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"At least I didn't lose money"
- Nominal Loss Aversion Shapes Evaluations of Housing Transactions

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Nominal Loss Aversion Shapes Evaluations of Housing Transactions

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Abstract

Loss aversion is one of the most robust findings to have emerged from behavioral economics. Surprisingly little attention, however, has been devoted to *nominal* loss aversion, the interaction of loss aversion and money illusion. People tend to think of transactions in terms of their nominal (monetary) values. Real losses may therefore loom larger in people's minds when they lose money than when real losses are hidden by purely nominal gains. Using a survey experiment with a large and heterogeneous sample, we show that evaluations of housing transactions are systematically biased by purely nominal gains versus losses.

JEL: A10, C91, D00

Keywords: loss aversion, money illusion, bounded rationality, cognitive reflection, cognitive ability, survey experiment

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1. Introduction

Loss aversion is one of the most robust findings to have emerged from research in behavioral economics (see e.g. Camerer 2005, Fudenberg 2006). Despite the wealth of evidence that "losses loom larger than gains" (Kahneman and Tversky 1979), surprisingly little attention has been given to the role of money in defining reference points, and hence perceptions of the gain and loss domains. Transactions involving money may simultaneously entail nominal losses *and* real losses, but these need not coincide. In the presence of inflation, real losses may appear as nominal gains. Nominal gains may "hide" or "obfuscate" real losses, while nominal losses may make real losses more salient. Nominal losses vs. gains may thus make real losses more or less salient in people's minds, and shape the effects of loss aversion on their willingness to transact. For example, loss-averse homeowners are reluctant to sell their houses at a loss. If, in addition, homeowners think about transactions in terms of money, they are even more reluctant to sell when the real loss is salient (because they lose money on the transaction) than when it is obfuscated by a monetary gain.

To illustrate, consider Anne, who buys a house for $200,000 in cash and sells it some years later for $170,000. She makes a nominal loss (of 15%) on this transaction. In an environment without inflation, the nominal loss corresponds to the real loss (15%). Compare this with Ben, who buys a house (somewhere else) for $200,000 in cash, and later sells it for $220,000. He makes a nominal gain (of 10%) on this transaction. However, if accumulated inflation in Ben's environment is substantial (30%, say) over the holding period, the transaction involves a substantial real loss (roughly 15%). Anne and Ben face equally disadvantageous situations in economic terms, with each facing the same real loss (15%). If they are equally prone to nominal loss aversion and at least partly evaluate the advantageousness of the transactions according to whether or not they lose money, Anne will be more reluctant to sell than Ben. The reason is that the real loss is more salient to Anne, who loses money, and less salient to Ben, who gains money.

This paper uses survey experiments to investigate how purely nominal (monetary) representations shape perceptions of real losses. We identify the effect of nominal loss aversion by presenting a given real loss as a nominal gain vs. nominal loss. More specifically, we present subjects with a series of eight hypothetical housing transactions, each involving the purchase and subsequent sale of a house. A subject's task is to evaluate the advantageousness of each transaction. Using scenarios on housing transactions is ideal for investigating nominal loss aversion (NLA), because holding periods in housing markets tend

to be relatively long, allowing for substantial inflation to accumulate. The eight nominal transactions actually represent four real transactions, each of which is presented twice. In the *nominal loss* treatment, a given real loss is combined with low inflation, so it is also a nominal loss. In the *nominal gain* treatment, it is combined with high inflation, producing a nominal gain, and thereby obfuscating the real loss if respondents evaluate the transaction in terms of gaining vs. losing money. This technique allows us to construct an index of nominal loss aversion (NLA index) for each respondent, showing how strongly a person's evaluations of housing transactions involving real losses are shaped by gaining or losing money.

We present results from two studies, both of which were run using iLEE, the internet Laboratory for Experimental Economics.[1] Each study uses a large subject pool recruited from a random sample of the adult Danish population. The data set is exceptionally rich, allowing us to match subjects' choices from controlled treatment variation with measures of cognitive ability, as well as detailed information about subjects from official register data provided by the National Bureau of Statistics (Statistics Denmark).

Study 1 (N = 732) presents subjects with scenarios involving real losses. We find that for 17% of subjects, the nominal representation has no effect on evaluations. For about 60% of our subjects, however, evaluations are systematically biased by nominal representations. These subjects view real losses much more favorably when they involve nominal gains. The remaining respondents are noisy, but not systematically biased. We then discuss who is prone to nominal loss aversion by investigating its socioeconomic and psychometric correlates. Demographic data include age, gender, education, income, and property ownership. Psychometric data include the results of three psychological tests. The first is taken from a standard intelligence test (IST, Beauducel et al. 2010), which provides a measure of fluid intelligence similar to an IQ score. The second is a cognitive reflection test (CRT, Frederick 2005), and the third is the Big Five Inventory (BFI, Costa and McCrae 1992) personality test.

We find that NLA is largely a cognitive phenomenon. Individuals with higher intelligence, as measured by IST scores (ISS), are less averse to nominal losses. However, cognitive reflection, measured by CRT scores (CRS), is even more important than intelligence in explaining NLA. This finding suggests that the key to nominal loss aversion is not so much the difficulty of uncovering the real loss, but rather the impetus to do so. We also find various

[1] The internet Laboratory for Experimental Economics (iLEE) is operated at the University of Copenhagen. See: http://www.econ.ku.dk/cee/ilee/.

socioeconomic correlates of NLA, including less aversion to nominal losses among those with higher levels of education and higher incomes.

Study 2 (N = 481) extends Study 1 in two ways. First, it adds scenarios with real gains such that we can compare evaluations of housing transactions when they involve real losses vs. real gains, and gaining vs. losing money. Reassuringly, we find that evaluations strongly respond to real gains vs. losses. In fact, average evaluations more than double when moving from an average real loss of 7% to a real gain of 7% (about 3.7 vs. 8.5, on a scale of 1–15). Thus, as expected from the perspective of standard economics, evaluations are responsive to economic "fundamentals." Surprisingly from the perspective of standard economics but in line with the nominal loss hypothesis, we find that purely nominal changes strongly affect evaluations when they mask given real losses as nominal gains (about 2.9 vs. 4.5), but have a weak effect for given real gains (about 8.3 vs. 8.7). Thus, we find that the effect of gaining money is substantially larger when it obfuscates real losses than when it simply increases the size of nominal gains (as in the real gain treatment of Study 2).

Second, Study 2 serves to shed more light on our finding from Study 1 that nominal loss aversion is largely a cognitive phenomenon. Study 2 presents the eight real loss scenarios side-by-side on a single screen, while they were presented on separate screens in Study 1 (the new scenarios involving real gains are also presented on a single screen). We expected the more transparent presentation in Study 2 to reduce the bias observed in Study 1 and to weaken the relation between NLA and cognitive ability. We find that this is indeed the case. The bias is reduced by about 50% for real losses (but remains highly significant), and the correlation between NLA and our measure of intelligence disappears completely. However, the correlation with cognitive reflection is essentially unchanged. This finding supports our conclusion from Study 1 that the impetus to uncover the real loss plays an important role, which it is distinct from the difficulty of doing so.

The paper proceeds as follows. Section 2 briefly reviews the related literature. Section 3 presents the design of the experimental survey, including our measure of nominal loss aversion and our hypotheses. Section 4 presents the results from Study 1, Section 5 presents Study 2, and Section 6 concludes.

2. Related Literature

The expression "nominal loss aversion" (NLA) captures the idea that two behavioral phenomena, loss aversion and money illusion, interact with each other. Our paper therefore contributes to both of these literatures.

Loss aversion is the idea that losses loom larger in people's minds than corresponding gains, a phenomenon that can occur in risky or riskless choice (see e.g. Gächter, Johnson, and Herrmann 2010). While Kahneman and Tversky (1979) are usually credited with introducing the concept to the literature, the idea had struck earlier economists as natural.[2] Mounting evidence in support of this view has accumulated, from experimental laboratory studies (e.g. Gneezy, Kapteyn, and Potters 2003), field experiments (e.g. Camerer et al. 1997, Fehr and Goette 2007) and neuroeconomic studies (e.g. De Martino et al. 2006, see Camerer 2005).

