Sweating the Small Stuff:
Demand for Low Deductibles in Homeowners Insurance

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Abstract

How much do individuals pay to insure against moderate losses? To address this question I study a new homeowners-insurance data set on individual deductible choice. Even though lower deductibles require sharply higher yearly premiums, 83% of customers paid for a deductible lower than the maximum available of $1000. The prototypical homeowner paid $100 to reduce the deductible to $500, yet with claim rates under 5% this additional coverage was worth less than $25 in expectation. Those insured with the company for longer were more likely to hold low deductibles, which can be plausibly explained by consumer inertia. Even among new customers, however, 61% chose a lower deductible, typically paying 400-500% of what that marginal insurance was worth in expectation. Using conservative assumptions, I find that the standard model of decision making under risk requires triple-digit coefficients of relative risk aversion to explain these choices. Such measures are inconsistent with estimates from studies of lifecycle-consumption and labor-supply behavior and imply implausible risk aversion over large-stakes gambles. In contrast, applying a variant of prospect theory with existing parameter estimates to insurance purchases fits well with the observed deductible choices. I also discuss other possible explanations for the extreme risk aversion observed.

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People face a host of moderate-scale financial risks in their daily lives and often have the ability to insure against these risks. Extended warranties on consumer durables, insurance on rental products, and insurance deductibles are all examples. The standard expected-utility-of-wealth model predicts that individuals will be approximately risk neutral toward such moderate-scale risks. Whether people actually conform to that prediction, however, is an open question. A question that matters to economists in part because risk attitudes in these domains can fundamentally affect the functioning of major product and insurance markets. In addition, while the financial importance of deviations from risk neutrality for such decisions may be modest in isolation, their cumulative effects, both across individuals and over a lifetime, may be significant.

This paper addresses this issue using a new data set on deductible choice in the homeowners-insurance industry. Individual choices from a menu of four available deductibles – {\$1000, \$500, \$250, \$100} – along with subsequent claim experience are observed for 50,000 customers of an American insurance company for one year. The data reveal that the average homeowner pays a great deal to avoid high deductibles. Even though insurance premiums rise sharply for lower deductibles, 83% of homeowners in the sample paid for a deductible lower than \$1000. The prototypical homeowner paid \$100 to reduce the deductible to \$500, yet with claim rates under 5% this additional coverage was worth less than \$25 in expectation.

In Section 2 I discuss the nature of insurance pricing at this company as well as the details of the data set. This section also provides some basic background information on the \$36 billion U.S. homeowners-insurance industry, and documents that the menu of deductibles and premiums at this company is similar to that at other companies. Thus, to the extent that these customers make representative decisions, the evidence suggests that most homeowners may be paying something like 400 to 500% of the expected value for the additional insurance provided by lower deductibles.

Section 3 presents the main empirical findings based on both simple sample averages
and nonparametric kernel regressions. The central finding is that the 83% of customers who held a lower deductible would have saved an average of $99.88 during the year had they instead held the $1000 deductible. A back-of-the-envelope calculation sheds light on the long-term costs of holding lower-deductibles. Consider a typical customer investing this ($99.88) savings at a yearly real interest rate of only 3% from the age of 30 to 65. Assuming that the menu remains constant, this homeowner could expect to have an additional $6,300 in savings for retirement. More importantly, with a yearly Poisson claim rate of 5%, over 35 years there is only a \(\frac{1}{455}\) chance that this homeowner would lose any money and only a \(\frac{1}{11,236}\) chance of losing more than $1,000 by holding the high deductible.

Further analysis in Section 3 reveals that consumer inertia may be a plausible partial explanation for the prevalence of low deductibles. Those insured by the company for longer were more likely to hold lower deductibles. Due to both price and home-value inflation, low deductibles would have been more attractive in the past. Combining this observation with the fact that the company’s renewal notices do not remind customers of other options, and with evidence from a host of settings that even when significant money is involved people often fail to adjust their initial choices over time, suggests that for some customers low deductibles may reflect consumer inertia and not necessarily their current risk preferences.

However, 61% of customers who were new to the company in the sample year also chose one of the lower deductibles. Most held the $500 deductible, and because these $500-deductible customers had an average claim rate of only 4%, this additional insurance was worth at most $20 in expectation. Yet, they paid on average $95 more in yearly premium than they would have with the $1000-deductible alternative. Thus, while consumer inertia may offer a partial explanation of the prevalence of costly lower

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\(^1\)For example, see DellaVigna and Malmendier (forthcoming) on health club members as well as Madrian and Shea (2001) and Choi et al. (2003) on 401(k) participants for examples of costly consumer inertia.
deductibles in the full sample, the fact that the majority of new customers also made such choices seems to suggest a high degree of risk aversion in these insurance decisions.

Sections 4 and 5 consider how the choices of these new customers fit with two of the leading models of risk preferences: the standard expected-utility-of-wealth (EU(w)) model and prospect theory (Kahneman and Tversky, 1979 and 1992). The maintained assumption for both models is that homeowners accurately predict loss probabilities. Choices in the standard model are based on final wealth states and risk aversion arises from the diminishing marginal utility of wealth. In prospect theory, on the other hand, the carriers of value are changes in money from a reference point and risk preferences are driven primarily by loss aversion – in which even very small losses are more painful than same-sized gains are pleasurable – and a nonlinear probability weighting function – in which small probabilities are overweighted and high probabilities underweighted. The results of these sections suggest that while the curvature of the utility function needed to explain the choice of low deductibles in the standard model is implausibly extreme, prospect theory can rationalize the observed choices using preexisting estimates of model parameters.

Section 4 analyzes the standard model, exploiting the fact that observing an individual’s choices from the menu of available deductibles places bounds on the curvature of her utility function. Benchmark calculations, using the common CRRA utility function and conservative values of initial lifetime wealth, imply that the average lower bound on the coefficient of relative risk aversion for the 61% of new customers who chose one of the lower deductibles ranges from 125 to 397. These measures are not only highly inconsistent with the single-digit estimates typically found in studies of labor-supply and lifecycle-consumption behavior, but unrealistic on their face: with the preferences in the baseline specification 99.8% of these low-deductible customers would be predicted to reject a gamble with an even chance of losing $1,000 or gaining $10 million. These measures of risk aversion therefore support recent critiques suggesting the inability of
the standard EU(w) model to account for moderate-stakes risk aversion, since the utility function needed to do so would imply paradoxically risk-averse attitudes toward larger-scale risks. This paper offers some of the first clean evidence that this critique of the standard model is empirically relevant in an important market.

Section 5 explores the predictions of a variant of prospect theory based on the assumptions that homeowners narrowly bracket (considering only a one-year horizon) and that there is “no loss aversion in buying”. This last assumption, which is consistent with experimental evidence and long-standing intuitions in the literature, implies that money that is given up as part of a transaction does not induce loss aversion, while monetary losses due to risk do. The basic intuition in this setting is that because insurance premiums are planned and routine transactions, they may not induce the psychological pain associated with chance losses. Having to cover the deductible in the event of an unexpected loss, however, is psychologically painful. This difference, then, increases the willingness to pay for a low deductible. With the existing parameter values estimated by Tversky and Kahneman (1992), this variant of prospect theory accounts well for the average observed willingness to pay for lower deductibles. That is, for each deductible level the parameterized model rationalizes the choice of the average new customer, and furthermore, when paired with individual estimates of claim rates, it correctly predicts the observed choices of the majority of homeowners.

Those familiar with prospect theory may find these results surprising, because other common variants of prospect theory have trouble explaining insurance purchases, in part because the value function is convex (risk loving) in the loss domain. There are a number of alternative explanations that could help explain deductible choice if risk preferences arise from these other variants of prospect theory or the EU(w) model. For example, one of the simplest explanations is that homeowners may systematically overestimate the probability of a loss. Yet, to reconcile deductible choice with risk neutrality or risk-loving attitudes requires that on average the majority of homeowners
overestimate the probability of a loss by roughly five times. That is, they must believe the probability of insured damage to the house is nearly 20% per year. Section 6 discusses risk misperception along with other alternative explanations for the observed behavior, including extreme liquidity constraints, sales-agent incentives, and menu effects.

Section 7 concludes the paper with a discussion of extensions and implications of this analysis. In particular, I argue that incorporating reference-dependent preferences into studies of risk aversion in markets may help explain observations that seem contradictory or anomalous within the standard model. Although generally useful, modelling risk aversion solely as the result of a concave utility-of-wealth function is not appropriate to all settings. Seriously considering the ways in which individuals process probabilities and frame decisions over risk can better inform economists’ understanding of insurance and of risk aversion in markets more generally. This paper is a step in that direction, demonstrating that meaningful risk aversion over moderate-stakes is a market reality, that standard theory is inconsistent with these choices, and that a leading alternative model shows promise for explaining observed insurance purchases.

1 Related Literature

A few previous papers have used deductible choice to examine risk aversion. Pashigian, Schkade, and Menefee (1966) conclude from aggregate auto-insurance data that choices of lower deductibles would imply high Arrow-Pratt measures of risk aversion. Cutler and Zeckhauser (2004), come to similar conclusions by looking at examples of insurance menus and comparing those to national claim rates.² Unlike the individual-level data available here, however, these studies did not have hard data on who (if anyone) actually chose lower deductibles.

The most similar study to this one comes from Cohen and Einav (2005), who analyze the deductible choices of Israeli automobile-insurance customers. They estimate a struc-

²See also Dreze (1981).
tural model of absolute risk aversion, and address preference heterogeneity and adverse selection. Because the Israeli company has a more complicated menu of deductibles, direct comparisons with their work are somewhat difficult. Qualitatively, though, their automobile customers appear less risk averse than my sample of homeowners. That is, despite facing additional premiums for lower deductibles that were typically much closer to the ex-post risk-neutral level than those observed by my sample, only 18% of their customers paid for a lower deductible. In Section 4 I compare the Arrow-Pratt measures I find with theirs, and indeed the homeowners are significantly more risk averse. However, while they do not do so explicitly, I interpret both the Cohen-Einav evidence and my evidence as suggesting that the diminishing marginal utility of wealth is an implausible explanation for why people chose lower deductibles.

The results here could also in principle be related to the large literature on estimating risk aversion over moderate stakes using data from surveys and experiments. This is difficult, however, because such studies tend to use measures of initial wealth (e.g. zero) that are inconsistent with the classical expected-utility-of-wealth model. Notable exceptions, however, include Binswanger (1981) and Schechter (2005). Schechter’s results in particular correspond to those here. In experiments with rural Paraguayans, after appropriately accounting for the ability of farmers to save (and thus to smooth consumption over time), Schechter found an average coefficient of relative risk aversion of 2,428.

