DUTCH MORTGAGE ARREARS AND THE ROLE OF THE GLOBAL FINANCIAL CRISIS

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Abstract
As in many countries, the Dutch housing market was severely hit by the recent financial crisis. Following the recession, the average house price in the Netherlands fell by almost 25% and the proportion of homeowners with mortgage payment arrears nearly doubled. In this paper, we study mortgage payment arrears in the Netherlands and investigate the contribution of the credit crisis to the development of the current phenomenon of mortgage default. An aggregate distributed-lag model is employed for the period between 2004 and 2013 to assess the influence of various socio-economic factors. The variables considered include: aggregate mortgage debt, mortgage interest rate, unemployment rate and the dissolution of families. The paper concludes that family break-down remains the most important risk factor associated with mortgage default in the Netherlands. The effect of unemployment is generally minor while mortgage interest rates have no statistically significant impact except that they implicitly contribute to the level of mortgage debt. The impact of mortgage debt on payment arrears is limited because of the unique characteristics of the housing market.

Keywords: Distributed-lag model, Dutch housing market, Financial crisis, Home ownership, Mortgage arrears

1. Introduction

The factors that determine mortgage default are well-known in the housing finance literature. In the context of the US and the UK in particular, many academic papers have been written on the subject (e.g., Quercia & Stegman, 1992; Kau et al., 1994; Lambrecht, Perraudin & Satchell, 1997; Figueira, Glen & Nellis, 2005; Ford, 2006). There are two main theories associated with mortgage default in these academic papers: the *ability-to-pay* hypothesis and the *equity* hypothesis. The ability-to-pay hypothesis relates to defaults resulting from situations in which the flow of household income is insufficient to service regular mortgage outlays. This income shortfall may come about due to unemployment, fluctuations in interest rates, divorce, and other disruptive family demographic developments unique to the setting of the specific housing market under consideration (see, Boelhouwer et al., 2005; Kloth, 2005; Dol & Neuteboom, 2006). The equity hypothesis, on the other hand, concerns voluntary default by mortgagors where the liability held in the house outweighs the equity thereof (Jackson & Kaserman, 1980). This, of course, only occurs when there is no right of recourse and the borrowers are not financially responsible for the associated residual debt. In the US, for example, mortgage contracts may or may not include a recourse clause (Baker, 2008; Mizen, 2008).

In the Netherlands, all mortgages include a right of recourse. However, the literature examining the phenomenon of mortgage default is very limited. One reason could be the very small number of recorded cases; fewer than 1% of Dutch mortgages were affected by arrears prior to 2007. After the financial crisis of 2008, however, it became a much more common phenomenon. A greater number of mortgagors are getting into arrears than before; in fact, the number more than doubled between 2008 and 2013. What remains unclear, though, is whether the recent surge is a simple consequence of the credit crisis or a result of other factors unrelated to the economic situation. Understanding the role of the economic crisis and identifying the contribution of the key factors in the growth of mortgage arrears has become crucial if appropriate policy measures are to be taken. If it is established, for instance, that unemployment is a less relevant factor, policymakers would not then have to worry so much about problems on the labour market.

We therefore focus on identifying the important socio-economic factors underlying mortgage arrears in the Netherlands, as well as the impact of the recent economic crisis. An aggregate distributed-lag equation for payment arrears from 2004 to 2013 is used to achieve these objectives. Distributed-lag models form one class of the most widely used statistical tools for assessing the delayed impact of economic variables. This paper considers the current default rate as a linear function of socio-economic events that occurred in the past and the prevailing conditions on the housing market in previous years. The specific variables examined in this paper include: the break-up of families, the unemployment rate, the mortgage interest rate and aggregated mortgage debt. These factors have been chosen on the basis of the existing literature and the distinctive characteristics of the Dutch housing market described in the next section.

As a contribution to the existing literature, this paper increases our empirical understanding of mortgage default in the context of the Netherlands, where market conditions differ from those in the US and the UK, where most previous studies have been conducted. Furthermore, by disentangling the impact of the credit crisis on the phenomenon of mortgage default, the paper contributes to the debate on the effects of the crisis in the Dutch housing market. Since 2008, there has been considerable debate on the extent to which the Dutch housing market has been affected by the financial crisis. The emphasis has, nonetheless, been on the steep decline in house prices following the crisis (see e.g., Boelhouwer, 2014; Teulings, 2014; Brounen & Eichholtz, 2012; de Vries, 2010). This paper departs from that perspective and introduces a new dimension: the upward trend in mortgage arrears.

In order to place this study within the context of the Netherlands, a general overview of the Dutch housing market is presented in Section 2. Sections 3 and 4 discuss the dataset and empirical methodology. The estimated results are presented in Section 5, while the essential findings and policy implications are summarised in Section 6.

2. Overview of the Dutch housing market

The Dutch housing market consists of three tenure types: the owner-occupied sector, the social rental sector and the private rental sector. These currently account for 60%, 33% and 7% of the total housing stock, respectively. Each of these market segments is shaped by policies of the Dutch government. Elsinga et al. (2014) argue that the housing market is also currently being influenced by external bodies such as: the International Monetary Fund (IMF), the European Commission and the bond rating agencies. The discussion below focuses mainly on the owner-occupied sector.

