

# Policy uncertainty and precautionary savings: Does a possible reduction of the mortgage interest deduction increase savings in the Netherlands?\*

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## Abstract

We analyze whether uncertainty related to the outcome of future policy results in precautionary saving. We focus on an important cause of policy uncertainty for households in the Netherlands: the possible limitation of the mortgage interest deduction. To isolate the effect of policy uncertainty on saving we survey participants in the Dutch CentERpanel. We elicit the subjective distribution of house prices in both a policy neutral scenario and a realistic but simplified reform scenario. We find that the subjective measures of house price uncertainty contain useful information and that households do recognize both aggregate house price uncertainty and policy uncertainty. Households who are more uncertain about aggregate house price movements (*ceteris paribus*) save more than households who are less uncertain. We also find that policy uncertainty alone increases precautionary saving. We discuss that a reform that is not credible could *ex post* exacerbate rather than mitigate precautionary saving which leads to an additional welfare loss.

**Keywords:** precautionary savings, income uncertainty, mortgage interest policy reform.

**JEL classification:** D12, D91, E21.

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# 1 Introduction

In most of the Western world house prices have been falling since the onset of the financial crisis, especially in countries with a very elastic housing supply (as in Spain) and in countries where the housing market and the mortgage market are highly regulated (as in the Netherlands). Consequently, the financial crisis makes clear that households face considerable house price risk which might induce precautionary saving behavior. The theory of precautionary saving predicts that households increase savings as a response to an increase in future income risk (see e.g. Carroll and Kimball, 2008). Additional savings can be realized by either increasing the ‘buffer stock’ of financial assets or by making additional mortgage payments to increase housing equity. The latter channel is described by Banks et al. (2010) who formulate a theoretical model of house price risk and housing choice. Indeed, major financial institutions in the Netherlands report that many homeowners recently made extra mortgage payments to increase housing equity.<sup>1</sup>

In addition to idiosyncratic house price risk (or market risk) there are other sources of risk which also induce precautionary saving. One important source of risk lies in the uncertainty related to the outcome of possible future policy reforms. For example, in the Netherlands there is a lengthy political debate to reduce the generosity of the mortgage interest deduction. Given that an increase in saving due to ‘policy uncertainty’ reduces consumer welfare, as shown by Luttmer and Samwick (2012)<sup>2</sup>, it is of primary importance to understand how much of the precautionary saving is caused by market risk and how much is because of policy uncertainty.

The subject of policy uncertainty has often been investigated by macro economists and environmental economists. Pastor et al. (2012), for example, review studies on the role of policy uncertainty in determining stock prices and also present a theoretical model on this topic. Baker, Bloom and Davis (2013) develop an index of economic policy uncertainty based on the number of newspaper articles which mention this topic. (This method is also used by Van der Wiel (2009) to measure the formation of expectations). Less empirical research has been conducted at the micro (i.e. household) level. Giavazzi and McMahon (2012) show that an increase in uncertainty about the political outcome in the run-up to the ‘close’ German elections in 1998 resulted in a higher household saving rate. They also show that the increase in policy uncertainty was related to a major debate about future pension reforms at that time.

In this study on precautionary savings we focus on another important cause of policy uncertainty: the possible reduction of the mortgage interest deduction (MID) in the Netherlands. This was a major theme in the 2010 elections and it was highly uncertain whether the reform would gain a majority in the Parliament. Using the DNB household survey (DHS) we directly estimate the increase in uncertainty due to a possible policy reform by eliciting the subjective distribution of housing prices in both a policy neutral scenario and a realistic but simplified reform scenario. We fielded our questionnaire in the weekend before the 2010 elections, at that moment, the policy uncertainty about the outcome of the MID reform was high.

We follow the reduced form approach put forward by Carroll and Samwick (1998). We

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<sup>1</sup>See the ING news release, ‘Repayment of the mortgage loan has become more popular and more structural (In Dutch)’, 18 September 2014. Available from: < <http://www.ing.com> >. [1 October 2014]. Besides the reduction in house price risk, the current low interest rate on savings accounts is another important reported reason for making additional mortgage payments or for refinancing the mortgage.

<sup>2</sup>In their paper policy uncertainty is measured by.

regress the household saving rate on important background characteristics and a proxy variable for income uncertainty. We extend the approach of Carroll and Samwick (1998) by allowing for other sources of uncertainty: we add to the regression a term for subjective housing price uncertainty attributable to the MID reform. Notice that we treat in our model house price risk in a similar way as income risk in the model of Carroll and Samwick (1998). In other words, we assume that uncertainty about house prices signal income uncertainty in a changing policy environment. But why is this assumption reasonable? There are two reasons to expect a link between policy-related uncertainty and the actual or forecast value of a house. Firstly, a restricted reform of the MID system results in less generous tax relief for specific groups. This means that their mortgage costs rise, leaving them with a lower disposable income and capacity to purchase a house, resulting in falling house prices and housing-market stagnation. In this case, uncertainty about house prices (due to the prospective reform) is a signal of uncertainty about incomes. Secondly, increases or decreases in housing wealth affect future income if people are planning to annuitize housing wealth later on in life. In this case, uncertainty about house prices is a signal of a wealth effect on future income. It is only at first sight, therefore, that the decision to use price uncertainty as a proxy for uncertainty about the fiscal treatment of the MID may seem not intuitive. Most of all the attractiveness of this proxy is its simplicity, as respondents are more familiar with house prices than tax rules.

Our findings are as follows: first, we find a large correlation between our subjective measures of uncertainty and regional variation in house prices in the years around the reform. This suggests that the subjective measures of house price risk contain useful information and that homeowners do recognize both house price uncertainty and policy uncertainty. Second, households who are more uncertain about house price movements (*ceteris paribus*) save more than households who are less uncertain. Third, we find that policy uncertainty alone could increase household savings. Although a credible reform could mitigate this effect on accumulated savings, we also show that reforms that are not credible could *ex post* exacerbate rather than mitigate the effect on precautionary savings.