Money illusion refers to a tendency to think about the value of economic transactions in nominal (money) terms. The key to money illusion is that, as the price level changes over time, real prices become obfuscated, but nominal prices remain salient. The idea has received much less attention in the recent economics literature than loss aversion, perhaps because it apparently contradicts the idea that economic agents optimize (see Howitt 2008, Tyran 2007 for surveys).[3] Many economists cherish the intuition that money illusion is unlikely to have important effects because they usually think of a situation in which it is commonly known that all nominal prices and incomes are scaled by some common factor.[4] Contrary to this intuition, starting with Shafir, Diamond, and Tversky (1997), evidence for economic effects of money illusion has been building.[5] For example, various studies claim that money illusion can affect valuations in financial markets (e.g. Cohen, Polk, and Vuolteenaho 2005, Noussair, Richter, and Tyran 2012) and housing markets (e.g. Brunnermeier and Julliard 2008). Fehr and Tyran

2 For example, Adam Smith (1759 [1982], p. 213): "We suffer more […] when we fall from a better to a worse situation, than we ever enjoy when we rise from a worse to a better."

3 Before the advent of the rational expectations revolution in the 1970s, money illusion was routinely invoked by economists, perhaps because it seemed so natural to them. For example, Irving Fisher (1928) devoted an entire book to the topic (see also Akerlof and Shiller 2009, ch. 4). The concept has received more attention in the recent (economic) psychology literature (e.g. Svedsäter, Gamble, and Gärling 2007). While the focus in this paper is how perceptions are affected by changes in the price level, currency changeovers provide another example of naturally occurring nominal shifts (e.g. Kooreman, Faber, and Hofmans 2004).

4 However, van Rooij, Lusardi, and Alessie (2011) find that in a representative sample of the Dutch population about 22% of the respondents fail to answer exactly that question correctly (they ask: "Suppose that in the year 2010, your income has doubled and prices of all goods have doubled too. In 2010, how much will you be able to buy with your income?")

5 Fiscal illusion, where tax framing obfuscates prices, is a related phenomenon (see Sausgruber and Tyran 2005 for evidence from the laboratory, as well as Chetty, Looney, and Kroft 2009, and Finkelstein 2009 for field evidence). In addition, various examples of "shrouding" have been provided in research on partitioned prices (e.g. Brown, Hossain, and Morgan 2010, Morwitz, Greenleaf, and Johnson 1998).

(2007, 2008) have argued that effects of money illusion may be mediated by expectations and be multiplied in the presence of strategic complementarity. Similarly, the effects of money illusion may be multiplied when money illusion interacts with loss aversion.

The literature on nominal loss aversion is relatively thin. An exception is the much-discussed phenomenon of downward nominal wage rigidity, i.e. that workers react more adversely to cuts in real wages when they come along with nominal wage cuts, rather than when real wages are eroded by inflation (see Kahneman, Knetsch, and Thaler 1991, Agell and Lundborg 2003 for survey evidence, Fehr and Goette 2005 for empirical evidence). Evidence of nominal loss aversion is also available for housing markets in the United States (e.g. Engelhardt 2003, Genesove 2003, Anenberg 2011). In a fascinating study, Genesove and Mayer (2001) find evidence that condominium owners in the Boston area are reluctant to sell when facing nominal losses, but less so when real losses are masked by inflation as nominal gains. Einiö, Kaustia, and Puttonen (2008) find that apartment owners in the greater Helsinki area are reluctant to sell at a nominal loss and that disproportionately many apartments are sold exactly at the nominal buying price (with an average holding period of about 6 years). Some papers, however, refer to the concept without naming it explicitly. For example, the so-called disposition effect (e.g. Odean 1998), a tendency of investors in financial markets to ride losers too long and sell winners to early, has been documented for nominal gains and losses (i.e. without correcting for inflation). In another example, Brachinger (2008) develops an index of perceived inflation, showing how loss aversion can affect perceptions of inflation. Fehr and Tyran (2001) link their finding of asymmetric effects of monetary expansion and contraction to money illusion generally, but nominal loss aversion is likely to be the driving factor for this result.

Our finding that nominal loss aversion is largely a cognitive phenomenon also relates to research on intuitive and deliberative cognitive processes, which Stanovich and West (2000) call “System 1” and “System 2”. In fact, Shafir et al. (1997) view money illusion as involving two representations of a given economic transaction, one nominal and one real, which are evaluated simultaneously. This view is consistent with the two-system model, where the nominal representation is evaluated by System 1, and the real representation by System 2. We expand on this view by focusing on loss aversion, where the real and nominal outcomes differ not only in magnitude, but in direction. Following Camerer (2005), we expect that nominal loss aversion is primarily an emotional reaction governed by System 1, as opposed to a

genuine preference more likely to involve System 2.[6] We contribute to that literature by relating a measure of nominal loss aversion (the NLA index) to both a measure of cognitive reflection, which is essentially the tendency to rely on System 1, and a measure of intelligence, which can be thought of as a measure of the capacity of System 2.

The two most closely related papers to our study are Shafir et al. (1997) and Weber et al. (2009). We follow Shafir et al. (1997) in using a survey involving hypothetical scenarios of housing transactions (see in particular their problem 2). We add to Shafir et al. (1997) by investigating a wide range of socioeconomic and psychometric correlates of responses, and by focusing on nominal loss aversion. The housing questions from Shafir et al. (1997) were slightly adapted by Weber et al. (2009), who included them as a follow-up to a neuroeconomic experiment on money illusion. As in Weber et al. (2009), we present each housing transaction twice to each subject, but vary the nominal representation. However, the method and scope of our study is rather different from Weber et al. They analyze brain activity within a small sample and focus on money illusion generally, while we present our survey to a large sample of the adult Danish population and focus on nominal loss aversion. Key advantages of our sample include heterogeneity and the availability of psychometric data, as well as of officially verified socio-demographic data.

3. Design

This section presents the design of our experimental survey. Section 3.1 describes the scenarios presented to the subjects. Section 3.2 explains the index of nominal loss aversion (NLA index) for each subject, and Section 3.3 presents our hypotheses for Study 1. Section 3.4 describes the sample and explains other procedural aspects of the survey experiment.

3.1 The housing scenarios

Subjects are shown eight scenarios in which they evaluate the advantageousness of a transaction involving the purchase and subsequent sale of a house. The buying and selling prices are presented in money (nominal) terms, but subjects are also given information about nominal percentage changes and changes in accumulated inflation (price levels) over the

[6] This view is consistent with neuroeconomic research by De Martino, Camerer, and Adolphs (2010), who find that amygdala damage eliminates monetary loss aversion.

holding period, allowing them to compute real changes.[7] The changes in the price level range from 1% to 38%, and reflect plausible values for holding periods between 1 and 20 years, with low annual inflation. To illustrate, with an average annual inflation rate of 2%, accumulated inflation of 31% requires a holding period of about 14 years. According to the National Association of Realtors (2011), the typical expected holding period for home buyers in the United States in 2011 was 15 years, so accumulated inflation of 30% or more is entirely plausible.[8]

Figure 1 presents an example of a housing scenario (translated from Danish). In this example, the buying price is 2,000,000 Danish crowns (DKK), and the selling price is DKK 2,515,200.[9] The accumulated inflation during the holding period is 31%. Therefore, this transaction results in a nominal gain of about 25.8%, but a real loss of 4%. Owing to the accumulated inflation, the real loss appears as a nominal gain. Note that the text mentions the nominal gain but not the resulting real loss. In the paired transaction, the buying price is the same, but the selling price is DKK 1,958,400, and the accumulated inflation is 2%. This transaction gives the same real loss of 4%, but since the accumulated inflation is smaller than the real loss, it also appears as a nominal loss of about 2%. Thus, a pair of scenarios holds the real loss constant but varies the nominal dimension (by varying the selling price) such that the real loss is either salient (is presented as a nominal loss) or obfuscated (is presented as a nominal gain). All eight scenarios (or four pairs) have the same structure as shown in the example. They also all use the same (round) buying price, making the reference level salient.

Figure 1: Example housing scenario (Study 1)

Maria bought a house for 2 million (2,000,000) DKK. Some years later she sold the house. In the period she owned the house, inflation was 31% (i.e. over the entire period, prices in society increased by 31%). Maria received 2,515,200 DKK for the house (i.e. 25.8% more than she paid for it).

How advantageous do you think that the purchase and sale of the house was?