2.1. 1985-2008: Promotion of homeownership and massive house price boom

From the mid-1980s onwards, the ambition of the Dutch government shifted towards promoting homeownership in order to free itself of the responsibility for providing housing for much of the population. This new policy direction set the agenda for Dutch housing policy in later years, especially after 1989. In 1989, the then State Secretary Enneüs Heerma published the *Housing in the*

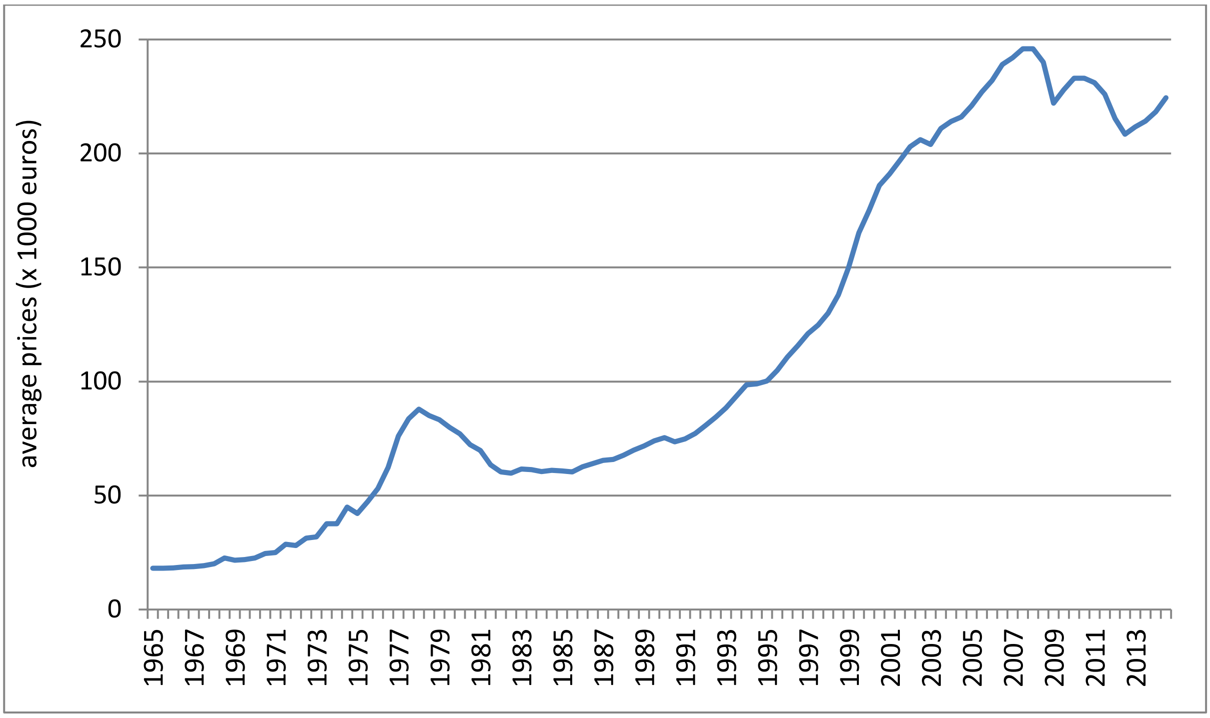
Nineties memorandum, which set out the government's objectives of pushing up the rate of homeownership. The same goal was echoed by Secretary Johan Remkes in 2001 in his *Mensen Wensen Wonen*, ('People want homes') memorandum (see, Elsinga, 2003; Boelhouwer & Neuteboom, 2003). Specifically, Remkes fixed the objective of achieving a homeownership rate of 65% by 2010. At that time, the homeownership rate was at around 52%, a figure far below the European average.

Part of the means of achieving the new housing objective was to earmark a substantial number of social rental dwellings (almost half a million) for sale, and several incentives were put in place to encourage individuals to purchase their own dwellings (Elsinga, 2003, Elsinga et al., 2014). The National Mortgage Guarantee (NHG) scheme, established in 1993, was one such incentive package. Its aim was mainly to lower the mortgage threshold for younger age groups and lower income groups. With the support of the NHG, these target groups were able to purchase dwellings without any appreciable down payments. In practice, they could obtain mortgages with a loan-to-value ratio (LTV) of up to 115%, yet the scheme guarantees the residual debts in the event of foreclosure due to circumstances such as unemployment, bad health or divorce. This contributed greatly to the increase in the rate of homeownership among younger age groups and lower income groups.

Until 2011, the income tax deductibility of mortgage interest was another huge incentive which mainly benefited those in higher income groups. By 2000, the Dutch mortgage market had been liberalised to a fair degree and more financial institutions began to take part in it (Elsinga et al., 2014). The generous income tax deductibility of mortgage interest, which had in fact existed well before the 1990s (see, Haffner 2002), enabled financial institutions to engineer a range of mortgage products. The construction of these loans maximised the tax advantages and enabled homeowners to make repayments that only covered the interest rate charges. Repayment of the loan principals was in many cases postponed for 30 years or more. These mortgage products enhanced the accumulation of capital from the tax provision, providing massive incentives towards greater homeownership, particularly among higher income groups (see, Boelhouwer, 2002; Toussaint & Elsinga, 2007). Surprisingly, tax officials tolerated these 'endowment' and 'interest-only' mortgages, which were more risky by nature. They were probably permitted because they encouraged competition in the provision of low mortgage interest rates, which in turn encouraged higher rates of homeownership, which remained the government's ultimate objective.

Ostensibly, the consequences were improved access to mortgages, lower monthly payments for homeowners in comparison to tenants, and ultimately a boom in demand. House prices responded accordingly, and between 1985 and 2008, the average house price has increased by 313% in nominal terms and 153% in real terms. This was the most remarkable and sustained price boom in the history of the Dutch housing market. (see, Brounen & Eichholtz, 2012; Figure 1).