## 1.1 Related literature and contribution

There are several studies on precautionary saving which are relevant for our study. Carroll and Samwick (1998) use a similar model to estimate the ‘buffer stock model’ in a reduced form. With simulations based on a CRRA (constant relative risk aversion) utility consumer, they find a high positive correlation between the target wealth to income ratio and income uncertainty. Kazarosian (1997) and Mastrogiacomo and Alessie (2013) confirm these results. Using different measures of uncertainty and different data sets, they show that the share of precautionary savings attributable to income uncertainty ranges between 30% and 46% of net worth, and is therefore substantial in relative terms. These studies use panel data (such as the Panel Study of Income Dynamics, the National Longitudinal Survey and the DHS) to determine the measure of income risk (e.g. variance of income). Guiso et al. (1992), Lusardi (1997) and Mastrogiacomo and Alessie (2013) investigate people’s actual responses by asking direct questions about their expectations on future income. The first of these studies establishes the share of total savings that could be attributed to individual earnings uncertainty by regressing the log of the wealth

to income ratio on the subjective earnings variance, while the second study examines household income uncertainty and the subjective uncertainty about future household income expressed by both household members.

The studies referred to above investigate only the subjective anticipation of income changes when institutions remain constant. We add to the literature by introducing an extra dimension to income uncertainty. We isolate one specific source of uncertainty, while previous studies have only taken one total measure of uncertainty into account. Income uncertainty may stem from a range of different prospective events, including perceived unemployment risk, health deterioration, family circumstances, and so on. Isolating uncertainty about fiscal policy is important because policy makers can take action to reduce uncertainty by adopting credible reforms for instance. However, they are typically unable to reduce uncertainty relating to personal circumstances. The literature to date has been silent on the specific effect of income uncertainty on precautionary saving when this stems from an insecure policy environment. The recent study by Giavazzi and McMahon (2012) is an exception. This is because uncertainty is normally regarded as a general concept relating to lack of knowledge about future outcomes and is not broken down into its underlying components.

In the Netherlands, over time, the possible reform of the MID system created uncertainty about consumers' future income (and housing wealth) as the details of the reform remained unclear. This uncertainty could affect savings behavior. Our research question is consequently relevant because it helps to understand how policy uncertainty can depress consumption and economic growth with it and what can be done to mitigate this effect.

The remainder of the paper is organized as follows. Section 2 describes the lengthy political debate and the formation of expectations concerning the reform of the MID over time. We also discuss the timing of our questionnaire. Section 3 describes the data and the design of our questionnaire. Section 4 discusses the measurement of idiosyncratic house price uncertainty, policy uncertainty and aggregate house price uncertainty and provides descriptive evidence about the quality of these measures. Section 5 presents the empirical model and discusses the results. The final section concludes and provides policy implications.

## **2 Expectations regarding a possible reform of the MID and timing of the questionnaire**

The Netherlands is one of the few countries (other countries include Switzerland, Italy and the US) where all interest paid on a mortgage loan is deductible from taxable income and so translates into a substantial tax refund. Many other countries with MID already implemented major reforms in the past; either by abolishing opportunities for mortgage interest deduction (as in the UK) or reducing it to a large extent (as in the US).

The amount of this refund depends on factors such as the marginal tax rate, meaning that its benefit increases in line with income and the mortgage principal. To give an example: the highest tax rate in the Netherlands is 52%; this means that someone paying € 18,000 mortgage interest a year—which is a normal amount for a standard house valued at around € 350,000—could receive a monthly tax refund of around € 800, which is almost as high as the monthly social assistance

benefit. The fact that high amounts are at stake could prompt a response from risk-averse consumers.

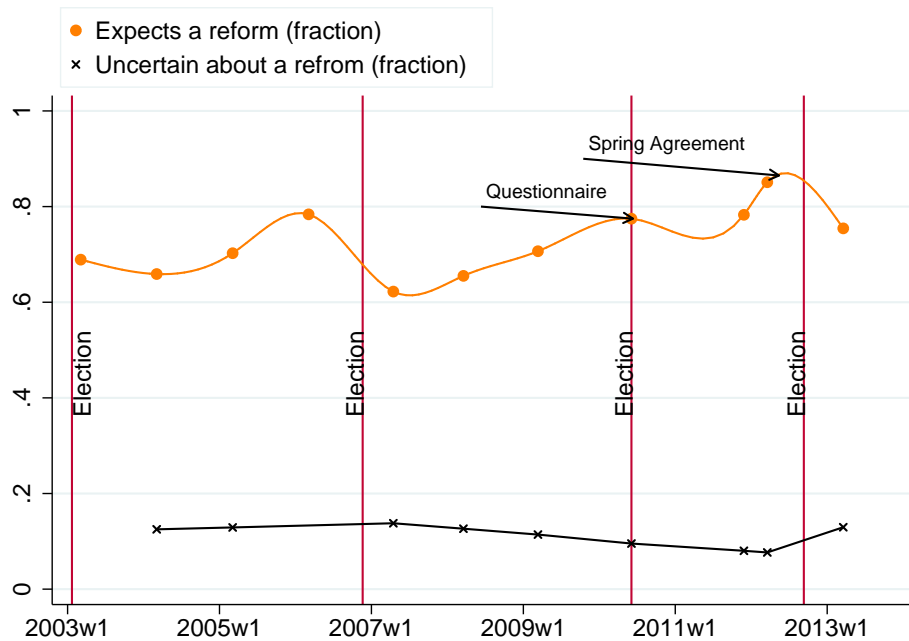
Faced with the high costs of these programs and some negative externalities (see Glaeser et al. 2003), the Dutch government introduced some limitations to the MID system over time. The recession in the late 1980s and early 1990s resulted in the MID being limited to a maximum of 30 years. Various reforms have been proposed since then, and sometimes even implemented. However, the process has been slow and it generated considerable uncertainty. Although further reforms seemed inevitable, and indeed many lobbies were initiated it took another 20 years, before any substantial reform of the system was seen. In April 2012 the government agreed to abolish the MID for new interest-only mortgages. This was announced in the Spring Agreement, an agreement reached between the government and opposition at a time when new elections were already being planned. The comprehensive reform of the housing market, including the heavily regulated and often subsidized rental market, was not addressed until the government's autumn 2012 plans. These reforms followed on the September 2012 elections and were implemented in 2013.

As we will show below, the political debate about the MID affects households expectations regarding the likelihood of a possible reform in the near future. The DNB household survey (DHS) is a panel study which among other things monitors the beliefs about a reform which reduces the generosity of the MID since 2003 (we discuss the DHS questionnaire at length in Section 3). The DHS asks the head of household whether the government will reduce the mortgage interest deduction: “*Do you expect a limitation of the mortgage deductibility in the foreseeable future, say 10 years?*” We consider the respondents who respond ‘don’t know’ as uncertain about a future limitation of the MID. We observe the exact week number at which the question is answered.

