

Psychological and Cultural Factors in the Choice of Mortgage Products: A Behavioral Investigation

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Using data from three countries that differ economically, culturally, and geographically, this study examines the role of Prospect Theory's reflection effect, a psychological factor, in combination with Uncertainty Avoidance (UA), a cultural factor, on the choice of mortgage products. Experiments were conducted using business professionals in the United States, Germany, and Japan. The results suggest that risk-averse people tend to become more risk seeking, leaning more toward adjustable-rate mortgages (ARMs) when choosing a mortgage type, and that this psychological effect may underlie the mortgage choices of people who tend to choose ARMs, even across countries with different cultures.

Keywords: Adjustable-rate mortgage, Fixed-rate mortgage, Prospect theory, Uncertainty avoidance, Experiment

INTRODUCTION

In terms of household risk management, the choice of a residential mortgage is one of the most significant decisions to make. At the end of second-quarter 2005, the value of outstanding U.S. residential mortgages was \$8 trillion, 65% of the 2005 GDP (Federal Reserve Board of Governors [2005]). In Germany, the residential mortgage debt ratio as a percentage of GDP was 51% at the end of 2006 (European Mortgage Federation). In Japan, the value of outstanding residential mortgages was 190 trillion Yen in 2005, which was 36% of the GDP (The Government Housing Loan Corporation, Japan). The choice of residential mortgages, which determines risk-sharing between borrowers and lenders, has a great impact globally on housing markets and national economies, as well as on the finances of individual families.

Mortgages can be classified into two broad categories: fixed rate mortgages (FRMs) and adjustable rate mortgages (ARMs). A FRM specifies an interest rate that stays fixed for the life of the mortgage (typically 15 or 30 years), regardless of market conditions. An ARM is a mortgage in which the interest rate is tied to an index (i.e., the market interest rate) and is periodically—usually annually—adjusted as the rate index moves up or down. ARMs were first introduced in the United States during the 1980s, and a considerable number of U.S. borrowers still choose them over FRMs, even when interest rates are historically low. As an example, during 2004 and 2005 when interest rates were at 30-year lows, ARMs accounted for approximately a third of all mortgage originations in the United States. By contrast, Germany has one of the lowest shares of ARMs among European countries. In Germany, variable- or adjustable-rate mortgages account for only 10% of mortgage originations. The choice between ARMs and FRMs only recently became available for Japanese borrowers. Until October 2003, very few long-term fixed-rate mortgages were available in Japan. Then a new mortgage loan product, called a FLAT35, was introduced to the Japanese market. FLAT35 is the first long-term

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fixed-rate mortgage supported by a mechanism of securitization; private lenders originate FLAT35s and avoid bearing the interest rate risk by selling them in a secondary mortgage market through the Government Housing Loan Corporation.

Most empirical studies on the choice of mortgage type suggest that pricing factors, such as the FRM-ARM rate differential and the level of either the ARM or the FRM rate, play a dominant role in deciding which mortgage is chosen.¹ Phillips and VanderHoff [1991, 1994] analyze mortgage transaction data from the National Association of REALTORS and a large national lending institution to show that ARMs' teaser discounts, as well as points on ARMs and FRMs, are important factors in choosing an ARM. At the same time, they also find that the personal characteristics of borrowers, including levels of income, assets, and debts, have a negligible effect on mortgage choice. Bucks and Pence [2006] deepened insights into the issue by reporting that borrowers seem to ignore or to be unaware of the risk factors of ARMs, while Lino [1992] illuminated the irrational attitude many mortgage borrowers have toward interest-rate risk. This irrationality is of particular concern in light of the findings of VanderHoff [1996] and Ambrose, LaCour-Little, and Huszar [2005], who make clear that ARMs expose borrowers to a great deal of interest-rate risk.

Despite its global importance, the current understanding of the rationale behind borrowers' choices of residential mortgage is limited, especially their attitude toward residential mortgage interest-rate risk. This study contributes to the existing literature on mortgage choice by incorporating psychological and cultural lines of study to examine borrowers' attitudes toward interest-rate risk in residential mortgages. The findings will be important in that they may aid governments and lenders develop and introduce new mortgage products in countries with diverse cultures.

In terms of results, despite evidence from other studies that different countries maintain different levels of culturally induced uncertainty avoidance, we find little evidence that these differences are likely to influence an individual's choice of mortgage product. Consistent with prospect theory's reflection hypothesis, the results suggest that risk-averse people change their level of risk aversion when considering mortgages in each country examined. That is, those who prefer risk-averse assets (fixed-rate bonds) are likely to choose a riskier liability (ARM) regardless of their nationality, suggesting that this behavioral inclination is more "human" than it is culturally induced. It further suggests that mortgage products that are successful in one developed country are likely to be successful in other developed countries as well.

