Till debt do us part:
strategic divorces and a test of moral hazard

Yeorim Kim [a, b, c], Mauro Mastrogiacomo [a, b, c], Stefan Hochguertel [a, b], Hans Bloemen [a, b]

[a] *VU Amsterdam*

[b] *Netspar*

[c] *De Nederlandsche Bank*

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Abstract

We test whether prospective losses on the housing market induced moral hazard in the form of divorce. We study the Dutch context, where qualifying homeowners can buy into a guarantee scheme—essentially a lender's insurance against borrower default that transfers the risk to the public. Divorce is one of the major events following which the guarantor repays outstanding residual debt after foreclosure sale. We argue in this paper that divorce is endogenous to holding underwater mortgages, and hence constitutes a strategic choice in times of crisis. Using administrative data, we find a significant, 31% increase in the chance to divorce, causal to being insured. The identification relies on a regression discontinuity design, exploiting the fact that the insurance is only available for properties with values below a legislated threshold. The house price crisis (2008-2013) provides an unexpected shock in house values, leaving about 40% of owners with an underwater mortgage, and with negative home equity of about €50.000 on average. Observationally similar couples above the threshold experienced significantly less often a divorce, relative to couples below the threshold during the crisis.

Keywords: moral hazard, mortgage insurance, divorce

JEL codes: D10, G21, J12

1. Introduction

Divorces or marital dissolutions are common.[1] The economic theory of the family (Becker, 1991; Browning et al., 2014), suggests that divorces and separations respond to unforeseen changes in economic circumstances, and available empirical studies suggest that individual income shocks (relative between spouses), business cycle fluctuations, or changes in legislation affecting post-divorce property division, alimony or custody matter for divorce decisions (e.g. Becker et al., 1977; Peters, 1986 and Allen, 1992; Borenstein and Courant, 1989; Stevenson and Wolfers, 2006; Allen, 2007; Hellerstein and Sandler, 2011; Hellerstein et al., 2013).

With home ownership rates in western countries in the order of two thirds, housing wealth is on aggregate the most important asset component of individual couples' asset portfolios,[2] and housing equity investment constitutes accordingly the largest flow of resources channeled into net wealth accumulation during marriage. House prices are known to be very volatile (Ferreira et al., 2010, and Catte et al., 2004). Transaction costs associated with purchase, sale, and relocation tend to be significant.[3]

While it is intuitive that in the face of large transaction costs house-price-induced fluctuations in home equity may be associated with lock-in effects restricting residential mobility (Engelhardt, 2003) and affecting the propensity to divorce, the institutional context is first-order relevant for default decisions of (married) households with underwater mortgages (outstanding mortgage debt exceeding the market value of the housing collateral, or negative home equity). The latter phenomenon occurred during the financial crisis on a global scale, but may have offered opportunities for strategic choices by affected home owners, as a number of research papers investigates. Guiso et al. (2013), for instance, show that it is likely that moral hazard plays a role in the US for those with large absolute values of negative home equity. They estimate that between 26% and 35% of mortgage defaults in the aftermath of the US subprime mortgage crisis and house price meltdown can be classified as 'strategic'. Strategic default here means to walk away from

[1] In most OECD and EU countries, where divorce is possible, more than a third of individual marriages end in divorce, aggregate divorce-to-marriage ratios are in the order of 40-50% (Eurostat: Marriage and Divorce Statistics). Insightful descriptives are provided in Stevenson and Wolfers (2007)

[2] In the Netherlands for example, housing represents about 70% of the total assets of homeowners, whereas for renters financial assets accounts for approximately 74% of their assets (values averaged over the years 2006-2017). Homeowners are the larger of the two groups. See https://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=83834ENG&D1=0-2&D2=37-38&D3=0-2,5,8-12,l&D4=a&LA=EN&HDR=G3,T&STB=G1,G2&VW=T

[3] A common estimate for transaction costs used in the academic literature is in the order of magnitude of 10% of the house value (Weinberg et al.(1981), Venti & Wise (1984), Linneman (1986), Goodman (1995), Haurin & Grill (2002), Engelhardt (2003), etc.)

one's liabilities (forfeiting the underlying asset), even though income receipts may still be large enough to service mortgage repayment plans. Bajari et al. (2011), using a structural model, predict that a house price fall of 20% makes borrowers that bought their house one year earlier more than 15% more likely to default. Gerardi et al. (2018), using household survey data from the Panel Study of Income Dynamics, estimate that 38% of defaulters would have had the funds to keep repaying their loans.

European countries experienced similarly precipitous falls in house prices as the US,[4] but the different legal system often does not allow households to be easily relieved from negative equity. There is at least one interesting exception: the Dutch case. The Netherlands have a nation-wide mortgage guarantee program (*Nationale Hypotheek Garantie*, henceforth NHG), originally intended to make home ownership more accessible to the middle classes (see Francke and Schilder, 2014, for institutional description and analysis of defaults).[5] The program is available to first-time buyers of an averaged-priced house, and is intended to provide debt relief upon major shocks triggering the sale of the property. Given high leverage ratios, many affected households would keep residual debt. The program steps in as it may cancel residual debt that materializes upon disability, unemployment or death of a spouse. Important to note is that also divorce is a qualifying event for the guarantee to be effected.

We argue in this paper that strategic default may occur among those covered by the guarantee scheme, as couples may choose to divorce in order to shed negative equity. The asymmetric information we focus on is not between the divorcing spouses[6] but between covered households and the insurance program, and may in this sense be classified as a form of moral hazard. Indeed, raw data suggests that divorce rates shot up among those couples that qualified for the guarantee scheme when house prices tumbled.

We investigate in this paper the particular impact of housing wealth revaluation on couples' divorce decisions during the house price crash of the Great Recession. The negative wealth shocks can in theory have an effect on the marital stability of couples through a number of channels. One mechanism pertains to lower house prices implying decreased cost of living separately, as well as to opportunity costs including heightened financial stress (Rainer and Smith, 2010; Farnham et

[4] For instance, from 2008 to 2013, house prices in the Netherlands plummeted by approximately 20% from their 2008 peak and bounced back only after 2013.

[5] See BIS (2013) for institutional descriptions of similar programs around the globe.

[6] The economics of divorce literature sometimes uses the term strategic divorce for cases where, for instance, unilateral divorces can be strategically induced because one spouse may be able to extract an additional surplus upon arrival of private information (e.g., Borenstein and Courant, 1989). Our notion differs from that one.

al., 2011; Klein, 2017). Divorces are typically associated with new housing for the departing spouses, implying individual housing costs for both spouses.[7] These are partly offset by lower down-payments when house prices drop, while at the same time less equity will be extracted from the previously jointly-owned house. Additionally, couples are subjected to more (financial) stress due to a contraction of their household wealth or even home equity turning negative. The reduced cost-of-living and stress arguments are two factors which potentially lead to a higher risk of divorce.

A potential mechanism working in the opposite direction is a transaction costs channel. Housing markets typically exhibit positive correlation between price appreciation and transaction volume (Genesove and Mayer, 2001), and tend to freeze up during a downturn. In case that owners are loss averse, they may be reluctant to sell their home when the market is in a slump (Ferreira et al., 2010; Farnham et al., 2011). Genesove and Mayer (2001) show that nominal loss aversion is a more crucial factor than liquidity constraints to explain why there are fewer houses on the market when prices fall. They find that loss-averse sellers set relatively high asking prices, obtain high selling prices, but have a low hazard of sale. Engelhardt (2003) studies US metropolitan areas and finds that loss aversion reduces residential mobility. On the other hand, underwater mortgages hinder residential mobility, as couples are subject to a "housing equity constraint" (Farnham et al., 2011, p.616). Chan (2001) shows convincing evidence that low home equity limits residential mobility because of residual mortgage debt and new down payments. He also shows more pronounced lock-in effects for high loan-to-value (LTV) mortgage owners.

Farnham et al. (2011) find a significant effect of declining house prices reducing divorce risks in the US. On the contrary, Rainer and Smith (2010) show that negative house price shocks in the UK significantly increased divorces, especially for couples with high mortgage debt, with children, and with low income. More recently, Klein (2017) shows that positive house price changes enhance marital stability. She finds no significant effect of negative house price shocks on divorces.