Not at all advantageous	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Very advantageous
	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

[7] By telling subjects the accumulated inflation over the holding period, rather than an inflation rate and a number of years, we simplify the problem, eliminating possible computational errors such as multiplying the annual inflation rate by the number of years of ownership. This simplification also allows us to avoid explicitly defining the holding period.

[8] There is considerable heterogeneity across age groups. Buyers aged 45 to 64, for example, have an expected holding periods of 20 years, compared with only 5 years for those aged 18 to 24. The overall average of 15 years in 2011 is considerably higher than the average of 8 years in 2006 (National Association of Realtors 2006), but the median age is also higher (45 years in 2011, versus 41 years in 2006).

[9] A price of DKK 2,000,000 is equal to approximately €268,000.

Analytically, the information available to the subjects includes the (constant) nominal buying price B, the nominal selling price S_j, where $j \in \{1, 2, 3, \ldots, J\}$ indicates the scenario number, and the accumulated inflation π_j, with $J = 8$. The nominal change, in percentage terms, is $C_j = (S_j - B) / B$. Using lower-case letters for real values, the real loss is

$$c_j = \frac{s_j - b}{b}. \tag{1}$$

Real prices can in principle be measured in either units at the time of the purchase or units at the time of the sale. We use the first approach, which implies the same real units for all of the scenarios. The real buying price is therefore $b = B$, and the real selling price is $s_j = S_j / (1 + \pi_j)$. Inserting these values into (1) gives the real change in terms of the nominal change and inflation,

$$c_j = \frac{C_j - \pi_j}{1 + \pi_j}. \tag{2}$$

A computation of this sort is not intuitive, requires some cognitive effort, and would be handled by System 2 rather than System 1.[10] Determining the sign of c_j is a less complex problem, only requiring a comparison of the relative sizes of C_j and π_j.

Table 1: Parameters for the housing scenarios (Study 1)

j	S_j	$S_j - B$	C_j	π_j	c_j
1	1,979,600	-20,400	-1.0%	1.0%	-2.0%
2	2,175,600	175,600	8.8%	11.0%	-2.0%
3	1,958,400	-41,600	-2.1%	2.0%	-4.0%
4	2,515,200	515,200	25.8%	31.0%	-4.0%
5	1,858,400	-141,600	-7.1%	1.0%	-8.0%
6	2,355,200	355,200	17.8%	28.0%	-8.0%
7	1,754,400	-245,600	-12.3%	2.0%	-14.0%
8	2,373,600	373,600	18.7%	38.0%	-14.0%

j – Question number; B – Buying price (DKK) = 2,000,000; S_j – Selling price (DKK);
C_j – Nominal change (%); π_j – Accumulated inflation (%); c_j – Real change (%)

[10] It is a common heuristic to use the approximation $c_j \approx C_j - \pi_j$. The heuristic yields a good approximation of the true real change in (2) when inflation is low, but results in substantial deviations when inflation is high. For example, the deviation is about 5 percentage points in the case of Ben (see second paragraph of introduction), compared with a true real loss of $c_j = (0.10 - 0.30) / (1 + 0.30) = 15.38\%$).

Table 1 lists the parameters used in Study 1. For ease of exposition, the table groups the scenarios in pairs, i.e. for a given real loss (subjects were presented with the scenarios in random order). All transactions have the same buying price (of DKK 2,000,000), with inflation ranging from 1% to 38%, and real losses ranging from 2% to 14%. Half of the scenarios involve gaining money, and the other half involve losing money.[11]

3.2 Index of nominal loss aversion (NLA index)

The NLA index is a measure of proneness to nominal loss aversion for each subject. We construct the NLA index by calculating the difference in evaluations by a given subject in a pair of scenarios with a given real loss, and averaging over the scenarios. Thus, a subject whose evaluations do not depend on gaining vs. losing money has an NLA index of zero. The remainder of this section explains the specifics of measurement in more detail, and explains that the distribution of the NLA index for noisy subjects is also centered on a value of zero.

For a given subject $i \in \{1,2,3,\dots,N\}$, the perceived advantageousness of a housing transaction is a latent variable a_{ij}^*, which is mapped by some subject-specific function f_i to the measured variable $a_{ij} = f_i\left(a_{ij}^*\right) \in A = \{1,2,3,\dots,15\}$. Since f_i is specific to subject i, we use a within-subject design.

The impact of the nominal representation on the evaluation of a given real loss is measured by the difference in evaluations between the nominal gain and the nominal loss representations of a given real scenario k, for a given subject i. Specifically, the nominal gain represented by $j^+ \in \{2,4,6,8\}$ is paired with the nominal loss represented by $j^- = j^+ - 1$. The difference $a_{j^+} - a_{j^-}$ is the measured effect of the nominal representation for the real scenario k, where $k = j^+ / 2 \in \{1,2,3,\dots,K\}$, and $K = J / 2$.

On the subject level, we create an index of nominal loss aversion (NLA index), by averaging the differences between the nominal gain and loss evaluations across all four real losses,

$$\frac{1}{K}\sum_{k=1}^{K}\left(a_{i(2k)} - a_{i(2k-1)}\right).$$

Adding an error term ε_{ij} to each of the decisions gives the observed index for subject i,

[11] The parameters shown in Table 1 were also used in Study 2, which adds scenarios with equivalent real gains. For details, see Table 3.

$$y_i = \frac{1}{K}\sum_{k=1}^{K}\left(a_{i(2k)} + \varepsilon_{i(2k)} - \left(a_{i(2k-1)} + \varepsilon_{i(2k-1)}\right)\right). \quad (3)$$

For a subject whose evaluations are independent of the nominal representation, $\forall k$: $Ea_{i(2k)} - Ea_{i(2k-1)} = 0$. Assuming errors centred on zero, $\forall k$: $E\varepsilon_{i(2k)} = E\varepsilon_{i(2k-1)} = 0$. If the errors are independent, then $\forall k$: $E\left[\varepsilon_{i(2k)} - \varepsilon_{i(2k-1)}\right] = 0$, which implies that $Ey_i = 0$. By the same logic, for a subject who is consistently averse to nominal losses, $\forall k$: $Ea_{i(2k)} > Ea_{i(2k-1)}$, with the implication that $Ey_i > 0$.

It is clear from (3) that, for subjects who choose answers randomly or choose the same answer for all of the questions, $Ey_i = 0$. Since the expected index is zero for both rational and noisy subjects, a positive index indicates a systematic bias against nominal losses.

The aim of the NLA index is to provide a measure of (biased) perceptions. However, a given subject's true perception of the advantageousness of a housing transaction is known only to the subject. As a result, it is not possible to provide incentives for truthful or correct answers. Subjects can, however, be incentivized to answer the questions. We provided such incentives by including the survey within a series of incentivized experiments.[12] In order to receive their earnings from other experiments, subjects were required to complete the entire wave, including our survey experiment.

3.3 Hypotheses

Study 1 allows us to investigate two key hypotheses. The first is that presenting a real loss as a nominal gain vs. loss biases evaluations, and the second is that the extent of the bias is negatively related to cognitive ability.

Hypothesis 1: *For a given real loss, transactions involving a nominal gain are evaluated more favorably than those involving a nominal loss (the average NLA index is positive).*

If nominal representations have no impact on perceptions of real losses but respondents are noisy, then the distribution of the nominal loss aversion index Y is symmetric around 0, giving the null hypothesis $H_0^1: \mu_Y = 0$, with the alternative $H_A^1: \mu_Y \neq 0$. If subjects are systematically biased towards nominal gain representations, Y is asymmetrically distributed, with greater mass to the right of 0 and $\mu_Y > 0$.

[12] Details on the overall structure of the internet experiments that have been run contemporaneously with the survey can be found at http://www.econ.ku.dk/cee/ilee/description/.

Hypothesis 2: *Subjects with greater cognitive ability respond less with their evaluations to the presentation of a given real loss as a monetary gain vs. loss (the NLA index is negatively related to cognitive ability).*

We expect cognitive ability to influence nominal loss aversion in two ways. First, cognitive effort is required to compute the real changes, and those with lower cognitive ability are thus more likely to base their evaluations on nominal changes. Second, previous research suggests that greater cognitive ability is associated with less aversion to losses generally (see for example Benjamin, Brown, and Shapiro Forthcoming). Moreover, the measures we use seem to be predictive of biases in decision making in general. For example, Oechssler, Roider, and Schmitz (2009) and Hoppe and Kusterer (2011) show that respondents with higher CRT scores are less prone to a number of biases (like overconfidence).