Figure 1. Development of Dutch average house prices (1965-2014)



Source: NVM (Dutch organisation for real estate agents), CBS (Statistics Netherlands)

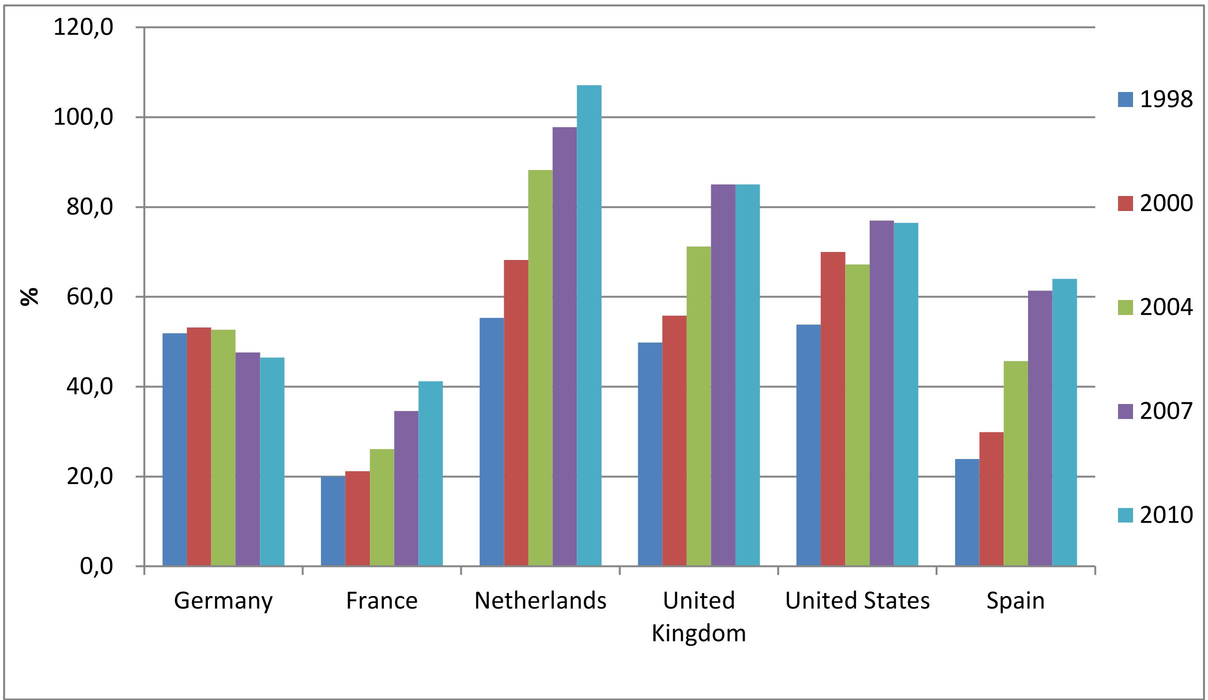
2.2. Beyond 2008: the financial crisis and policy responses

In 2009, GDP in the Netherlands fell by almost 3% and unemployment climbed from 3.7% in 2008 to a peak of around 8.5% at the end of 2013. The economic crisis affected the major Dutch banks severely and the Dutch government injected almost €31 billion in the form of soft loans to support the liquidity of these financial institutions. About €17 billion in loans were obtained by the banks from other sources, but were guaranteed by the government to assist in their lending and overall operations (van der Heijden et al., 2014).

The effect of the crisis on the housing market also led to the introduction of various remedial measures by the Dutch government (see e.g., Elsinga et al., 2014; Boelhouwer, 2014). These measures mainly centred on reducing the huge mortgage debt on the housing market in order to avert a collapse of the entire system amid declining house prices and rising default rates. The IMF and the EU, as well as other international supervisory authorities, had all warned the Netherlands about its level of mortgage debt. In terms of the proportion of GDP, this debt grew from 55.3% in 1998 to almost 105.4% by 2009 (see, Figure 2). The risks posed by this debt, to both financial stability and to the general economy, became particularly evident as it emerged about 30% of mortgage loans were deep 'underwater' and the default rate (as well as the foreclosure rate) rose to levels seldom witnessed previously (DNB, 2014). Although some have argued that the savings component of endowment type loans provides an adequate financial buffer for mortgage debt, the Dutch authorities seem to have been compelled by international pressure to consider measures to reduce the mortgage debt. This led to the drawing up of a new code of conduct for mortgage providers in 2011, which specified various regulations for mortgage provision.

As part of the measures, the maximum permitted LTV ratio is currently being reduced incrementally and will reach 100% by 2018, and eventually be reduced further to 80% in accordance with international standards. The income tax deduction, which was previously permissible for an unlimited duration, has been restricted to a period of 30 years. Only amortising loans which involve at least annual repayments qualify for income tax deduction under the new regulation. This legislation has particularly affected home buyers since 2013, since when monthly mortgage bills have increased significantly. More specifically, the terms for accessing mortgage loans have become much tighter. The consequence has been a reduction in the number of new homebuyers and a drastic reduction in the number of transactions and house prices (see, CPB, 2013; Boelhouwer, 2014).

Figure 2. Dutch mortgage debt in comparison to other countries



Source: CESifo-DICE (Database for institutional comparisons in Europe)