We make a couple of contributions. First, relative to the specific empirical literature on divorce and house prices, we add an additional source of identification, namely an institutional discontinuity within the aforementioned mortgage guarantee program. This is important, because the identification of the causal effect in the existing studies only relies on the crisis as a source of exogenous variation. The crisis, however, was a multifaceted macro shock with repercussions along many dimensions in housing, financial and labor markets, and may have hit different types of

[7] Divorce legislation sometimes requires divorcing spouses to live at separate addresses.

households differentially. Our approach allows controlling for a group whose behavior may have been affected by the crisis but not by the divorce incentive.

Second, our paper contributes to understanding a fundamental issue, namely the identification and quantification of moral hazard in public insurance schemes that are not very sharp in terms of monitoring but allow the insured to choose their risk behavior (Chetty and Finkelstein, 2013; and Cohen and Siegelman, 2010, for private insurance contracts). For instance, Ejrnaes & Hochguertel (2013) study risk taking of self-employed entrepreneurs that may select into unemployment insurance; Bajari et al (2014) provide an econometric method to disentangle moral hazard from adverse selection effects in health insurance claim data.[8] In the specific case of the Dutch NHG, adverse selection can be excluded as the insurance is bought virtually by all those who qualify for it (see institutional details below) so that the whole causal effect on strategic defaults can be attributed solely to moral hazard. One contribution of our study is that we isolate the effect of moral hazard, as we do not need to disentangle it from the effect of adverse selection.

Our findings suggest a strong effect of the house price meltdown on divorce rates of insured households. In particular, we find that insured underwater mortgage holders experienced a 31% higher divorce hazard than the non-insured during times of the crisis. This finding is consistent with Farnham et al.'s (2011) statement that "policies to speed the foreclosure process, by relieving housing lock-in, may increase divorce rates among foreclosed-upon couples" (2010, p.618).

The structure of the paper is as follows. In the next section, we discuss salient institutional details of the guarantee scheme and of the Dutch mortgage market. In section 3, we derive optimality conditions for the participation in the NHG and the choice of marital status in the presence of negative home equity. In Section 4, we discuss the data and in Section 5, we test the predictions of the theoretical framework using a regression discontinuity design. Section 6 briefly discusses specifics of the policy relevance of this study in the present economic policy debate in the Netherlands. Section 7 summarizes and concludes.

[8] Brown and Finkelstein (2008) allow for moral hazard when assessing willingness to pay for private insurance in relation to the public Medicaid program.

2. Institutions

In order to understand the incentives that are offered to households to deal with debt in the Dutch context, we clarify the functioning of some specific institutions. These are key to understanding our identification strategy later on.

2.1 Mortgage market

Mortgages are wide-spread. Almost all homeowners will finance their first home using such a loan that is partially covered by the collateral value of the house and whose size is also determined by the repayment capacity of the household. Couples regularly have joint ownership of the property and are jointly liable to service the loan contract. Mortgage holders also enjoy particular tax incentives. As in other countries, mortgage markets are subjected to particular regulation.

Of particular relevance is the rather high loan-to-value (LTV) ratio of first-time buyers, regularly exceeding 100% of the value of the home. As recently as 2009, initial LTV ratios of up to 120% were not uncommon. This feature results in Dutch home owners belonging to the most heavily indebted owners in the world. Only in the wake of the financial crisis, macro-prudential regulation started to cap the LTV ratios, now allowing a leverage of not more than 100%.

In addition to LTV caps, loan-to-income ratios were the main instrument for lenders to control borrower risk exposure, in particular caps on the debt-service-to-income (DSTI) ratio. Depending on their income and current interest rates, households can borrow amounts between 4 and 5.5 times their annual earned income. These caps are only checked at mortgage inception. Part of secondary-earner income is also considered when determining household earnings. This implies that following a divorce, spouses could be forced to either sell the house or keep joint responsibility of the mortgage if the income of one spouse alone is no longer enough to qualify under the DSTI cap regulation.

The tax treatment of mortgage payments arguably contributed to the high leverage ratios of Dutch households, but also to popularity of particular mortgage types. In particular, interest payments were fully tax-deductible from the income tax base, prompting households to choose so-called interest-only mortgages on a large scale.

Two more aspects are worth mentioning. First, residual debt is portable. If a household moves from an underwater mortgaged home to a rental home, there will still be residual debt, even though no collateral exists anymore. Second, as of 2013, only interest on new linear and annuity mortgages is tax-deductible. However, there is a large legacy from the past in terms of interest-only loans (about 60%), investment loans (about 7%), and saving loans (about 25%).

2.2 Residual debt insurance

Residual debt insurance (NHG – Nationale Hypotheek Garantie) creates a guarantee at inception of a mortgage loan. Essentially, it takes over outstanding debt that cannot be recovered from collateral, upon sales triggered by adverse shocks to the borrower. NHG is a nation-wide program, enjoying large popularity among first-time home buyers.[9]

If the borrower is unable to keep servicing the repayment plan and about to default, the insurance can step in by acting as a guarantor and limit or eliminate the loss to the lender. Borrowers pay a one-off commission or fee (e.g., 0.70% in 2012) for this insurance. Banks give borrowers with NHG guarantee a discount on mortgage interest of typically between 30 and 60 basis points. This discount can be higher when the borrower has a higher LTV ratio at the time of origination. When the borrower sells the property and retains residual debt, the NHG fund will repay the bank if conditions are met. The borrower continues to be liable but now has the NHG foundation as creditor. At observed parameter values, it was advantageous for the borrower to pay the commission and buy the guarantee. Due to the high leverage ratios and low housing prices during the credit crisis, residual debts became very common. If the reason for default is divorce, disability, unemployment, or death, and if the borrower has taken action to minimize the losses, the fund may unilaterally cancel the debt.[10]

The NHG guarantee can be bought on properties up to a ceiling amount. This ceiling is chosen to normally match median house prices. It was €240,000[11] in 2005 and was lifted step by step to €265,000 in 2008. In the wake of the crisis in 2009 when house prices tumbled, the ceiling

[9] At year-end 2016, the aggregate balance of mortgage loan guarantees covered by the NHG program amounted to approximately €193 billion, for a total of 1,309,000 active guarantees. In 2016 the NHG guarantee fund reimbursed a total of €109 million of losses, an average of €34,000 per case. The net assets of the fund then amounted to €960 million.

[10] As from 2014, an affordability test is carried out. Our study focuses, however, on the years before that.

[11] The average purchase price of the house in the Netherlands are as follows. The corresponding years are shown in parentheses: €222,706 (2005), €254,918 (2008), €238,259 (2009), €230,194 (2013), and €263,295 (2017). See https://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=83625ENG&D1=0&D2=0&D3=5-23&LA=EN&HDR=T,G2&STB=G1&VW=T

was abruptly lifted to €350,000, and then lowered back in steps to €245,000 in 2015. At present, the ceiling follows the development of average house prices and stands at €265,000. Neither the ceiling nor the premiums depend on the household composition, location or other property features, or on the riskiness of the loan. Once a bank agrees to a loan, the NHG will guarantee it if its original value is below the ceiling amount.

The guarantee covers not only the principal mortgage, but also additional loans that are used either for quality improvements (such as remodeling) or for the purchase of the land or ground lease (typically for a period longer than ten years).

The number of households that made use of the NHG guarantee due to forced sale at a loss increased considerably during the crisis, mostly in 2010 and 2011. Approximately 80% of annual guarantee requests are honored. In 2011 for instance, more than 1,700 households applied for reimbursement, which is more than twice the number of requests in 2007. The increase is the direct result of two effects: household income loss, which led to higher default rates during the crisis, and the sharp drop in house prices, which increased the chance that in case of forced sale the value of a house would be lower than the remaining mortgage balance.