Figure 1 summarizes the evolution of these beliefs over time. The figure shows that after the 2003 political elections, 68% of the sample believed that the MID system would be reformed within 10 years. The situation remains largely unchanged after the November 2006 elections, with the DHS 2007 measurement for this period ending up at around 62%. This was a period of political instability as both elections followed a premature fall of the government. The unchanged uncertainty as shown in Figure 1 may reflect the assumption that MID reform would occur only in the event of a stable majority. From then on, according to respondents, the likelihood of a reform increased. The number of respondents who indicate to be uncertain about the likelihood of a reform also gradually declined over time.

A new DHS measurement was conducted a week after election time in 2010 and shows that 77% of respondents were expecting a MID reform within ten years. The reform of the MID was one of the major themes during the 2010 elections. We fielded our separate questionnaire to measure house price uncertainty in the week after the 2010 elections, since it was highly uncertain at that time whether there was a majority coalition in favor of a reform. According to the polls in terms of Parliamentary seats in the week in which we sent out the questionnaire both opponents and supporters of a MID reform represented about half of the seats in Parliament. The possible reform of the MID system created uncertainty about housing prices and future income as the outcome of the coalition formation and exact institutional details about a limitation of the MID

Figure 1: Do you expect a limitation of the mortgage deductibility in the next 10 years?



Source: DHS 2003-2013.

remained unclear.

Two years later, and a few weeks before the MID reform was first announced in the Spring Agreement, the 2012 DHS measurement was conducted. About 85% of the households now believe in the possibility of a MID reform. The latest elections were held in September 2012; and a few weeks later the MID reform became official. Despite the fact that the government reformed the MID, according to the 2013 DHS measurement, the majority of households expect new or additional reforms (75%). We also observe a noticeable increase in uncertainty about possible new reforms in the future. This suggests that the implemented reforms are not very credible as households are more uncertain and expect additional policy measures in the future.

### 3 Data

In order to measure housing price uncertainty we have designed a detailed questionnaire (we will discuss this questionnaire in detail below). In our study we will merge the questionnaire on house price expectations with the the 2010 wave of the DNB household survey (DHS). The DHS was launched in 1993 and is the main survey based on the CentERpanel. The CentERpanel is an Internet based panel of over 2,000 households administrated by CentERdata at Tilburg University and sponsored by De Nederlandsche Bank. The panel is representative of the Dutch population. Panel members without Internet access receive a set-top box and equipment that enables them to participate through their television.

For each wave of the DHS, information has been collected by means of five questionnaires: household and work, accommodation and mortgages, health and income, assets and liabilities and economic and psychological concepts. These questionnaires, except the second one on

accommodation and mortgages, should be filled in by all respondents, i.e. those household members who are at least sixteen years old. The housing and accommodation questionnaire is in principle filled in by the household head. The five questionnaires have been launched at different weeks of the year so that the number of responding households differs across the questionnaires. CentERdata also provides the data set with general information of the household which contains demographic and socio-economic information for all member—also those who are younger than 16—for households who responded to at least one of the 5 questionnaires mentioned above. In our study we use the following information available in this data set: age, marital status, education level, disposable income (in brackets), a dummy variable indicating homeownership status, the number of cohabiting children, a dummy variable indicating self-employment. We will only consider the answers of the head of the household.

Our question of interest is whether household saving reacts to an increase in house price uncertainty due to a reform of the MID. Following Giavazzi and McMahon (2012) we will use active saving as a percentage of permanent income as the dependent variable.

The DHS questionnaire on economic and psychological concepts elicits information on active saving by asking the respondents whether or not the household has saved in the past year and if yes how much. The amount of saving is reported in brackets. We take the mid value to represent active saving. This saving measure does not take the possibility of negative active saving into consideration. The minority of households heads who answered that they did not save might either have no saving or a negative saving rate. We identify respondents with negative saving by means of the question: “*Would you say the expenditures of your household were higher than the income of the household, about equal to the income of the household, or lower than the income of the household?*” We impute the amount of negative active saving using the difference in financial wealth. We transform this into a negative active saving brackets similar to the question of active saving. For the few households who do not report the amount of saving we impute saving in the same way. Permanent income has been estimated using the procedure of Kapteyn et al. (2005); see the Appendix A for more details on the estimation of permanent income.

Alternatively, the longitudinal nature of the DHS also allows us to measure saving by taking the first difference of net worth. The advantage of the active saving measure is that it is less prone to measurement error than using the first difference in net worth. Moreover, the difference in net worth might not measure true intended savings because of unanticipated capital gains in the housing market or stock market which is difficult to take into consideration.

In our regression analysis we also account for expectations concerning the general economic situation of the household which is derived from the question: “*How do you think the economic situation of your household will be in five year time in comparison to the current situation?*” We assume that this dummy variable—of an improved economic situation of the household—is a good proxy for income expectations. As a proxy for income uncertainty, we derive the variance of the subjective probability to become unemployed (or to find a job) in the next 12 months by the head of the household. Unemployment is for sure one of the main sources of income uncertainty. The information on income uncertainty is available in the DHS questionnaire on health and income. We also use information on whether or not the head of the household is self-employed since this group of workers experience a greater uncertainty of income.

### 3.1 Questionnaire on housing price uncertainty

The questionnaire was fielded in the CentERpanel in the weekend of June 18, 2010. Within each household both the head and the partner aged 20 or above were interviewed. The questionnaire has been presented to 2,184 household members of which 1,465 members (1003 households) have completed the questionnaire; this implies a response rate of 67 percent at the individual level. This corresponds with the response rates to the modules of the annual DHS (Teppa and Vis 2012).