To test hypothesis 2, we use the linear model

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\eta},$$

where $\mathbf{y}$ is an N-dimensional vector of NLA index values for the subjects, $\mathbf{X}$ is the $N \times M$ matrix of explanatory variables, including the IST (Intelligence Structure Test Matrices) measure of fluid intelligence and the CRT measure of cognitive reflection, $\boldsymbol{\beta}$ is the M length vector of regression coefficients and $\boldsymbol{\eta}$ is the N-length vector of errors. Our hypothesis concerns the coefficients for ISS and CRS, β_{ISS} and β_{CRS}, respectively, and we expect that $\beta_{\text{ISS}} < 0$ and $\beta_{\text{CRS}} < 0$.

Study 1 also investigates socioeconomic and demographic correlates of NLA (i.e. which sorts of people are particularly prone to nominal loss aversion). Our analysis is rather explorative in this respect, but we discuss the plausibility of our results in light of previous research when presenting the results.

3.4 Procedures and sample description

The data presented in this paper were collected as part of the iLEE (internet Laboratory for Experimental Economics) project developed at the University of Copenhagen. The project develops a "virtual lab" approach by constructing an internet platform to conduct economic experiments with a large and heterogeneous sample drawn from the adult Danish population. The experiments follow the standards in experimental economics (e.g. no deception, payment according to choices) and use the same procedures (e.g. with respect to instructions) as in a conventional laboratory experiment, but subjects make choices remotely, over the internet.

Several waves have been run since 2008 (numbered iLEE1, etc., one per year), and each wave consisted of incentivized experiments and non-paid survey parts. Subjects earned on average around €35 per wave.

Study 1 was run as part of iLEE2, and Study 2 as part of iLEE3, while the psychometric measures were elicited in iLEE1. Collaboration with the National Bureau of Statistics in Denmark allowed us to recruit a random sample, drawn from the adult population, for iLEE1, and to match subjects' responses to detailed socioeconomic data.[13] Study 1 was randomly assigned to a subsample of iLEE2 participants. We only analyze the data of subjects whose identities we can verify, resulting in a sample of 732 subjects for Study 1 and 481 for Study 2.[14] The psychometric (and socioeconomic) data are available for all subjects in both Studies reported here, with most (N = 399) of the subjects participating in Study 2 having participated in Study 1 one year earlier, while some had not (N = 82). As a consequence, our sample for Study 2 includes subjects who are experienced with the survey experiment (had seen the scenarios one year before) and a control group of subjects who are not. However, subjects did not receive feedback on the surveys in any wave. We do not find that inexperienced vs. experienced subjects provide significantly different evaluations on average (t-test, p = 0.463), and we therefore merge the data in the analysis below.

The subject pool used in this paper is highly heterogeneous and captures a large amount of the underlying variation of the Danish population with respect to important socioeconomic variables. All age and educational groups are well represented, although the highly educated, the high-salary earners, and middle-aged people are somewhat over-represented. Nevertheless, the participation rate and degree of representativeness of iLEE is similar to that of the CentERpanel (Hoogendoorn and Daalmans 2009).[15] For example, in Study 1, the subjects are divided fairly evenly by sex, with 49% male and 51% female. All major education levels are represented, from 9–10 years of basic education to more than 4 years of

[13] For more detailed information on iLEE1 and the recruiting procedures used, see Thöni, Tyran, and Wengström (2012).

[14] Since subjects participate remotely (over the internet) and are anonymous to us, we do not know whether the respondent is the person we invited. There is thus a risk that we match a respondent's choices with the register data of some other person (e.g. a child of the intended respondent). To prevent such a mismatch, we ask the respondent for his or her age and gender at the beginning of each wave, and check if the response matches the data in the register. This technique serves to validate the respondent's identity, since subjects do not know that we have this information from the register. Validation was successful for 97.5% of subjects who were allocated to Study 1. We only use data from validated subjects in both studies.

[15] As with the CentERpanel, subjects tend to be more educated than the overall population, with somewhat higher incomes and a narrower age distribution. This difference is not a problem, however, because our aim is not to draw inference about the overall Danish population, but rather about the way in which nominal loss aversion varies with cognitive and demographic characteristics.

higher education. The average age is 47.3 years, and the average annual income is DKK 310,000, with a maximum of more than DKK 1.8 million. About 62.7% of respondents own real estate.

4. Results (Study 1)

Section 4.1 shows that nominal loss aversion is common, and that the evaluations of housing transactions are strongly shaped by whether they involve gaining vs. losing money. In particular, we find in Study 1 that most people (about 60%) have an NLA index biased away from zero. Section 4.2 shows that the extent to which respondents' evaluations are affected by gaining vs. losing money correlates well with socioeconomics (like age, gender, education, and income), and is strongly related to respondents' cognitive abilities.

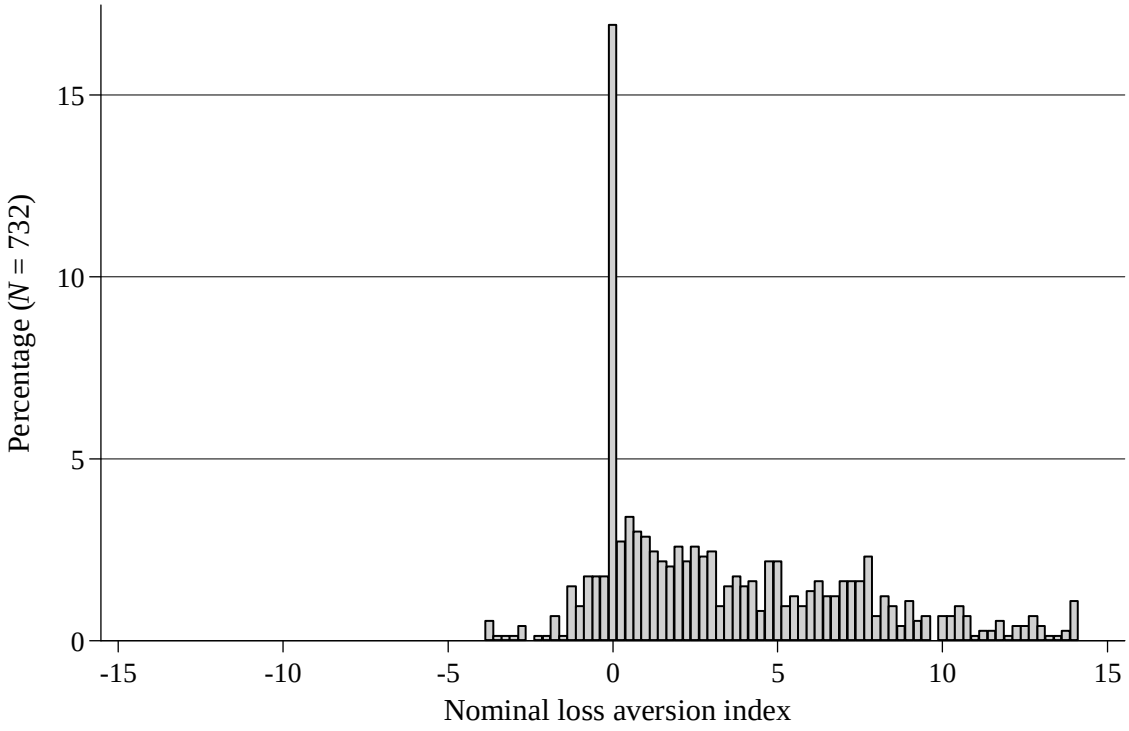
4.1 Nominal gains vs. losses bias evaluations

Figure 2 presents our first main result. The figure shows that the distribution of the NLA index is clearly asymmetric, with the mass of observations to the right of zero. Of the 732 subjects, 16.9% had index values of zero, compared with 10.2% with values below zero, and about three quarters of respondents (72.8%) with values above. Thus, we observe that a substantial proportion of subjects (about one in six) do not seem to be affected by the nominal representation. About one in ten subjects has a negative value, which is not in line with our hypothesis. We believe that they are the result of noise, perhaps random errors that have resulted in an average NLA index below zero. If we assume that a similar proportion (one out of ten) of the observations with NLA index values above zero is also due to noise, we infer that about 60 percent (i.e. 72.8% − 10.2%) of subjects are systematically biased in their evaluations by the nominal representation. The average NLA index value is $\overline{y} = 3.36$, which is clearly biased away from zero.[16] Result 1 summarizes our findings.