As noted in the introduction, the evidence in this paper (like Schechter’s results) supports recent critiques by Rabin (2000), Rabin (2001), and Rabin and Thaler (2001) (among others) that the diminishing marginal utility of wealth cannot explain moderate-stakes risk aversion. At the same time, this paper would seem to contradict arguments by those such as Palacios-Huerta et al. (forthcoming) and Watt (2002) suggesting that individuals are not in fact meaningfully risk averse over small or moderate stakes.

Ultimately, the spirit of this paper may actually be closest to some of the work on
the equity premium puzzle. Mehra and Prescott (1985) demonstrated that empirically the historical premium for equities over bonds is a puzzle within the standard model, typically requiring coefficients of relative risk aversion over 30. In search of an alternative explanation for the observed patterns, Benartzi and Thaler (1995) showed that if investors evaluate their portfolios annually, the equity premium puzzle can be explained with the same previously estimated parameters of Kahneman and Tversky’s (1979, 1992) prospect theory that I use in this paper.

2 Data Set

Homeowners-Insurance Industry. The homeowners-insurance industry in the U.S. is large and an important part of the broader property-casualty insurance market.\(^3\) While homeowners are free to choose their insurance company and the details of their policies, virtually all mortgage lenders require borrowers to insure their home. In part because of this requirement, nearly all homeowners in the U.S. carry homeowners insurance.\(^4\) In 2001 the industry brought in approximately $36 billion in homeowners-insurance revenue, with the average household paying $536 in annual premiums.\(^5\)

Homeowners insurance is really a bundle of insurance, covering structures (e.g. home, garage), personal property (e.g. furniture), and liability (e.g. injuries to visitors). A standard policy covers damage or loss due to theft, accidents, and weather, with weather-related incidents being the most frequent. However, flood and earthquake damage are generally excluded and must be insured through separate or additional policies. Beyond the cost of repairs or replacements, in the event that a home becomes uninhabitable, insurance companies typically pay for living expenses, such as motel bills and meals at

\(^3\)See Grace and Klein (2003a) and (2003b) for comprehensive studies of the industry.

\(^4\)For instance, a 2002 poll of 1,000 homeowners conducted by RoperASW found that 95% carried homeowners insurance (IRC news release “Study Reveals Most Homeowners Support Home Safety Requirements” June 3, 2003).

\(^5\)Insurance Information Institute website – www.iii.org.
restaurants. The insurer will pay for losses up to specified policy limits, which generally correspond to the insured value of the home. This insured value, in turn, is a reflection of the estimated cost to rebuild the home and does not include the value of land.

The homeowner is responsible for some amount of initial losses in the form of a per-claim deductible, and the company pays only for losses in excess of the deductible. Most companies offer their customers a choice from a menu of fixed deductibles. Because a lower deductible moves the policy closer to full insurance, the homeowner naturally pays higher yearly premiums for a lower deductible.

Data. This study uses a new individual-level data set obtained from an insurance company. The data comprise a random sample of 50,000 of the company’s homeowners-insurance customers. A recent year was chosen to be the sample year, and for each policy the characteristics of the home and policyholder known to the company at the beginning and the end of the calendar year were recorded. All 50,000 observations come from the same post-2000 year, and the data contain all variables used by the company when determining rates. In addition to being drawn from the same year, all observations are for houses in the same western state. Only standard homeowners-insurance policies were used, which excludes renters, commercial-property, and condominium insurance.

The customers at this company choose from four available deductible levels: $1000, $500, $250, and $100. Deductibles are not bundled with other features of coverage, and basic contracts differ only in the deductible level. Both the level of premiums and the premium differences between the deductibles are individual specific. The company provided the algorithm to calculate the full menu of deductible-premium pairs available to each homeowner. As such, I observe the chosen contract, the premium paid, and the alternatives each homeowner had available.

In addition to the information on the available menu, the company provided individual-

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6 While per-year deductibles are common in health insurance, the norm for homeowners insurance is a per-claim deductible.
7 The company used a SAS random-number generator to create the data set.
8 All policies used form HO-3, the most common policy type in the industry.
level claims data. The data set includes the total number of claims each homeowner filed for losses occurring during the sample year. The total amount of money paid by the company to the homeowner for these losses was also recorded.\footnote{While it is now the norm within the industry, during the sample year the insurance company did not raise premiums for homeowners who filed claims (a practice known as “experience rating”). It is perhaps worth noting, however, that to the extent that homeowners (wrongly) thought they would incur such charges, it should have made low deductibles less attractive to them.}

**Deductible Pricing.** The insurance company uses a very standard actuarial pricing scheme, in which the premium associated with each deductible level is individual specific. Let $X_i$ be the matrix of policyholder variables for customer $i$, including the insured value of the home, zip code, etc. . . Then the deductible-premium menu is generated by:

$$(\text{Premium}_i \mid \text{Deductible}_i = D_j) = \delta_j f(X_i) + g(X_i),$$

where $f(X_i)$ is a base premium charged to the individual (known to me) using a proprietary algorithm (unknown to me), $\delta_j$ is a deductible specific factor (confidential but known to me), and $g(X_i)$ is an additive adjustment term (known to me) derived again from a proprietary algorithm (unknown to me).

The base premium, $f(X_i)$, is a function of the characteristics of both the home and policyholder that influence expected losses. The most important policy characteristic is the insured home value, and it turns out that, all else equal, rates are roughly a linear function of home value. The additive term, $g(X_i)$, typically represents the purchase of additional coverage such as extended coverage for expensive jewelry.

Because premiums are adjusted for different deductible levels using a multiplicative factor, those with higher base premiums face higher relative prices for lower deductibles. A few simple examples may help to clarify the deductible-premium menus available to customers in the sample:
Policyholder 1: Home was built in 1966 and had an insured value of $181,700. The menu available to this policyholder in the sample year was:

<table>
<thead>
<tr>
<th>Deductible</th>
<th>Premium</th>
<th>Relative to $1000 policy</th>
<th>Chosen</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1000</td>
<td>$504</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$500</td>
<td>$588</td>
<td>+84</td>
<td></td>
</tr>
<tr>
<td>$250</td>
<td>$661</td>
<td>+157</td>
<td>x</td>
</tr>
<tr>
<td>$100</td>
<td>$773</td>
<td>+269</td>
<td></td>
</tr>
</tbody>
</table>

Policyholder 2: Home was built in 1992 and had an insured value of $266,100. The menu available to this policyholder in the sample year was:

<table>
<thead>
<tr>
<th>Deductible</th>
<th>Premium</th>
<th>Relative to $1000 policy</th>
<th>Chosen</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1000</td>
<td>$757</td>
<td>0</td>
<td>x</td>
</tr>
<tr>
<td>$500</td>
<td>$885</td>
<td>+128</td>
<td></td>
</tr>
<tr>
<td>$250</td>
<td>$999</td>
<td>+242</td>
<td></td>
</tr>
<tr>
<td>$100</td>
<td>$1,171</td>
<td>+414</td>
<td></td>
</tr>
</tbody>
</table>

Policyholder 2 had a higher premium for the $1000 deductible contract than Policyholder 1, largely because Policyholder 2 had a higher insured home value. Policyholder 2, then, also faced a greater increase in premium for the alternative of a $500 deductible. While Policyholder 2 chose not to pay the extra premium for a lower deductible, Policyholder 1 chose the $250 deductible, paying $157 more in yearly premium than he or she would have paid with the alternative $1000 level.

3 Empirical Findings

Sample Averages. Summary statistics for the full sample of homeowners are given in Table 1.\(^{10}\) Panel 1a provides a summary of important policy variables, while Panel 1b describes the average deductible-premium menu. Both of these tables list figures for the full sample as well as breakdowns by chosen deductible.

\(^{10}\)Eight observations were dropped because they had invalid data values.
These tables reveal that while those who faced higher costs were less likely to pay for the lower deductibles, the vast majority (82.7%) of customers in the full sample held one of the two middle deductibles. Forty-eight percent of customers held the $500 deductible and 35% the $250. Just over 17% of customers held the $1000 deductible, while less than 1% selected the $100 level. That so few chose the $100 level is not surprising, because the extra premium required for the $100 deductible was particularly extreme. Indeed, for the average homeowners it cost more to move from the $250 to the $100 deductible ($133.22) than it did to move from the $500 to the $250 ($85.59).

The interest here is on how much homeowners paid for lower deductibles relative to what that extra insurance was worth in expectation. Analyzing the relative expected value (to the homeowner) of insurance contracts with different deductibles is a straightforward exercise. Because the potential losses to the homeowner are capped at the deductible level, an upper bound for the relative expected value of any two contracts is simply the expected number of claims (claim rate) multiplied by the difference between the two deductibles under consideration.\footnote{If all potential losses exceed the highest deductible under consideration, this formula gives the exact difference in expected value. Because most losses exceed $1000, this formula is a fairly close approximation.}

For example, those with the $500 deductible had an average claim rate of 4.3% (Panel 1a of Table 1), implying an upper bound on the expected value for their contract relative to the $1000 alternative of $21.50 (0.43[1000-500]). Yet, they paid an average of $99.85 more in yearly premium (Panel 1b of Table 1) than they would have with the $1000 deductible. Similarly, with a claim rate of 4.9%, those with a $250 deductible could expect a reduction in out-of-pocket losses of $36.75 relative to the $1000 deductible. But they paid on average almost $159 more in yearly premium.

Another way of quantifying the average difference between the cost and expected value of lower deductibles for these customers in presented in Table 2. For this table

\footnote{The average additional cost for the $100 deductible would imply a risk-neutral yearly claim rate of 88%.}
I calculated at the individual level how much each of the lower-deductible customers would have saved or lost ex-post had they instead held the $1000 deductible. The table then reports the average of this value. Panel 2a reveals that in the full sample as a group, the $500 and $250 customers could have saved an average of $99.88 during the sample year. This table also provides a direct measure of the relative expected value of each deductible to the $1000 alternative. For the $500-deductible customers this measure is $19.93, which is slightly lower than the approximation in the previous paragraph ($21.50).

**Patterns by Price and Home Value.** Figure 1 demonstrates that these basic results hold at all premium levels. The upper-left-hand graph shows the fraction of customers who held a deductible of $500 or lower as a function of the additional premium needed to move from the $1000 to the $500 deductible. The curve gives the predicted values from a kernel regression using a quartic kernel, where the dependent variable is one if an individual chose a deductible lower than $1000 and zero otherwise.\(^\text{13}\) As one would expect, those who faced higher additional premiums were more likely to hold the highest deductible. However, at all premium levels a significant fraction of customers chose one of the lower deductibles. Roughly 80% of those who faced an additional premium of $100 actually held a deductible of $500 or lower. At $150 this fraction is still roughly 65%, and falls below 50% only for premium increases above $225. To interpret how high this cost is, note that a risk-neutral individual would be willing to pay $225 more for the $500 deductible only for expected yearly claim rates above 45%. On the other hand, the bottom left-hand graph gives the distribution of additional premium, and shows that only 2.3% of customers actually faced premium differences of $225 or more.

