increase in the unemployment rate is expected to reduce home buying optimism, consistent with the economic downturn depressing the demand for durable goods. We also expect home buying optimism to increase with educational attainment and real income. This positive effect would be consistent with homes being a normal good (positive income elasticity), and with their demand increasing with more stable incomes and financial literacy, of which education may be a proxy. Due to economies of scale and possibly a stronger preference for home buying (in expectation of raising a family, for instance), married individuals may also exhibit a stronger demand for home purchases. The effect of household size (number of children) is a priori ambiguous. On the one hand, more children may raise the demand for space and homes. On the other hand, conditional on real income, more children represent a lower income per family member and greater household expenses, which may reduce the demand for home ownership. We also include linear and quadratic measures of age to capture non-linear life-cycle effects with respect to home buying attitudes. It is expected that home buying optimism may increase with age up to a certain point and then perhaps decline. We also control for indicators for the census region to capture unobserved region-specific factors, including weather, interregional differences in cost-of-living, and preferences for home buying.

Table 1. Summary Statistics

Data period: 1978-2013

	Mean	Std. Dev.
Good time to buy home *0=Bad or Neutral 1=Good*	0.69	0.46
30-Year Conventional Mortgage Rate	9.02	3.34
Personal Real Mortgage using 5-year inflation	3.14	4.62
Personal Real Mortgage Rate using TIPS Breakeven	1.73	0.53
Personal Real Mortgage using 1-year inflation	3.41	4.91
Expectations for Prices % Next Year	5.61	4.46
Expectations for Prices % Next 5-years	4.68	4.55
Civilian Unemployment Rate	6.47	1.63

Female	0.52	0.50
HS Degree	0.30	0.46
Some College No Degree	0.25	0.43
College Degree	0.21	0.41
Graduate Education	0.14	0.35
Real Household Income using CPI headline ($ 1000s)	30.88	25.58
Age	45.04	16.59
Age Squared	2303.71	1640.73
Not Married	0.17	0.38
Divorced	0.14	0.34
Widowed	0.08	0.27
Midwest	0.27	0.45
West	0.21	0.40
South	0.33	0.47
Number of Children under 18	0.76	1.10
Number of Observations	163,078	

Notes: Number of observations represents the maximum analysis sample size. The sample size for some variables is slightly less due to missing information.

Table 1 above presents the means for the key variables from the analysis sample spanning 1978-2013. Over this period, about 69% of consumers reported that the current period was a good time for purchasing a home. The mean 30-year conventional mortgage rate over this period was 9.02%. The personal real mortgage rate was estimated at 3.14% (based on 5-year inflation expectations) and 3.41% (based on 1-year inflation expectations), and differed substantially from the market real rate (based on the TIPS breakeven rate) which was 1.73%. The average civilian unemployment rate was 6.5% over this 36-year span.

4. Results

Table 2 presents the estimated coefficients of alternate interest rate measures based on equation (2). Specifications 1-3 utilize the larger analysis sample of respondents who have non-missing information on self-reported 1-year inflation expectations, and specifications 4-6 utilize the sample of respondents with non-missing information on 5-year inflation expectations. We limit the sample thus and utilize a consistent sample across our models in order to facilitate comparison of the interest rate effects. That is, if we find differences in the effects of the nominal versus the real rate, we want to ensure that these differences are not driven by differences in the sample size.

Models (1) and (4) suggest that the nominal rate is statistically significant and has a negative effect on home buying attitude. Specifically, a one percentage point increase in the 30-year nominal mortgage rate is predicted to reduce the probability that a household will be optimistic about purchasing a home by about 3.1 (model 4) to 3.6 (model 1) percentage points. In contrast, across the other specifications, the real rate does not appear to have any statistically or economically significant effect on home buying attitudes. Though the

coefficients of the real rate are negative as expected, they are substantially smaller in magnitude (ranging from -0.004 to -0.01) when compare to the magnitudes for the nominal rate. This statistical insignificance of the real rate carries over across both the market-observed real rate as well as the personal real rate, and also across the personal real rate adjusted for self-perceived 1-year inflationary expectations versus longer-term 5-year inflationary expectations. Consistent with these patterns, the models which utilize the nominal rate have significantly higher explanatory power relative to models which utilize the real rate.