RESULT 1: *Evaluations of transactions involving real losses are systematically biased by nominal representations, with nominal gains inducing more favorable evaluations. The NLA index is biased away from zero, and the distribution of NLA index is asymmetric.*

[16] The 95% confidence interval for μ_Y is $(2.90, 3.85)$, using a Schlag (2008) exact test, and $(3.09, 3.65)$ with a t-test. A χ^2 goodness of fit test rejects equality of proportions above and below zero with p = 0.000, and a null hypothesis of equal probability of non-zero index values being above or below zero is rejected by a binomial test with p = 0.000.

Figure 2: Distribution of the nominal loss aversion index



RESULT 2: *Nominal loss aversion is a cognitive phenomenon. NLA index values are strongly related to cognitive reflection, and to a lesser extent to intelligence.*

Table 2 presents regressions of the NLA index on two measures of cognitive ability (ISS and CRS), to test whether NLA is a cognitive phenomenon, controlling for various factors (e.g. decision time, respondents' socioeconomic characteristics, personality). Our discussion in the next few paragraphs focuses on cognitive ability. Section 4.2 discusses other correlates in more detail.

Column 1 presents a minimal specification that focuses on cognitive ability and cognitive effort. As a rough proxy for cognitive effort, we used decision time, i.e. time spent evaluating the eight scenarios in the survey. The average time spent was 3.4 minutes, or about 25 seconds per question. The measures of cognitive ability we use are IST (the Matrices subtest of the IST-R 2000, which is a standard measure of fluid intelligence; see Beauducel et al. 2010) and CRT (a measure of cognitive reflection, see Frederick 2005) scores.[17] IST scores

[17] Permission to use the IST-R Matrix test was provided by the Dansk Psykologisk Forlag.

can range from 0 to 20 and are approximately normally distributed (avg. 8.8, sdev. 3.1).[18] CRT scores can range from 0 to 3, and the distribution of CRT scores is fairly uniform (avg. 1.6, sdev. 1.1). The two measures are related but capture clearly different aspects of cognition. In our sample, the pairwise Pearson correlation coefficient between CRT and IST scores is 0.30, and highly significant.

Table 2: Correlates of nominal loss aversion (Study 1)

Nominal Loss Aversion	(1)	(2)	(3)	(4)	(5)
Time spent on all questions	−0.278***	−0.264***	−0.282***	−0.287***	−0.291***
	(0.055)	(0.059)	(0.056)	(0.056)	(0.056)
Cognitive reflection score (CRS)	−0.847***		−0.797***	−0.685***	−0.689***
	(0.129)		(0.133)	(0.135)	(0.135)
IST Matrix intelligence score (ISS)	−0.133***		−0.130***	−0.125***	−0.122**
	(0.045)		(0.045)	(0.048)	(0.048)
High school or vocational education		−0.302	−0.347	−0.063	0.001
		(0.492)	(0.476)	(0.472)	(0.467)
Short or medium tertiary education		−0.855*	−0.610	−0.467	−0.413
		(0.488)	(0.475)	(0.470)	(0.470)
Long tertiary education		−1.724***	−1.057**	−0.565	−0.429
		(0.533)	(0.517)	(0.515)	(0.520)
Age				0.130**	0.136**
				(0.062)	(0.061)
Age²				−0.001*	−0.001**
				(0.001)	(0.001)
Female				0.879***	0.743**
				(0.286)	(0.310)
Gross income				−1.652**	−1.448*
				(0.743)	(0.741)
Property owner				−0.131	−0.237
				(0.308)	(0.304)
Personality (BFI)	No	No	No	No	Yes
Constant	6.801***	4.929***	7.220***	3.812***	4.029
	(0.496)	(0.493)	(0.610)	(1.469)	(2.450)
F -test	31.969	8.977	17.242	11.449	8.783
Prob. > *F*	0.000***	0.000***	0.000***	0.000***	0.000***
R^2 adjusted	0.104	0.032	0.106	0.126	0.131
N	732	732	732	732	732

The table shows OLS estimates for the NLA index in Study 1. Independent variables include the number of minutes spent answering all of the questions. The cognitive variables include a cognitive reflection test score (CRT, 0–3) and a measure of fluid intelligence (IST-R Matrix, 0–20). Demographic variables include three education dummies, age and age squared, a gender dummy, income (millions of Danish crowns) and a dummy for property ownership. Controls for personality, using the Big Five Inventory, are also included. The figures reported are coefficients, with robust standard errors in parentheses below each. Significance at 10% is denoted by *, at 5% by **, and at 1% by ***.

[18] A skewness/kurtosis test fails to reject normality, with $p = 0.135$.

Column 1 shows that nominal loss aversion is less pronounced among subjects with higher cognitive ability. We find that the coefficients for both the CRS and ISS are highly significant, with point estimates of $\hat{\beta}_{\text{CRS}} = -0.847$ and $\hat{\beta}_{\text{ISS}} = -0.133$, respectively. These effects are remarkably strong. For example, an increase of one standard deviation in the CRS reduces the NLA index by about 28% (or 0.95 points) of the average index value. For the average subject (with time spent 3.4, and ISS 8.8), having a CRS of 3 rather than 0 reduces the NLA index by more than half, from about 4.7 to about 2.2. The analogous effect of ISS (again evaluated at the averages of CRS and time spent) is smaller than the effect of CRS, but still substantial. We find that a one standard deviation increase in ISS reduces the NLA index by about 12% (0.42 points).

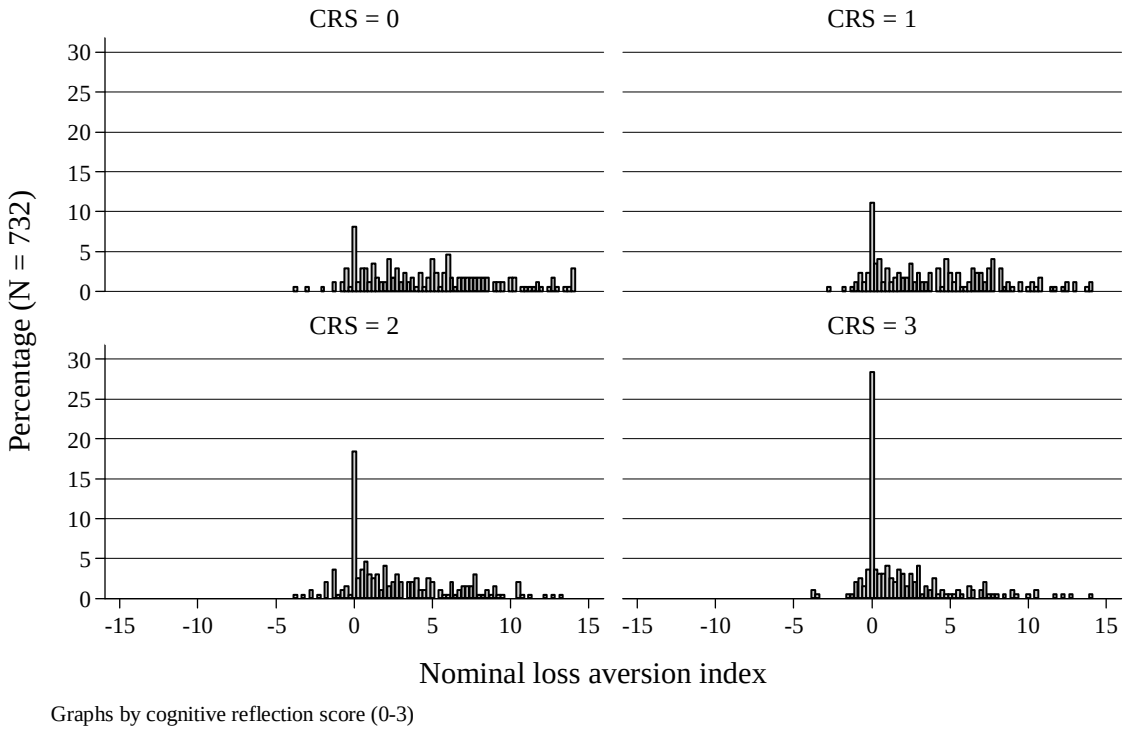
Column 2 in Table 2 regresses the NLA index on education without CRS or ISS, while column 3 combines the two. We discuss the effects of education in more detail in the next section, and focus here on how robustly cognitive ability predicts nominal loss aversion. We find that even controlling for education, the effects of cognitive ability remain strong in column 3.