Again using a kernel regression, the upper-right-hand graph shows how much lower-deductible customer could have saved by instead holding the $1000 deductible. If the additional cost for lower deductibles were equal to the expected value of that extra insur-

\(^{13}\)95% confidence intervals were calculated using a standard (with-replacement) bootstrap routine with 200 repetitions.
ance, on average this savings measure would be zero. At all premium levels, however, the potential savings is significantly positive, both statistically and economically. Furthermore, I find that within both the $500- and $250-deductible groups the claim rate was roughly constant across premium levels. This implies that the savings measure will be linearly and positively related to the additional premium paid for the lower deductible, which is indeed reflected in the figure.

Figure 2 presents this same analysis, but now as a function of insured home value. This figure matches Figure 1 almost exactly, which reflects the fact that additional premiums are almost perfectly collinear with insured home value. At all home values a significant fraction of individuals held the lower deductibles, suggesting that these choices are not made only by those with low wealth.

Patterns by Tenure with Company. These results are for the full sample of homeowners, which includes individuals who started their coverage with the company at different times. Figure 3 reveals that those insured with the company for longer were more likely to hold one of the lower deductibles. For instance, less than 10% of those who had been insured with the company for 3 years or less held the $250 deductible, while those insured 11-15 years chose this level 60% of the time. Figure 4 repeats the analysis shown in Figures 1 and 2, splitting the sample into those insured for 3 years or less versus those insured 10 years or more, and shows that this pattern holds at all premium levels.\textsuperscript{14} Thus, on the surface, it would appear that those insured longer had a higher demand for low deductibles.

However, it seems likely that this pattern is the result of consumer inertia. The menu of deductibles offered by the company in the sample state was constant over time, and because of inflation in the past low deductibles would have been more attractive than they are today. Because of regular inflation a $1000 deductible was simply a bigger

\textsuperscript{14}In Figure 4, the potential savings curve for the longer-tenure customers is shifted up relative to the newer customers. This reflects that more of the longer-tenure customers held the $250 deductible, and that the $250 was ex-post a worse buy than the $500 deductible.
risk to bear in the past. In addition, because the linear relationship between premium differences and insured home value has remained roughly constant over time, home-price inflation has led to a corresponding rise in the premium differences for different deductibles. While individuals are free to update their deductible at any time, renewal notices do not list the current deductible-premium menu. Moreover, even if they are aware of the menu, there is growing evidence that even when there is significant money at stake, individuals often fail to adjust their initial choices over time. Therefore, for some homeowners it is likely that the observed choice of lower deductibles reflects inertia more than risk preferences.

However, roughly 12% of the sample consisted of customers who were new to the company in the sample year.\textsuperscript{15} For these homeowners consumer inertia is not an issue. The majority (61%) of these new customers also chose the middle deductibles, with 55% holding the $500 and 6% the $250. Only 3 customers (0.05%) held the $100, while the remaining 39% held the $1000 deductible. Panel b of Table 2 reveals that, just as in the full sample, the new customers who chose a lower deductible paid much more than that extra coverage was worth in expectation. For the $500-deductible customers the expected value of their chosen contract relative to the $1000 alternative was $17.16, yet they paid an average of $94.53 more for the $500 deductible. Similarly, for the $250 customers the expected value relative to the $1000 alternative was $35.68, while they paid additional premiums of $154.90. In sum, in order to hold a deductible lower than $1000, the prototypical new customer paid roughly 500% of what that marginal insurance was worth in expectation.

\textbf{Magnitude}. These payments for low deductibles represent “real money” at both the individual and aggregate levels. With roughly 60 million homes insured, if these patterns hold nationally, a crude (and partial equilibrium) back-of-the-envelope calculation reveals that homeowners could expect to save a total of roughly $4.8 billion per year by

\textsuperscript{15}These could be new homeowners, or homeowners previously insured with other companies. I cannot distinguish between the two in my data.
holding the highest available deductible. At the individual level, assuming that the menu of deductibles and prices remains constant, and that the yearly-compounded real interest rate on savings will be only 3%, the choice of low deductibles can have significant long-term effects. In such a case, a typical individual who bought his house at the age of 30, and consistently chose the highest deductible, could expect to save roughly $6,300 by the time he retired at the age of 65. Furthermore with a Poisson claim rate of 5%, over 35 years there is only a $\frac{1}{455}$ chance that this homeowner would lose any money and only a $\frac{1}{11,236}$ chance of losing more than $1,000 by holding the high deductible.

**Industry Comparisons.** It is worth considering how the findings of this section might apply to the homeowners-insurance market more broadly. In a comprehensive study on the industry, Grace and Klein (2003b) state that most homeowners carry fixed deductibles, “ranging from $100-$1,000 or more, with $250-$500 being the most common.” This suggests that the deductible menu observed here is quite standard, and my own surveys of insurance-company websites confirm this impression.

Furthermore, both the rating structure and level of premium differences are broadly consistent with those at other companies. For instance, Cutler and Zeckhauser (2004) report premium differences of over $200 between contracts with $1000 and $500 deductibles for two example policies in Philadelphia and Orlando. Similar magnitudes are also found in the California Department of Insurance’s online survey of homeowners-insurance premiums. As an example, in September 2005 for a new home in Berkeley with an insured home value of $250,000 the average difference in premium at the top seven insurance companies (by market share) between $1000-deductible and $500-deductible contracts was $137.14. Similar magnitudes hold for other locations.

As for typical claim rates, a 2003 Insurance Research Council survey found that 27% of homeowners stated that they had filed at least one claim on their home or condo policy in the previous 10 years, implying a constant yearly Poisson claim rate of roughly $\frac{16.60 \text{ million homes}}{} \times 0.80 \times \text{“low deductibles”} \times \text{expected savings of $100}$. 

\footnote{60 million homes multiplied by 80% with “low deductibles” multiplied by an expected savings of $100.}
3.2%. The industry reports higher national claim rates, with the Insurance Information Institute listing the average claim rate from 1999 to 2003 at 8.44%. National statistics, which are affected by the more extreme weather in the Midwest and South, are likely to be higher than those for customers in western states. In a study using data provided by 13 insurance companies, covering 77% of the homeowners-insurance market in California for the years 2000 through 2002, Singh (2004) reports an average yearly claim frequency of 5.5% per insured home.

Taken together it appears that the menu, prices, and (at least in western states) the claim rates observed in this sample are all in line with those at other companies. Thus, if the customers at other companies make similar choices to those observed here, it would seem that payments on the order of four to five times the expected value for insurance against losses under $1000 are common in the homeowners-insurance market.

4 Standard Model: EU(W)

From a qualitative standpoint there is nothing particularly interesting about individuals paying more than the actuarially fair value for insurance – that is what risk aversion predicts. However, the magnitude of the observed willingness to pay combined with the fact that this is insurance over moderate-scale risks, makes these purchases of lower deductibles difficult to rectify with the standard model of risk aversion.

In this section I demonstrate this with a simple version of the classical model of risk aversion for an individual with rational expectations who maximizes utility over the life cycle, facing no borrowing or saving constraints.

Model. Formally, consider a simple $T$-period life-cycle model.\textsuperscript{18} Denote consumption in each period by $c_t$. Let $U(c_1, c_2, \ldots, c_T)$ denote the lifetime utility over this stream of consumption. Make the usual assumptions that utility is smooth and that $U_{c_t} > 0$,
For income streams, $y_t$, the individual chooses consumption to solve:

$$\max_{c_t} U(c_1, c_2, ..., c_T),$$

s.t. $c_1 + c_2 + ... + c_T = y_1 + y_2 + ... + y_T$.

To study attitudes toward one-time risks, this problem can be re-written as a two-stage maximization problem as follows:

$$\max_w u(w),$$

where $u(w) = \max_{c_t} U(c_1, c_2, ..., c_T),$

s.t. $c_1 + c_2 + ... + c_T = y_1 + y_2 + ... + y_T = w$.

So, here $w$ is total lifetime wealth and $u$ is the Von Neumann-Morgenstern (indirect) utility function over wealth. The primary value of expressing the problem in this way is that it clarifies that initial wealth should be related to permanent income, rather than other ad hoc measures such as physical wealth or yearly income.\(^\text{19}\)

Consider a homeowner who faces a choice between insurance contracts with yearly premium, $P$, and deductible, $D$. For simplicity assume that the insurance contract is active for only one year, and that the individual faces no risk in future years. Also, assume that other than a loss to the home the individual faces no other risk to lifetime wealth. Finally, assume that all losses exceed the highest deductible under consideration, which simplifies the analysis and overstates the value of lower deductibles.

Consider first the case in which there is at most one loss during the year. Under these assumptions the expected utility of the contract with premium $P$ and deductible $D$ for loss probability $\pi$ is given by:

\(^{19}\)Much of the literature in macroeconomics and finance is concerned with the per-period utility function. If the utility over consumption, $U$, is additively separable and time invariant, in this simple framework the curvature of the per-period utility function over consumption corresponds to the curvature of the utility of wealth function. However, for static risks if an initial wealth level of $\frac{w}{T}$ is used in estimating risk aversion parameters, then any changes from that initial wealth must also be denoted as a fraction of the length of the lifetime $T$. 

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Given a choice between contracts, the individual chooses the contract $j$ that maximizes her expected utility:

$$\max_j \pi u(w - P_j - D_j) + (1 - \pi)u(w - P_j).$$

Allowing for the possibility of multiple losses during the year, and recalling that the deductible is per-claim, this expression becomes:

$$\max_j \sum_n \pi_n u(w - P_j - nD_j) \text{ for } n = 0, 1, 2, \ldots,$$

where $\pi_n$ is the probability of incurring exactly $n$ losses to the home during the year.

**Functional Form.** The baseline analysis uses the common function form of constant relative risk aversion (CRRA) for $u$:

$$u(x) = \begin{cases} \frac{x^{1-\rho}}{1-\rho} & \text{for } \rho \neq 1, \\ \ln(x) & \text{for } \rho = 1. \end{cases}$$

Note that $\rho$ is the Arrow-Pratt measure of relative risk aversion, and that $\rho = 0$ is the risk neutral case, while $\rho > 0$ implies risk aversion.