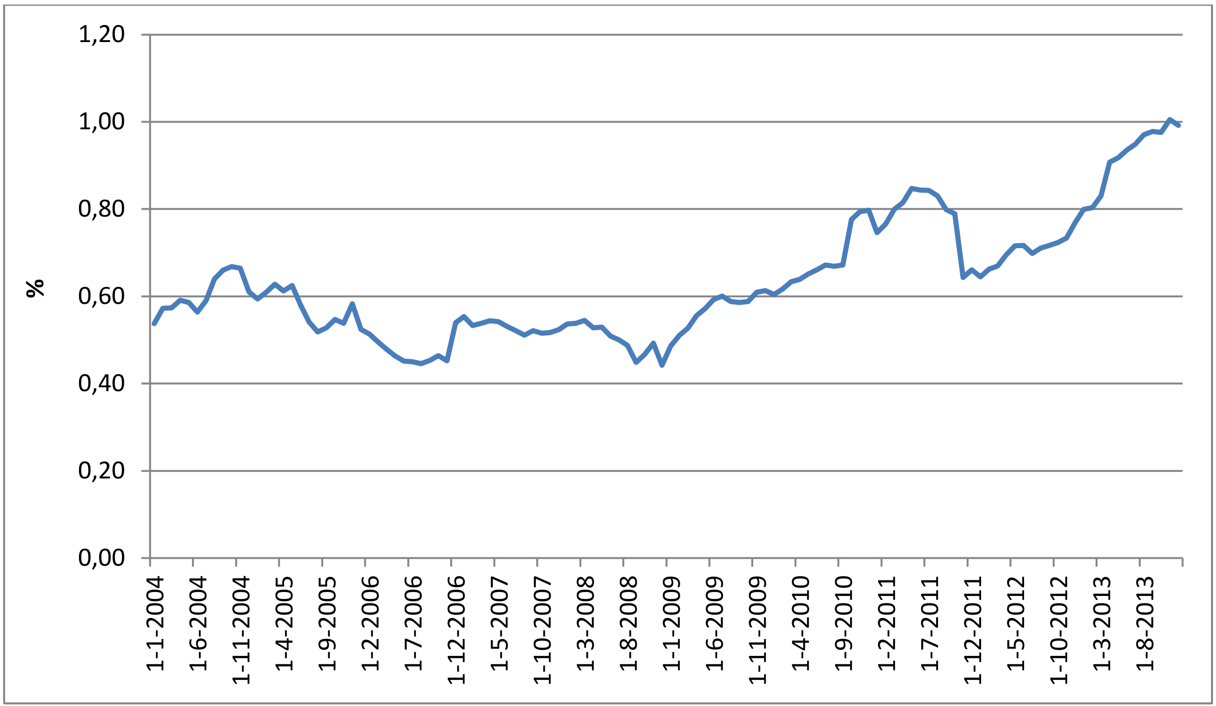
3. Data Description

The data on mortgage arrears consists of the percentage of borrowers in default for 60 days or beyond and was obtained from Moody's (Moody's Investors Service). Figure 3 shows that, as mentioned earlier, loan default rose sharply after 2008; the monthly average until the end of 2008 is about 0.54%; this rose to 0.74% between 2009 and 2013. However, compared to countries such as Ireland and Italy, for example, loan default has remained very low (Fitzsimons, 2013).

The information on family break-up and unemployment was acquired from Statistics Netherlands (CBS; the official statistical bureau of the Netherlands). The number of dissolved families represents the sum of divorce cases, marriages ending due to the death of one partner and discontinued cohabitation. Mortgage interest rates and mortgage debt data were taken from the Netherlands Central Bank (De Nederlandsche Bank; DNB).

DNB categorises interest rates into three groups according to their maturity. The first group includes interest rates with a fixed maturity beyond 5 years. The second includes those with a loan tenure set at between 1 and 5 years. The third group has maturity fixed at below one year. During our study period, from 2004 to 2013, the total mortgage debt consisted of over 95% of loans with a maturity beyond 5 years. We therefore only consider interest rates from this category in this paper. On the other hand, mortgage debt figures are the total of all mortgages given to households for home purchases, based on a combined statistical report compiled by DNB using data from the individual Dutch financial institutions.

Figure 3. Monthly proportion of mortgagors in arrears for 60+ days



Source: Moody's

All the time series were obtained in monthly frequency. Except for arrears (due to the very small values), a logarithmic transformation is used to stabilise the variability and reduce the range disparity of the figures. This practice is advocated in the literature by for example, Shumway & Stoffer (2010) and Wooldridge (2012). Table 1 gives the summary statistics relating to the untransformed data for this paper.

Table 1. Data summary and description

Variables	Description	Average	Deviation	Max	Min	Source
PA	Payment arrears	0.635	0.1401	1.000	0.440	Moody's
DF	No. of dissolved families	7 369	395.85	8 423	6 484	CBS
UR	Unemployment rate	5.183	1.0303	7.600	3.200	CBS
MD	Total mortgage debt	369.6	22.863	399.1	304.3	DNB
IR	Mortgage interest rates	4.798	0.1455	5.250	4.500	DNB
CD	Crisis dummy	…	…	…	…	…

Max and Min are the maximum and minimum time series value respectively. The number of family break-ups is shown in absolute values. Mortgage debt is in millions of euros and the rest of variables are in percentages.

4. Empirical methods and techniques

The impact of high mortgage indebtedness and socio-economic phenomena such as divorce and unemployment on mortgage repayment is in most cases not immediate. It may take several months before there are any serious repercussions on the affected household. We use an aggregate distributed-lag model to examine these lagged effects. A distributed-lag model basically considers the dependent variable as a linear function of past (and sometimes present) values in the explanatory variable(s). An estimation of the parameters of interest can mostly be achieved by ordinary least square (OLS) regression techniques.

All the time series involved in this regression must either be stationary or co-integrated; otherwise the results would be spurious. Stationarity is a desirable property for time series variables, implying that their mean and variance do not change over time. That is, they may randomly fluctuate up and down, but remain constant on average and stable in their development over time. If time series were to wander and become unstable, it would be difficult to examine how they associate with each other over time, unless of course, they wander in a similar manner and their association is thus preserved. Such a class of time series is referred to as co-integrated variables and their over-time relationship may also be studied.