Column 4 adds controls for other demographic data to specification (3), and column 5 adds controls for personality. In both cases, substantial and significant correlations remain between cognitive measures and the NLA index.

Figure 3 illustrates that respondents with higher CRS are less prone to nominal loss aversion. The figure shows distributions of the NLA index for subjects with particular CRT scores. For subjects where CRS = 0 (upper left panel), about 8% have index scores of 0, while more than 84% have positive values. The percentage of subjects with NLA index values of 0 increases to about 11% at CRS = 1, to 18% at CRS = 2, and to 28% at CRS = 3. At the same time, the percentage with positive index values declines to about 80%, 70% and 59% for the respective CRT scores.

In summary, the discussion above shows that NLA is strongly related to measures of cognitive ability taken approximately one year before Study 1 was run. The correlation of NLA with CRS is especially strong. This finding is consistent with the idea of an intuitive response from System 1, which evaluates transactions according to whether they involve gaining vs. losing money.

Figure 3: Nominal loss aversion index by cognitive reflection score (CRS)



4.2 Who is prone to nominal loss aversion?

Table 2 also provides information about who is prone to nominal loss aversion, i.e. the socioeconomic correlates of nominal loss aversion. We summarize our findings in

RESULT 3: *Highly educated individuals are less averse to nominal losses than others, but the correlation disappears when controlling for cognitive ability and demographic characteristics. Several of these characteristics, in turn, are significantly correlated with nominal loss aversion.*

Columns 2 and 3 of Table 2 show the correlation between the NLA index and education, represented by three dummy variables (with basic education as the left-out category). Column 2 controls only for the time spent, while column 3 adds controls for cognitive ability. We find that having short and medium tertiary education (up to 4 years of higher education) is marginally significant without controls for cognitive ability. When cognitive controls are added, however, it becomes insignificant. Long tertiary education (more than 4 years of higher education) is highly significant. Even with cognitive controls, completion of long

tertiary education is associated with a reduction in the NLA index of about a third (1.1 out of an average index value of 3.4).

Column 4 adds demographic controls for age, gender, gross income and property ownership, using official register data. When these variables are added, all education variables, including long tertiary education, cease to be significant. This effect is not altogether surprising, since long tertiary education is correlated with some of them, including in particular income.[19] Column 5 adds controls for personality, which do not affect the results (and we find no significant correlations between the BFI personality variables and the NLA index).

Columns 4 and 5 in Table 2 show that the NLA index initially increases with age, but at a decreasing rate, which eventually turns negative. According to model (5), NLA is minimal (an index of about 2) amongst the youngest subjects, peaks at age 51 (about 4 points), and falls back below 3 points by age 70. Although this non-monotonic relationship is surprising, it is consistent with the raw index values, which show a rise and then fall in the index as age increases. Previous research (e.g. Gächter et al. 2010) suggests that general loss aversion increases with age. This view is consistent with the initial increase we observe, but not with the reversal of the trend at higher ages.[20]

Column 4 in Table 2 shows a surprisingly large and highly significant difference in the NLA index between men and women in our sample. There is some evidence that women are more loss averse in general then men (Croson and Gneezy 2009), and our results are consistent with this finding. A possible explanation for the gender effect observed here is personality differences, which have been found to be pronounced in previous research, and there are significant gender differences in our sample.[21] To test this explanation, column 5 of

[19] The pairwise Pearson correlation coefficients for female and for gross income are -0.11 and 0.21, respectively. Both are highly significant.

[20] Kovalchik et al. (2005) find similar levels of loss aversion for elderly people (average age 82) and students (average age 20) in their sample, but their elderly subjects are highly educated relative to their age group. Elderly subjects in our sample also tend to be highly educated. Subjects over 70 are significantly more likely to have competed long tertiary education than those aged 70 and under (χ^2 test, $p = 0.006$).

[21] In line with other studies (see e.g. Costa, Terracciano, and McCrae 2001), men in our sample tend to be less agreeable (avg. of 31.1 vs. 33.7, p = 0.000) and less neurotic (avg. of 16.8 vs. 21.0, p = 0.000) than women, while there are no significant differences with respect to conscientiousness (avg. of 33.5 vs. 33.0, p = 0.201), openness (avg. of 27.0 vs. 27.5, p = 0.250) or extraversion (avg. of 30.9 vs. 30.1, p = 0.085). All comparisons based on two-sided *t*-tests.

Table 2 includes controls for personality, using the BFI. The gender difference is somewhat reduced (falls from 8.88 to 7.43) but remains large and significant.[22]

Subjects with higher incomes are likely to have more experience with financial investment, and such experience may help to overcome a bias like aversion to nominal losses. Based on model (4) in Table 2, this appears to be the case, even controlling for cognitive ability, education, age and gender. With an average gross income of about DKK 310,000, an income increase of one standard deviation (about DKK 195,000) reduces the NLA index by about 10% (0.32 points).

A related variable is property ownership, which could conceivably be associated with greater experience of buying and selling property, and hence less aversion to nominal losses. Various authors have argued that experience with transactions helps overcome anomalies (e.g. the endowment effect, see Engelmann and Hollard 2010 for a discussion). Columns 4 and 5 of Table 2 show, however, that we find no evidence for such a relation in Study 1.[23]

5. Study 2: Nominal versus real gains

Study 1 focused on the evaluation of real losses when presented as involving gaining vs. losing money. Study 2 extends Study 1 by adding otherwise identical scenarios, but with real gains instead of real losses. The change from the real loss to the real gain domain should induce higher evaluations, and we find that it does. Within the real gain domain, however, we find that higher inflation has little impact on evaluations. The reason is that, for a given real gain, higher inflation only means gaining more rather than gaining less money. Our finding that this variation has little effect further underscores the importance of gaining vs. losing money for how people think about economic transactions.

Study 2 includes a replication of Study 1, but with all eight scenarios presented on the same screen. This design allows subjects to more easily compare scenarios and should facilitate the insight that the paired cases with gaining vs. losing money are in fact identical (real losses). In addition, the study includes another screen with eight new scenarios. These

[22] This may be related to unobserved differences. For example, when controlling for occupation, Gächter et al. (2010) find no evidence of a gender effect for general loss aversion.

[23] We do find a negative and significant effect in Study 2. The effect is weakly significant when both datasets are merged, and personality controls are included. In Study 2, the coefficient for the property ownership dummy is −0.798 when personality controls are included, and −0.747 when they are not. Both are significant at the 5% level.

are identical with the original eight scenarios, except that the signs of the real losses are reversed, so that they are real gains.[24]

The inclusion of real gains in Study 2 doubles the number of treatments from two to four. In the real dimension, a "real loss" (RL) treatment (a replication of Study 1) is accompanied by a "real gain" (RG) treatment. Within each of these, there is a "low inflation" treatment and a "high inflation" treatment, as in Study 1. In the RL treatment, high inflation again masks real losses as nominal gains. In the RG treatment, however, it simply increases nominal (monetary) gains. Apart from the selling prices, and hence the real and nominal changes, all parameters in RL and RG are identical.[25]

Table 3: Parameters for the housing scenarios (Study 2)

j	S_j^{RL}	S_j^{RG}	$S_j^{RL} - B$	$S_j^{RG} - B$	C_j^{RL}	C_j^{RG}	π_j	$\lvert c_j \rvert$
1	1,979,600	2,060,400	-20,400	60,400	-1.0%	3.0%	1.0%	2.0%
2	2,175,600	2,264,400	175,600	264,400	8.8%	13.2%	11.0%	2.0%
3	1,958,400	2,121,600	-41,600	121,600	-2.1%	6.1%	2.0%	4.0%
4	2,515,200	2,724,800	515,200	724,800	25.8%	36.2%	31.0%	4.0%
5	1,858,400	2,181,600	-141,600	181,600	-7.1%	9.1%	1.0%	8.0%
6	2,355,200	2,764,800	355,200	764,800	17.8%	38.2%	28.0%	8.0%
7	1,754,400	2,325,600	-245,600	325,600	-12.3%	16.3%	2.0%	14.0%
8	2,373,600	3,146,400	373,600	1146,400	18.7%	57.3%	38.0%	14.0%

j – Question number; RL – Real loss; RG – Real gain; B – Buying price (DKK) = 2,000,000;
S – Selling price (DKK); C_j – Nominal change (%); π_j – Accumulated inflation (%); c_j – Real change (%)

Table 3 shows the parameters used in Study 2. Because Study 2 adds an RG treatment to the RL condition of Study 1, there are now two selling prices, S_j^{RL} and S_j^{RG}, two nominal changes, C_j^{RL} and C_j^{RG} and two real changes, c_j^{RL} and $c_j^{RG} = -c_j^{RL}$. The real changes are the same in absolute value across RL and RG, so the table includes only the absolute real change.