**Expected Claim Rates.** Naturally, the implied coefficient of relative risk aversion depends on the expected claim rate. One approach would be to use the sample average claim rate, but that would ignore the fact that those who chose lower deductibles had higher claim rates. The analysis could instead be based on the average claim rate within each deductible group, yet that might still suffer from the problem of adverse selection within the deductible group. That is, those who paid relatively more to acquire a particular lower deductible might also have filed more claims. Recall, however, that the kernel regressions in Section 3 did not reveal such a pattern. Nevertheless, to capture what little variation there is, I ran basic Poisson regressions of claim rates on the policy variables that affect premiums. The specifications included dummies for the chosen deductible and a continuous measure of the length of time an individual had
been insured with the company. The results of these regressions are presented in Table 3 where specification (3) is the main specification. The coefficient estimates are generally sensible and statistically significant. They are, however, typically small in magnitude, implying little variation in predicted claim rates.\textsuperscript{20} For the calibrations of the CRRA model, I use the predicted values from specification (3) in Table 3, though none of the conclusions of this section change meaningfully if deductible-level average claim rates are used instead.\textsuperscript{21}

**Initial Wealth Level.** The coefficient of relative risk aversion also depends on the initial wealth level. I do not observe lifetime wealth or even yearly income for these households. A reasonably conservative estimate for lifetime wealth would be to assume that individuals work from the age of 25 to 65 earning $25,000 per year, which would imply a lifetime wealth of $1 million. In the baseline calibrations, I use a more conservative measure of wealth, the individual’s insured home value. With an average value of $215,186, this is almost surely an understatement of lifetime wealth.\textsuperscript{22}

**Calibration Results.** Observing an individual’s choice between deductible levels places bounds on $\rho$. For instance, observing that the homeowner chose the $1000 deductible places an upper bound on the curvature of that individual’s utility of wealth function. For those who chose the $500 deductible, because we observed that the individual preferred this level to the $250 and $1000 alternatives, we can find both an upper and lower bound respectively for $\rho$. The alternatives of the $500 and $100 deductibles provide a similar bound for those who chose the $250 deductible.

Because there is not a closed-form solution for these bound, a simple search algorithm

\textsuperscript{20}In particular, the coefficient on insured home value implies that for every $10,000 increase in insured home value, all else equal an individual is expected to file 1.45% more claims. Starting from an average claim rate of 4.2%, this is a percentage-point increase of only 0.06%.

\textsuperscript{21}I allow for the possibility of multiple claims, using the probabilities of experiencing $n$ claims in a year under the Poisson model. I capped the number of potential losses in a year at 5. Given their very low probability of occurrence, including more losses has a negligible effect on the estimates.

\textsuperscript{22}Recall also that land value is not included in the insured value, and thus the insured home value is typically lower than the market value of a home, often by a substantial margin.
was used to calculate for each individual in the sample the cutoff value of $\rho$ for indifference between any two deductible-premium pairs. Due to the concerns of consumer inertia raised in the previous section, I focus this analysis only on new customers. The bounds are similar for the full sample, but in the full sample even more homeowners chose the lower deductibles.

The results of the calibrations are presented in Table 4. Panel 4a gives the results for the base-line specification, which assumes that individuals have the fitted claim rates discussed above, and face no variation in lifetime wealth other than the risk of paying the deductible. The average lower bound on the coefficient of relative risk aversion, $\rho$, required to explain the $500$-deductible customers’ choices over the $1000$ alternative is 397. This average minimum value for the $250$ customers is 780. To get a sense of the distribution, for the $500$-deductible customers the median lower bound is 352. Furthermore, the minimum lower bound for any $500$-deductible customer in this baseline specification is 40, while the maximum is 3,813.

How should one interpret these levels of $\rho$? One way to interpret them is to ask how individuals with these preferences would respond when offered other gambles. Taking the lower bound on $\rho$, for each low-deductible customer I use the search algorithm to find the gain, $G$, that the homeowner would need to be just willing to accept a 50-50 lose $1,000 / \text{gain } G$ gamble. It is entirely possible that there may exist no such $G$, so I chose to truncate the program at a gain of $10$ million. Of the 3,791 new customers who chose either the $250$ or $500$ deductible 99.8% would reject a 50-50 lose $1,000 / \text{gain } 10$ million gamble.

Another way to analyze the $\rho$ implied by deductible choices is to compare it to studies that have looked at lifecycle-consumption behavior. Such studies typically estimate a value for $\rho$ in the neighborhood of 1. For example, Gourinchas and Parker (2002) estimate a structural model of consumption over the lifecycle using data from the Consumer Expenditure Survey. They use a separable per-period CRRA utility function
and estimate coefficients of relative risk aversion ranging from 0.5 to 1.4. On another front, Chetty (forthcoming) presents calibrations that bound the coefficient of relative risk aversion using estimates of labor supply elasticities in the U.S. Employing elasticity estimates from a number of studies, and under various assumptions, Chetty concludes that the labor supply evidence bounds the coefficient somewhere under 2.

Finally, it is also worth comparing the aversion to moderate risk exhibited by American homeowners to that of Israeli automobile drivers (Cohen and Einav, 2005). From a structural model that captures the joint distribution of absolute risk aversion and claim propensity, they estimate a mean coefficient of absolute risk aversion from a CARA utility function \( u(x) = \frac{1}{r} e^{-r x} \) of 0.00088. In contrast, using CARA utility I find a lower bound on the coefficient of absolute risk aversion for the average $500-deductible customer of 0.002, roughly twice as high.\(^{23}\)

Robustness Checks. I conduct a number of robustness checks for the bounds on risk aversion. First, I consider the possibility of background risk in lifetime wealth. Although the measure of lifetime wealth is already conservative, it is instructive to see how allowing for downward risk in lifetime wealth, stemming perhaps from layoffs, affects the results. As a rather extreme case, I assume that starting from an expected lifetime wealth of the insured home value individuals face a 10% chance of a 10% reduction in lifetime earnings, a 5% chance of a 20% reduction in lifetime earnings, and a 1% chance of a 70% reduction in lifetime earnings. The calibrations with this assumption are presented in Panel 4b. The average minimum bounds on \( \rho \) fall by about a half, but are still consistently in the triple digits.

What about the claim rates? One might worry that my sample happened to have been drawn from a particularly good year, and that the 4% claim rate is unusually low. As I noted in the previous section, a yearly claim rate in the neighborhood of 5% appears

\(^{23}\)To interpret a CARA parameter of 0.002, note that an individual with these preferences would turn down a 50-50 lose $400 / gain infinite gamble. For Cohen and Einav’s estimate of 0.00019 a person would accept a 50-50 lose $400 / gain $433 gamble, but would turn down a 50-50 lose $4,000 / gain infinite gamble.
to be a reasonable estimate for western states. Nevertheless, Panel 4c shows the average bounds for $\rho$ if each individual is assumed to have an expected claim rate matching the national average of 8.44%. These results include the variation structure used in the preceding paragraph, and the average lower bound on $\rho$ for the $500 customers is still 125. Thus, even after assuming a low value for lifetime wealth, rather extreme downward variation in wealth, and more than doubling the observed claim rates, triple-digit bounds on the coefficient of relative risk aversion persist.

Finally, while homeowners have shown the ability to borrow considerably from future income by holding mortgages, one might worry that individuals face limits to borrowing, and thus do not maximize utility over the entire lifecycle as the model assumes. For instance, if the homeowner can only maximize consumption over one year, deductible choices essentially reveal the curvature in the yearly (per-period) utility function. In this case yearly income is a reasonable measure for initial wealth. Table 5 gives an example of the predicted willingness to pay for the $500 deductible, assuming a 4% claim rate, for a number of assumptions about wealth and $\rho$. Note that the relative expected value of the $500 deductible versus the $1000 alternative in this case is $20. For a coefficient of relative risk aversion of 1 in the CRRA model, no initial wealth level from $1,000,000 to $25,000 predicts the individual would be willing to pay even $1 more than this expected value. The coefficient of relative risk aversion needed to explain the choice of the average $500-deductible customer, who actually paid $94.53 in additional premium, ranges from 2,022 for an initial wealth of $1,000,000 to (a still implausibly high) 48 for an initial wealth of $25,000. For either of these wealth-$\rho$ pairs, though, an individual would turn down a 50-50 lose $1,000 / gain $10 million gamble.

The ultimate conclusion of this section is that individuals are not paying for lower deductibles because of the diminishing marginal utility of wealth. Under the classical model of risk aversion, however, that is the only explanation for these insurance purchases.
5 Prospect Theory

The results of the previous section argue for a model of decision making under risk that decouples risk aversion from the diminishing marginal utility of wealth – at least over small to moderate risks. One of the leading alternative theories of how individuals make decisions about monetary risks is prospect theory (Kahneman and Tversky, 1979 and Tversky and Kahneman, 1992). In this section, I study the ability of prospect theory to explain deductible choice. In particular, I use Tversky and Kahneman’s (1992) cumulative-prospect-theory (CPT) representation, and examine how well existing parameter estimates predict the observed willingness to pay for lower deductibles.

Prospect Theory Background. Unlike standard expected-utility theory, in which final wealth states are the carriers of value, in prospect theory individuals are sensitive to changes in asset positions. These changes are measured from a reference point, which in practice is usually taken to be the status quo at the time of decision making. The value function over these changes is given by:

\[ v(x) = x^\alpha \quad \text{for } x \geq 0 \quad \text{and} \quad v(x) = -\lambda(-x)^\beta \quad \text{for } x \leq 0, \]

(5.1)

where \( \lambda \) is the coefficient of loss aversion describing how much steeper the value function is in the loss domain than the gain domain.\(^{24}\)

A second difference between prospect theory and the EU(\(w\)) model is that prospect theory weights the outcomes of different gambles using a nonlinear probability weighting function. The weighting function, \( w \), describes the transformation of each probability into a decision weight.\(^{25}\) If this function is linear in probabilities, prospect theory is an expected-utility model (though not an expected-utility-of-wealth model). However, experimental studies have consistently estimated a nonlinear weighting function in which

\(^{24}\)Typical estimates find that \( \lambda \) is around 2, implying that losses are roughly twice as aversive as same-sized gains are pleasurable.

low probability events are overweighted and high probability ones underweighted. It is worth noting that such studies are conducted in laboratory settings with known (risk) probabilities given to subjects. As such, probability weighting is not generally interpreted as a distorted degree of belief, but rather as a decision-weighting process.

The final piece of prospect theory relevant to the discussion in this section is the longstanding intuition in this literature that there is “no loss aversion in buying” (NLIB). Novemsky and Kahneman (2005) propose that “money given up in purchases is not generally subject to loss aversion.” That is, $\lambda \approx 1$ when the money lost is coded as a “buying price” or “transaction money.” Novemsky and Kahneman support this position in part with evidence from experiments on the “endowment effect.” Appendix A describes these experiments and provides a derivation showing how the results lead to a coefficient of loss aversion on “transaction money” of 1.