RESEARCH HYPOTHESES

Kahneman and Tversky's Nobel Prize-winning Prospect Theory's reflection hypothesis (Kahneman & Tversky [1979]) suggests that people tend to be more risk-averse in

positive decision situations, while they tend to be more risk-seeking in negative decision situations. Taking out a mortgage often means that the borrower will have negative cash flows for an extended time period. These negative cash flows are fixed with FRMs and tied to market interest rates with ARMs. Thus, the choice between ARMs and FRMs can be framed as a choice between two types of negative prospects (loss situations) under risk. On the other hand, when people invest in a bond, they receive coupon income over time, which is fixed with fixed rate bonds (FRBs) and tied to a market interest rate with variable rate bonds (VRBs). Thus, the choice between FRBs and VRBs can be framed as the choice between two types of positive prospects (gain situations) under risk.

By forcing research participants (business professionals in the United States) into these decision frames,² Mori, Diaz, and Ziobrowski [2009] test Prospect Theory's reflection hypothesis as a contributing factor in a borrower's choice of mortgage type. They hypothesize that *people, who exhibit a risk-averse preference for a FRB over a VRB when choosing a bond type, will tend to demonstrate a risk-seeking preference for an ARM over a FRM when choosing a mortgage type*. As expected, the results suggest that risk-averse people tend to become more risk seeking when choosing a mortgage type, leaning more toward ARMs. Mori et al. [2009] argue that this psychological factor may explain why ARM borrowers tend to ignore the risk factors associated with ARMs and therefore focus most heavily upon the pricing factors when choosing a mortgage type. In Mori et al. [2009], both mortgage choice and bond choice are decisions made under risk. However, the mortgage choice actually involves a greater degree of uncertainty than bond choice because borrowers may be uncertain about their future job, salary, or even family status which ultimately may affect the borrower's ability to make mortgage payments. On the other hand, the bond choice eliminates the uncertainty associated with the investor's ability to receive the specified cash flows since the U.S. government is identified as a bond issuer.

Hofstede [1991, 2001] clearly differentiates risk avoidance from uncertainty avoidance. Risk is often expressed in a percentage of probability that a particular event may happen. Uncertainty is a diffuse feeling not attached to a specific event and has no probability attached to it. Thus, uncertainty avoidance leads to an escape from ambiguity, which sometimes may result in risky behavior, such as starting a fight with a potential opponent rather than sitting back and waiting. Hofstede suggests that people in different cultures and countries may well evaluate uncertain situations in different ways. He analyses a large survey database collected by IBM between 1967 and 1973 from employees in 50 countries and 3 regions to develop a model that identifies four primary dimensions that assist in differentiating cultures. Uncertainty avoidance (UA), one of these four dimensions, is defined as "*the extent to which people feel threatened by uncertain or unknown situations*" (Hofstede [2001, p. 113]). The

author computed a UA score for each of the IBM countries on the basis of three measures of the level of uncertainty avoidance: rule orientation, employment stability, and stress. Disagreement with the rule orientation statement indicates a tolerance for uncertainty. Employment stability indicates a preference to avoid uncertainty. Stress measures the overall level of anxiety in a country. The survey results show that UA values range between 8 (lowest UA: Singapore) and 112 (highest UA: Greece).

Therefore, considering the possibility that people in different cultures may behave differently when choosing a mortgage, which involves both uncertainty as well as risk as Hofstede defines it, this study uses data from the United States, Germany and Japan—which are economically, geographically, and culturally different—to test the role of psychological factors in conjunction with cultural factors on the choice of mortgage products. According to Hofstede's ranking of 50 countries and 3 regions based upon UA scores, with a mean UA scores of 65, the United States ranked forty-third with a low UA score of 46, Germany ranked twenty-ninth with a middle UA score of 65, and Japan ranked seventh with a high UA score of 92. Consequently, the large range of UA scores between Japan and the United States motivates a valid intercultural comparison among these three countries.

Specifically, Prospect Theory's reflection hypothesis, in combination with the cultural factor of uncertainty avoidance (UA), leads to two research hypotheses: (1) The psychological effect proposed by Prospect Theory's reflection hypothesis prevails in the choice of mortgage products in all three countries. Thus, our umbrella hypothesis is:

RH1: People in the U.S., Germany, and Japan who exhibit a risk-averse preference for a FRB over a VRB when choosing a bond type generally demonstrate a risk-seeking preference for an ARM over a FRM when choosing a mortgage type.

(2) The strength of Prospect Theory's reflection hypothesis may differ among people with different levels of uncertainty avoidance, so the level of UA may work as a moderating factor for Prospect Theory's reflection effect in the choice of a mortgage. Accordingly, the second hypothesis is:

RH2: People who are less threatened by uncertain situations tend to exhibit a greater degree of preference for an ARM than do those who are more threatened by uncertain situations.

METHODOLOGY

Our study is purposefully designed to enhance internal validity as a study at the very earliest stage of behavioral research in home mortgage choice to serve as a significant foundation in borrower risk-taking behavior. The primary study architecture calls for three parallel studies—one in the United States, one in Germany, and one in Japan—to assess the main effect proposed by Prospect Theory's reflection hypothesis and the

moderating cultural factor of uncertainty avoidance on risk preference in the choice of mortgage products.