The estimation of the distributed-lag model must therefore be preceded by pretesting. First, the stationarity properties of the time series must be examined. Second, a probe must be conducted to establish whether co-integration exists between the variables. Based on the first and second steps, a suitable distributed-lag model can then be formulated to estimate the lagged effect of the explanatory variables. A more technical account of how to perform each of these tests and estimation results is presented below.

4.1 Testing for Stationarity

The class of stationary time series is denoted by $I(0)$. There are also time series which must first be differenced to obtain this stationarity property. These are called unit root or first-order integrated time series, and are represented by $I(1)$. The difference operator is Δ and involves subtracting past values from current ones (i.e. $\Delta y_t = y_t - y_{t-1}$, for a time series y_t). Testing for these stationarity properties in a time series is commonly done using the augmented Dickey & Fuller procedure (1979, ADF elsewhere) or the Kwiatkowski et al. (1992, KPSS elsewhere) procedure. The difference between these two is that, while the first tests the null hypothesis that y_t belongs to the class $I(1)$, the null for the latter assumes that y_t is an $I(0)$ element.

When the time series exhibit structural breaks, however, these two techniques are known for producing unreliable results (see e.g., Perron, 1989; Narayan, 2005; Pfaff, 2008). The period of our study exhibits potential structural shifts from 2008 (see Figure 3 & 4), and the structural breaks are thus accommodated in this paper with the unit root test of Zivot & Andrew (1992, ZA test hereafter) and the stationarity test of Becker, Enders & Lee (2006, BEL test hereafter).

The ZA test controls for one time break which is determined endogenously from the data without assuming prior knowledge of the break date. Two versions of the ZA test were implemented. Model A, which assumes breaks in mean or intercept and Model C, is based on the assumption that there is a break in both the mean and slope (or direction of growth) of the time series. For the time series y_t, the specifications of the models take the respective forms, (1) and (2) below.

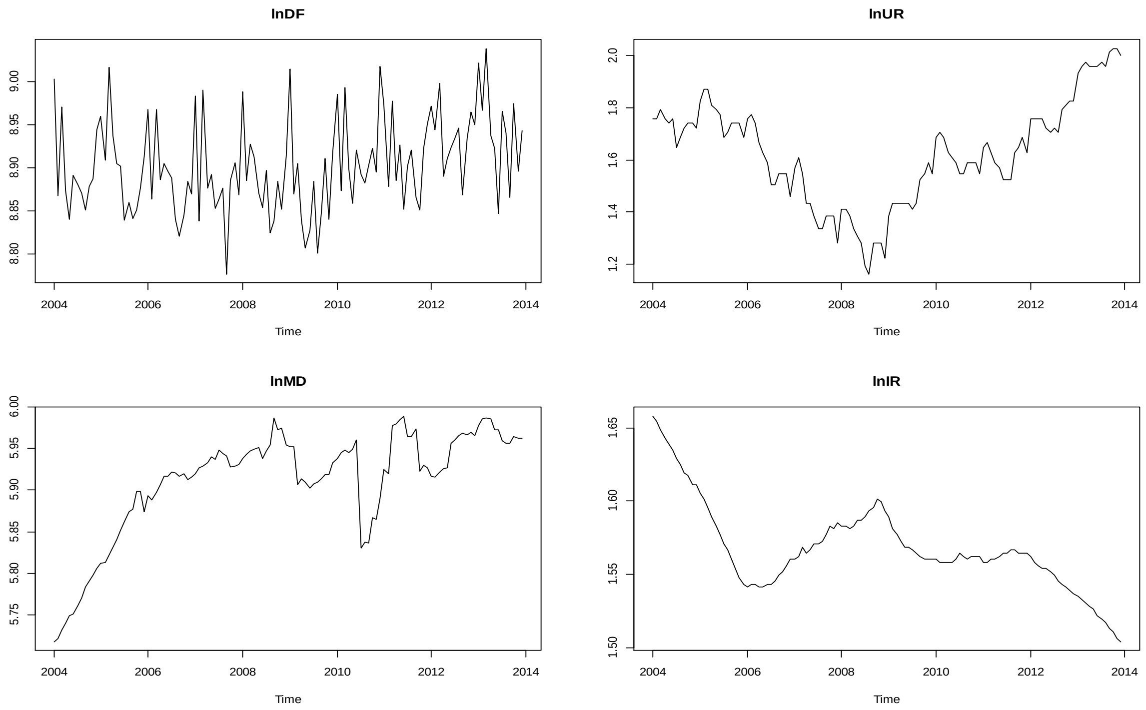
$$\Delta y_t = \mu + \rho y_{t-1} + \gamma t + \beta M_t + \sum_{j=1}^{k} \alpha_j \Delta y_{t-j} + \varepsilon_t \quad (1)$$

$$\Delta y_t = \mu + \rho y_{t-1} + \gamma t + \beta S_t + \sum_{j=1}^{k} \alpha_j \Delta y_{t-j} + \varepsilon_t \quad (2)$$

By notation, ε_t is a mean-zero error term assumed to be a white noise sequence with a variance of σ. The augmented lag k must be optimally chosen using information criterion (e.g., BIC or AIC) to adjust for serial correlation in the error term. M_t and S_t are dummy variables that respectively capture the shift in mean and slope at the unknown break date, say τ. By definition, $M_t = 1_{(t>\tau)}$ and $S_t =$

$(t-\tau)1_{(t>\tau)}$. The notation $1_{(.)}$ is the zero-one indicator function. The null hypothesis for the test is $H_0: \rho = 0$ and defines the hypothesis that y_t belongs to $I(1)$ without structural breaks against the alternative that the series is trend stationary with a break at some unknown period τ (see, Pfaff, 2008; Narayan, 2005).