First, to estimate the probability that the government will reduce the MID we ask the question: *When do you expect that the government announces a limitation of the mortgage interest deductibility?*

We create a dummy variable which equals one if the respondent expects a reform of the MID in the future and zero otherwise. We also create a variable measuring the number of years in which the respondent expects an announcement of the reform by the government. Next, in the questionnaire we ask respondents about expectations regarding the value of their own property, in the short-term (next two years), if no reform were to be implemented. Tenants are asked about price movements on the housing market. We use the question:

*Suppose that the government decides not to change the tax treatment of owner-occupied housing. This implies that the mortgage interest deduction remains unaltered. What is the change out of 100 that the value of your property will (increase/decrease) between  $y_k$  % and  $y_{k+1}$  % in total in the next two years?*

Each respondent reports the probability of a price movement within five specific intervals  $[y_k, y_{k+1}] : k = 1, \dots, 5$ . We present all five intervals at the same time to the respondent and provide instructions that the probabilities should add up to 100. We randomly present the intervals in increasing or decreasing order. This allows us to test whether the ordering of the intervals affects response behavior. The intervals are respectively  $(-\infty, -15]$ ,  $(-15, -5]$ ,  $(-5, 5]$ ,  $(5, 15]$ ,  $[15, \infty)$ . The first and final interval are not bounded. We assume that the maximum change of the value of the own property is 30 percent. The respondents are also given the possibility to answer ‘don’t know’ if they are unsure about future price movements.

Next, we confront each respondent with one of three hypothetical and simplified reform scenarios that the Dutch Social Economic Council (SER) had proposed to the Government in 2010. For all the three reform scenarios we mention that they will be implemented gradually (starting in five years time) and that they hold for both existing and new mortgage contracts. We randomly assign the respondents to one of the following simplified reform scenarios:

1. The maximum rate at which the mortgage interest can be deducted will reduce from 52% to 30%, in small steps of 1%-point per year.
2. The maximum amount over which mortgage interest can be deducted will be reduced from € 500,000 to € 250,000, in small steps of approximately € 11,000 each year. Interest on loans above € 250,000 will then no longer be tax-deductible.
3. The primary residence and the mortgage will receive the same fiscal treatment as taxable wealth. In other words, the maximum rate at which the mortgage interest can be deducted



will reduce to 30% in 22 years time. A Mortgage interest of 4% will be assumed, irrespective of the actual interest rate. The imputed rent on the owner-occupied house will be abolished by then with housing wealth taxed in the same way as savings and investments (i.e. an effective wealth tax of 1.2 %).

We then asked the respondents again about their housing value uncertainty in the short-term assuming that one of the hypothetical scenarios will be implemented:

*Suppose that the government will announce tomorrow that they gradually change the tax treatment of owner-occupied housing. The reform will be implemented in steps in five years time after the announcement and will be fully implemented in 22 years of time. [SIMPLIFIED REFORM SCENARIO 1., 2. OR 3.] What is the change out of 100 in this scenario that the value of your property will (increase/decrease) between  $y_k$  % and  $y_{k+1}$  % in total in the next two years?*

Next, we repeat the previous question and ask about price movements (in the same scenario) but ask about expected price movements in the long-term (next ten years). Table 9 in the Appendix provides the mean and standard deviation of the reported probability distribution of (cumulative) price movement of the own property in the no-reforms scenario (in the next two years) and the reform scenario (in the next two years and next ten years).

A considerable fraction of the respondents state that they are “unsure” about future price movements in the no-reform scenario (37%) and this fraction further increases in the reform scenario in the next two years (48%). These households are excluded from the empirical analysis. This group of ‘unsure’ respondents does not differ in observable characteristics from the group who answers the subjective probability questions. We also drop 26 households who provide incomplete information to derive the subjective distribution function about future house price movements. This leaves us with 487 households of which 84 percent is homeowner. Upon merging our questionnaire with the DHS the final sample further reduces to 410 households.

Table 1 provides summary statistics for the variables used in the empirical analysis.

## 4 Measuring house price uncertainty

We assume that aggregate house price uncertainty is made up out of general housing price uncertainty and policy uncertainty due to a possible reform of the MID.

Suppose that the random variable  $Y$  is the cumulative price movement of the own property (or average property for tenants) in the next two years. We assume that the distribution of  $Y$  depends on (1) the state of nature  $R$  where individuals can either deduct mortgage interest from income tax (no-reform scenario:  $R = 0$ ) or where the deduction of mortgage interest is substantially reduced or abolished all together (reform scenario:  $R = 1$ ) and (2) the probability that the government will reduce the MID, i.e.  $\Pr(R = 1)$ .

To estimate  $\Pr(R = 1)$  we use a probit model:

$$\Pr(R = 1|X) = \Phi(X'\beta), \quad (1)$$

where  $R$  is a dummy variable whether or not the respondent expects a limitation of the MID in the foreseeable future (which is asked in the DHS),  $X$  is a vector of regressors from our

Table 1: Summary statistics

	Mean	Std. Dev.
Saving rate (ratio of active saving to permanent income)	0.121	0.190
No. of children	0.561	0.993
Married	0.705	0.457
Self employed	0.041	0.20
Homeowner	0.841	0.366
Higher educated	0.529	0.50
Improved econ. situation	0.188	0.391
Income uncertainty	0.045	0.075
Y \$ < \$ 1,150	0.037	0.188
1,151 \$ < \$ Y \$ < \$ 1,800	0.166	0.372
1,801 \$ < \$ Y \$ < \$ 2,260	0.256	0.437
Y \$ > \$ 2,260	0.541	0.499
Age 20-34	0.083	0.276
Age 35-44	0.159	0.366
Age 45-54	0.198	0.399
Age 55-64	0.305	0.461
Age 65+	0.256	0.437

Notes: N=410. The variable ‘income uncertainty’ is available for 387 households.

questionnaire which are good predictors of this probability and  $\Phi$  is the CDF of the standard normal distribution. We include a dummy variable whether or not the respondent expects a reform of the MID and a variable measuring the number of years in which the respondent expects an announcement of the reform. Figure 2 shows the distribution of the predicted probability of a reform  $\Pr(R=1)$ . The figure shows that most respondents assign a high likelihood to a reform of the MID in the short-term.

To derive the conditional cumulative distribution function  $F_i^r(y) = P_i^r(Y \leq y)$  we use the reported probability distribution by the respondent. We denote the reported probabilities as  $p_{ik}^r$ ,  $k = 1, \dots, 5$ , where  $p_{ik}^r = p(y_k \leq Y_i \leq y_{k+1} | R = r)$ , with  $r = \{0, 1\}$ .