We use business professionals recruited at part-time MBA programs in the U.S., Germany, and Japan as experiment participants, since these people are likely to have already made home mortgage decisions in the past or to make such decisions in the near future. This group also has relatively homogeneous demographic characteristics—particularly age, income, education level, and work experience, all of which are potential confounding factors in this study—even across countries. In the United States, Germany, and Japan, 85, 55, and 49 business professionals, respectively, participated in the study. Average ages were 32, 31, and 29, respectively. Table 1 compares participant profiles among the three countries. Both U.S. and Japanese participants were highly homogeneous in terms of household income, work experience, and education level, while Germany had a relatively larger number of participants who were single and had less work experience and fewer graduate degrees. Parametric tests and their nonparametric alternatives found no significant effects of demographic factors on preference scores in the United States, Germany, or Japan.³

Two decision tasks (mortgage task and bond task) were provided to the participants. The mortgage decision task was a choice between an ARM and a FRM, and the bond decision task is a choice between a VRB and a FRB. The cases were designed to simplify mortgage and bond decision problems and to isolate a cause-effect relationship between borrower risk preferences and the sign of cash flow by controlling for alternative explanations. At the same time, the cases need to maintain enough reality so participants can perceive cases as mortgage and bond decision tasks. Hypothetical mortgage and bond instruments were prepared to maintain the focus on typical homebuyer behaviors in all three countries while minimizing a potential confounding effect caused by any difference in instruments among the U.S., German and Japanese cases. Table 2 summarizes the mortgage and bond instruments provided in the U.S., German and Japanese cases. Participants took approximately 10 minutes to complete both tasks.

A tenure period in a personal residence was specified in the mortgage case to control for the potential confounding factor of mobility. To examine behaviors of typical homebuyers, a five-year tenure period was chosen for American participants, and a 10-year tenure period was chosen both for German and Japanese participants; these choices were based upon the median tenure periods of American, German, and Japanese homeowners. While the median tenure periods of German and Japanese residents in single-family homes are over 20 years, the median tenure periods of German and Japanese who live in condominiums are approximately 10 years. Since German and Japanese residents tend to more commonly live in condominiums, the German and Japanese cases specified a condominium as the subject residence, while the American case used a single-family home as the subject residence.

TABLE 1
Comparison of Participant Profiles among the United States, Germany, and Japan.

Item	Category	U.S.		Germany		Japan	
		Number	%	Number	%	Number	%
Marital status	Married	47	55.3%	14	25.5%	23	46.9%
	Single	38	44.7%	41	74.5%	24	49.0%
Household income	Under \$20,000	5	5.9%	8	14.5%	0	0%
	\$20,000–34,999	1	1.2%	5	9.1%	0	0%
	\$35,000–49,999	7	8.2%	6	10.9%	2	4.1%
	\$50,000–74,999	18	21.2%	9	16.4%	14	28.6%
	\$75,000–99,999	17	20.0%	6	10.9%	12	24.5%
	\$100,000 or more	34	40.0%	20	36.4%	13	26.5%
Work experience	2 years or less	8	9.4%	18	32.7%	3	6.1%
	3–5 years	17	20.0%	18	32.7%	9	18.4%
	6–10 years	34	40.0%	8	14.5%	27	55.1%
	11–15 years	14	16.5%	6	10.9%	7	14.3%
	16–20 years	6	7.1%	3	5.5%	1	2.0%
	21 or more years	6	7.1%	2	3.6%	0	0%
Education	Bachelor's Degree	62	73.0%	13	23.6%	36	73.5%
	Master's Degree	22	25.9%	42	76.4%	11	22.4%
	Doctoral Degree	1	1.2%	N.A.	N.A.	0	0%

Note. The exhibit does not include participants who did not answer demographic questions, although the percentages were calculated based upon the total number of participants in each country. In the U.S., 3 participants did not report their household income. In Germany, 1 participant did not disclose household income. In Japan, 2 participants chose not to answer any demographic questions, and 8 participants did not disclose their household income.

TABLE 2
Summary of Mortgage and Bond Instruments in Cases.

MORTGAGES	ARM	FRM
Loan amount	\$150,000 (U.S.)	\$150,000 (U.S.)
	120,000 (Germany)	€120,000 (Germany)
	¥20,000,000 (Japan)	¥20,000,000 (Japan)
Initial rate	8% (U.S.)	8% (U.S.)
	6.5% (Germany)	6.5% (Germany)
	5% (Japan)	5% (Japan)
Payoff period	30 years	30 years
Payment frequency	Monthly	Monthly
Interest rate adjustment period	1 year	—
Periodic and lifetime cap	No	—
BONDS	VRB	FRB
Issue price	\$150,000 (U.S.)	\$150,000 (U.S.)
	€120,000 (Germany)	€120,000 (Germany)
	¥20,000,000 (Japan)	¥20,000,000 (Japan)
Initial coupon rate	8% (U.S.)	8% (U.S.)
	6.5% (Germany)	6.5% (Germany)
	5% (Japan)	5% (Japan)
Maturity	5 years (U.S.)	5 years (U.S.)
	10 years (Germany)	10 years (Germany)
	10 years (Japan)	10 years (Japan)
Coupon frequency	Monthly	Monthly
Coupon rate adjustment period	1 year	—