**Model.** As before, consider a homeowner choosing between insurance contracts with annual premium $P$ and a per-claim deductible $D$. Also as above, assume that the homeowner makes this choice with respect to the current year in isolation and ignores any other variation in wealth. Again, the identifying assumption is that subjective beliefs of claim rates correspond to the empirical claim rates. Furthermore, for simplicity, I restrict attention to the one-loss case, however the analysis is easily expanded to account for the possibility of multiple losses during the year. Finally, as in Section 4, to simplify the analysis I assume that all losses exceed the highest deductible under consideration.

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26 See for example, Camerer and Ho (1994) who estimate probability weighting functions using data from a number of studies. Also see Gonzales and Wu (1999) who use a nonparametric approach.

27 See Kahneman and Tversky (1979), Tversky and Kahneman (1992), and Lowenstein and O’Donoghue (2005) for discussions of potential psychological mechanisms behind the weighting of these known probabilities.


29 In support of this assumption, Fox and Tversky (1998) studied decision making under uncertainty, and conclude that a reasonable model of such decision making is that individuals form subjective beliefs and then weight those subjective beliefs in the same way that they weight known (risk) probabilities.
Under the assumption that decision makers segregate the riskless premiums, \( P \), from the remaining risk of paying the deductible, \( D \),\(^{30}\) the value of the insurance contract \((P, D, \pi)\) is given by:

\[
V(P, D, \pi) = v(-P) + w^-(\pi)v(-D).
\] (5.2)

where again \( P \) is yearly premium, \( D \) is the deductible, \( \pi \) is the probability of a loss (claim rate), and \( w^- \) is the probability weighting function in the loss domain. When choosing between two insurance contracts with different deductible levels, an individual chooses the low-deductible contract only if:

\[
v(-P_D^L) + w^-(\pi)v(-D_L) \geq v(-P_D^H) + w^-(\pi)v(-D_H),
\] (5.3)

where \( D_L < D_H \) and \( P_D^L > P_D^H \).

Plugging in the value function, Equation (5.1), with the assumption that the coefficient of loss aversion on premium payments is one, into Expression (5.3) and rearranging yields an expression describing the maximum willingness to pay for a lower deductible – the PT NLIB Case:

\[
P_D^\beta_L = P_D^\beta_H = \lambda w^- (\pi)[D_H^\beta - D_L^\beta],
\] (5.4)

where again \( \lambda \) is the coefficient of loss aversion on unexpected losses of money. For the linear-value-function case (\( \beta = 1 \)) this equation reduces to:

\(^{30}\)The intuition for this segregation is that once the individual has paid the premium, that payment becomes part of her reference point. Any losses in the future, then, will be compared to this new reference point. Given the typical delay between the payment of premiums and any insured losses, the alternative assumption that people anticipate feeling the payment of the deductible as a further loss on top of the premiums they paid, seems less psychologically intuitive. By itself, however, the assumption that individuals segregate their premium payments and remaining deductible risk does little to change the predictions of the model. Indeed, when the value function is linear, the segregated model corresponds exactly to the unsegregated interpretation.
\[ \Delta P = \lambda w^-(\pi) \Delta D, \]  

where \( \Delta P = P_{D_L} - P_{D_H} \) and \( \Delta D = D_H - D_L \). It is worth noting that the risk neutral case would have \( \Delta P = \pi \Delta D \). Thus, the deviation from risk neutrality in this model comes from the multiplied effects of loss aversion and probability weighting.\textsuperscript{31}

**Calibration Results.** Tversky and Kahneman (1992) provided a full set of parameter estimates for prospect theory by analyzing individual certainty equivalents for a number of two-outcome gambles. They used the following form for the probability weighting function:

\[ w(\pi) = \frac{\pi^\gamma}{(\pi^{\gamma^+} + (1-\pi)^{\gamma^-})^{\frac{1}{\gamma}}}, \]

where the weighting functions in the loss domain \( (w^-) \) and gain domain \( (w^+) \) are distinguished by respective parameters \( \gamma^- \) and \( \gamma^+ \). They report median values for the weighting-function parameters, the two value-function curvatures, and the coefficient of loss aversion, for which they give a value of 2.25.\textsuperscript{32}

With these parameter estimates, I can examine the predicted maximum willingness to pay for lower deductibles from Equation (5.4). The average new customer who ultimately chose the $500 deductible faced a premium of $572 for the $1000 deductible. Such a customer had a claim rate of roughly 4\%, implying that a risk-neutral individual would pay at most $20 more to acquire the $500 deductible. The NLIB version of prospect theory, however, predicts that this typical customer would be willing to pay as much as $107 more for the lower deductible. This fits with the observed willingness to pay of $94.53. Yet, does the model predict too much risk aversion? The average $500-deductible customer faced an additional premium of $177 to hold the $250 over the

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\textsuperscript{31}It is worth noting that typical estimates imply a convex (risk-loving) value function in the loss domain. Thus, in the absence of loss aversion and probability weighting, the value function alone may imply that an individual would be willing to pay less than the expected value for insurance.

\textsuperscript{32}Their estimates are 0.88 for the curvature of the value function in either domain, 0.61 for \( \gamma^+ \), and 0.69 \( \gamma^- \).
$1000 alternative. The model predicts that our average $500-deductible customer would be willing to pay at most $166 for this extra coverage, so it correctly predicts the choice of the $500 deductible for this average homeowner.

What about the other new customers? The new customers who chose the $1000 deductible faced an average increase in premium of $128 to instead hold the $500 deductible. Given this high price, and noting that these individuals had lower claim rates, the NLIB version of prospect theory accounts for the choice of the average $1000-deductible customer as well. The 6% of new customers who chose the $250 deductible had an average predicted claim rate of 4.9%, and faced an average premium of $502 for the $1000-deductible contract. The model predicts that such an individual would be willing to pay an additional $186 for the $250 deductible, which exceeds the average additional premiums ($155) that they actually paid. The model also predicts that this average $250-deductible customer would not have been willing to pay for the $100 deductible. Thus, this specification fits the choice of the average $250 deductible customer as well.

Table 6 gives a sense of the overall fit of the NLIB specification with Kahneman and Tversky’s parameters. Again using the estimated claim rates from specification (3) in Table 3, for each individual I use Equation (5.4) to predict which deductible the individual would have chosen given the prospect theory preferences. Panel a shows that, except for the 3 homeowners who chose the $100 deductible, for each deductible level the majority of new customers who chose that deductible were in fact predicted by the model to do so. As a comparison, a CRRA expected-utility-of-wealth model, with an initial wealth of the insured home value and a coefficient of relative risk aversion of 10, predicts that every new customer would have chosen the $1000 deductible.

Panel 6b shows how the model fits for customers insured 10 years or longer. Compared
to the new customers these existing customers chose lower deductibles more often than prospect theory would predict. For example, for new customers the model incorrectly predicts that 18.78% of $500-deductible customers would have chosen the $1000 level. For those insured over 10 years this number is 32.71%. Therefore, if the new and existing customers have the same preferences, the predictions of the model are consistent with the idea that there is consumer inertia in this market.

**Discussion.** Caution is needed when interpreting these results. I observe only one choice for each homeowner, and there is no exogenous variation in the data for use in estimation of the separate effects of probability weighting versus loss aversion. It could be mere coincidence that Kahneman and Tversky’s parameter estimates fit these choices so well. On the other hand, it is clear that the predictions of this model are in the right ballpark. Furthermore, Benartzi and Thaler (1995) show that if individuals re-evaluate their portfolios annually, these very same parameters for prospect theory can explain the historical equity premium. Thus, in two different settings the estimates of prospect theory obtained from controlled experiments plausibly explain real-world risk aversion.

This analysis rests heavily on the assumption that premium payments do not induce loss aversion. There is support for this idea beyond the endowment-effect experiments already discussed. For instance, Slovic, Fischhoff, and Lichtenstein (1982) demonstrate that individuals respond differently to questions about insurance than they do for ostensibly similar gambles. They found that when framed as a choice between gambles, 80% of subjects preferred a 25% chance of losing $200 to a sure loss of $50. When framed as a payment of $50 for insurance against a 25% risk of losing $200, however, 65% said they would insure.

Furthermore, Köszegi and Rabin (forthcoming) have a formal model of reference-dependent preferences that captures much of the NLIB intuition.\footnote{I do not use this model here, because it has not yet been calibrated with data, and is more complicated than needed to analyze the effects of reference-dependent preferences on deductible choice.} Their model includes
a specific theory of reference-point formation based on the idea that reference points correspond to recent expectations. For goods one expects to purchase, the payment does not suffer from loss aversion because the expectation of that payment is incorporated into the reference point. One of the intuitions of this model as it applies to deductible choice is that one can never fully anticipate having to pay the deductible, and thus if damage occurs, these out-of-pocket expenses will feel like “losses”. Premium payments, though, involve no unexpected risk.

Nonetheless, there are variants of prospect theory for which premium payments would induce loss aversion. In this case, the coefficient of loss aversion drops out of the equation for the maximum willingness to pay for insurance. With this somewhat more standard assumption the equation is the *PT Standard Case*:

\[
P_{DL}^\beta - P_{DH}^\beta = w^-(\pi)[D_H^\beta - D_L^\beta]
\]  
(5.6)

For the linear value function case \((\beta = 1)\) this equation reduces to:

\[
\Delta P = w^-(\pi) \Delta D.
\]  
(5.7)

Notice that if probabilities are weighted linearly the linear-value-function case, Equation (5.7), is simply the expected value of the additional insurance. Thus, in this standard formulation the willingness to pay for insurance is driven solely by the overweighting of low probabilities. Using equation (5.6), the Tversky and Kahneman parameters imply that the typical $500-deductible customer from before would be willing to pay as much as $45 more in yearly premium for the lower deductible – or a little more than two times what it is worth in expected value and roughly half what they actually paid.\(^{35}\)

\(^{35}\)Other estimates of probability weighting yield similar results. For example, Gonzales and Wu (1999) report estimates for a two-parameter weighting function. Applying those estimates here gives a willingness to pay of $55 for this same exercise.
6 Alternative Explanations

The preceding section demonstrated that the risk attitudes observed in laboratory settings are a plausible (and to some extent full) explanation for deductible choices. However, in the absence of these effects, there are a few alternative explanations for the observed deductible choices.

**Extreme Liquidity Constraints.** The calibrations in Section 4 addressed the issue of limits to borrowing, however one potential explanation for the choice of low deductibles is that homeowners have extreme liquidity constraints and thus avoid high deductibles. However, this argument bites both ways and might actually favor the choice of higher deductibles. One reason is that while there is flexibility when filing claims and making repairs (e.g. one need not replace a stolen television), paying higher premiums for lower deductibles requires coming up with something like $100 extra cash “today”. If cash-strapped homeowners held the $1000 over the $500 deductible, after only 5 years without claims (82% chance) they would accumulate a nest egg of $500 to cover the deductible difference. Further evidence against a liquidity-constraints explanation comes from looking at the choices of those with more valuable homes, who are likely to be wealthier. Despite facing higher prices for lower deductibles, the new customers with insured home values above the sample median ($195,000) still chose one of the lower deductibles 45% of the time. Finally, if these homeowners carried a single credit card with at least $1,000 in available credit, they could borrow the money for any future deductible payments at an 18% a.p.r. for an average of 7.74 years before the expected value of the $500-deductible contract exceeded that of the $1000 contract.