After dividing the reported probabilities  $p_{ik}^r$  by 100 we can derive the five revealed points on the respondents ‘subjective’ cdf

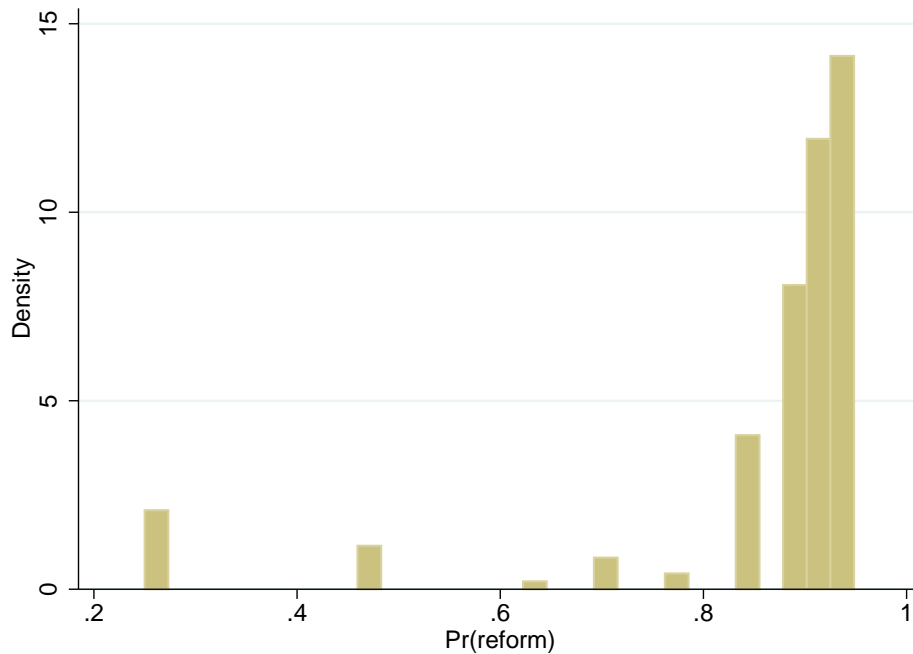
$$F_{ik}^r(y_k) = P_i^r(Y \leq y_k | R = r) \equiv \sum_{l=1}^k p_{il}^r. \quad (2)$$

For each respondent we can fit a log-normal cumulative distribution function through the revealed points of the ‘subjective’ cdf using the method of nonlinear least squares —following Dominitz and Manski (1997). That is, for each respondent  $i$ , we find the parameters  $\mu_i^r$  and  $\sigma_i^r$  that minimize the sum of squared deviations between the point on the ‘subjective’ cdf and the log-normal cdf

$$\min_{\mu_i^r, \sigma_i^r} \sum_{k=1}^6 \left[ F_{ik}(y_k | R = r) - \Phi \left( \frac{y_k - \mu_i^r}{\sigma_i^r} \right) \right]^2, \quad (3)$$

where  $\mu_i^r = E[\ln(Y_i | R = r)]$  and  $\sigma_i^{r2} = \text{var}[\ln(Y_i | R = r)]$ . Next, we can easily compute the conditional expectation  $E[Y_i | R] = \exp(\mu_i^r + \frac{1}{2}\sigma_i^{r2})$  and the conditional variance  $\text{var}[Y_i | R] =$

Figure 2: Distribution of the  $Pr(R = 1)$ , head of the household (N=487)



$\exp(2\mu_i^r + 2\sigma_i^{r2}) - \exp(2\mu_i^r + \sigma_i^{r2})$ . We make sure that the standard deviation is zero when the respondent is 100 percent certain that the price movement falls in one interval.

We also derive the subjective probability distribution of  $Y$  by fitting a cubic spline function through the five revealed points of the cumulative distribution function— following Bellemare et al., 2012). This is a more flexible method to derive the subjective probability distribution and results in very similar statistics. We find a correlation between the IQR of the non-parametric (cubic spline) distribution and the IQR of the log-normal distribution of 0.92.

The above measures allow us to derive the unconditional variance, or the ‘aggregate’ uncertainty. The unconditional variance is a convex function of the conditional variance in both scenarios. See Appendix B for the derivation.

Table 2 reports both the average mean value and the average interquartile range (IQR) of the subjective probability distribution of price movement of the own property in different scenarios. The table shows that households on average expect a minor increase in housing prices of 0.33 percentage points in the no-reform scenario and a small decline of -1.92 percentage points after a reform of the interest deduction. The average variance of expected house price movements increases slightly. The increase in uncertainty is not statistically significant. We do observe a significant increase in the variance of price movements in the reforms scenario in the long-term (after ten years). Unfortunately, we can not distinct whether the increase in the variance in the long-term is caused by the reform or by the longer time span which makes predictions more uncertain (as we do not have information about long-term uncertainty in a policy neutral scenario).

There are different ways how a reduction in the mortgage interest deduction can be accomplished. To test whether responses differ depending on how the limitation on tax

Table 2: Average expected value and interquartile range of the subjective distribution of house price movement (in percentage points), head of the household

	Group 1	Group 2	Group 3	All	F-test (p-value)
<b>Expected value (<math>\mu</math>)</b>					$H_0 : \mu_1 = \mu_2 = \mu_3$
No-reform scenario (next two years)	0.42 (5.88)	0.41 (6.41)	0.18 (5.33)	0.33 (5.86)	0.92
Reform scenario (next two years)	-2.33 (6.24)	-1.11 (6.13)	-2.25 (6.66)	-1.92 (6.37)	0.16
Reform scenario (next ten years)	0.00 (8.68)	1.41 (8.43)	0.35 (9.18)	0.55 (8.79)	0.37
F-test. $H_0 : \mu_{\text{no-reform}} = \mu_{\text{reform}}$ :	next two years (p-value)			0.00	
	next ten years (p-value)			0.00	
<b>Interquartile range (IQR)</b>					$H_0 : \text{IQR}_1 = \text{IQR}_2 = \text{IQR}_3$
No-reform scenario (next two years)	9.19 (5.40)	9.84 (6.09)	8.86 (5.29)	9.28 (5.60)	0.28
Reform scenario (next two years)	9.76 (5.32)	9.50 (5.25)	9.57 (5.93)	9.61 (5.51)	0.91
Reform scenario (next ten years)	9.72 (5.89)	10.26 (5.66)	10.42 (6.29)	10.13 (5.96)	0.56
F-test. $H_0 : \text{IQR}_{\text{no-reform}} = \text{IQR}_{\text{reform}}$ :	next two years (p-value)			0.36	
	next ten years (p-value)			0.02	
Observations	162	154	171	487	

*Notes:* Standard deviation is given within parentheses. F-test: equality of means test for the three randomized groups. Group 1: The maximum rate at which the mortgage interest can be deducted will reduce to 30%. Group 2: The maximum amount over which mortgage interest can be deducted will be reduced to € 250,000. Group 3: The primary residence and the mortgage will receive the same fiscal treatment as taxable wealth.

deductibility occurs we randomly assigned the respondents to three different policy reforms of the mortgage interest rate deduction (as described above). We use a F-test to assess whether the average value of the mean expected price movement within the three groups differs from each other. There are no significant differences between the group means for both the IQR and expected value for all scenarios. In the empirical analysis we will, therefore, not distinguish between the different groups.