As summarized in Table 2, a hypothetical bond instrument was prepared so that both the mortgage and bond instruments maintained consistency, except for the sign of the cash flows, which is the main treatment for Prospect Theory's reflection hypothesis. To provide consistent perceptions of instruments to American, German, and Japanese participants, initial rates in each of the cases were set based upon historical averages in each country. In an effort to avoid any bias caused by participants' perceptions about interest rate levels, we used historical average rates for

not have a mid-point, participants were forced to show their preferences for one of the two instruments, which mimics a mortgage decision in a real life. The score of 1 represents the strongest preference for variable-rate products, while the score of 6 represents the strongest preference for fixed-rate products. Some demographic questions were also asked.⁴

The original measure for UA used by Hofstede was intended to be used for measurement at a national level. However, Donthu and Yoo (1998) developed a five-item scale to measure Hofstede's dimensions of culture at the individual level, which measure was validated in their subsequent study (Yoo and Donthu [2002]). We measure UA scores of participants by means of a 5-item scale established by Donthu and Yoo, wherein a score of 1 represents the lowest level of uncertainty avoidance (i.e., least averse to uncertainty) and a score of 5 represents the highest level of uncertainty avoidance (i.e., most averse to uncertainty). The scale is shown in the Appendix.

Each participant evaluated a mortgage case and a bond case. We used *counterbalancing*, in which approximately half of the participants (Group A) conducted the mortgage case first and the bond case second, and the other half (Group B) conducted the bond case first and the mortgage case second, and assigned each participant randomly to one of the two experimental groups. Therefore, the experimental design to test the hypothesis in each country is a 2×2 counterbalanced design. The within-subjects factor is the sign of cash flow fixed at two levels: bond (positive cash flow) and mortgage (negative cash flow). The between-subjects factor is the counterbalancing sequence fixed at two levels: mortgage-bond sequence and bond-mortgage sequence. The design is summarized in Figure 1.

FIGURE 1 Summary of experimental design.

Within the 2×2 counterbalanced design, the initial task the participants undertook was expected to enforce the hypothesized decision frames within their second task; this was to be achieved by sensitizing participants toward the sign of cash flow, which mimics decision making in real life, so that they frame their second task as a choice between two types of positive prospects under risk for the bond case; or as a choice between two types of negative prospects under risk for the mortgage case. Thus, the main focus in testing the research hypotheses is on decisions under the framing control situation. Participants' decision results under situations that have no framing control are separately analyzed as an exploratory analysis, primarily to gain implications for further study on the topic.

Just as not all borrowers necessarily frame the choice of mortgage in the same way, not all borrowers necessarily make their decisions in the same way. We hypothesized that, when choosing a mortgage type, people who show a preference for risk-aversion (RA) when choosing a bond type may behave differently from people who show a risk-seeking (RS) preference when choosing a bond type. Since testing behaviors of both RA and RS participants at the same time could mask important implications, we examined the behavior of the participants separately based on their risk preferences in a bond choice. We define RA people as participants with preference scores of 4, 5, or 6 when choosing a bond type, and RS people as those with preference scores of 1, 2, or 3 when choosing a bond type.

Thus, we define four groups for our analyses: (1) RA-framing control, (2) RA-no framing control, (3) RS-framing control, and (4) RS-no framing control. The direct test of the RH1 is done in each country with an independent two-sample T test that tests the difference in preference scores, focusing on the RA-framing control group between participants in Cell II versus Cell III, Cell VI versus Cell VII, and Cell X versus Cell XI in Figure 1, for the U.S., German, and Japanese experiments, respectively.

To test RH2, we utilized the combination of moderated multiple regression and subgroup analysis proposed by Sharma, Durand, and Gur-Arie [1981] in the overall sample, including the U.S., German, and Japanese data and a broad range of UA scores. This approach has been one of the most common statistical techniques used to estimate moderating effects. The procedure proposed by Sharma et al. tests where the subject variable (UA) is among three types of moderator variables—homologizers, pure moderators, and quasi moderators—or whether the variable is not relevant to the dependent variable (risk preference score). A homologizer influences only the strength of the relationship between the main independent variable (sign of cash flow) and the dependent variable. A pure moderator variable modifies the form of the relationship between the independent and dependent variables through an interaction with the independent variable. A quasi moderator variable also modifies the form of the relationship, but it has a direct relationship with either

TABLE 3
Uncertainty Avoidance (UA) Scores of U.S., German, and Japanese Participants.