Figure 4: Covariates in the natural log transformed



The BEL procedure, on the other hand, tests the stationarity null directly, allowing for any possible number and form of structure breaks. More precisely, the BEL technique investigates the stationarity of a time series by adding the so-called optimal Fourier series components ($sine$ and $cosine$ functions) to the test regression. The set-up estimates the regression of the form:

$$y_t = a + bt + a_k \cos\frac{k\pi t}{T} + b_k \sin\frac{k\pi t}{T} + e_t \qquad (3)$$

and obtains the test statistic $\tau_\mu(k)$ or $\tau_\tau(k)$, corresponding to whether b is zero or not. The test-statistics are computed as:

$$\tau_\mu\ (k),\ \tau_\tau(k) = \frac{1}{T^2}\frac{\sum_1^T \tilde{S}_t^2(k)}{\tilde{\sigma}^2} \qquad (4)$$

where $\tilde{S}_t(k) = \sum_{j=1}^{t} \tilde{e}_j$ is the partial sum of the estimated OLS residuals from (3), and $\tilde{\sigma}^2$ is the consistent estimator of the long run variance of e_t using $\tilde{e}_j$. In practice, $\tilde{\sigma}^2$ is computed as $\tilde{\sigma}^2 = \tilde{\gamma}_0 + 2\sum_{j=1}^{l} w_j\, \tilde{\gamma}_j$, with truncated parameter l, a set of weights w_j and the sample autocovariance of the residual $\tilde{\gamma}_j$. The authors also suggest choosing the optimum value of the integer k in the interval 0 to 5 such that the sum of squares of errors is minimal.

4.2 Testing for co-integration

The ARDL bound co-integration techniques of Pesaran, Shin & Smith (2001) are adopted for this paper. This method is flexible and suitable for handling several variables when a mixture of both $I(0)$ and $I(1)$ time series are involved. Unlike other methods in the literature, you can also explicitly specify the dependent and independent variables to be tested for co-integration. The first step in the process is to estimate a conditional autoregressive distributed lag (ARDL) model. For the time series in this paper, AR, lnF, $lnUR$, $lnMD$ and $lnIR$, this equation takes the form:

$$\Delta PA_t = \theta + \alpha CD_t + \sum_{k=1}^{p} \beta_k \Delta PA_{t-k} + \sum_{j=0}^{q} \pi_j{}' \, \Delta X_{t-j} + \gamma' X_{t-1} \; + \; \delta AR_{t-1} + \; \mu_t \qquad (5)$$

Here, CD_t the dummy variable for the crisis is defined as 1 from 2008 to 2013 and zero otherwise. $X_t \equiv (lnDF, lnUR, lnMD, lnIR)_t'$ and the quantities γ and π_j are 4-vectors while θ, α, β_k and δ are the coefficients. The lags p and q can be chosen optimally using any information criterion (AIC or BIC) to ensure the serial independence of the error sequence μ_t and dynamic stability of the model. What is also important is the decision to add a time trend depending on the stationarity properties of the time series.

The actual co-integration test was performed in the second step and involved testing the null hypothesis H_0: $\gamma' = (0,0,0,0)$; $\delta = 0$. Because elements of $I(0)$ and $I(1)$ are both included, the distribution of the F-statistic and hence the critical values derived by Pesaran et al. (2001) are non-standard. Separate cases for purely $I(0)$ and for purely $I(1)$ elements are considered to form what are respectively called the lower and upper critical bounds. These bounds themselves depend on the number of regressors and the sample size. The decision on co-integration depends on where the computed F-statistic lies relative to the upper and lower critical bounds of Pesaran et al. (2001). If this value is greater than the upper critical bound, the null of co-integration cannot be rejected. The null is rejected if the computed F-statistic is less than the lower bound, and no valid conclusion can be drawn when this figure falls between the critical bounds. The F-statistic here is equivalent to the Wald-statistic nonetheless.

5. Estimation techniques and results

5.1 Stationarity

The two stationarity test results are shown for the 5% significance level in Tables 2 and 3. For the time series, PA, $lnMD$ and $lnIR$, the results of the ZA and the BEL tests do not differ. Each test recognises them as $I(1)$. Similarly, both tests identify $lnDF$ with $I(0)$ as expected (see Figure 4). On the other hand, the status of $lnUR$ vary for ZA and BEL. While ZA detects $lnUR$ as $I(1)$, the BEL approach considers $lnUR$ as being $I(0)$.

For the purposes of this paper, we only require the highest order of integration for the time series. Particularly for the ARDL-bound techniques, once we have established that none of the time series is integrated beyond the first order, a possible co-integration relationship amongst the variables can be tested. This framework, whereby a combination of both $I(0)$ and $I(1)$ elements can be used, is what makes the ARDL-bound method very appealing. This cannot be done for the other methods discussed in the literature, where variables must necessarily be $I(1)$ (see, Johansen & Juselius, 1992; Johansen, 1988).

Table 2. ZA - test statistics

	Levels		First – difference		
Variables	Model A	Model C	Model A	Model C	Status at 5%
PA	-2.6235(0)	-2.8177(0)	-10.4774**(0)	-10.7960**(0)	*I(1)*
$lnDF$	-5.7909**(1)	-5.9271**(1)	-12.5148 **(1)	-12.7296**(1)	*I(0)*
$lnUR$	-3.3325(0)	-4.3831(0)	-11.5252**(0)	-11.5083**(0)	*I(1)*
$lnMD$	-3.6496(0)	-3.7957(0)	-7.76720**(0)	-7.78350**(0)	*I(1)*
$lnIR$	-3.7383(1)	-3.1530(1)	-5.71840**(1)	-5.69730**(1)	*I(1)*

Critical values	Model A	Model C
5Pct	-4.80	-5.08
1pct	-5.34	-5.57

Critical values are taken from Zivot & Andrews (1992). ** and * denote significance at 1% and 5% respectively. Numbers in brackets indicate the augmented lags selected using BIC.