These results consistently show that nominal rates are more strongly associated with home buying attitudes than are real rates. Thus, households appear to observe and pay greater attention to the nominal rate when determining the optimal time to purchase a home, which suggests that household appear to exhibit at least some money illusion. It is possible that this non-rational behavior may be due to financial illiteracy. Households may lack the knowledge or understanding, especially lower-educated households, regarding inflation and purchasing power, and the distinction between nominal and real rates.

Table 2. Regression Results

Coefficients of the Nominal / Real Rate

Outcome: Home Buying Attitude (Good time to purchase a home)						
Sample	Non-missing data on 1-year expectations			Non-missing data on 5-year expectations		
Specification	1	2	3	4	5	6
30-year Nominal	-0.0361***	_	_	-0.0307***	_	_
Mortgage Rate	(-5.56)			(-4.13)		
Market Real Rate	_	-0.0081	_	_	-0.0116	_
(adjusted for 30-year TIPS breakeven rate)		(-0.77)			(-0.75)	
Personal Real Rate	_	_	-0.0018	_	_	_
(adjusted for personal 1-year inflation expectations)			(-0.55)			
Personal Real Rate	_	_	_	_	_	-0.0041
(adjusted for personal 5-year inflation expectations)						(-0.89)
Socio-economic controls	Yes	Yes	Yes	Yes	Yes	Yes
Unemployment rate	Yes	Yes	Yes	Yes	Yes	Yes
Census regions	Yes	Yes	Yes	Yes	Yes	Yes

R-squared	0.101	0.059	0.045	0.078	0.055	0.040
Observations	163078	163078	163078	130439	130439	130439

Notes: Each column represents a separate regression model. Coefficients from OLS regression are reported; t-statistics (reported in parentheses) are computed based on standard errors adjusted for heteroscedasticity and correlated errors across individuals within a given survey year. Specifications 1-3 utilize the sample of respondents with non-missing information on personal 1-year inflationary expectations; specifications 4-6 utilize the sample with non-missing information on personal 5-year inflationary expectations. All models further control for various socio-economic factors in addition to the monthly unemployment rate and indicators for the census regions (see Table 3 for full regression results). Asterisks denote statistical significance as follows: *** p-value $\leq$ 0.001; ** 0.001 < p-value $\leq$ 0.01; *** 0.01 < p-value $\leq$ 0.05.

Another potential explanation could be that consumers and households face costs associated with determining the real rate. Time and resources spent developing an inflation forecast could be better spent elsewhere, as there are opportunity costs involved. In this case, households may prefer a simple and observable heuristic or "rule of thumb", and the nominal rate may serve this purpose. Consumption decisions of agents may be varied for those who face "costs of acquiring, absorbing and processing information" (Reis, 2004). These consumers choose to only randomly and occasionally update their information and adjust their plans. In between this spaced or staggered updating frequency, households remain inattentive. This lack of attentiveness shows that that news disperses slowly throughout the population, such that events may have a gradual and delayed effect on aggregate consumption. The same may be said for changes in other macroeconomic variable observed by consumers such as inflation and interest rates. There may also be a difference in the utilization of real interest rate between the household and firm level. This may be due to the costs associated with re-evaluating inflation expectations which may be more significant at the household level than at the firm level. Households have less access to comprehensive data and economic resources. Therefore, households may use the nominal rate more frequently to determine the best time to invest compared to firms.

This line of reasoning is also consistent with rational inattention theory, which also emphasizes the costs of processing information, suggesting that households may not spend a lot of time and effort rethinking their estimate of the prevailing inflation rate (Sims 2010). These information-processing costs tend to cause consumers to update their inflation expectations less frequently, especially during periods when inflation is relatively stable. Moreover, instead of using sophisticated models to predict inflation, consumers are more likely to rely on a few simple rules of thumb. Without the concept of inflation-adjusted costs, as the nominal rate increases, the perceived cost of a mortgage increases thus making it a less opportune time to buy a home. When drawing this conclusion, households are observing the trend of nominal interest rates rather than real rates.