	RA participants			RS participants		
	U.S. (<i>n</i> = 52)	Germany (<i>n</i> = 34)	Japan (<i>n</i> = 26)	U.S. (<i>n</i> = 33)	Germany (<i>n</i> = 21)	Japan (<i>n</i> = 23)
Mean	3.89	3.11	3.55	3.91	3.08	3.57
Standard deviation	0.61	0.59	0.74	0.62	0.97	0.72
Maximum	5.00	4.40	5.00	5.00	4.80	4.60
Minimum	2.20	2.00	1.60	2.80	0.00	1.60

the independent variable or the dependent variable. (A pure moderator variable doesn't have such a direct relationship.) Two regression models are first estimated such that:

$$Y = b_0 + b_1X + b_2Z + b_3X \cdot Z + e \quad (1)$$

$$X = b_0 + b_4Z + e \quad (2)$$

where *Y* = risk preference score; *X* = sign of cash flow or choice (bond or mortgage), dummy variable; *Z* = hypothesized moderator variable, Uncertainty avoidance (UA) score.

If *b*₃ in Equation 1 is significant and *b*₂ in Equation 1 is not significant, *Z* is a pure moderator. If both *b*₂ and *b*₃ are significant, *Z* is a quasi moderator. If *b*₃ in Equation 1 is not significant, Equation 2 is estimated. If *b*₄ in Equation 2 is significant, *Z* is an exogenous, or suppressor variable to the relationship between *X* and *Y*. If *b*₄ is not significant, a subgroup analysis is conducted in which the whole sample is divided into two subsamples based on the median value of UA. For each subsample, the risk preference score is regressed on the sign of cash flow and a chow test is performed to compare the two regressions. If two regressions are significantly different, *Z* is a homologizer variable; otherwise, *Z* is determined not to be a moderator variable.

RESULTS

Among the usable participants, 52 (61%) of U.S. participants, 34 (62%) of German participants, and 26 (53%) of Japanese participants exhibited risk-averse preferences when choosing a bond type. The fact that the majority of the participants in all three countries showed risk-averse preferences when choosing a bond type is not surprising. Prospect Theory and the traditional expected utility theory both predict risk-averse behaviors in a gain situation such as a bond type choice, and we hypothesize that cultural differences measured by uncertainty avoidance might affect only behaviors in a mortgage type choice that involves uncertainty as well as risk. Since Prospect Theory's reflection hypothesis predicts that risk-averse people show the preference reversal in loss situations, these risk-averse participants become the main focus of our research hypothesis and are labeled *RA*. The remaining participants demonstrated risk-seeking preferences

when choosing a bond type; they are labeled *RS* and analyzed separately as an exploratory analysis.

Based on the country rankings by Hofstede [1991, 2001], we initially expected that Japanese participants in the study would exhibit the highest uncertainty avoidance scores, followed by the Germans and the Americans. However, Table 3 shows that, on average, American participants exhibited the highest UA scores, followed by Japanese participants and German participants. Although this is somewhat surprising, people in different countries may have different UA scores. We collected individual UA scores to be utilized in testing the moderating role of the cultural factor uncertainty avoidance (RH2). Even so, the intercultural comparison in testing RH1 was meaningful. One-way analysis of variance (ANOVA) with post-hoc Fisher's LSD tests detected significant differences in the UA scores among the three samples (all three means are statistically different from each other at the 5% level). This resulted in an overall sample with diverse UA scores, which had been the initial purpose of collecting data from the three countries.

Figure 2 summarizes the behavior of U.S., German, and Japanese participants who demonstrated a risk-averse preference (preference score of 4, 5, or 6) when choosing a bond type. The results are shown in the order of country averages of UA scores. Panel A shows scores under framing control situations (i.e., scores collected during participants' second tasks), and Panel B shows those under no-framing control situations (i.e., scores collected during participants' first tasks). For RH1—*People in the United States, Germany, and Japan who exhibit a risk-averse preference for a FRB over a VRB when choosing a bond type generally demonstrate a risk-seeking preference for an ARM over a FRM when choosing a mortgage type*—the null hypothesis is that the mean for the mortgage case (negative cash flow) is equal to or larger than (more risk-averse) the mean for the bond case (positive cash flow) under the hypothesized decision frames. Panel A in Figure 2 shows that, under framing control situations, mortgage scores are lower (more risk-seeking) than bond scores in all three countries, which is in line with RH1. Formally, independent two-sample T tests assuming unequal variances rejected the null hypothesis for all of Germany ($t[22] = 2.24$, $p = .018$ (one-tailed)), Japan ($t[16] = 2.14$, $p = .024$ (one-tailed)), and the United States ($t[25]$