#### 4.1 Quality of our measurement

To examine whether the calculated measures of subjective house price uncertainty contain useful information we will relate the subjective measures to actual house price risk. As a measure of actual house price risk we use the variation in house price movements within the region of residence of the household. Studies by Banks et al. (2010) and Gathergood (2011) show that regional variation in house prices is an important determinant for household financial decision making in the US and the UK, such as the accumulation of housing equity, investment behavior and homeownership choice.

We use aggregate information for 76 regions on house prices. This information is provided on

Table 3: Frequency distribution of regional house price volatility (%) and movement between 2008 and 2012, head of the household

S.D. of house price movements (within the region of residence) <sup>a</sup>	%	Percentage price decline (within the region of residence) <sup>b</sup>	%
0.00 — 0.04	0.0	0.00 — 0.05	6.0
0.04 — 0.06	22.0	0.05 — 0.10	29.2
0.06 — 0.08	44.6	0.10 — 0.15	38.6
0.08 — 0.10	24.6	0.15 — 0.20	21.8
0.10 — 0.12	4.3	0.20 — 0.25	3.9
0.12 — 0.14	4.5	0.25 — 0.30	0.6
Average	0.076	Average	0.118
Median	0.074	Median	0.112
SD	0.019	SD	0.048

Notes: N=410. <sup>a</sup>  $SD(\log \text{ price index}_t - \log \text{ price index}_{t-1})$ , where  $t$  is the value of the index in the first quartile of the stated year. <sup>b</sup>  $\log \text{ price index}_{2012Q1} - \log \text{ price index}_{2008Q1}$

Table 4: Association between subjective house price uncertainty (interquartile range) and ‘actual’ house price risk, dependent variable: subjective housing price uncertainty, head of the household

	Conditional IQR			Uncondition IQR	
	No-reform Two years	Reform Two years	Reform Ten years	Two years	Ten years
S.D. of house price movements (within the region of residence)	38.117**	25.704*	23.483	27.135*	24.414
	(16.382)	(13.813)	(17.153)	(14.214)	(16.838)

Notes: N=410. Results of a multivariate regression for the head of the household. Included controls: see regression Table 5. Standard errors clustered at the postcode level in parentheses. Significant at the \* 1 percent; \*\* 5 percent; \*\*\* 10 percent level.

a quarterly basis by NVM which is the largest association of real estate agents in the Netherlands and represents almost 70 percent of the Dutch housing supply. We merge this data to the respondents in our questionnaire according to the final two digits of the postcode. Some postcode areas fall in more than one neighboring region. For these households we calculate the weighted average of these measures according to the population size of each region the postcode falls in. For each respondent we calculate the standard deviation of regional house price movements in the five year period around the time of our questionnaire, between 2008 and 2012, following the procure of Banks et al. (2010). We observe sizable differences in both the volatility and movements in house prices across regions for this period (as reported in Table 3).

Table 4 shows that the regional specific actual house price risk is significantly associated with the perceived house price risk in de short-term by the head of the household as measured in our questionnaire. This suggests that households do recognize both housing price uncertainty and policy uncertainty.<sup>3</sup>

<sup>3</sup>The excess supply of houses, or market tightness, on the regional level is also significantly related to perceived house price risk (not reported but available upon request). For example, Mian and Sufi (2014) show that excess supply within US regions plays an important role in the adjustment process of house prices and consequently for house price risk.

## 5 Empirical model and results

The starting point of our empirical analysis is the buffer stock model developed by Carroll and Samwick (1998). Using simulations based on a CRRA utility function, they notice that a reduced form model for savings could be estimated with a 99% fit. This model shows that the logarithm of savings divided by permanent income correlates with the variance of the logarithm of income—which is a proxy of uncertainty—and a polynomial in age since the life cycle model postulates a non-linear relation between savings and age. Following Giavazzi and McMahon (2012), we use the ratio of active savings to permanent income  $s$  as our dependent variable, instead of the accumulated savings to permanent income, since an increase in the flow of saving due to increased policy uncertainty because of a reform of the MID will probably not immediately result in a higher ‘buffer stock’ of wealth.

To determine whether precautionary saving is affected by aggregate (i.e. uncondition) house price uncertainty we first estimate the following equation:

$$s_i = \beta_0 + \sum_{a=1}^5 \delta_a \text{Age}_i + \beta_1 \text{IQR}_i + \beta_2 \mu_i + x_i' \theta + \epsilon_i, \quad (4)$$

where IQR measures the subjective aggregate house price uncertainty, Age is a dummy variable which equals one if the head of the household falls in an particular age group  $a$  and zero otherwise and  $x_i'$  is a vector of control variables. The control variables include demographic factors such as marital status (living together with a partner) and the number of children to account for variation in tastes over the life cycle and other important determinants of saving such as the level of education, household income (in categories) and homeownership status. We also account for expectations concerning the general economic situation of the household which might be correlated with house price risk. We include a dummy variable for self-employment to account for income uncertainty. We also experimented with the variance of the subjective probability to become unemployed as a proxy for income uncertainty. This variable is, however, not available for the full sample. The exclusion of income uncertainty results in virtually similar estimation results. Moreover, the coefficient of income uncertainty is never statistically significant. We therefore decide to leave this variable out of the regression model.