Consumers may also observe nominal rates with more regard due to the emphasis on nominal income requirements determined by banks in order to obtain loans. These effects arise because the household sector becomes increasingly constrained as the nominal interest rates increase and lenders impose limits on interest rate payments as a percentage of their nominal

income. "Such liquidity constraints make consumer spending dependent on nominal interest rates and actual cash flow" rather than real variables (Wilcox, 1990). "Payment-to-income" limits constrain the amount of credit consumers can obtain. During a period of adjustment when mortgage rates are changing but wages are adjusting more slowly, consumers may feel more or less cash constrained. In this case, the "money illusion" is more a consequence of liquidity constraints than reflective of non-rational decision-making.

Drawing from psychology and behavioral economics, decision makers are found to often discard potentially relevant and crucial information in order to simplify their decision making process (Kahneman & Tversky, 1979). Relying on simple heuristics, individuals rule out less important considerations and often focus on the few factors that appear to matter most. In this context, if inflation does not appear to be a substantially important factor at the time of the decision making, it will often be discarded all together from the equation. Akerlof, Dickens, and Perry (2000) explore the implications of a macroeconomic model through the lens of behavioral economic theories. The authors allow for "behavioral editing" among market participants which affects their ability to make decisions and forecast future economic performance. In their model, when inflation is sufficiently low, most agents do not focus on the difference between real and nominal variables. Therefore, in times of low inflation, the distinction between real and nominal measures is relatively unimportant for wage and price negotiation. With zero inflation the distinction between real and nominal variables is unimportant; indeed, targeting a constant price level would make it easier for people to plan for the future. As inflation rises, however, the distinction between values becomes more important. As the US has generally been a relatively low-inflation nation, it is possible that individuals do not pay much heed to inflation (assuming price stability) and thus rely more on nominal quantities.

Evidence from surveys performed by Shiller (1997) and Di Tella and McCulloch (2007) reveal that individuals strongly dislike inflation. It appears to reduce reported happiness. Individuals heavily rely on nominal frames of reference in decision making, which may reinforce the desirability of keeping inflation quite low.

Table 3 below reports the full regression results and the coefficients for the other control variables across all six models. The estimated effects of these other covariate are generally as expected. Higher unemployment rates reduce home buying optimism, consistent with a dampening effect of an economic downturn and labor market uncertainty on durable goods purchases. During an economic downtown, although home prices may also be lower, greater economic uncertainty about future cash flows results in delaying a home purchase. Estimates also suggest that greater optimism about purchasing a home is more prevalent among males and married individuals. Higher levels of education and income, associated with more stable employment and greater purchasing power, are also more likely to invest in a home. Both higher household income and education may also reflect greater financial literacy and therefore a greater ability to consider the appropriate timing of a home purchase. The coefficients of the linear and quadratic age terms suggest that positive home buying attitude generally declines with age. Specification 6 suggests that home buying optimism increases up to around age 55 and then starts to decline. Not surprisingly, married respondents are more

likely to be optimistic about buying a home. This is consistent with data from the Census Bureau on homeownership by marital status, which indicate that 81% of those who own their own home in 2012 were married. Residents of the northeast (omitted census region indicator) are the least optimistic in terms of home buying attitudes. According to the Census Bureau, the Northeast had the second lowest homeownership rate at 62.8% in the fourth quarter of 2013. Areas in which home buying is less prevalent may also represent individuals who are less optimistic about buying a home because it is less popular. Number of children is inversely related to home buying optimism. While more children may raise the demand for space and home ownership, this may also entail higher transition costs which may dampen home buying optimism. Furthermore, holding real income constant, a larger family size indicates greater expenses and less income per household member, which may further reduce the demand for a home.