Table 3. BEL - test statistics

	Levels		First – difference		
Variables	Intercept only	*k*	Intercept only	*k*	Status at 5%
PA	0.2763**	1	0.1949	3	*I(1)*
$lnDF$	0.1447	1	0.1795	4	*I(0)*
$lnUR$	0.1085	1	0.0597	1	*I(0)*
$lnMD$	0.6089*	2	0.1585	1	*I(1)*
$lnIR$	0.6077*	3	0.1173	1	*I(1)*

Critical values

k	1	2	3	4	5
5pct	0.1703	0.4044	0.4296	0.4544	0.4534
1pct	0.2740	0.6638	0.6989	0.7209	0.7332

Critical values are obtained with $T = 120$ and 50,000 Monte Carlo simulations according to Becker, Enders & Lee (2006:388). The truncation parameter was set equal to 9 in all cases following Pfaff (2008). ** and * denote significance at 1% and 5% respectively.

5.2 Co-integration

The estimate for equation (5) must be preceded by selecting appropriate values for p and q to adjust for serial correlation in the error term and to ensure the dynamic stability of the model. Besides that, p and q must not be too large to avoid over-parametrising the model. Therefore, with the aid of an information criterion, Pesaran et al. (2001) propose setting $p = q$ and estimating the optimal lags from an underlying VAR model. In this paper, a range of values from 1 to 8 is considered using the Akaike information criterion (AIC) and the Schwarz Bayesian information criterion (BIC) to select the optimum value of p. Whereas AIC chooses 3 as optimal for p, BIC suggests using $p = 1$. For robustness, the co-integration test was carried out for both lags (1 and 3), and the results are reported in Table 4.

In addition to the lag selection, two versions of (5) are also considered: one with unrestricted intercept, and a second with both unrestricted intercept and unrestricted deterministic time trend. As is apparent from the table, the F-statistics in all cases, either AIC or BIC with each of the two models, are below the lower critical bound even at the 10% confidence level. According to the procedure of Pesaran et al. (2001), therefore, the null of co-integration among the time series with PA as the dependent variables must be rejected. This suggests that the trending behaviour in the time series PA is not driven by stochastic phenomena that are common to the explanatory variables (Lütkepohl, 2005). Most importantly of all, the result indicates that the distributed-lag regression model cannot be estimated at the levels of the time series since not all are $I(0)$.

Table 4. Bounds co-integration test

F-statistics		Bound critical values			
Without time deterministic trend		5%		10%	
AIC	BIC	*I*(0)	*I*(1)	*I*(0)	*I*(1)
1.394	1.391	2.86	4.01	2.45	3.52
With time deterministic trend					
AIC	BIC				
1.809	2.073	3.47	4.57	3.03	4.06

The test is based on $ARDL(1,1,1,1,1)$ for BIC and $ARDL(3,3,3,3,3)$ for AIC. Bound critical values are taken from Table *CI*(iii) and *CI*(v) of Pesaran, Shin & Smith (2001).

5.3 The lagged effect

The model specification for the lagged effects depends on the stationarity property of the time series and co-integration results, as discussed in Section 4. If all the time series were $I(0)$, a distributed-lag model could be estimated in levels directly. For co-integrated variables, the consequence of Pesaran et al. (2001) procedure also allows us to estimate a distributed-lag model in levels. However, the test results in the previous section suggest that we have a mixture of both $I(0)$ and $I(1)$ time series which are not co-integrated. We must therefore be more cautious about avoiding the spurious regression problem (see, Granger & Newbold, 1974; Section 4).

The appropriate way to proceed, then, is to difference the time series so that each of them becomes stationary and can be included validly in the distributed-lag model. The resulting model is given by (6), from which the long-run elasticity (LRE) can be deduced to assess the effect of each covariate. The LRE indicates the cumulative effect of a unit change in the covariate on the dependent variable over the period for which the lags are significant (Pesaran & Shin, 1998; Wooldridge, 2012).

$$\Delta PA_t = \alpha_0 CD_t + \sum_{j=1}^{r} b_j\, \Delta lnDF_{t-j} + \sum_{j=1}^{m} c_j\, \Delta lnUR_{t-j} + \sum_{j=1}^{n} \varphi_j\, \Delta lnMD_{t-j} + \textstyle\sum_{j=1}^{o} \phi_j\, \Delta lnIR_{t-j} + e_t \tag{6}$$

A top-down approach was followed to determine the appropriate lags for each of the explanatory variables. Starting from 15, insignificant lags are deleted and restricting the lag structure was initially avoided. The value 15 was chosen because of our supposition that effects of the explanatory variables on arrears are not immediate and may take several months to have any significant impact. Table 5 shows the estimates of (6). Using the top-down techniques, the influence of mortgage interest rate on arrears was found to be insignificant. This could reasonably be due to the fact that the interest rates are fixed for longer periods so that an increase will have less impact on ability to pay, unlike in the case of floating interest rates. Moreover, the general downward trend in interest rates (see Figure 4) also means that the inherent risks during renegotiation at the end of the initial tenure would also dissipate.