To separate the contribution of policy uncertainty on precautionary saving we subsequently estimate the equation:

$$s_i = \beta_0 + \sum_{a=1}^5 \delta_a \text{Age}_i + \beta_1 \Delta \text{IQR}_i + \beta_2 \text{IQR}_i^0 + \beta_3 \mu_i^0 + x_i' \theta + \epsilon_i, \quad (5)$$

where  $\Delta \text{IQR}_i$  equals  $\text{IQR}_i^1 - \text{IQR}_i^0$  which measures policy uncertainty: the additional uncertainty—over and above the house price uncertainty in a policy neutral scenario—due to a possible reform of the MID. We estimate the effect of policy uncertainty on precautionary saving both in the short-term (two years time) and long-term (ten years time).

## 5.1 Results

Table 5 reports the parameter estimates for the household active saving rate (expressed as the ratio of active saving to permanent income). We first examine whether aggregate (or unconditional) house price uncertainty is related to precautionary saving behavior (model 1). We find a positive but insignificant ( $p < 0.15$ ) coefficient for aggregate uncertainty. Thus, we do not find strong evidence that households who are more uncertain, with respect to short-term house price movements, save more.

Next, we examine whether the additional uncertainty due to policy uncertainty, keeping uncertainty in a policy neutral scenario constant, results in more saving (model 2). We find a positive and significant relationship between policy uncertainty and precautionary saving ( $p < 0.05$ ). Households who experience a higher uncertainty due to uncertain policy have (ceteris paribus) a higher saving rate than households who are less uncertain about the influence of uncertain policy on house prices. In model 3, (as a robustness check) we replace uncertainty in the reform scenario by aggregate uncertainty to test whether policy uncertainty, keeping ‘aggregate’ uncertainty constant, results in more saving. This specification is less clean than specification 2, in the sense that aggregate uncertainty contains policy uncertainty as well. We again find that policy uncertainty (ceteris paribus) results in a significant higher saving rate.

Next, we re-estimate the models for the measures of uncertainty over a long-term perspective. Model (4) shows that if we increase the time span over which the head of the household reports their subjective distribution of house prices from two years to ten years, aggregate house price uncertainty is again positively but now also significantly related to precautionary saving ( $p < 0.05$ ). We also find that over a longer time-span policy uncertainty results in a significant higher saving rate (model 5) ( $p < 0.05$ ). For the ‘less clean’ specification (model 6) the effect of policy uncertainty turns out not to be significant.

We also tried to estimate model 2 using instrumental variables (IV) to more precisely quantify the effect of policy uncertainty on saving. The reason for resorting to IV estimation is that our subjective distribution of house prices, using the hypothetical questions, could be measured with error which results in biased estimates towards zero and, therefore, underestimates the importance of policy uncertainty for precautionary saving. The set of explored instruments is the volatility in house prices in the region of residence of the household (or actual house price risk). We have proven that this is a relevant predictor for subjective house price uncertainty. We also include market tightness within the region of residence as an instrument. The first stage regression, however, shows that explanatory power of the instruments is rather low (not reported but available upon request). As a result, we refrain from using IV since the F-statistic indicates a weak instrument (Staiger and Stock, 1997) and we are thus unable to say anything about the level of the estimated effects. Other papers who use regional specific measures of uncertainty to instrument subjective uncertainty also suffer from weak instruments; see Lusardi (1997).

Table 5: Effect of policy uncertainty on precautionary saving, dependent variable: saving rate (ratio of active savings to permanent income)

	(1)	(2)	(3)	(4)	(5)	(6)
	Short-term (two years)			Long-term (ten years)		
IQR	0.003 (0.002)		0.002 (0.002)	0.004** (0.002)		0.004* (0.002)
$\mu$	0.003** (0.002)		0.003** (0.002)	0.003*** (0.001)		0.003*** (0.001)
$\Delta$ IQR		0.005** (0.002)	0.019*** (0.007)		0.004** (0.002)	0.005 (0.010)
$\Delta\mu$		0.003** (0.002)	0.003 (0.007)		0.002** (0.001)	-0.006 (0.006)
IQR <sup>0</sup>		0.002 (0.002)			0.003 (0.002)	
$\mu^0$		0.003 (0.002)			0.003 (0.002)	
Age 20-34	0.071* (0.037)	0.068* (0.036)	0.070* (0.037)	0.061* (0.037)	0.061 (0.038)	0.063* (0.037)
Age 35-44	0.072** (0.034)	0.069** (0.034)	0.068** (0.034)	0.067* (0.036)	0.066* (0.037)	0.066* (0.036)
Age 45-54	0.043 (0.034)	0.040 (0.033)	0.044 (0.034)	0.029 (0.033)	0.029 (0.033)	0.031 (0.033)
Age 55-64	0.008 (0.025)	0.006 (0.025)	0.008 (0.025)	0.006 (0.028)	0.005 (0.028)	0.006 (0.028)
Y < 1,150	-0.150*** (0.035)	-0.151*** (0.036)	-0.149*** (0.035)	-0.151*** (0.039)	-0.149*** (0.039)	-0.150*** (0.039)
1,151 < Y < 1,800	-0.127*** (0.030)	-0.130*** (0.030)	-0.131*** (0.030)	-0.133*** (0.032)	-0.131*** (0.032)	-0.133*** (0.033)
1,801 < Y < 2,260	-0.051*** (0.018)	-0.052*** (0.018)	-0.050*** (0.018)	-0.047** (0.018)	-0.046** (0.018)	-0.048*** (0.018)
Married	-0.040 (0.027)	-0.042 (0.026)	-0.041 (0.026)	-0.042 (0.027)	-0.042 (0.027)	-0.042 (0.027)
No. of children	-0.023** (0.010)	-0.023** (0.010)	-0.023** (0.010)	-0.026*** (0.010)	-0.026*** (0.010)	-0.025*** (0.010)
Homeowner	-0.004 (0.033)	-0.007 (0.034)	-0.003 (0.033)	-0.018 (0.037)	-0.020 (0.039)	-0.016 (0.038)
Higher educated	0.044** (0.019)	0.044** (0.019)	0.044** (0.019)	0.035* (0.019)	0.034* (0.019)	0.034* (0.019)
Self employed	0.064 (0.082)	0.063 (0.082)	0.066 (0.082)	0.062 (0.094)	0.063 (0.094)	0.064 (0.094)
Improved econ. situation	-0.045* (0.023)	-0.043* (0.022)	-0.046** (0.022)	-0.038 (0.024)	-0.039 (0.025)	-0.041* (0.024)
Constant	0.140** (0.056)	0.148** (0.058)	0.143** (0.056)	0.145** (0.061)	0.151** (0.066)	0.144** (0.062)
Adjusted R <sup>2</sup>	0.091	0.089	0.093	0.103	0.097	0.099
N	410	410	410	382	382	382

Notes: Regression results for the head of the household. Robust standard errors between parenthesis. Significant at the \* 1 percent; \*\* 5 percent; \*\*\* 10 percent level.