3. Theoretical background

3.1 Mortgage problem

We consider the choice to buy a mortgage guarantee plan (NHG) for a new home owner who finances the home acquisition solely using a mortgage loan. We also consider the choice to strategically divorce for NHG-covered owners. In principle, both choices may be interdependent, but we will argue that it is realistic to assume that everyone who buys a house that qualifies for NHG coverage, will buy the plan. As strategic divorce only applies to NHG holders, we treat both problems sequentially.

In the first choice problem, we assume that a house of a given value is bought at the beginning of the first period, and that the house is financed using mortgage debt without downpayment (corresponding to an LTV ratio of 100%). Every consumer has initial savings at the beginning (enough to pay the NHG fee) and buys either a linear or an annuity mortgage. Even though NHG acts as insurance, we will show that even risk neutral agents purchase the insurance.

In the second choice problem, we show that strategic divorce—a notion to be defined exactly below—can occur for NHG-owners. Here, we assume that the value of the house will drop at some point, to capture the impact of a financial crisis on home equity. This implies that some households will then exceed the 100% LTV, thus experiencing negative home equity. We allow for uncertainty along two margins: home equity may or may not turn negative, divorce may or may not occur for exogenous reasons. Over and above those, we then consider the role of strategic divorce for shedding debt.

3.2 The NHG choice

Consider first a household buying a house of price A_1 with a linear mortgage with principal D_1 that has fixed term T, and a fixed interest rate r. Let τ indicate time. $\tau = 1$ is the contracting period, when the loan principal at origination is equal to the cost of the house ($D_1 = A_1$). The loan will be fully paid back by the beginning of period $T + 1$. With D_1 nominally fixed, D_τ falls deterministically over time as the loan is being serviced periodically according to a fixed repayment plan. The linearity refers to constancy of repayment of the principal, $\frac{D_1}{T}$, whereas interest payments decrease over time, $rD_{\tau-1}$. Annual payments consist of annual principal repayment and annual interest payments, $D_1 r\left(\left(1 - \frac{\tau-1}{T}\right)\right)$.

Next, suppose that a guarantee scheme is in place for houses with values up to a threshold $\bar{A}$, such that$A_1 \leq \bar{A}$. Mortgage owners that have bought houses above the threshold ($A_1 > \bar{A}$) are subject to the risk of carrying residual debt upon defaulting. They do not qualify for the guarantee. Those that do, with $A_1 \leq \bar{A}$, when participating in the NHG guarantee, have their default risk eliminated from the lender's perspective. This results in NHG-covered loans enjoying an interest rate reduction. Mortgage owners with $A_1 \leq \bar{A}$ may thus choose to sign up for the plan, pay a fee αD_1 upfront, and receive a discount (δ) on the interest rate for the entire duration of their loan. Therefore, the annual payments for NHG participants become $\frac{D_1}{T} + D_1(r - \delta)\left(1 - \frac{\tau-1}{T}\right)$.

Holding fixed the loan principal between insured and uninsured borrowers, the difference in per-period payments arises from the interest part. Borrowers will then compare the present value of the insurance, from $\tau = 1$ to T, with the initial fee paid at $\tau = 1$.

At a discount rate of ρ, the present value at $\tau = 1$ of the interest rate advantage $\delta D_1 \left(1 - \frac{\tau-1}{T}\right)$, is $D_1 \delta \sum_{\tau=1}^{T} (1+\rho)^{1-\tau} \left(1 - \frac{\tau-1}{T}\right)$. A risk-neutral consumer will therefore buy the insurance if

$$D_1 \delta \sum_{\tau=1}^{T} (1+\rho)^{1-\tau} (1 - \tfrac{\tau-1}{T}) \geq D_1 \alpha. \quad (1)$$

For commonly used values of δ (0.5%) and α (1%), the insurance will not be bought at implausibly high values of ρ

$$93.1\% < \rho, \quad when \quad T = 30$$

$$89.4\% < \rho, \quad when \quad T = 20$$

Similar conclusions apply to an annuity mortgage. For instance with $T = 30$ years ρ should exceed 38% before the risk-neutral consumer refrains from finding the insurance attractive.

Conversely, when we take commonly used discount rates (for example 2% or 3%) the condition above implies that T must be smaller than 3 years in order for NHG not to be chosen. This implies that borrowers will not buy the insurance if they plan to redeem their mortgage within three years, which is a lot less than the average length (of ten years) of a moving spell in the Netherlands, where more than 95% of households borrow for at least 20 years. Conversely, risk neutral borrowers should buy the NHG if they are willing to keep their mortgage for at least three years; put differently, they are able to recover the costs of the insurance within the first three years of their mortgage contract. Since the NHG contract is portable for new qualifying dwellings, even moving houses does not entail losing insurance. NHG is in essence an offer you cannot refuse for risk-neutral borrowers. Risk-averse borrowers will find it even more attractive because of the additional insurance value. Therefore, we conclude that borrowers always buy the insurance if they qualify.

3.3 Strategic divorce under NHG

Define home equity a_τ as the difference between the current value of the house and current debt. Whereas we kept the house value fixed at A_1, assume now that an asset price shock hits the housing market at the beginning of period t such that,

$$A_\tau \begin{Bmatrix} = \\ < \end{Bmatrix} A_1 \quad if \quad \begin{cases} \tau < t \\ \tau \geq t \end{cases}.$$

The price drop may result in the home being underwater (negative home equity) and potentially lead to realizing a loss upon sale (residual debt). An inusred household may have recourse to reimbursement from the NHG fund. To keep the exposition transparent, we shall assume that divorce is the only event occurring upon which covered households can qualify for an NHG reimbursement (so we ignore unemployment, death and disability). Let η be the exogenous probability that the household divorces. We assume divorce involves costs, k. One may think of the direct cost of settlement, but also monetized psychological cost or the cost of living at separate addresses.

Conditional on house prices dropping, future home equity is uncertain due to the possibility that divorce occurs. If the house price shock is large enough to rendering home equity negative, the choice to divorce strategically within the NHG scheme can become important. In case of a strategic divorce, divorce cost are k', and it is realistic to assume that $k' < k$. Introduce a binary variable to indicate whether (1) or not (0) divorce, should it takes place, is strategic: I_t^{SD}. The index t on I_t^{SD} indicates that the strategic divorce decision is taken at beginning of period t as well, once it is clear that the house price drop has occurred. Focusing on the (expected) home equity at the beginning of period $\tau = t + 1$, at given the parameters, NHG owners decide at the beginning of period $\tau = t$ to initiate a strategic divorce according to the following maximization problem,

$$\max_{I_t^{SD}} \{E(a_{t+1} | I_t^{SD} = 0), E(a_{t+1} | I_t^{SD} = 1)\}. \tag{2}$$

Two cases can be distinguished, depending on whether or not home equity at beginning of period t is non-negative. In the first case, when $a_t \geq 0$, indemnification will never apply. Therefore, there is no incentive to strategically divorce, because such action only carries divorce cost k', that otherwise would not be incurred. Thus, $I_t^{SD} = 0$. Divorce may nonetheless occur as a random exogenous event with expected divorce cost ηk. The expected pay-off is then:

$$E(a_{t+1} | a_t \geq 0) = a_t - \eta k$$

Next assume the case of an underwater mortgage, $a_t < 0$. Here, the choice of I_t^{SD} may become relevant. The problem is:

$$\max_{I_t^{SD}} \{E(a_{t+1} | a_t < 0, I_t^{SD} = 0), E(a_{t+1} | a_t < 0, I_t^{SD} = 1)\} \tag{3}$$

With probability η, the household divorces anyway, and residual debt will be discharged. With probability $(1-\eta)$, even an intact marriage can be dissolved for strategic reasons: the households profits from shedding debt, but pays the strategic divorce cost k'. In summary, we have

$$E(a_{t+1}|a_t < 0) = -\eta k + (1-\eta)\{-I_t^{SD}k' + (1-I_t^{SD})a_t\} \quad (4)$$

To determine whether strategic divorce will occur, the expectation in (4) can be computed per case when strategic divorce is or is not chosen, respectively:

$$E(a_{t+1}|a_t < 0, I_t^{SD} = 1) = -\eta k - (1-\eta)k' \quad (5)$$

$$E(a_{t+1}|a_t < 0, I_t^{SD} = 0) = -\eta k - (1-\eta)a_t \quad (6)$$

Comparison reveals a positive incentive for a strategic divorce as long as divorce costs do not exceed (negative) home equity, $-a_t \geq k'$. Therefore, to maximize their expected home equity at $t+1$, NHG owners strategically divorce ($I_t^{SD} = 1$) in t if $-(a_t + k') \geq 0$. Otherwise, they do not choose to strategically divorce ($I_t^{SD} = 0$). This implies that NHG participants have a positive incentive to divorce strategically when the size of their negative home equity is larger that the costs of a strategic divorce. Such a situation might have presented itself right after the crisis in the Netherlands, when almost 40% of mortgage owners were underwater, and their negative home equity was on average about 50,000 euro (median 37,000). In the next section we test this prediction empirically.