Table 3. Regression Results

Coefficients of Control Variables

Outcome: Home Buying Attitude (Good time to purchase a home)						
Sample	Non-missing data on 1-year expectations			Non-missing data on 5-year expectations		
Specification	1	2	3	4	5	6
Unemployment Rate	-0.00848	-0.0195	-0.0258	-0.00966	-0.0123	-0.0190
	(-1.00)	(-2.23)	(-1.71)	(-1.27)	(-1.06)	(-1.47)
Female	-0.0400***	-0.0273*	-0.0358***	-0.0326***	-0.0268*	-0.0320***
	(-14.81)	(-4.94)	(-11.27)	(-10.73)	(-5.01)	(-9.18)
HS degree	0.0877***	0.141*	0.124***	0.0882***	0.139*	0.119***
	(10.02)	(4.79)	(17.64)	(11.38)	(5.09)	(13.21)
Some College No Degree	0.123***	0.207**	0.180***	0.126***	0.199**	0.174***
	(10.76)	(7.02)	(17.24)	(11.09)	(7.05)	(11.81)
College Degree	0.151***	0.256**	0.211***	0.153***	0.246**	0.202***
	(11.48)	(9.67)	(17.14)	(11.86)	(10.11)	(12.08)
Grad	0.153***	0.240**	0.204***	0.155***	0.240**	0.200***
	(11.66)	(7.38)	(17.74)	(12.61)	(7.88)	(13.33)
Real Income	0.00082***	0.0013***	0.00140***	0.00062***	0.0012***	0.00096***
	(7.39)	(28.01)	(5.93)	(7.09)	(31.08)	(6.17)
Age	-0.00155	0.00329	0.000870	0.000726	0.00338	0.00327***
	(-1.87)	(2.19)	(0.87)	(0.93)	(2.83)	(4.57)
Age Squared	-0.000001	-0.000022	-0.000002	-0.000019*	-0.000024	-0.00003***
	(-0.16)	(-1.75)	(-0.23)	(-2.59)	(-1.86)	(-4.00)
Not Married	-0.0494***	-0.0536*	-0.0207	-0.0559***	-0.0542**	-0.0355***
	(-6.83)	(-3.62)	(-1.85)	(-10.54)	(-6.21)	(-5.29)
Divorced	-0.00502	-0.0311*	0.00723	-0.0155**	-0.0364*	-0.0115*
	(-0.90)	(-3.31)	(0.87)	(-3.13)	(-4.96)	(-2.15)
Widowed	-0.00551	-0.0212	-0.0279***	-0.00909	-0.0186	-0.0241**
	(-0.88)	(-2.68)	(-4.15)	(-1.43)	(-1.88)	(-3.61)

Midwest	0.0436***	0.0342	0.0507***	0.0439***	0.0310*	0.0484***
	(5.32)	(2.76)	(6.27)	(4.80)	(3.22)	(5.35)
West	0.0250***	0.0102	0.0284***	0.0134*	0.00866	0.0153**
	(3.92)	(0.80)	(4.48)	(2.46)	(1.09)	(2.84)
South	0.0393***	-0.0345	0.0496***	0.0335**	-0.0314	0.0388***
	(4.46)	(-2.55)	(5.52)	(3.20)	(-2.82)	(3.74)
Number of Children	-0.00763***	-0.00234	-0.00376*	-0.0070***	-0.00254	-0.00358*
	(-4.25)	(-0.42)	(-2.05)	(-3.93)	(-0.52)	(-2.20)
30-year Nominal Mortgage Rate	-0.0361***			-0.0307***		
	(-5.56)			(-4.13)		
Market Real Rate		-0.00809			-0.0116	
(adjusted for 30-year TIPS breakeven rate)		(-0.77)			(-0.75)	
Personal Real Rate			-0.00184			
(adjusted for personal 1-year inflation expectations)			(-0.55)			
Personal Real Rate						-0.00409
(adjusted for personal 5-year inflation expectations)						(-0.89)
Constant	1.014***	0.644**	0.621***	0.931***	0.604*	0.608***
	(10.84)	(6.14)	(6.31)	(9.12)	(5.17)	(7.67)

Notes: See Table 2.

5. Discussion

The premise that nominal rates may be influential in investment decisions is controversial and rarely studied over the past few decades. Indeed, standard economic theory and macroeconomic models generally presume that investment decisions respond to real costs rather than nominal costs. In this study, we specifically test this assumption using long-span (1978-2013) household survey data with innovative measures of the personal real rate combined with alternate measures of the nominal and real rates. Our focus on households and on personal real rates is an important contribution for two reasons. First, if there is a possibility that economic agents exhibit some form of money illusion, reacting to nominal rather than real costs, then we would most likely expect this to be the case for household rather than firms, for the reasons noted above. Second, if households are found to not respond to the real rate, then it is important to understand whether this is an artifact of measurement error in the real rate.[3] In utilizing both the market-observed real rate as well as the personal real rate, and showing that both are statistically and economically insignificant, we are able to rule out this possibility. Across all specifications, we therefore find consistent and robust evidence that home buying attitudes are more responsive to nominal rates and do not respond significantly to the real rate. This result is contrary to the standard neoclassical assumption

[3] In a regression model, measurement error in an X variable will generally bias the coefficient of that variable towards zero.

that households do not exhibit money illusion and respond only to real costs.