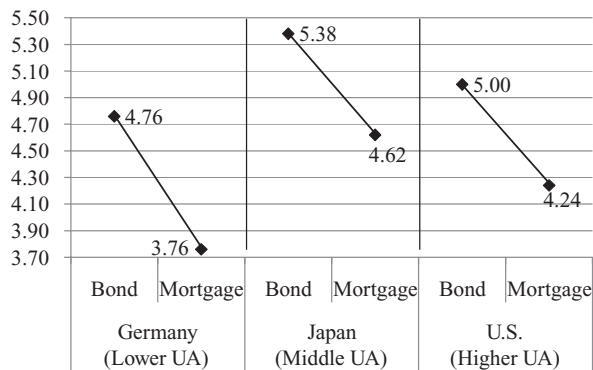
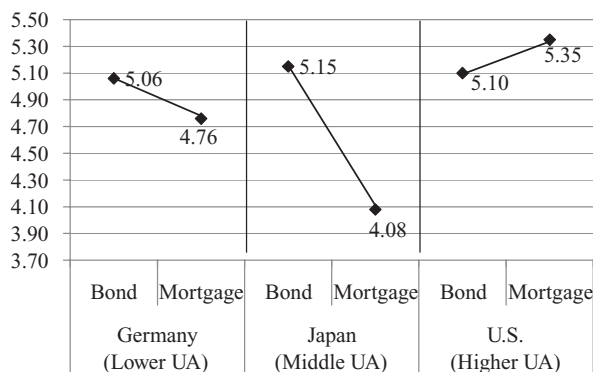
Panel A: Framing Control (scores in 2nd tasks)**Panel B: No-Framing Control (scores in 1st tasks)**

FIGURE 2 Summary of RA participants' risk preference. RA participants are 52 U.S., 34 German, and 26 Japanese participants. The figure shows the results in the order of country averages of UA scores. Panel A shows the results under framing control situation and Panel B shows the results under no-framing control situation.

= 1.68, $p = .033$ (one-tailed)). Thus, RH1, which is, essentially, Prospect Theory's reflection hypothesis, was supported among the U.S., German, and Japanese participants (i.e., at all levels of UA), meaning that risk-averse people significantly change their risk preferences when choosing a mortgage type, leaning more toward an ARM under the hypothesized decision frames. Since both the mortgage case and the bond case were designed to be consistent except for the sign of cash flows, the preference reversal observed with RA participants is likely to be due to the effect proposed by Prospect Theory's reflection hypothesis. This psychological effect prevailed in the mortgage choice decisions of people who tend to choose ARMs in all three countries, which are economically, culturally, and geographically different.

Although the effect of uncertainty avoidance on the mortgage choice (i.e., the strength of the reflection effect) is technically examined in testing RH2, the results of the T tests shown earlier are consistent with RH2. The p -value, which indicates the strength of the reflection effect, is most significant with the German participants who have the lowest UA

scores (are least uncertainty avoidant). As we would further expect, the p -value is least significant for U.S. participants with the highest UA scores (most uncertainty avoidant). Note that uncertainty avoidance appears to have no direct effect on bond scores.

Panel B of Figure 2 (behaviors under no-framing control situations) revealed that the expected preference reversal characterized by Prospect Theory's reflection hypothesis is still evident for both German participants (lower UA group) and Japanese participants (middle UA group). Both German participants and Japanese participants showed, to some extent, more risk-seeking preferences when choosing a mortgage type than when choosing a bond type, even under a no-framing control situation. Although the preference reversal is statistically significant only with Japanese participants ($t[15] = 1.97$, $p = .03$ (one-tailed)). U.S. participants showed even more risk-averse preference for a FRM when they conducted the mortgage case as their first task, even though this risk reversal was not statistically significant. This result is also in line with RH₂, indicating that the hypothesized reflection effect appears stronger among people with lower UA scores (Japanese and German) than among people with higher UA scores (American) even without framing control.

RH2—*People who are less threatened by uncertain situations tend to exhibit a greater degree of preference for an ARM than those who are more threatened by uncertain situations*—is formally tested using the combination of moderated multiple regression and subgroup analysis in the overall sample, including the U.S., German, and Japanese participants and a broad range of UA scores. Risk preference scores used for the test of RH2 are the mortgage and bond scores of RA participants collected during their second tasks (under the framing control situation). As Model 1 in Table 4 indicates,

TABLE 4
Moderated Regression Analysis for Uncertainty Avoidance.

Model	Dependent Variable	Independent Variable	B	t	P > t	Adj. R ²
Model 1	Y	X	−2.24	−1.80	.075	.085
		Z	−.54	−1.30	.318	
		X*Z	.35	1.12	.254	
Model 2	X	Z	−.06	−.88	.380	.008

This exhibit shows two sets of regressions used for the moderated regression analysis to test a moderating effect of Uncertainty Avoidance (UA) on the relationship between risk preference score and sign of cash flow (decision choice: mortgage choice vs. bond choice). All t -statistics are based on heteroskedasticity-robust standard errors.

Model 1: $Y = b_0 + b_1X + b_2Z + b_3X \cdot Z + e$

Model 2: $X = b_0 + b_4Z + e$,

where:

the partial regression coefficient of the interaction term (Sign of Cash Flow $\times$ Uncertainty Avoidance) is not significant, nor is the direct effect of UA. Thus, UA turned out to be neither a pure moderator nor a quasi moderator. An additional regression model (Model 2) is also estimated, but we find no significant effect of UA on the Sign of Cash Flow. This suggests that UA is not an exogenous nor suppressor variable in the relationship between Sign of Cash Flow and risk preference score. Thus, the result of the moderated regression analysis shows that UA does not affect the form or fundamental relationship between risk preference score and Sign of Cash Flow, which is the hypothesized reflection effect.