**Risk Misperception.** The majority of homeowners could simply be expected-utility-of-wealth maximizers who significantly overestimate the probability of a loss. Of course, my data cannot rule out this possibility, and indeed such an explanation could be given to virtually any finding of deviations from risk neutrality in a market setting. However, the bias in subjective beliefs would need to be quite extreme and widely held.
In the baseline specification, the choice of the $500 deductible by the average new customer is consistent with a single-digit coefficient of risk aversion only for a subjective claim rate of 18.3% – nearly 5 times the observed claim rate of 3.7%. Furthermore, even new homeowners have lived in homes all their lives, and could be expected to have formed reasonable priors about the probability of losses. Even if this is not true in general, one might expect that older individuals would have learned more about claim rates. However, Figure 5 reveals that, among new customers, older homeowners are no more (or less) likely to hold higher deductibles. Finally, it might be worth asking why individuals with such high estimates of loss rates chose to live where they do, or even why they chose to own instead of rent.

**Sales-Agent Incentives.** What about the role of sales agents? Individuals typically purchase their insurance through a sales agent who walks the homeowner through the coverage options and discusses the details of the insurance contracts. These agents are paid a partial commission on the premiums paid by their customers, and as such have a financial incentive for homeowners to choose lower deductibles. One might worry that the agents do not reveal the available menu or that they pressure their customers into choosing lower deductibles. The clear patterns of price responsiveness in the data, however, are at the least suggestive that homeowners are responding to the available menu. Also, while to my knowledge there is no set procedure for how that menu is presented to customers, the company’s brochures and websites clearly show the range of available deductibles and, as noted above, this menu is quite standard. Furthermore, while markets such as extended warranties may involve heavy-handed sales pressure or misleading advertising, such tactics are uncommon in the homeowners-insurance market. Homeowners-insurance is a long-term relationship, and agents who push low deductible policies heavily risk losing customers to competitors. In fact, the only tool at the agents’ disposal for offering a less expensive policy is to suggest higher deductibles.

**Menu Effects.** Another possibility is that the menu itself influences deductible
choice. The idea here is that people dislike choosing the endpoints from a menu. One common example is diners ordering the second-cheapest bottle of wine from a restaurant menu. As it applies here, in such a model individuals could be essentially risk neutral toward deductible risks, but have some distaste for choosing the “extreme” choices from the menu. This could potentially explain the choices of new customers, who chose the $1000 deductible roughly 40% and the $500 roughly 55% of the time. It is not clear, though, how this explanation fits with the choice of the $250 deductible over the $500 deductible, which is needed to understand those insured longer with the company. Future studies exploring the effects of the available menu on insurance purchases would be valuable.

7 Discussion and Conclusions

This paper has demonstrated that significant risk aversion over moderate-scale risks is an empirical reality in an important insurance market. Individuals make insurance decisions all the time that are similar (at least on the surface) to these deductible choices. People choose collision, comprehensive, and deductible levels for their automobile insurance. Consumers also buy extended warranties on an amazing array of consumer products, from televisions to dish washers to cell phones. Even in settings without explicit insurance markets, we might interpret individuals who pay more for brands with reputations of good quality as in a sense buying insurance. It seems that aversion to moderate-scale risks plays a significant role in our economy. Yet, the very existence of these markets is at odds with the standard economic conception of risk aversion. Over such small- to moderate-scale risks the diminishing marginal utility of wealth simply does not justify people paying more than a few cents over the expected value for insurance.

This paper has also shown, though, that economists need not abandon these insurance markets to the realm of unexplainable anomalies. If one makes the usual identifying assumption that individuals have rational expectations about their claim rates, and if,
as the literature suggests, the payment of insurance premiums does not induce loss aver-
sion, the existing parameter estimates for prospect theory account well for the observed
willingness to pay for lower deductibles.

Such a reference-dependent framework may have interesting implications for future
work. For example, returning to the comparison between my sample of homeowners
and the Israeli drivers studied by Cohen and Einav, the effects of probability weighting
might explain why the drivers look relatively less risk averse. Typical estimates of the
weighting function imply much less severe overweighting of probabilities in the range of
20-30%, which is what the drivers experienced, than they do for low probabilities like
the 4-5% chance of a homeowners insurance loss. Extending the analysis in this paper
to their sample would be valuable, and might reveal whether the underlying preferences
of the two samples could be the same.

However, there is clearly a great deal of work yet to be done on these issues. For
instance, the NLIB hypothesis relies on an ill-defined distinction between money given
up in a buying transaction and that given up due to chance losses. As discussed above,
this is one of the motivations for the formal reference-dependent model of Kőszegi and
Rabin (forthcoming). In a new paper, Kőszegi and Rabin (2005) provide a refinement
of their model that can be applied to insurance purchases, which in some cases predicts
extreme risk aversion. Their model combines a more classical “consumption utility”
with the sort of “gain/loss utility” seen in prospect theory, but does not yet incorporate
probability weighting. A goal for future work is to add probability weighing to this
model with the aim of establishing whether risk attitudes in different settings can be
incorporated in a single unified framework.

Finally, the next step is to address the firm response to consumer aversion toward
moderate risks. An important question is whether the insurance company is profiting
from the demand for low deductibles, and if so why such profits are not driven out of the
market in equilibrium. Despite the net expected losses consumers receive from low de-
ductibles, it is not obvious whether the firm is profiting from lower-deductible customers. In fact, in my data the average profitability is roughly equal across deductible levels. There are a number of potential reasons for this. First, there are fixed transactions costs to processing claims, which is relevant if those with low deductibles file small claims that otherwise would not be filed. Furthermore, if low deductibles generate a moral hazard problem, the company might not profit from an individual who switches from a higher to a lower deductible. Finally, the observed menu could reflect a sorting equilibrium under adverse selection, in which the high-risk types sort into lower deductibles (Rothschild and Stiglitz, 1976). Given that the company is liable on the full distribution of losses above the deductible, even small differences in claim propensities can require large premium differences across groups. Ultimately, understanding the extent to which firms can profit from consumers’ aversion to moderate risks, the effects such preferences have on the structure of insurance markets, and the implications for regulation seems like a worthy goal for future research.
APPENDIX A: NLIB and The Endowment Effect

In “endowment-effect” experiments some individuals are randomly given an object (often a mug). Subjects endowed with the item are asked for their minimum selling price, $P_S$, while subjects without the item are asked for a maximum buying price for the good, $P_B$. In a third treatment individuals are allowed to choose between the item and money, which provides a choosing price, $P_C$. These choosing prices are usually very close to the buying prices of those not endowed with the item, implying that the money given up to acquire the good does not induce loss aversion. The endowed subjects, on the other hand, are averse to losing the item, and their selling prices are typically somewhere in the range of twice as high. To summarize: $P_B \approx P_C$, and $P_S \approx 2P_B$.

This in turn implies that the coefficient of loss aversion for “transaction money” is approximately one. To see this, note that in prospect theory the buying price, $P_B$, in these endowment-effect experiments over a good $m$ would be defined as:

$$v(m) + v(-P_B) = v(0).$$

The choosing price, $P_C$, is given by:

$$v(m) = v(P_C).$$

Thus we see that:

$$-v(-P_B) = v(P_C),$$

and plugging in Equation [5.1] this gives:

$$\lambda P_B^\beta = P_C^\alpha.$$

Since $P_B$ typically equals $P_C$, and estimates for the curvature of the value function in the gain and loss domains are also typically equal, this implies that for buying prices the coefficient of loss aversion is approximately one.
References


Figure 1. Fraction Holding Lower Deductibles and Potential Savings with Alternative $1000 Deductible as a Function of Additional Premium for the $500 Deductible

The curves in the upper graphs are fan locally-weighted kernel regressions using a quartic kernel. The dashed lines give 95% confidence intervals calculated using a bootstrap procedure with 200 repetitions. The range for additional premium covers 98% of the available data.

The graph in the upper left gives the fraction that chose either the $250 or $500 deductibles versus the additional premium an individual faced to move from a $1000 to the $500 deductible. The graph in the upper right represents the average expected savings from switching to the $1000 deductible for customers facing a given premium difference. The potential savings is calculated at the individual level and then the kernel regressions are run. Because they filed no claims, for most customers this measure is simply the premium reductions they would have seen with the $1000 deductible. For the roughly 4% of customers who filed claims the potential savings is typically negative.

The graph in the lower left shows the kernel density of the additional premium for the full sample. The graph in the lower right shows the kernel density of the additional premium for low deductible customers. The full sample is represented with a quartic kernel, bw = 10, while low deductible customers are represented with a quartic kernel, bw = 20.

Epanechnikov kernel, bw = 10

Quartic kernel, bw = 10

Quartic kernel, bw = 20

Low Deductible Customers
The curves in the upper graphs are fan locally-weighted kernel regressions using a quartic kernel. The dashed lines give 95% confidence intervals calculated using a bootstrap procedure with 200 repetitions.

The range for insured home value covers 99% of the available data. The graph in the upper left gives the fraction that chose either the $250 or $500 deductibles as a function of the insured home value.

The graph in the upper right represents the average expected savings from switching to the $1000 deductible for customers who chose one of the lower deductibles. The potential savings is calculated at the individual level and then the kernel regressions are run. Because they filed no claims, for most customers this measure is simply the premium reductions they would have seen with the $1000 deductible. For the roughly 4% of customers who filed claims the potential savings is typically negative.
Figure 3. Deductible Choice by Years Insured with Company

This chart gives the fraction of customers holding each deductible level by groups of tenure with the company. The percent of the sample that falls into each tenure category is as follows: 0-3 years (34.16%), 3-7 years (22.97%), 7-11 years (12.95%), 11-15 years (10.48%), 15+ years (19.44%).
Figure 4. Fraction Holding Lower Deductibles and Potential Savings with Alternative $1000 Deductible as a Function of Additional Premium: Split by Years Insured with Company

The curves in the upper graphs are fan locally-weighted kernel regressions using a quartic kernel. The dashed lines give 95% confidence intervals calculated using a bootstrap procedure with 200 repetitions.

The proportion of the full sample in each of these cohort groups is approximately 35%.

The range for additional premium covers 95% of the available data.

The graph in the upper left gives the fraction that chose either the $250 or $500 deductibles versus the additional premium an individual faced to move from a $1000 to the $500 deductible.