Table 6: Opinion about future reforms

No, there will be no new reforms in the next 20 years	10%
Yes, I expect new reforms within 2 years	17%
Yes, I expect new reforms within 2—5 years	39%
Yes, I expect new reforms within 5—10 years	26%
Yes, I expect new reforms within 10—20 years	8%

*Source:* 2012 Follow-up questionnaire.

Table 7: Response to reform

	All	Owners	Tenants
I will not respond to this reform	49%	56%	30%
I will postpone the purchase of a house	4%	3%	6%
I will renegotiate my interest rate and fix it for a longer period of time	3%	4%	0%
I will save more	15%	16%	12%

*Source:* 2012 Follow-up questionnaire.

## 6 Conclusion and policy discussion

We investigated the separate effect of policy uncertainty caused by a possible reform of the MID system in the Netherlands on precautionary saving. Asking questions about standard market uncertainty and uncertainty linked to a hypothetical reform of the MID, we unraveled the effect of policy uncertainty. This is a novel contribution. We estimate that policy uncertainty alone results in higher saving and that taking away this uncertainty increases consumer welfare.

The Government could reduce policy uncertainty by implementing credible policy. Following the premature fall of the Dutch Government in 2012, the newly elected Government announced plans to reform the MID. The reform became effective as from 1 January 2013. The reform is, however, not very comprehensive since it limits the tax relief only for new mortgage contracts. The news was given huge media coverage, and at the end of the week of the announcement we re-interviewed our sample to examine whether policy uncertainty is taken away by the reform.

Table 6 shows the answers to the question whether respondents think that the reform will be definitive in the long-term. Only 10% of the respondents believe that there will be no new reforms in a period of twenty years, while 56% thinks that new reforms will be announced in five years time. We then asked about their response to the current reform. Table 7 shows selected answers from an originally larger list. The majority of the respondents answers that they will not do anything in response to the reform. Those who will take action are planning to save more, also 16% of the homeowners who were left unaffected by the reform are planning to save more.

Finally, Table 8 shows expectations about the future development of several market fundamentals, such as price levels, transactions and uncertainty. Respondents expect that price levels and the number of transactions will fall, which is hardly surprising following the restrictive reforms. The surprising result is that a large majority of respondents indicates that the reform has fueled rather than dampened uncertainty. Combining this with the statement about additional savings, it is not evident at all that the MID reform has mitigated policy uncertainty.

Table 8: What will happen in 2013?

		Fall	Rise	Remain un- changed	don't know
All	House prices	68%	7%	17%	8%
	Uncertainty on the housing market	16%	46%	32%	6%
	Number of transactions	44%	18%	29%	9%
Owners	House prices	71%	5%	18%	6%
	Uncertainty on the housing market	16%	46%	32%	5%
	Amount of transactions	45%	19%	29%	7%
Tenants	House prices	61%	13%	14%	12%
	Uncertainty on the housing market	15%	44%	33%	8%
	Amount of transactions	42%	17%	28%	12%

Source: 2012 Follow-up questionnaire.

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## A Estimation of permanent income

Provide details on the estimation of permanent income.

## B Derivation of the unconditional variance

The variance of  $Y$  given  $X = x$  is defined by  $\text{var}[Y|X = x] = E[Y^2|X = x] - (E[Y|X = x])^2$ . Using the law of total expectations we can derive the unconditional expectation of  $Y$  which is given by

$$E(Y_i) = E_R[E_{Y_i|R}(Y_i|R)] = E(Y_i|R = 0)Pr_i(R = 0) + E(Y_i|R = 1)Pr_i(R = 1).$$

The unconditional variance of  $Y$  is given by  $\text{var}(Y_i) = E[Y_i^2] - (E[Y_i])^2$ , where  $E(Y_i^2) = E_R[E_{Y_i^2|X}(Y_i^2|R)] = E(Y_i^2|R = 0)Pr_i(R = 0) + E(Y_i^2|R = 1)Pr_i(R = 1)$ , where  $E(Y_i^2|R = r) = \text{var}[Y_i|R = r] + (E[Y_i|R = r])^2$ .

More specific, the unconditional variance of  $Y$  is given by

$$\begin{aligned} \text{var}(Y_i) = & Pr_i(R = 0) \times \text{var}[Y_i|R = 0] + Pr_i(R = 1) \times \text{var}[Y_i|R = 1] + \\ & + Pr_i(R = 0) \times E[Y_i|R = 0]^2 + Pr_i(R = 1) \times E[Y_i|R = 1]^2 - \\ & [Pr_i(R = 0) \times E(Y_i|R = 0) + Pr_i(R = 1) \times E(Y_i|R = 1)]^2. \quad (6) \end{aligned}$$

## C Tables and figures

Table 9: Subjective probability distribution of cumulative price movement of the own property (in percentage points) in different scenarios

	Homeowner			Tenant		
	No-reform	Reform 2 year	Reform 10 year	No-reform	Reform 2 year	Reform 10 year
$p \geq 15$	6.57 (11.24)	5.07 (8.57)	11.59 (19.45)	9.26 (12.62)	7.85 (13.67)	12.37 (16.50)
$5 < p < 15$	23.06 (22.32)	16.86 (19.57)	22.00 (22.11)	23.40 (21.18)	19.53 (19.09)	23.70 (21.16)
$-5 < p < 5$	44.20 (26.71)	41.82 (26.64)	35.61 (26.82)	37.69 (25.15)	37.00 (23.24)	30.75 (22.14)
$-15 < p < -5$	18.28 (17.84)	24.35 (20.71)	19.72 (20.10)	18.94 (18.07)	24.57 (20.07)	21.27 (20.89)
$p \leq -15$	7.89 (13.07)	11.90 (18.08)	11.09 (18.64)	10.71 (15.49)	11.06 (13.93)	11.91 (17.95)
Do not know	0.31 (0.46)	0.45 (0.50)	0.47 (0.50)	0.56 (0.50)	0.70 (0.46)	0.72 (0.45)
Observations	1,032			359		

Notes: N=1,391.