The presence of money illusion may be driven by the possibility that the opportunity cost for determining the true borrowing costs may be perceived by households as too high. Our results could also be explained by a lack a fundamental understanding of the concept of purchasing power or an absence of time and resources to reasonably forecast future inflation. These results are also consistent with liquidity constraints as well as with behavioral economic frameworks of individual decision-making.

These results may have important implications for monetary policy. When determining whether an interest rate policy is expansionary or contractionary, policy makers observe the real rate for its assumed correlation with investment and credit decisions. In the case of a positive price shock, policy makers today would assume that a reduced real rate, with nominal rates being held constant, would exert further expansionary pressure on the economy. However under the assumption that market participants possess money illusion, higher inflation could actually reduce consumption spending. Without the concept of purchasing power, a higher nominal value means less affordability and a contraction in credit.

Thus, efforts of the Federal Reserve in reducing real rates by changing inflationary expectation may be less effective, at least for the consumer sector, than anticipated. Furthermore, when the economy is at the zero lower bound (nominal interest rates are closed to zero) and thus essentially in a "liquidity trap", expansionary monetary policy aims to raise inflation expectation in an effort to reduce the real rate and in turn stimulate spending. However, if households do not pay attention to the real and only look at the nominal rate, than this monetary transmission channel would be less effective in the presence of the zero lower bound.[4] Thus, there may be a role for fiscal policy for stimulating the economy when nominal rates are bound below by zero. In general, such "non-rational" decision making by households, regardless of what is causing this, would mean that monetary policy predictions of standard models may diverge from actual outcomes in the short term.

In 2007 at the Boston Federal Reserve Conference on Monetary Policy and Behavioral Economics, Chairperson Janet Yellen discussed the applications of behavioral economics for monetary policy. The Phillips curve, for example, is a core component of every realistic macroeconomic model that shows the trade-off between inflation and output. It plays a critical role in policy determination because its characteristics and shape influence the short- and long-run tradeoffs that central banks face as they strive to achieve price stability and maximum sustainable employment. Chairperson Yellen noted that behavioral economics can enhance our understanding of the Phillips curve. This is important for two reasons: "First, better models of the inflation process help improve our forecasts and clarify limitations on what monetary policy can do. Second, the theoretical underpinnings of the Phillips curve are important in understanding what central banks should do" (Yellen, 2007). In other words, models using the Phillips curve could have implications for the way in which central banks should interpret and achieve their mandates as well as "for assessing the welfare costs of

[4] This may partly explain why the housing market has not fully recovered and remained relatively weak despite large monetary stimulus.

fluctuations in output and inflation" (Yellen, 2007). It is important to note that models that create assumptions based on periods of low and steady inflation could easily be altered by a shift in policy. Federal Open Market Committee members who recognize well-anchored inflation expectations, as we have had in the United States since the mid-1980s, reduce the sacrifice ratio and the sensitivity of inflation to supply shocks must also recognize this ratio is subject to change dependent on policy and real economic performance (Yellen, 2007).

Sparse research has been conducted on the topic of money illusion. Macroeconomic models used to study monetary policy as well as standard economic textbooks continue to place emphasis on real rates rather than nominal ones. However, in order to expand our forecasting ability and our understanding of the macro-economy, these basic assumptions may need to be questioned and scrutinized further. The results from this study suggest that econometric models based on real variables may be underestimating the contractionary nature of higher nominal interest rates for a positive inflation shock as well as overestimating the stimulus of lower nominal interest rates during periods of subdued inflation. By breaking down aggregate expenditures into their components and determining the significance of real versus nominal rates on each component, we can better understand monetary policy and business cycle fluctuations. While this study has focused on households, future research should study whether the reliance on nominal rather than real rates carries over to firm behavior. Research could also be expanded to periods during which inflation varied from its current low and steady pattern. During such periods of higher inflation, we may expect that consumer may be more responsive to real rates due to a greater divergence between nominal and real rates.

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