The graph in the upper right represents the average expected savings from switching to the $1000 deductible for customers facing a given premium difference. The potential savings is calculated at the individual level and then the kernel regressions are run. Because they filed no claims, most customers this measure is simply the premium reductions they would have seen with the $1000 deductible. For the roughly 4% of customers who filed claims the potential savings is typically negative.
Figure 5. Deductible Choice by Average Age for New Customers

This chart gives the fraction of new customers holding each deductible level by groups of average age of household members. Each group represents 20% of new customers for whom the insurance company had the average age measure. The measure of average age is calculated by the insurance company based on their knowledge of household members, but is not used in rating.
Table 1. Summary Statistics

1a. Selected Policy Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Full Sample</th>
<th>1000</th>
<th>500</th>
<th>250</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insured home value</td>
<td>206,917</td>
<td>266,461</td>
<td>205,026</td>
<td>180,895</td>
<td>164,485</td>
</tr>
<tr>
<td></td>
<td>(91,178)</td>
<td>(127,773)</td>
<td>(81,834)</td>
<td>(65,089)</td>
<td>(53,808)</td>
</tr>
<tr>
<td>Year home was built</td>
<td>1970</td>
<td>1972</td>
<td>1973</td>
<td>1966</td>
<td>1962</td>
</tr>
<tr>
<td></td>
<td>(20.1)</td>
<td>(22.9)</td>
<td>(20.3)</td>
<td>(17.6)</td>
<td>(15.2)</td>
</tr>
<tr>
<td>Number of years insured by the company</td>
<td>8.4</td>
<td>5.1</td>
<td>5.8</td>
<td>13.5</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td>(7.1)</td>
<td>(5.6)</td>
<td>(5.2)</td>
<td>(7.0)</td>
<td>(6.7)</td>
</tr>
<tr>
<td>Average age of H.H. members</td>
<td>53.7</td>
<td>50.1</td>
<td>50.5</td>
<td>59.8</td>
<td>66.6</td>
</tr>
<tr>
<td></td>
<td>(15.8)</td>
<td>(14.5)</td>
<td>(14.9)</td>
<td>(15.9)</td>
<td>(15.5)</td>
</tr>
<tr>
<td>Number of paid claims in sample year (claim rate)</td>
<td>0.042</td>
<td>0.025</td>
<td>0.043</td>
<td>0.049</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.17)</td>
<td>(0.22)</td>
<td>(0.23)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>Company payout per claim above deductible level</td>
<td>5,571.53</td>
<td>6,880.77</td>
<td>6,227.63</td>
<td>4,496.38</td>
<td>2,679.50</td>
</tr>
<tr>
<td></td>
<td>(21,022.20)</td>
<td>(15,583)</td>
<td>(25,234.58)</td>
<td>(16,298.04)</td>
<td>(4584.58)</td>
</tr>
<tr>
<td>Yearly premium paid</td>
<td>719.80</td>
<td>798.60</td>
<td>715.60</td>
<td>687.19</td>
<td>709.78</td>
</tr>
<tr>
<td></td>
<td>(312.76)</td>
<td>(405.78)</td>
<td>(300.39)</td>
<td>(267.82)</td>
<td>(269.34)</td>
</tr>
<tr>
<td>N</td>
<td>49,992</td>
<td>8,525</td>
<td>23,782</td>
<td>17,536</td>
<td>149</td>
</tr>
<tr>
<td>Percent of sample</td>
<td>100%</td>
<td>17.05%</td>
<td>47.57%</td>
<td>35.08%</td>
<td>0.30%</td>
</tr>
</tbody>
</table>

Note: Means with standard deviations in parentheses. The average age measure was calculated by the insurance company based on information they have about household members. This variable is not used in rating. Insured home value is the coverage limit on the insurance policy. For the claim rate and payout by the company per claim, only claims that resulted in positive payouts by the company were counted.

1b. Deductible-Premium Menu

<table>
<thead>
<tr>
<th>Available Deductible</th>
<th>Full Sample</th>
<th>1000</th>
<th>500</th>
<th>250</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$615.82</td>
<td>$798.63</td>
<td>$615.78</td>
<td>$528.26</td>
<td>$467.38</td>
</tr>
<tr>
<td></td>
<td>(292.59)</td>
<td>(405.78)</td>
<td>(262.78)</td>
<td>(214.40)</td>
<td>(191.51)</td>
</tr>
<tr>
<td></td>
<td>+99.91</td>
<td>+130.89</td>
<td>+99.85</td>
<td>+85.14</td>
<td>+75.75</td>
</tr>
<tr>
<td></td>
<td>(45.82)</td>
<td>(64.85)</td>
<td>(40.65)</td>
<td>(31.71)</td>
<td>(25.80)</td>
</tr>
<tr>
<td></td>
<td>+86.59</td>
<td>+113.44</td>
<td>+86.54</td>
<td>+73.79</td>
<td>+65.65</td>
</tr>
<tr>
<td></td>
<td>(39.71)</td>
<td>(56.20)</td>
<td>(35.23)</td>
<td>(27.48)</td>
<td>(22.36)</td>
</tr>
<tr>
<td></td>
<td>+133.22</td>
<td>+174.53</td>
<td>+133.14</td>
<td>+113.52</td>
<td>+101.00</td>
</tr>
<tr>
<td></td>
<td>(61.09)</td>
<td>(86.47)</td>
<td>(54.20)</td>
<td>(42.28)</td>
<td>(82.57)</td>
</tr>
</tbody>
</table>

Note: This table gives the average premium for insurance with a $1000 deductible in the top row. Then for each of the lower deductibles it gives the average increase in premium relative to the next higher alternative. For example, in the first column 86.59 is the average increase in premium relative to the next higher alternative. For example, a homeowner would have had to pay to hold the $250 instead of the $500 deductible. Standard deviations are given in parentheses.
Table 2. Potential Savings with the $1000 Deductible

2a. Full Sample

<table>
<thead>
<tr>
<th>Chosen Deductible</th>
<th>Number of claims per policy</th>
<th>Increase in out-of-pocket payments per claim with a $1000 deductible</th>
<th>Increase in out-of-pocket payments per policy with a $1000 deductible</th>
<th>Reduction in yearly premium per policy with $1000 deductible</th>
<th>Savings per policy with $1000 deductible</th>
</tr>
</thead>
<tbody>
<tr>
<td>$500</td>
<td>0.043</td>
<td>469.86</td>
<td>19.93</td>
<td>99.85</td>
<td>79.93</td>
</tr>
<tr>
<td>N=23,782 (47.6%)</td>
<td>(.0014)</td>
<td>(2.91)</td>
<td>(0.67)</td>
<td>(0.26)</td>
<td>(0.71)</td>
</tr>
<tr>
<td>$250</td>
<td>0.049</td>
<td>651.61</td>
<td>31.98</td>
<td>158.93</td>
<td>126.95</td>
</tr>
<tr>
<td>N=17,536 (35.1%)</td>
<td>(.0018)</td>
<td>(6.59)</td>
<td>(1.20)</td>
<td>(0.45)</td>
<td>(1.28)</td>
</tr>
</tbody>
</table>

Average forgone expected savings for all low-deductible customers: $99.88

2b. New Customers

<table>
<thead>
<tr>
<th>Chosen Deductible</th>
<th>Number of claims per policy</th>
<th>Increase in out-of-pocket payments per claim with a $1000 deductible</th>
<th>Increase in out-of-pocket payments per policy with a $1000 deductible</th>
<th>Reduction in yearly premium per policy with $1000 deductible</th>
<th>Savings per policy with $1000 deductible</th>
</tr>
</thead>
<tbody>
<tr>
<td>$500</td>
<td>0.037</td>
<td>475.05</td>
<td>17.16</td>
<td>94.53</td>
<td>77.37</td>
</tr>
<tr>
<td>N = 3,424 (54.6%)</td>
<td>(.0035)</td>
<td>(7.96)</td>
<td>(1.66)</td>
<td>(0.55)</td>
<td>(1.74)</td>
</tr>
<tr>
<td>$250</td>
<td>0.057</td>
<td>641.20</td>
<td>35.68</td>
<td>154.90</td>
<td>119.21</td>
</tr>
<tr>
<td>N = 367 (5.9%)</td>
<td>(.0127)</td>
<td>(43.78)</td>
<td>(8.05)</td>
<td>(2.73)</td>
<td>(8.43)</td>
</tr>
</tbody>
</table>

Average forgone expected savings for all low-deductible customers: $81.42

Note: Means with standard errors in parentheses. The second column in each table gives the increase in out-of-pocket payments per claim if individuals instead held the $1000 deductible. If all claims were for losses exceeding $1000, this measure would be $750 for the $250-deductible customers and $500 for the $500-deductible customers. The increase in out-of-pocket payments per claim with a $1000 deductible is a measure of the relative expected value of the lower deductible. It is calculated by averaging the increase in out-of-pocket payments that each individual would have paid with the $1000 deductible. Most did not file a claim, so for most this number is zero. The potential savings (the last column) is calculated at the individual level by taking the difference between that individual's potential reduction in yearly premium and the increase in out-of-pocket losses that individual would have experienced with the alternative $1000 deductible.
### Table 3. Poisson Regression Results

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Dependent Variable: Number of Paid Claims (All Losses) Mean = 0.0425 for $500 group</th>
<th></th>
<th>Dependent Variable: Number of Paid Claims (Implied Losses over $2000) Mean = 0.02426 for $500 group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>$250 Deductible</td>
<td>0.145738** (0.046272) [1.1568]</td>
<td>0.221724** (0.055424) [1.2482]</td>
<td>0.232335** (0.055523) [1.2615]</td>
</tr>
<tr>
<td>$1000 Deductible</td>
<td>-0.522786** (0.075057) [0.5929]</td>
<td>-0.555494** (0.078115) [0.5738]</td>
<td>-0.554091** (0.078181) [0.5746]</td>
</tr>
<tr>
<td>Ins. Home Val. ($10,000s)</td>
<td>0.012729** (0.002702) [1.0128]</td>
<td>0.014425** (0.002822) [1.0145]</td>
<td>0.019171** (0.003242) [1.0194]</td>
</tr>
<tr>
<td>Years Insured = (days/365)</td>
<td>0.033988** (0.011567) [1.0346]</td>
<td>0.025750* (0.011720) [1.0261]</td>
<td>0.042930** (0.016149) [1.0439]</td>
</tr>
<tr>
<td>Years Insured Squared</td>
<td>-0.002047** (0.000494) [0.9980]</td>
<td>-0.001702** (0.000498) [0.9983]</td>
<td>-0.002584** (0.000717) [0.9974]</td>
</tr>
<tr>
<td>Age of Home (years)</td>
<td>0.017064** (0.004096) [1.0172]</td>
<td>0.014294** (0.005406) [1.0144]</td>
<td></td>
</tr>
<tr>
<td>Age of Home Squared</td>
<td>-0.000231** (0.000053) [0.9998]</td>
<td>-0.000211** (0.000069) [0.9998]</td>
<td></td>
</tr>
<tr>
<td>Senior Discount</td>
<td>-0.140466* (0.065227) [0.8690]</td>
<td>-0.193057* (0.093839) [0.8244]</td>
<td></td>
</tr>
<tr>
<td>Smoke/Burglar Alarm Discount</td>
<td>0.130935** (0.050788) [1.1399]</td>
<td>0.155087* (0.069556) [1.1678]</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-3.157335** (0.031342) [1.1568]</td>
<td>-3.923618** (0.171102) [1.1711]</td>
<td>-4.028504** (0.195303) [1.1953]</td>
</tr>
</tbody>
</table>