[24] The order of the two screens is randomized, as is the order of the eight decisions on each screen.
[25] We do not include scenarios where real gains are masked by deflation as nominal losses because such situations tend to be exceedingly rare in practice, and might be perceived by subjects as artificial.

Study 2 is motivated the hypothesis that inflation has a larger impact on perceptions when it obfuscates real losses as nominal gains (in RL) than when it simply makes real gains appear larger (in RG). The hypothesis thus reflects the idea that nominal loss aversion has powerful effects on the perception of the value of economic transactions because an aversion to losses interacts with money illusion. Money illusion as such is expected to have relatively minor effects in this context. Additionally, based on the cognitive findings in Study 1, we expect a more transparent presentation to reduce the bias.

RESULT 4: *Biased perceptions are driven by the interaction of loss aversion and money illusion. Subjects are more biased when inflation masks real losses as nominal gains than when equivalent inflation simply makes real gains look larger.*

Support for this result comes from statistical tests that clearly reject the hypothesis that for given (nominal) shifts in inflation, evaluations are independent of whether they involve real gains or losses (averages are $\bar{y}^{\mathrm{RL}} = 1.62$ and $\bar{y}^{\mathrm{RG}} = 0.38$, and a *t*-test rejects $Ey_i^{\mathrm{RL}} = Ey_i^{\mathrm{RG}}$ with p = 0.000). The respective confidence intervals for the mean NLA values show that evaluations are clearly biased in RL but the bias is weak, if anything, in RG.[26]

While it is clear that masking real losses as nominal gains biases decisions, an important question is whether or not decisions are responsive to real changes, i.e. to "economic fundamentals", despite variation in inflation. This question can be answered by comparing average evaluations (rather than the NLA index values) in the RL and RG treatments.

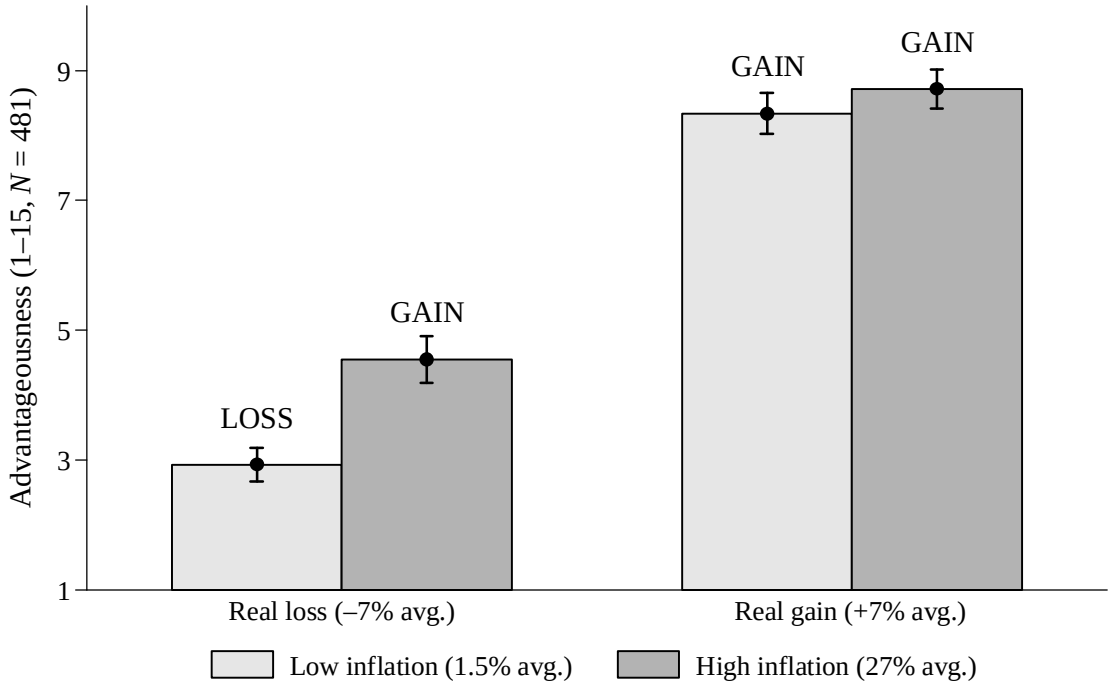
Figure 4 shows the effects of varying economic fundamentals (left vs. right), and of varying inflation for given economic fundamentals (light vs. dark shaded bars), on evaluations. The bars show average evaluations in the four treatments, with 97.5% confidence intervals for the means.[27] The figure makes clear that both nominal and real shifts affect evaluations, but that real shifts have a more pronounced effect. For example, when moving from a real loss of −7% to a real gain of +7% on average, the average evaluation rises from 2.9 to about 8.3. Importantly, the impact of low vs. high inflation is markedly different across real conditions. When high inflation prevents the loss of money, evaluations increase substantially (from 2.9 to 4.6; see leftmost bars). In contrast, when low vs. high inflation does

[26] The 97.5% confidence intervals for μ_Y^{RL} and μ_Y^{RG} are$(1.25, 2.00)$ and $(0.01, 0.75)$ with a *t*-test, and $(1.02, 2.25)$ and $(-0.22, 0.96)$, with a Schlag (2008) exact test, respectively.

[27] The 97.5% confidence intervals for columns 1 to 4 are (2.67, 3.19), (4.18, 4.92), (8.02, 8.66), and (8.42, 9.02) based on *t*-tests, and (2.58, 3.33), (4.10, 5.05), (7,91, 8.77), and (8.30, 9.13) based on Schlag (2008) exact test, respectively. The conclusions are the same.

not cross the nominal gain/loss boundary (in RG), it does not lead to significantly higher evaluations.

Figure 4: Average evaluations by treatment (Study 2)



Average evaluations by real and nominal treatments, with 97.5% CIs for means, and nominal GAIN or LOSS

The contrast between the strong and highly significant effect of inflation observed in the real loss domain, and the insignificant effect observed in the real gain domain, is particularly striking. When there are no losses, and the presentation is transparent, subjects are seemingly able to "pierce the veil of money" and consider transactions in real terms. However, even with transparent presentation, inflation continues to shape perceptions when it masks real losses as nominal gains. This result supports our view that money illusion has particularly pronounced effects if it interacts with loss aversion, i.e. that *nominal* loss aversion shapes evaluations.

Table 4 shows the marked responsiveness to real changes in Study 2. We regress individual evaluations (16 per subject) on real changes (in percentage terms). We add treatment dummies and interactions to measure treatment effects, including interactions with responsiveness to real changes. The dependent variable in both models is the advantageousness of a given housing transaction, on the 1–15 scale.

Table 4: Responsiveness to real changes (Study 2)

Advantageousness	(1)		(2)	
Real loss with nominal gain			1.135***	(0.172)
Real gain with low inflation			0.442*	(0.237)
Real gain with high inflation			1.000***	(0.243)
Real change (%)	0.339***	(0.007)	0.175***	(0.013)
× Real loss with nominal gain			−0.070***	(0.014)
× Real gain with low inflation			0.359***	(0.018)
× Real gain with high inflation			0.333***	(0.021)
Constant	6.136***	(0.086)	4.158***	(0.179)
F-test	2042.855		508.61	
Prob. > F	0.000***		0.000***	
R^2 adjusted	0.362		0.413	
N	7696		7696	
G	481		481	

The table shows OLS estimates for subjects' evaluations (16 per subject) of the advantageousness of the housing transactions in Study 2. The possible evaluations lie between 1 and 15. The baseline is the treatment involving real losses with low inflation. Treatment dummies are included for real losses with nominal gains (high inflation), real gains with low inflation and real gains with high inflation. The real change (ranging from −14 to 14) is included, together with treatment interactions. The figures reported are coefficients, with standard errors clustered by subject in parentheses to the right of each. Significance at 10% is denoted by *, at 5% by **, and at 1% by ***.