4. Data and summary statistics

Before testing the empirical validity of our model, we first describe the different datasets that can be used for this analysis, and the main summary statistics.

4.1 Data

For the main estimation, we use the Dutch income panel study (Inkomenspanelonderzoek or IPO). The IPO is an annually conducted micropanel dataset, made available by Statistics Netherlands (see CBS, 2016). We use the IPO in order to study couples who divorced or separated during the credit crisis. IPO is representative of the population and not only covers recent

mortgage holders, but also allows measuring a number of crucial covariates of divorce at the micro level. In addition, it straddles the pre-2008 and post-2008 periods. As NHG participation is not provided in the IPO data, we use the available measure of housing wealth as a key to determine NHG qualification. Housing wealth is available from 2005 onwards. The IPO data also do not cover the most recent years.

We also use two ancillary datasets for descriptive purposes and for the policy discussion. NHG participation is not observed in the IPO data. We have, however, access to the loan level data (LLD) of De Nederlandsche Bank (DNB), the Dutch central bank. We use these data in the descriptive analysis in the next section and the policy discussion in the last section. This unique micro-dataset is based on the register of mortgage contracts that commercial lenders must deposit with DNB in its role as financial market supervisor. This register was established in 2012 and is available on a quarterly basis. For more details see Mastrogiacomo and Van der Molen (2015).

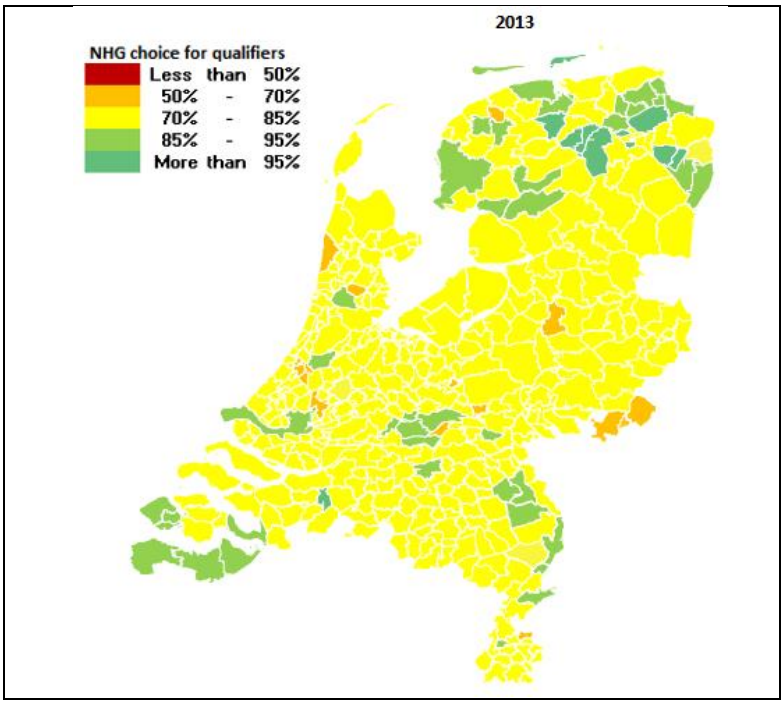
Further, we use aggregate balance sheet information published in the annual reports of the NHG foundation, in order to support the relevance of our identification strategy.

4.2 Descriptive analysis and summary statistics

In order to support our empirical strategy, we illustrate some relevant aspects discussed above. The residual debt insurance in the Netherlands is very popular. We use the LLD micro data where we have a precise NHG indicator available for one of the later years. Figure 1 shows that those who qualify for the insurance, choose to apply for it very often. Almost 90% does, and this is so in most Dutch municipalities.

This is relevant to our study, as such high take-up rates imply little role for adverse selection. In a companion paper to this study (Kim et al, 2019) however, we show that qualification for NHG has diminished a lot over the house price cycle. The reduced coverage is of main concern to policy makers because of the high exposure of Dutch households to mortgage debt.

Figure 1: Take-up rate among NHG qualifiers, by municipality



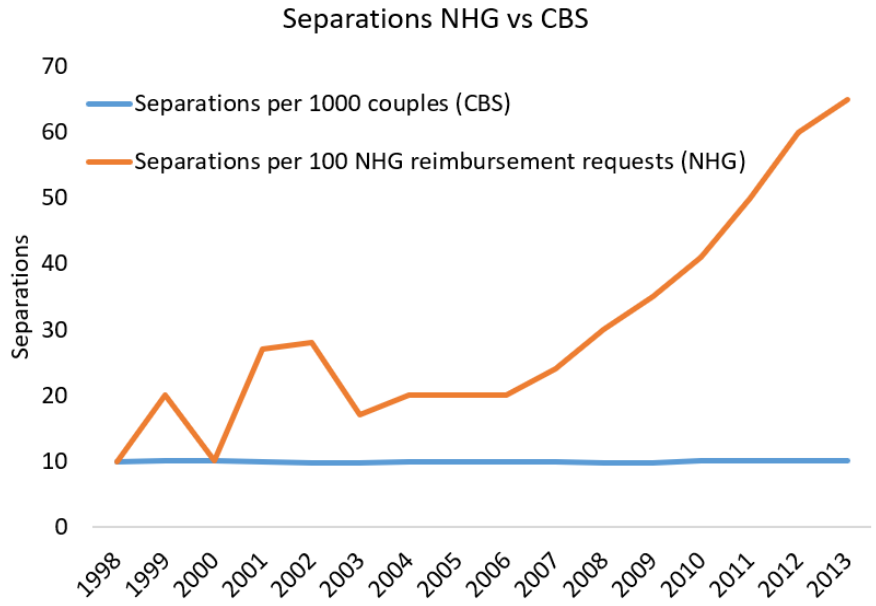
Explanatory note: Source: LLD, 2013 (DNB), own computations

In recent years, divorces have become the primary cause of NHG reimbursements. Figure 2 shows the development of divorces for 100 NHG reimbursement requests along with the nation-wide divorce rate.

The figure takes the data points in 1998 as being equal to 10 for both series and follows their development through 2013. While the nation-wide statistics show no increase in the divorce rate, the number of divorces that motivates a reimbursement request increased exponentially.

Figure 2 is suggestive of a strong differential effect within the insured pooled, although it actually compares two very different populations. Those who qualify for mortgage insurance are households that may in general suffer more during a period of asset prices crisis, while the nation-wide figure also includes tenants for instance, who have no home equity.