**Territory Controls**

| Observations                         | x                                   | x                                   | x                                   | x                                   |
| Log Likelihood                       | -8806.2832                          | -8722.596                           | -8703.7197                          | -5345.1712                          | -5279.694                           | -5266.9529                           |

Note: * significant at 5%; ** significant at 1%. Standard errors in parentheses. Incident rate ratios in square brackets. The Poisson regression model is: $\lambda = \exp(\beta'X)$, where $\lambda$ is the number of claims filed. Implied losses are calculated by taking the amount paid to the customer for a claim and adding that customer's deductible level.
Table 4. CRRA Calibration Results for New Customers

<table>
<thead>
<tr>
<th>Measure of Lifetime Wealth (W): (Insured Home Value)</th>
<th>Chosen Deductible</th>
<th>W</th>
<th>min ρ</th>
<th>max ρ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1,000</td>
<td>256,900</td>
<td>- infinity</td>
<td>794</td>
</tr>
<tr>
<td>N = 2,474 (39.5%)</td>
<td>(113,565)</td>
<td></td>
<td>(9.242)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$500</td>
<td>190,317</td>
<td>397</td>
<td>1,055</td>
</tr>
<tr>
<td>N = 3,424 (54.6%)</td>
<td>(64,634)</td>
<td>(3.679)</td>
<td>(8.794)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$250</td>
<td>166,007</td>
<td>780</td>
<td>2,467</td>
</tr>
<tr>
<td>N = 367 (5.9%)</td>
<td>(57,613)</td>
<td>(20.380)</td>
<td>(59.130)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure of Lifetime Wealth (W): (Insured Home Value)</th>
<th>Chosen Deductible</th>
<th>W</th>
<th>min ρ</th>
<th>max ρ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1,000</td>
<td>256,900</td>
<td>- infinity</td>
<td>301</td>
</tr>
<tr>
<td>N = 2,474 (39.5%)</td>
<td>(113,565)</td>
<td></td>
<td>(2.576)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$500</td>
<td>190,317</td>
<td>189</td>
<td>372</td>
</tr>
<tr>
<td>N = 3,424 (54.6%)</td>
<td>(64,634)</td>
<td>(1.204)</td>
<td>(2.361)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$250</td>
<td>166,007</td>
<td>301</td>
<td>739</td>
</tr>
<tr>
<td>N = 367 (5.9%)</td>
<td>(57,613)</td>
<td>(5.575)</td>
<td>(17.144)</td>
<td></td>
</tr>
</tbody>
</table>

4c. National Claim Rate (8.44%) / Variation in Lifetime Wealth

<table>
<thead>
<tr>
<th>Measure of Lifetime Wealth (W): (Insured Home Value)</th>
<th>Chosen Deductible</th>
<th>W</th>
<th>min ρ</th>
<th>max ρ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1,000</td>
<td>256,900</td>
<td>- infinity</td>
<td>191</td>
</tr>
<tr>
<td>N = 2,474 (39.5%)</td>
<td>(113,565)</td>
<td></td>
<td>(2.149)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$500</td>
<td>190,317</td>
<td>125</td>
<td>283</td>
</tr>
<tr>
<td>N = 3,424 (54.6%)</td>
<td>(64,634)</td>
<td>(1.104)</td>
<td>(1.890)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$250</td>
<td>166,007</td>
<td>241</td>
<td>608</td>
</tr>
<tr>
<td>N = 367 (5.9%)</td>
<td>(57,613)</td>
<td>(4.890)</td>
<td>(14.939)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Means with standard errors in parentheses. Standard deviations in braces for average insured home values. In panels b and c the following distribution of W is assumed: A 10% chance of a 10% reduction in lifetime wealth, a 5% chance of a 20% reduction in lifetime wealth, and a 1% chance of a 70% reduction in lifetime earnings. In panel c the national claim rate of 8.44% is used for all individuals.
Table 5. Model Predictions for Various EU(W) and Prospect Theory Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Expected Value</th>
<th>Maximum WTP for $500 Deductible over $1000 alternative (4% claim rate)</th>
<th>Accept a 50-50 Gamble of Lose $5,000 Gain $10 million?</th>
<th>Accept a 50-50 Gamble of Lose $1,000 Gain $10 million?</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU(W) with $W = 1,000,000, CRRA $\rho = 1$</td>
<td>$20.01$</td>
<td>Yes (G &gt; $5,025.13$)</td>
<td>Yes (G &gt; $1,001.00$)</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 1,000,000, CRRA $\rho = 50$</td>
<td>$20.77$</td>
<td>Yes (G &gt; $6,681.27$)</td>
<td>Yes (G &gt; $1,052.64$)</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 1,000,000, CRRA $\rho = 2,012.7$</td>
<td>$94.53$</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 100,000, CRRA $\rho = 1$</td>
<td>$20.15$</td>
<td>Yes (G &gt; $5,263.19$)</td>
<td>Yes (G &gt; $1,010.10$)</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 100,000, CRRA $\rho = 50$</td>
<td>$29.29$</td>
<td>No</td>
<td>Yes (G &gt; $2,085.86$)</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 100,000, CRRA $\rho = 199.19$</td>
<td>$94.53$</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 25,000, CRRA $\rho = 1$</td>
<td>$20.64$</td>
<td>Yes (G &gt; $6250.16$)</td>
<td>Yes (G &gt; $1,041.67$)</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 25,000, CRRA $\rho = 50$</td>
<td>$101.79$</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>EU(W) with $W = 25,000, CRRA $\rho = 47.96$</td>
<td>$94.53$</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>PT &quot;Standard&quot; Case, $\lambda = 2.25$, $\beta = 0.88$, $\gamma = 0.69$</td>
<td>$47.06$</td>
<td>Yes (G &gt; $13,703.44$)</td>
<td>Yes (G &gt; $2,740.69$)</td>
<td></td>
</tr>
<tr>
<td>PT &quot;NLIB&quot; Case, $\lambda = 2.25$, $\beta = 0.88$, $\gamma = 0.69$</td>
<td>$106.52$</td>
<td>Yes (G &gt; $13,703.44$)</td>
<td>Yes (G &gt; $2,740.69$)</td>
<td></td>
</tr>
<tr>
<td>Average Payment by $500$-Ded Customers</td>
<td>$94.53$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median Payment by $500$-Ded. Customers</td>
<td>$87.60$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This table gives the maximum additional willingness to pay for the $500 deductible over the $1000 alternative for each model. A typical new customer who chose the $500 deductible had an estimated claim rate of 4% and faced a premium of $550 if he/she chose the $1000-deductible contract. The first column gives the additional amount such an individual would be willing to pay to lower the deductible from $1000 to $500. In the next two columns I analyze whether an individual with the given preferences would be willing to accept two big 50-50 gambles. If the answer is yes, the table gives the minimum gain a person would need to accept the gamble. NLIB refers to the no-loss-aversion-in-buying specification for the willingness to pay for insurance described in Section 5. For the prospect theory cases the probability weighting parameter in the positive domain (not listed in the table) is $0.61$, and the curvature of the value function in the gain domain (not listed in the table) is $0.88$. These values are needed for the 50-50 gambles, but not for the willingness to pay calculations. The answers for the 50-50 gambles are the same for the two different prospect theory cases, because the no-loss-aversion-in-buying (NLIB) effects do not come into play for random gambles.
Table 6. Observed Deductible Choice versus Model Predictions

6a. New Customers

<table>
<thead>
<tr>
<th>Chosen Deductible</th>
<th>Predicted Deductible Choice from Prospect Theory NLIB Specification: $\lambda = 2.25$, $\gamma = 0.69$, $\beta = 0.88$</th>
<th>Predicted Deductible Choice from EU(W) CRRA Utility: $\rho = 10$, $W =$ Insured Home Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$$1,000$</td>
<td>87.39% 11.88% 0.73% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 2,474$ (39.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$$500$</td>
<td>18.78% 59.43% 21.79% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 3,424$ (54.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$$250$</td>
<td>3.00% 44.41% 52.59% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 367$ (5.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$$100$</td>
<td>33.33% 66.67% 0.00% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 3$ (0.1%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6b. Customers Insured with Company for 10 Years or Longer

<table>
<thead>
<tr>
<th>Chosen Deductible</th>
<th>Predicted Deductible Choice from Prospect Theory NLIB Specification: $\lambda = 2.25$, $\gamma = 0.69$, $\beta = 0.88$</th>
<th>Predicted Deductible Choice from EU(W) CRRA Utility: $\rho = 10$, $W =$ Insured Home Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$$1,000$</td>
<td>82.39% 15.63% 1.98% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 1,516$ (8.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$$500$</td>
<td>32.71% 45.64% 21.65% 0.00%</td>
<td>99.98% 0.02% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 5,053$ (26.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$$250$</td>
<td>12.10% 38.45% 49.45% 0.00%</td>
<td>99.92% 0.08% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 12,286$ (64.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$$100$</td>
<td>10.19% 44.44% 45.37% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>$N = 108$ (0.6%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: These tables show for each chosen-deductible group what percentage of customers the model predicts would have chosen each of the available deductibles. The prospect theory NLIB specification comes from Equation (5.4) and is based on Tversky and Kahneman’s (1992) parameter estimates. The EU(W) model assumes a CRRA utility function with a coefficient of relative risk aversion of 10. The initial wealth level used is the individual’s insured home value. These tables use the estimated claim rates from specification (3) in Table 3. Because these regressions did not take into account the fact that $1000 customers would not have filed claims for lower losses, the predicted claim rates for these customers are probably somewhat too low. This implies that, to some extent, all of these models will correctly predict the choices of the $1000 customers too often. Changing the claim rates for the $1000 customers to be the sample average for the $500 customers does not change the predictions of the EU(W) model, but implies that for the prospect theory preferences the $1000 customers should have been split roughly 50-50 between choosing the $1000 and $500 deductibles.