Consequently, a subgroup analysis is performed where the overall sample is split into two groups based on the median value of UA: a low-UA group of 66 participants and a high-UA group of 46 participants. Risk preference scores are regressed on Sign of Cash Flow for both groups, and a chow test is performed to compare the two regressions. If the chow test detects a significant difference between two regressions, UA would be a homologizer, which influences the strength of the main reflection effect. Averages of bond preference scores are 5.03 and 5.00 for the low-UA group and the high-UA group, respectively. Averages of mortgage preference scores were 4.11 and 4.31 for the low-UA group and the high-UA group, respectively. These results indicate that the reflection effect is evident with both groups and, consistent with the RH₂, the strength of the reflection effect is slightly stronger in the low-UA group. However, as shown in Table 5, the chow test detects no significant difference between two regressions, rejecting the possibility of UA's being a homologizer. Thus, RH₂ is rejected, suggesting that the reflection effect in the choice of mortgage crosses cultures, while the cultural factor only affects its strength slightly.

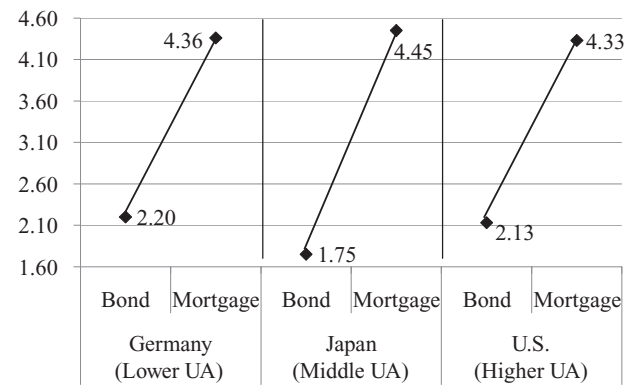
Although we have proposed no hypothesis for risk-seeking individuals, as an exploratory exercise we compare the behavior of U.S., German, and Japanese participants who demonstrated a risk-seeking preference (preference score of 1, 2, or 3) when choosing a bond type. As shown in Figure 3, ANOVA reveals a strongly significant main effect of Sign of Cash Flow among U.S., German, and Japanese participants

TABLE 5
Subgroup Analysis for Uncertainty Avoidance.

Pooled RSS	RSS for Low-UA group	RSS for High-UA group	F	P>F
180.40 df = 110	110.51 df = 64	69.44 df = 44	.13	.875

This exhibit shows results of the subgroup analysis. Two sets of regressions were estimated, one for the low-UA group of 66 participants and one for the high-UA group of 46 participants. Risk preference score was regressed on Sign of Cash Flow, and a chow test was performed to compare the two regressions utilizing residual sum of squares (RSS) of a regression for the overall sample (pooled RSS) and RSS of regressions for the two subgroups.

Panel A: Framing Control (scores in 2nd tasks)



Panel B: No-Framing Control (scores in 1st tasks)

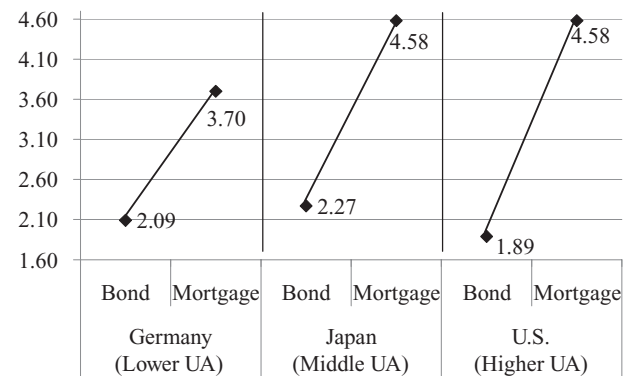


FIGURE 3 Summary of RS participants' risk preference. RS participants are 33 U.S., 21 German, and 23 Japanese participants. The figure shows the results in the order of country averages of UA scores. Panel A shows the results under framing control situation and Panel B shows the results under no-framing control situation.

($F[1,31] = 67.57$, one-tailed $p < .01$, $F[1, 19] = 21.09$, one-tailed $p < .01$, and $F[1,21] = 66.91$, one-tailed $p < .01$, respectively). The bond preference score and the mortgage preference score of all U.S., German, and Japanese participants under the hypothesized frames (Panel A in Figure 3) are found to be significantly different ($t[31] = -4.82$, $p < .01$, $t[19] = -3.69$, $p < .01$, and $t[21] = -6.82$, $p < .01$, respectively). None of the samples in any of the three countries shows any significant effects of the counterbalancing sequence which demonstrates that participants from all three countries behaved essentially the same, regardless of the framing control condition. RS participants significantly changed their risk preferences to a more risk-averse preference for a FRM when choosing a mortgage type, regardless of the sequence of the tasks (framing control condition) and the level of UA (country). Based on the observations shown in Figure 3, we argue that RS participants may have a rather myopic view of cash flow resulting from a strong propensity for current consumption. When people invest in a bond, they

must pay for it, which represents a negative present cash flow. Therefore, myopic individuals may view bond investment selection as part of a loss situation, resulting in risk-seeking behavior, despite the promise of a future income stream. On the other hand, when people take out a mortgage, they obtain a lump sum of money for a home purchase, which may appear to be positive cash flow. Therefore, myopic people may view mortgage selection as part of a gain situation, resulting in risk-averse behavior, despite the obligation to future payments.