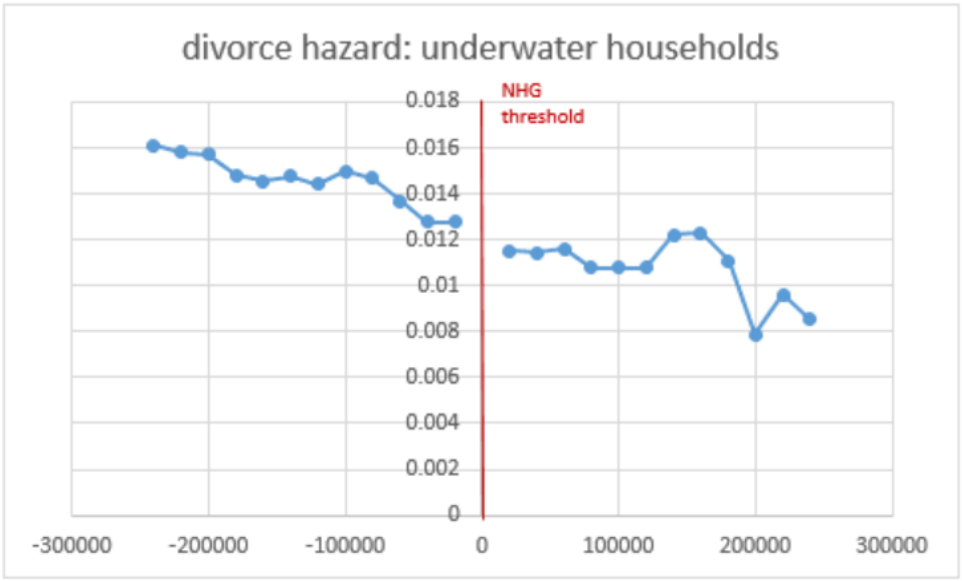
Figure 2. Divorces increase as a cause of NHG reimbursement and nation-wide divorce rates



Explanatory note: Source, NHG annual reports, various years, and Statistics Netherlands.

Once we narrow down the sample by looking at the divorce hazard of couples with negative home equity during the period from 2010 to 2013, a better picture can be traced. This is shown in Figure 3, which is ordered by the distance from the NHG threshold. Similar couples in terms of their house prices show very different divorce hazards depending on whether they do (below the threshold) or do not (above threshold) qualify for the insurance. There is a jump at the threshold and this motivates us to apply a regression discontinuity design.

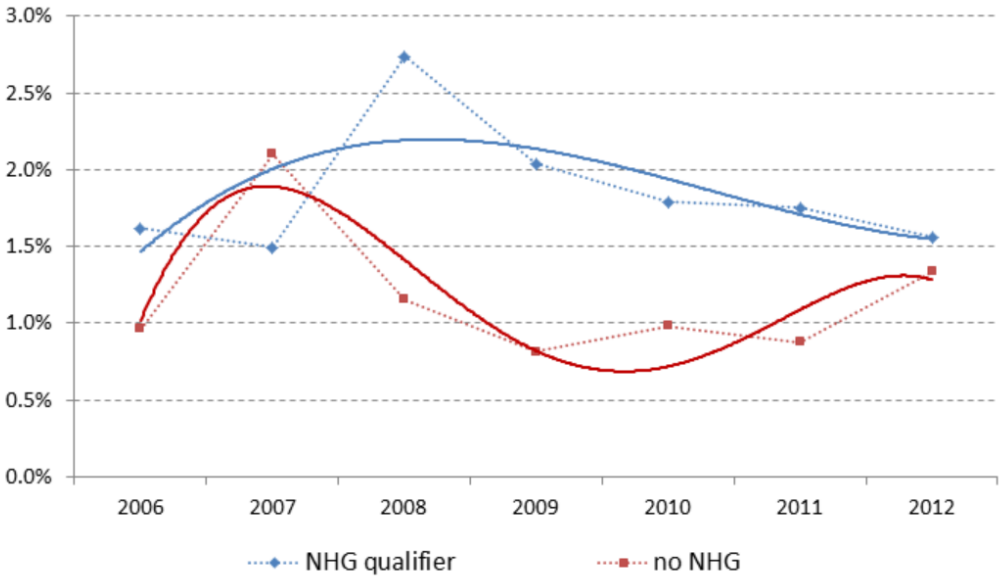
Figure 3. Divorce hazard among underwater households by the distance from NHG threshold



Explanatory note: different divorce behavior around threshold. Source, GBA(BURGERLIJKESTAATBUS), IVB, and IHI data 2010-2013 (CBS), own computations.

In order to be more specific, we show in Figure 4 a more appropriate comparison between two specific groups by different year from 2006 to 2012.

Figure 4: Hazard rate into divorces of Dutch couples with underwater mortgage, before and after the financial crisis.



Explanatory note: The pre-crisis means do not significantly differ. Source, IPO (CBS), own computations. Dotted lines represent data points, continuous lines are splines around the data points.

It depicts the hazard rate into divorce for households with underwater mortgages with or without an NHG insurance. This figure shows that in general NHG participants tend to divorce more often, and more so during the asset prices crisis. The figure suggests a drop in divorces among those uninsured, which is not observed among those who have a residual debt insurance. This figure is based on our entire sample, but narrowing the two groups around the threshold delivers very similar results.

Finally, in Table 1, we show that the sample used in Figure 4 is composed of individuals who are quite similar in terms of observed characteristics irrespective of whether they participate in the NHG or not.

Table 1: Summary statistics of NHG qualifiers and NHG non-qualifiers in the estimation sample: means and standard errors

Background Characteristics	NHG qualifier	NHG non-qualifier
Log of Marriage duration	1.79 (0.90)	2.05 (0.85)
(Log of Marriage duration) squared	4.03 (2.96)	4.93 (2.97)
Age at start of current marriage	30.71 (7.02)	33.5 (7.04)
Child dummy	0.73	0.7
Disposable income household ($\times 10^5$)	0.39 (0.16)	0.56 (0.37)
Difference between household and personal income ($\times 10^5$)	0.21 (0.14)	0.3 (0.29)
Log of Age	3.65 (0.24)	3.77 (0.22)
(Log of Age) squared	13.37 (1.78)	14.26 (1.68)
Employment	0.87	0.88
GAP (between House prices and NHG limit)	-0.23 (0.29)	1.03 (1.24)
GAP squared	0.14 (0.25)	2.61 (13.95)
Regional house price growth rates	0.003 (0.03)	0.009 (0.03)
Only young child dummy	0.62	0.54
Young and adult child dummy	0.05	0.06
Only adult child dummy	0.07	0.1

Live in four largest cities dummy	0.12	0.11
Number of household member	3.41 (1.13)	3.43 (1.24)
Financial Asset household ($\times 10^5$)	0.31 (1.18)	2.21 (11.5)

Explanatory note: Standard errors in parentheses, Source, IPO (CBS), own computations

Some differences, though, are worth discussing. Background characteristics are listed and compared in order to check whether there is a sizable difference between the two groups. Most of the characteristics of the two groups are similar in terms of means and standard errors. An exception is disposable income, which correlates with the value of the property. Couples in the NHG non-qualifier group have more valuable houses and are more likely to have higher incomes. We measure the relative difference between the house value and the NHG threshold by the variable GAP. By construction, this variable is negative for NHG qualifiers and positive for the NHG non-qualifier group. The marriage-relevant variables, such as marriage duration and age at start of the current marriage, indicate that NHG non-qualifiers get married at a somewhat later age and stay married somewhat longer. The last six characteristics in Table 1 are not included as control variables in our regression model but shown here to compare the difference between two groups. Both groups are on average similar in terms of child composition, the number of household members, and whether they live in one of the four largest cities in the Netherlands (Amsterdam, Rotterdam, Den Haag, and Utrecht). Couples with NHG have fewer financial assets.