Column 1 includes only the real percentage change, which ranges from −14 in the real loss scenarios to +14 in the real gain scenarios (note that the bars in Figure 4 show average evaluations over all possible real changes, which range in absolute value from 2 to 14 percent). The effect is both substantial, explaining more than a third of total variation, and highly significant. The largest real gain yields an estimated average evaluation of about 10.9 (= 6.136 + 0.339 × 14), while the largest real loss yields 1.4.

Column 2 investigates how the responsiveness to real changes depends on treatments. The baseline in column 2 is the RL treatment with low inflation. In the cases where nominal gains do not obscure real losses, moving from the lowest (−2%) to the highest (−14%) real loss means a reduction in average scores of about 55 percent. In the cases with real gains (i.e.

moving from a gain of 14% to 2%), we find very similar relative changes in evaluations.[28] But the relative change in evaluations is much smaller in the case where the nominal change obfuscates the real loss as a nominal gain. In this case, the corresponding drop is only about 25%.[29] Thus, evaluations on average respond to changes in "economic fundamentals" even when they are obfuscated by nominal changes (i.e. when real losses appear like nominal gains). But the response is dampened (is only about half as big) compared with when it is not obfuscated.

The RL treatment of Study 2 is identical with Study 1, except for the more transparent presentation of the scenarios, which are shown side-by-side on one screen rather than on separate screens. Based on the cognitive findings (see Result 2) from Study 1, we expect the more transparent presentation to reduce cognitive demands, and thereby to reduce the nominal bias. In addition, we expect reduced effects of intelligence and cognitive reflection on the NLA index in Study 2 (RL) vs. Study 1. We indeed find that the more transparent presentation reduces the bias as measured by the average NLA index values (1.6 in Study 2 vs. 3.4 in Study 1, $p = 0.000$ according to a *t*-test).[30] Also in line with our expectations, we find no significant correlation between our IQ measure (ISS) and the NLA index when running regressions as in Table 2 for Study 2.[31] However, the correlation with cognitive reflection is essentially unchanged. In Study 2, a one-point increase in CRS reduces the NLA index by -0.62 and -0.65 points for the RL and RG treatments, respectively. Neither is significantly different from Study 1, where an equivalent CRS increase is associated with a drop in the index of -0.69 points.[32]

Overall, the results of Study 2 show that subjects are highly responsive to "economic fundamentals" (real changes), and simply gaining more money for a given real gain makes little difference for evaluations. Yet, gaining vs. losing money has a strong and significant effect with real losses. These results underscore the relevance of *nominal* loss aversion, i.e. the interaction of aversion to losses and their presentation in terms of gaining vs. losing

[28] RL/low inflation: Estimated evaluation falls from about 3.8 to 1.7 (= 4.158 − 0.175 × 14) i.e. by 55%, RG/low inflation: falls from 12.1 to 5.7 (= 4.158 + 0.442 + (0.175 + 0.359) × 2) i.e. by 53%, RG/high inflation: falls from 12.3 to 6.2 (= 4.158 + 1.000 + (0.175 + 0.333) × 2), i.e. by 50%.

[29] Estimated evaluation falls from about 5.1 to about 3.8 (= 4.158 + 1.135 − (0.175 – 0.070) × 2), i.e. by 25%.

[30] The 97.5% confidence intervals are $(3.05, 3.70)$ and $(1.24, 1.99)$ with a *t*-test, and (2.90,3.85) and $(1.09, 2.18)$ with a Schlag (2008) exact test, respectively.

[31] For model (5) in Table 2, respective 97.5% confidence intervals for β_{ISS} in RL and RG of Study 2 are $(-0.14, 0.13)$ and $(-0.19, 0.08)$, compared with a 97.5% confidence interval of $(-0.24, -0.01)$ in Study 1.

[32] For model (5) in Table 2, respective 97.5% confidence intervals for β_{CRS} in the RL and RG treatments of Study 2 are $(-0.98, -0.26)$ and $(-0.99, -0.31)$, compared with $(-1.00, -0.38)$ in Study 1.

money. The use of a more transparent form of presentation does significantly reduce the bias, and eliminates the correlation between intelligence and nominal loss aversion. At the same time, the correlation with cognitive reflection is not significantly different across the two studies. This result adds further support to Result 2 from Study 1 – that nominal loss aversion is a cognitive phenomenon, in which cognitive reflection plays a particularly important role.

6. Concluding Remarks

This paper has shown that nominal loss aversion systematically shapes evaluations of housing transactions. Housing transactions that in fact are disadvantageous (involve real losses), are viewed much less favorably when they involve losing money than when they involve gaining money. The effects are strong and common. About 60 percent of our respondents in Study 1 gave systematically better evaluations when a transaction involved gaining rather than losing money. Transactions involving real gains are viewed more favorably, as they should be, but gaining more money without an increase in the real gain has little impact on evaluations.

Our findings suggest that people tend to think in terms of money about transactions – that losing money makes real losses more salient, while gaining money obfuscates real losses. We find that cognition is a key factor explaining the extent to which "illusionary" (purely nominal) gains mislead people into believing they made good deal when they did not. We use large samples of people from all walks of life (in Denmark), for whom we have extraordinarily rich and verified register data. While demographic characteristics like education, income, gender, and age have some explanatory power in accounting for the degree to which people are duped, the driving factor is the readiness of respondents to "think again." Higher scores of "cognitive reflection" have more explanatory power than a standard measure of intelligence or formal education taken together.

Asking for evaluations of housing transactions allows us to present subjects with substantial variation in real losses along with relatively large nominal gains, without using parameters that our subjects would find unusual. The reason is that the holding period for (residential) real estate is typically long, and in an environment with moderate inflation, substantial inflation accumulates over the typical holding period. We think that our paper complements and supports field evidence, such as Genesove and Mayer (2001) for the Boston housing market in the 1990s. However, we think that our results have potential implications

beyond housing markets, and nominal loss aversion could distort behavior in many other areas, including wage setting and financial investment (see Section 2 for references).

Our study also sheds light on how cognitive ability shapes nominal loss aversion. We find that intelligence (as measured by a standard test) matters, but cognitive reflection (CRS) matters more. Additionally, intelligence loses its predictive power when the problem is made simpler, but the CRS correlation remains essentially unchanged across all treatments. This finding is consistent with the argument made by Frederick (2005) that cognitive reflection is not simply a proxy for intelligence. In terms of the two-system theory (Stanovich and West 2000), what matters most is apparently not the raw processing power of System 2, but rather the ability to overrule the intuitive response of System 1, and engage System 2. The importance of overruling System 1 tends to support Camerer's (2005) view that loss aversion is often a mistake – an emotional overreaction rooted in evolutionary history – rather than a genuine preference.

An obvious caveat with our results is the absence of incentives for providing correct answers. On the one hand, we find that subjects respond strongly and systematically to variations in the "economic fundamentals" of the scenarios (i.e. the real gains vs. losses, as we expect according to standard theory). On the other hand, providing subjects with incentives might have motivated them to think more carefully about the problems. More careful consideration, in turn, could trigger the use of System 2, leading to evaluations that are more in line with rational decisions. A promising area for further research would therefore be to conduct an incentivized experiment to compare behavior in similar circumstances.

Thinking about transactions in terms of money is natural, simple, salient, and sometimes a good heuristic. But it biases evaluations of transactions when inflation is substantial, in particular when nominal gains obscure the fact that a transaction entails a real loss. While taking inflation properly into account to compute precise real changes is cognitively demanding, judging whether a transaction results in gaining or losing money is much simpler. When judging housing transactions, which often involve long holding periods and therefore large accumulated inflation, using the simple heuristic "I made some money, thus it must have been a reasonably good deal," is misleading. According to our results, many subjects seem to use such misleading heuristics, but many of our subjects would have been, with some additional cognitive effort, able to make more considered choices. With that in mind, the next time you find yourself thinking, "at least I didn't lose money," our advice is: think again.

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