CONCLUSIONS

Using data from the United States, Germany, and Japan, this study tests the role of Prospect Theory's reflection hypothesis in conjunction with a cultural factor of uncertainty avoidance (UA) on the choice of mortgage products. The research hypotheses tested consisted of:

RH1: People in the United States, Germany, and Japan, who exhibit a risk-averse preference for a FRB over a VRB when choosing a bond type, generally demonstrate a risk-seeking preference for an ARM over a FRM, when choosing a mortgage type.

RH2: People who are less threatened by uncertain situations tend to exhibit a greater degree of preference for an ARM than those who are more threatened by uncertain situations.

Data were collected through experiments using business professionals in the United States, Germany and Japan as participants.

Results supported RH1, suggesting that risk-averse people in all three countries change their preference from a risk-averse preference for fixed-rate bonds to a more risk-seeking preference for adjustable-rate mortgages. RH2 was rejected, suggesting that the psychological effect associated with the reflection hypothesis has a strong influence on mortgage choice decisions regardless of cultural background. Although we find some relationship between culturally induced uncertainty avoidance and mortgage type selection, this relationship is not statistically significant. Thus we conclude that mortgage products, which are popular in one culture or country, are likely to be successful in other cultures as well.

As an experimental exercise, we also test the behavioral characteristics of risk-seeking participants (RS). The behaviors of all RS participants are totally independent of task sequence (framing) and level of UA. RS participants, who behave in a risk-seeking fashion in positive choice situations (choosing a variable-rate bond over a fixed-rate bond) avoid risk with a FRM in their mortgage decision. We suspect this may be caused by an RS participant's myopic view of cash flow associated with a strong propensity for current

consumption. Such people may view investment as a negative cash flow situation (an immediate loss) and a mortgage as a positive cash flow situation (an immediate gain). Therefore recognition of a loss induces risk-seeking behavior in the bonds and recognition of the gain causes risk-averse behavior in the case of the mortgage decision. It should also be noted that we again see no difference in the results associated with country or with uncertainty avoidance. This further reinforces the notion that successful mortgage products are likely to be internationally attractive to borrowers.

Any extension of the findings of the current study into real-world settings must be done with caution. The current study emphasizes its internal validity to test the research hypotheses under the hypothetical decision frames. Thus, caution is warranted before extrapolating its findings to explain behaviors in no-framing control situations and in RS individuals. Further investigations are warranted before generalizing beyond the currently-studied samples.

We derived the results of this study under the situation wherein the initial rates were set to be the same for both the ARM and the FRM. We used a hypothetical (controlled) setting to ensure the study's high internal validity. Thus, the impact of the ARM-FRM rate differential on borrower behaviors is of general interest in answering two questions: How much of the rate differential makes borrowers favor an ARM? Does the size of impact differ between risk-averse and risk-seeking borrowers, and between lower- and higher-uncertainty avoidance borrowers? This study focused mainly on the behaviors under hypothesized decision frames, so further investigation into the situations and conditions wherein borrowers frame mortgage choices as part of a loss situation will be of importance to gain insights into the risks of ARM borrowers. It should also be noted that our experiments were conducted in developed countries with relatively highly educated participants. Transferring our results to less developed countries with less educated populations may also influence the results and conclusions.

NOTES

1. The detailed review of studies on the mortgage choice can be found in Mori, Diaz, and Ziobrowski (2009).
2. Note that, in order to test Prospect Theory's reflection effect on a borrowers' choice of mortgage type, it is necessary to prepare a gain decision situation in which test subjects can be screened to identify individuals who behave in a risk-averse fashion as suggested both by the Prospect Theory and traditional expected utility theory since the reflection hypothesis only predicts the behavior of risk-averse people in loss situations.
3. Test results are available from the authors upon request.
4. Demographic questions are available from the authors upon request.

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APPENDIX: SCALE TO MEASURE UNCERTAINTY AVOIDANCE

Please indicate how much you agree or disagree with the following statements using the scale below.

	1	2	3	4	5
	Strongly Disagree	Neutral (Neither agree nor disagree)			Strongly Agree
1. It is important to have instructions spelled out in detail so that I always know what I'm expected to do.	1	2	3	4	5
2. It is important to closely follow instructions and procedures.	1	2	3	4	5
3. Rules/regulations are important because they inform me of what is expected of me.	1	2	3	4	5
4. Standardized work procedures are helpful.	1	2	3	4	5
5. Instructions for operations are important.	1	2	3	4	5

We obtained the permission to use this scale from Dr. Boonghee Yoo on September 21, 2005.

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