5 Empirical results

5.1 Empirical test of moral hazard

We formally test whether NHG participation induced strategic divorce among couples with negative home equity. Our sample conditions on couples that are married or cohabiting in year $t-1$. We begin our regression discontinuity design approach by specifying the empirical model as:

$$y_{i,t} = \beta_0 + \beta_1 NHG_{i,t-1} + \beta_3 UW_{i,t-1} +$$

$$\beta_5 (NHG_{i,t-1} * UW_{i,t-1}) + \tag{1}$$

$$\beta_8 GAP_i + \beta_9 GAP_i^2 + \beta_{10}' X_{i,t-1} + \beta_{11}' Z_i + \gamma_{regional\ house\ price\_growth\_t} + \varepsilon_{i,t}$$

Here, $y_{i,t}$ is a dummy variable that indicates whether (1) or not (0) couple i divorces or separates in year t. The hazard rate into divorce is made up of different elements. $NHG_{i,t-1}$ is an indicator for the NHG qualification in $t-1$.[12] We include it because we are interested to see whether there is a potential difference between borrowers that take out the insurance, and those that do not. There are many reasons why these groups may display differing divorce behavior even in the absence of an underwater mortgage, and even when not making a claim, depending on observables. Perhaps the group is characterized by differential risk aversion and demand for insurance, perhaps there are lifecycle risks associated with early career stages and family formation that we cannot control for directly. $UW_{i,t-1}$ is a dummy variable for households whose outstanding mortgage debt in $t-1$ exceeds the market value of the housing collateral, the so called underwater (UW) status. Negative home equity may put couples under stress and threaten marital stability, but conversely it may also lock two partners into a marriage that would otherwise dissolve. Of particular interest is the interaction term, $NHG_{i,t-1} * UW_{i,t-1}$, which captures the specific divorce behavior of couples who see their home going underwater but who may default and request a bail-out from the NHG fund. We assume that neither NHG nor UW status can be manipulated by the household. Using lagged values for these variables mitigates potential endogeneity problems, as it makes sure that divorce and property loss occurs after qualifying for NHG insurance. The parameter on this interaction term, β_5, is the main parameter of interest in Model (1).

To reduce potential contamination by an effect of important correlated variables, we control for a range of other observable factors. GAP_i denotes the relative difference between house value at inception and the NHG price ceiling. This variable is relevant because it indicates the effect of proximity to the point of discontinuity (the threshold). We include also its square term.

Divorces will in important ways be a function of individual and match-specific characteristics that we wish to control for. We add regressors $X_{i,t-1}$ consisting of a set of time-varying characteristics of couples in year $t-1$, as well as regressors Z_i denoting time-invariant variables. In X, we include a dummy on having any children, a quadratic term in the log of age of the head of the family (or the partner), and a quadratic term in the log duration of the current

[12] In order to impute NHG qualification, we proceed as follows. In the income data of IPO 2000-2012, we elicit the inception year of the mortgage by looking at the year in which the interest rate on the mortgage is first reported. This procedure identifies the year of inception in about 20% of all cases. We then either observe the value of the house (if the year is 2005 or later) or impute it using a province-level house price index (if the year is before 2005). We then impute the NHG qualification, applying the IPO data on paid interest rates on mortgages also prior to 2000 (back to 1993) with the same method above. We can thus identify the purchase year (and thus determine NHG qualification) for around 40% of the sample.

marriage. In Z, we include the age at the start of the current marriage. These are meant to control for life cycle position, duration dependence, and initial condition of the marriage. It is also important to control for a measure of the household's total disposable income, and the intra-household distribution of resources (the difference between household and personal income), as the latter may directly influence intra-household bargaining weights and be an important driver of marital dissolution. In addition, we include an employment dummy.

Lastly, the growth rate of the regional house price index is included in our model to capture generic time effects. $\varepsilon_{i,t}$ is a composite error term that also allows for individual-specific time-invariant heterogeneity through a random effects component.

Parameter β_5 then measures the causal effect of being insured at the NHG threshold at the time of divorce. Conditional on GAP, it is a local effect comparing qualifying and non-qualifying households with similar home values relative to the NHG qualification ceiling.

In a second specification we also include an indicator for the crisis period, $Crisis_t$, meaning the period from 2008 onwards, when house prices dropped by more than 20%. We also include interaction terms. The reason for doing so is that the phenomenon of underwater mortgages becoming widespread and leading to a substantial number of defaults only occurred during the crisis. The model equation is

$$
\begin{aligned}
y_{i,t} = \beta_0 + \beta_1 NHG_{i,t-1} + \beta_2 Crisis_t + \beta_3 UW_{i,t-1} + \\
\beta_4 (NHG_{i,t-1} * Crisis_t) + \beta_5 (NHG_{i,t-1} * UW_{i,t-1}) + \beta_6 (Crisis_t * UW_{i,t-1}) + \\
\beta_7 (NHG_{i,t-1} * Crisis_t * UW_{i,t-1}) + \\
\beta_8 GAP_i + \beta_9 GAP_i^2 + \beta_{10}' X_{i,t-1} + \beta_{11}' Z_i + \gamma_{regional\ house\ price\ growth,t} + \varepsilon_{i,t}
\end{aligned}
\tag{2}
$$

Economic theory predicts (see Section 1) that divorces respond to economic conditions, including macroeconomic fluctuations. This is the base effect picked up by β_2. It will also pick up some variation that in Model (1) had been picked up by the regional house price variation. The interaction with $NHG_{i,t-1}$, parameter β_4, takes out a differential NHG effect during the crisis, for

instance the fact that the price ceiling for new mortgages was raised, or that insurance became more expensive. The interaction with $UW_{i,t-1}$, parameter β_6, measures the generic underwater effect on divorce during the crisis. Finally, the triple interaction, parameter β_7, is the parameter of interest in Model (2). Again, we interpret it as the causal effect on divorce of being NHG-qualified and exposed to negative home equity during the crisis. It measures how much higher or lower the divorce hazard is among NHG participants with an underwater mortgage when the phenomenon was widespread. It therefore is an indicator of strategic divorce (moral hazard).

For both models, note that we do not observe whether NHG has actually been taken up, as the IPO data are silent on this. We reiterate, however, that take-up rates conditional on qualifications have traditionally been very high (see Figure 1). Our sample window excludes the most recent years where selection effects may be more likely to occur. We do not observe default, but only negative home equity. Hence, we may overestimate the effect on divorce if we were solely interested in households that are actually insured and that are effectively bailed out with debt relief.

Table 2 shows OLS results for the two equations above. The left column refers to the first model (1), the right column to the second model (2). Many of the common coefficient estimates between the two models are very similar. The table shows the importance of structural demographic determinants of divorce. In particular, the hazard rate into divorce correlates positively with log marriage duration and age at the start of the current marriage, and negatively with a child dummy, as well as with the difference between household disposable income and personal income.

Table 2: Estimation results of divorce hazard at current time (t)

Dependent variable: dummy for divorcing couples	Model 1	Model 2
NHG Qualification Indicator$_{t-1}$	0.0038	0.0049
	(0.0034)	(0.0040)
After Crisis (year>=2008)		0.0059***
		(0.0026)
Underwater Households$_{t-1}$	0.0009	0.0017
	(0.0027)	(0.0049)

NHG Qualification$_{t-1}$ × After Crisis		-0.0019 (0.0032)
NHG Qualification$_{t-1}$ × Underwater Households$_{t-1}$ ($\boldsymbol{\beta_5}$)	0.0025 (0.0034)	-0.0101 (0.0065)
After Crisis × Underwater Households$_{t-1}$		-0.0001 (0.0053)
NHG Qualification$_{t-1}$ × After Crisis × Underwater Households$_{t-1}$ ($\boldsymbol{\beta_7}$)		0.0153** (0.0069)
Log of Marriage duration$_{t-1}$	0.0175*** (0.0034)	0.0178*** (0.0034)
(Log of Marriage duration) squared$_{t-1}$	-0.00001 (0.0016)	-0.0007 (0.0016)
Age at start of current marriage	0.0015*** (0.0005)	0.0013*** (0.0005)
Child dummy$_{t-1}$	-0.0180*** (0.0029)	-0.0180*** (0.0029)
Disposable household income$_{t-1}$	0.0093 (0.0067)	0.0084 (0.0067)
Difference between household and personal income$_{t-1}$	-0.0269*** (0.0061)	-0.0270*** (0.0061)
Log of Age$_{t-1}$	0.6409*** (0.1399)	0.5690*** (0.1386)
(Log of Age) squared$_{t-1}$	-0.0984*** (0.0198)	-0.0874*** (0.0196)
employment$_{t-1}$	- 0.004 (0.0029)	-0.0042 (0.0029)
GAP (relative, between house prices and NHG limit) $_{t-1}$	-0.0003 (0.0021)	-0.0001 (0.0021)
GAP squared$_{t-1}$	0.0001 (0.0001)	0.00001 (0.0001)
Regional house price growth rates	-0.0816*** (0.0178)	-0.0183 (0.0242)
Constant	-1.0668*** (0.2523)	-0.9461*** (0.2503)
Number of Observations	26,560	26,560
Number of Couples	6,341	6,341

Explanatory note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

With regard to the log variables and log-squared variables, we also calculated marginal effects at the sample means. The marginal effects of marriage duration and age of the head of the household are 0.0017 and 0.0069 respectively.[13]

The baseline effects for NHG and having an underwater mortgage are statistically zero, whereas the crisis coefficient in model (2) is positive and significant. Note that regional house price growth has a strongly negative coefficient in model (1). On the contrary, in model (2) this effect is non-significant, but the dummy that identifies the years of crisis is. The latter, together with some additional interaction terms, could be picking up part of the effect that in model (1) was being picked up by the variable regional house price growth.

The coefficient β_7 in Model (2) is positive and significant, meaning that we find during the crisis NHG participation had a positive causal effect for the group of underwater borrowers on divorce. This is consistent with moral hazard in the form of strategic divorce.

Note, however, that in Model (1) the corresponding causal effect of NHG participation when the mortgage is underwater, β_5, is positive but not significant. In model (2), β_5 is negative and only borderline significant. One possible interpretation of this negative sign is the effect of house price expectations before the crisis. Here, couples that started out with highly-leveraged negative home equity may not have expected to end up in a problematic debt situation, as house prices showed a sustained upward trend for many years until 2008. The turnaround came quickly and took many by surprise.

When we only consider the couples whose initial mortgage debts are below their house values (LTV ratio at origination below 100), β_5 in Model 1 becomes positive and significant with the value of 0.01187. This can partly explain the difference in outcomes between model (1) and (2).

Our two models both fit the mean hazard closely. Both models deliver similar predictions. Model (2) predicts that the hazard rate into divorce is 1.85%. When we set the coefficient β_7 to

[13] The marginal effect of marriage duration derives from both log duration of the current marriage and quadratic term in the log duration of the current marriage. The former is calculated as its coefficient in Model 2 multiplied by a reciprocal of the sample mean of the marriage duration, which is 0.0178*(1/10.12) =0.0018. The latter (quadratic term) is estimated as follows: -.0007*2*log(10.12)*(1/10.12) =-0.0001. Therefore, the marginal effect of the marriage duration would be the sum of those two estimated numbers (0.0018-0.0001=0.0017), even though the coefficient of the latter one (quadratic term in the log duration of the current marriage) was not statistically significant. The marginal effect of the age of the head of the household (or partner) is also produced in the same way: (0.569*(1/41.4) - 0.0874*2*log(41.4)*(1/41.4)= 0.0069).

zero in the prediction, to eliminate the effect of moral hazard, the hazard rate drops to 1.41%. This means that moral hazard has increased the hazard rate into divorce by about 0.44 percentage points (a relative effect of about 31%).

We have subjected the empirical results shown in Table 2 to a range of robustness checks (Table 3) and placebo effects (Table 4) in order to see whether and under what conditions the causal effect survives when we change sample and specification.

As a first robustness check, in specification A, we depart from the baseline sample and extend the sample to include the 1993-2000 period. For these additional years the NHG qualification is imputed from predicted house prices in the past (imputed until 1993). We use regional house price indices for this prediction. The sample we use is three times larger than the baseline sample (referring to observation number (N) in the right hand column of Table 3). The imputation may increase measurement error, thus the coefficient can be expected to be biased towards zero in this case.

In Specification B, we make the sample house values more comparable in the sense that we select observations that are closer to the NHG qualification ceiling. Whereas in the baseline model of Table 2, the distance from that threshold is solely controlled via the variable GAP, in specification B1 we reduce the sample to those couples that are within 50% of the qualification ceiling on either side. Specification B2 narrows the range even further, to the nearest 30% within the threshold; in addition, we exclude the narrow band of 5% on either side of the threshold. This is because the indicator of NHG qualification itself is partly imputed. In both cases, we have fewer observations than the baseline sample(77% for B1, and 45% for B2 compared to the baseline) we expect less precise coefficients here. Specification B3 drops the top 5% of participants whose house values were right below the threshold. Therefore, the sample size becomes slightly smaller, but it is expected to be less contaminated by the people who have tried to buy the house right below the threshold in order to be qualified for the insurance.

With reference to tests for various placebo effects , Specification C first uses a different hazard concept: not into divorce, but into divorce and separation, thus including cohabiting couples rather than only couples that were married in the previous year. Specification D assumes that the financial crisis started one year earlier. We use this in order to test whether there may have been anticipation effects of the crisis. Since this is a wrong crisis indicator, an imprecise estimate is expected. Specification E allows studying placebo effects for treatments. We assign the NHG insurance to all those couples with house value above the median.

Table 3 presents the results on the various exercises for robustness checks. All deviations are relative to the baseline in Table 2. We focus solely on the parameter of interest, β_7 in Model (2).

We see that the moral hazard effect survives when we use the larger sample in Specification A, although the effect is reduced relative to the baseline. Under classical measurement error this is expected. Specification B1, on the other hand, is very close to the baseline in both level and statistical significance. Specification B2, which reduced the sample considerably even further (refer to N in Table 3), also shows a positive, although weakened effect on divorce, but with a relatively large standard error. Specification B3 shows highly significant effect, and even higher than the baseline; it implies that our baseline results are robust and not contaminated by the participants who have chosen less expensive house in order to achieve NHG qualification.

Table 3: Different specifications for robustness checks

Coefficient of NHG qualification × Year>=2008 × Underwater households (β7)	Coefficient β_7	N
Baseline Estimation	0.0153**	26,560
Panel A: augmented sample using house values before 2000	0.0093*	76,721
Panel B: NHG qualification with range		
1.between 50%-100% vs 100%-150%	0.0165*	20,583
2.between70%-95% vs 105%-130%	0.0093	12,023
3.drop top 5% from the NHG qualifiers	0.0156**	25,268

Explanatory note: *** p<0.01, ** p<0.05, * p<0.10

The test results on various placebo effects are shown in Table 4. Once again, we only look at β_7 and the comparison target is the baseline.

Table 4: Different specifications for placebo effects

Coefficient of NHG qualification × Year>=2008 × Underwater households (β7)	Coefficient β_7	N
Baseline Estimation	0.0153**	26,560
Panel C: separation hazard (using couple identifier)	0.001	38,873
Panel D: anticipation effect underwater mortgages started from 2007 (Year<=2007)	0.0095	26,560
Panel E: placebo effect would have NHG if the house value at purchase is above the median house values of that year	-0.0183***	26,560

Explanatory note: *** p<0.01, ** p<0.05, * p<0.10

In Specification C we find no effect. Notice that there are far more separations than divorces, and the moral hazard problem may just not be very relevant for this larger group. On the other hand, the separation indicator is somewhat noisier, as identification of couples is more difficult than observing marital status, again possibly pointing to a typical measurement error effect.

Specification D shows that behavior is predicted to have been very different if we had assigned the crisis period to have started a year earlier. Now, of course, we contaminate actual behavior from 2008 onward with some of the pre-crisis behavior. The resulting coefficient estimate is zero.

Specification E shows a negative coefficient when we create an artificial treatment group based on median house prices alone; a finding that in itself is not surprising.

5.2 Reunions

In the context of strategic divorce it is also interesting to check whether separating couples reunited more frequently during the crisis years. We took all those who divorced in 2009 or 2010 and looked at the identity of their partners in 2013. We counted those that had the same partner as in the base year. We conducted a similar count for couples that divorced in 2002 or 2003 and look at their partners in 2006. We were able to establish the identity match by comparing personal identification numbers, but we could also simply base the comparison on sex and year of birth.

The first panel in Table 5 shows that about 1/3 of those who had divorced were no longer single three or four years later. About 6% of the total were again living with the same partner (person with the same identification code in the data).

Table 5: Reunions in the IPO data

1. In terms of identification number

divorce in 2009 or 2010 and reunion in 2013	
single in 2013	650
couple in 2013 (but with different ID code than before)	247
reunion in 2013	59
Total	956
reunion rate	6.20%
divorce in 2009 or 2010 and reunion in 2014	
single in 2014	618
couple in 2014 (but with different ID code than before)	279
reunion in 2014	55
Total	952
reunion rate	5.80%
Comparison: divorce in 2002 or 2003 and reunion in 2006	
single in 2006	561
couple in 2006(but with different ID code than before)	325
reunion in 2006	34
Total	920
reunion rate	3.70%

2. In terms of year of birth

divorce in 2009 or 2010 and reunion in 2013	

single in 2014	650
couple in 2014 (but with the same year of birth as before)	235
reunion in 2014	68
Total	953
reunion rates	7.1%

Source: CBS, own computations

This finding is corroborated in the second panel, where we checked matches in 2014 instead of 2013. For the 2002/2003 versus 2006 comparison, we found that a smaller fraction (3.7% of total) reunited. This comparison is consistent with strategic divorce behavior during the crisis years. Note, however, that for a cleaner comparison we should condition on having an NHG and being underwater—an exercise that is precluded by the small number of observations.

In order to check that CBS did not re-assign the old code to a different partner, we checked that the previous partner's year of birth also coincided. This was the case and if we were to identify the new partner by sex and year of birth only, the reunion rate would actually be slightly higher (7.1%). See the last panel in Table 5.

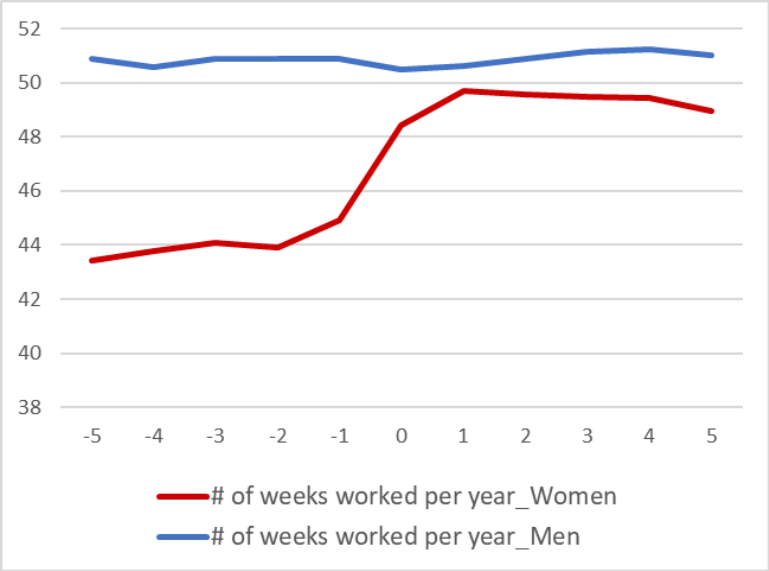
6. Policy Discussion

In order to discuss the relevance of divorce for a couple, Figure 5 shows a clear discontinuity in the number of weeks worked by women, but not by men, around the time of divorce. Prior to divorce, women work fewer weeks per year, whereas after divorce the number of weeks that they work becomes comparable to that of men. So, if the preferences of women were satisfied by their labor supply before the divorce, increasing the number of hours of work might entail a utility/welfare cost. In our companion paper, we show that such discontinuities also affect wealth, retirement preparation and income sources (see Appendix 2 about alimony regulations). This suggests that divorces can be considered as shocks that perturbate the welfare of households through multiple channels.

From a policy point of view these results are highly relevant. For instance, after a drop in NHG participants, the Dutch Parliament requested lifting the 100% loan to value (LTV) cap for those applying for an NHG. Currently one must pay the one-off premium out of pocket, and

additional debt seemed an appropriate alternative to not discourage those willing to apply for a residual debt insurance. Kim et al (2019) show that the drop in participation is not due to the lowering LTV-limits, but to the qualification rules for the scheme. In this study, we show that debt above 100% of the value of the property induces an increase in divorces, and we suggest that this entails potential welfare losses (see for instance Figure 5).

Figure 5: Labor market participation by time before/after divorce



Explanatory note: Source: IPO (CBS), own computations.

Policymakers have other ways to deal with the reduction of residual debt insurance. Rather than allowing increased indebtedness, we suggest for example an actuarially fair premium to reform the NHG. This allows competition in the mortgage insurance market and might improve the screening of customers and thus alleviate the problem of asymmetric information. Differentiating premiums by risk category (measured, for instance, by LTV and LTI ratios) may contribute to linking the choice for NHG to the insurance value of the product. In general, it would be obvious to set premiums in direct proportion to the expected risk. This problem is, however, more relevant in case of adverse selection, which is not really an issue with NHG, so it would not necessarily alleviate moral hazard. We believe that this policy option is worth exploring, even if further reduction of the LTV cap in the future were to actually lead to lower NHG participation.

7. Summary and Conclusions

We have analyzed the reasons for the very noteworthy but hardly discussed fact that divorce has increased disproportionately among NHG participants, qualifiers and reimbursement applicants in the wake of the financial crisis and house price slump. We have estimated the causal effect of NHG qualification on divorce and show that the scheme induces moral hazard. The effect on the hazard rate into divorce is considerable and statistically significant. It increases from 1.41% to 1.85%, which corresponds to a 31% higher probability. Since adverse selection issues are limited by the participation rates during our observation window, we attribute the effect to moral hazard. In practice, this means that strategic divorces/separations have taken place, aiming at cancelling residual mortgage debt upon selling a house with negative home equity or facilitating a divorce by removing a potential financial burden. Moral hazard is also confirmed by the sizeable reunion rates that we find in the data: four to five years after a divorce during the financial crisis, about 6% of couples were again cohabiting with the same partner as before the crisis and their divorce. This number is higher than in the pre-crisis period.

We conducted a quasi-natural experiment to show how the combination of negative home equity and mortgage-default insurance can cause moral hazard. We discussed how the average negative home equity of €50,000 could be reason enough for strategic divorce, but we did not discuss the associated costs, as we assumed the costs of a strategic divorce to be negibile (which is of course not the case for a genuine divorce, see Appendix 1).

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Appendices

Appendix 1: Relevant marriage and divorce law

Being married is not essential in order to qualify for NHG. However, many persons who qualify for NHG are married. In the Netherlands the default marriage regime is community property, unless a couple explicitly chooses to sign a prenuptial agreement. Our data do not provide any information about the marriage regime, so we cannot determine how this would impact our analysis. The option to sign a prenuptial agreement is costly, however, as it requires a tailor-made contract that is signed in the presence of a notary before the marriage, and in some cases also the intervention of the court. So, for a couples who are not married and for couples who have a prenuptial agreement, the explicit costs of an uncontested separation/divorce typically only amount to relocation, if applicable. An uncontested divorce takes about three months for a married couple and can be arranged with a few meetings with a lawyer, the so-called mediator. In case of children or a partner who is not economically self-sufficient, alimony regulations are called for. In the former case, also a parental plan is needed, as joint custody is the rule. If the terms are contested, divorce can take up to two years.

Divorces/separations account for 3.3% of terminations of cohabitation.[14] Ten couples out of 1,000 are divorced, with the average age of a divorcee being 47 for men and 44 for women. Marriages lasted on average 14 years before divorce.

Appendix 2: Alimony regulations

Alimony has been regulated by law since 1971. The purpose of the Dutch alimony regulation is to maintain the living standards of prior to the divorce, whereas in other countries alimony is often meant to provide self-sufficiency. In the Netherlands, alimony is decided in court. The lawyer of each party sends a proposal to court. If only one proposal is received, this will normally be accepted.

Alimony is paid by the main income earner and received by the secondary income earner within the divided couple. Since 1994, the maximum duration for alimony payments is twelve years (currently this applies for a marriage involving children, while without children it is five years). In the case of children, child support must be paid until the child turns 18, or in special cases until he or she turns 20. The duration of alimony can be reduced if the marriage was shorter than five years. Payments stop when the receiver starts cohabiting again or dies. Payments can be reduced if the payer starts a new family, but all changes are decided in court.

Alimony affects the income tax base. For the receiver it is taxable, for the payer it is deductible.

[14] See https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37556/table?ts=1526295428606