Table 5. Estimates of lag effects based on $ARDL(\mathbf{0}, \mathbf{12}, \mathbf{3}, \mathbf{8}, \mathbf{0})$

covariate	lag	estimates	std. error	p-value	Covariate	lag	estimates	std. error	p-value
	1	0.1839	0.0710	0.0113	CD	0	0.0017	0.0032	0.5892
	2	0.2381	0.0852	0.0065		1	0.1443	0.0690	0.0396
	3	0.1261	0.0893	0.1618	$\Delta lnUR_t$	2	0.0021	0.0676	0.9752
	4	0.1295	0.0881	0.1454		3	0.1939	0.0701	0.0070
	5	0.1950	0.0894	0.0320		1	0.0789	0.1392	0.5723
$\Delta lnDF_t$	6	0.2301	0.0940	0.0164		2	0.1277	0.1393	0.3619
	7	0.2216	0.0978	0.0260		3	-0.551	0.1396	0.0002
	8	0.2441	0.0976	0.0143	$\Delta lnMD_t$	4	-0.021	0.1398	0.8783
	9	0.3136	0.0889	0.0007		5	0.1796	0.1409	0.2060
	10	0.2491	0.0907	0.0074		6	0.3202	0.1406	0.0253
	11	0.0859	0.0915	0.3508		7	-0.109	0.1377	0.4303
	12	0.1943	0.0763	0.0127		8	-0.433	0.1380	0.0023

Residual error is 0.0243, $R^2 = 0.4492$, adjusted $R^2 = 0.2900$. The Breusch-Godfrey (BG) and Durbin-Watson (DW) statistics are 1.2923, 1.747 with respective p-values 0.2424 and 0.2656.

The effect of unemployment runs to the third lag (i.e., $m = 3$) while the influence of family break-ups extends to lag 12 (i.e., $r = 12$). The model also suggests that mortgage debt has an impact up to the eighth month (i.e., $n = 8$). The distribution structure of the lag estimates reveals that family break-down has an increasing effect from lag one but declines again after the ninth lag. The approximate LRE after controlling for the other variables is 2.4113. The lag structure for the unemployment rate, on the other hand, is V-shaped, suggesting that its impact declines from lag 1 to 2 before rising again in the third lag with an LRE of 0.3403. In the case of mortgage debt, the lag distribution fluctuates between positive and negative values with an LRE of -0.4076. The fluctuating values may suggest that there may be a problem with multicollinearity within its lags but could also reveal a complex dynamic relationship between mortgage acquisition and arrears in the Netherlands.

Two restrictions are imposed on the lag distribution to address the possibility of multicollinearity and clarify the dynamic association. First, the effect of mortgage debt on arrears is assumed to trend downwards in a linear fashion and to reach zero after twelve months. Second, it is supposed that the effect declines from lag 1 to 6 and then rises again gradually to a peak at lag 12. Dealing with multicollinearity in distributed-lag models in this way is strongly advocated in the literature (see, Wooldridge, 2012; Whittington et al., 1990).

Interestingly, in both restricted models, the estimate of the LRE for mortgage debt has a negative sign. The respective values for the first and second restricted models are -0.1930 and -0.4369. Together with the initial unrestricted model, these results point to an inverse correlation between mortgage uptake and arrears in the Dutch housing market. Particularly during our study period, it is expected that before 2008, when the economic situation remained very good in the Netherlands and there were many motivations for acquiring mortgage debt, the mortgage debt would rise but that there would be few people in default. The contrary is also true from 2008 to 2013 during which time the economy was in crisis (see Figure 3).

The implication of the crisis for those acquiring large mortgages prior to 2008 is however predicted to be moderate because of the unique characteristics of the Dutch housing market. For example, the tax deduction incentive, which boosted the level of loans before 2008, broadly favours higher-income groups, who equally have the lowest chance of defaulting. Dutch financial institutions also scrutinise income closely to ensure that those who apply for larger loans will be able to make the regular monthly repayments. There is therefore no such thing as 'predatory lending' whereby people are given loans and they immediately get into problems with the payments even without any change in their socio-economic conditions. Moreover, with the proliferation of different loan products, most of the homeowners who acquired large mortgages have lower monthly expenses (interest-only mortgages) which may not in fact be too burdensome. In sum, the debt level itself may not be the main problem for individuals. Its effect may only become pronounced when it coincides with unemployment or family break-up, which is also the argument of the NVB (2014).

The effect of unemployment rate is also very small. Its lag distribution suggests only a short-term impact on arrears. Considering that the Netherlands enjoys a rather generous social security system and that Dutch workers also have compulsory unemployment insurance, another possibility is that those who are made redundant may temporarily withhold payments until they have completed the processes required to arrange these benefits or found new jobs. Furthermore, finding a job does not generally take long in the Netherlands. On average, it should take about six months for university graduates to find new jobs based on extrapolated statistics from the CBS. For workers with many years of experience, this period may even be shorter.

The preceding results also affirm the existing notion that family break-ups remain the key risk factor for mortgage default in the Netherlands. Family break-up has the highest LRE and the longest identified significant lags, up to 12. The lag distribution shows a rising impact on arrears between the first and ninth months and then falling again till the twelfth month. This is as expected. A recent phenomenon is that most Dutch households enter into homeownership at the start of their marital relationships. At that time, their combined income is usually enough to access larger mortgage loans. Problems can then arise in the event of divorce or separation, when one partner leaves the home and the payments become too large for one individual to bear. As the figures in Table 1 show, family break-up has remained high over the years in the Netherlands.

5.4. Effect of the financial crisis

The estimate of the crisis dummy is correctly signed though not statistically different from zero. Of course, the number of mortgage defaults remained very low even during the crisis and it is tougher to evaluate what happened empirically during the period at the aggregated level. However, there are a few issues that may possibly have contributed to a higher incidence of mortgage default during the credit crisis. Firstly, as discussed in the preceding section, it is important to note that there are social security safety nets for unemployment in the Netherlands. Nevertheless, because an unemployed person may temporarily suspend mortgage repayments, the rising redundancy rate during the crisis may have played a role in the rising trend in the aggregate number of arrears after 2008. For example, the NVB (2014) attributes about 18% of arrears to unemployment in 2013.

Note that the link would be quite different if we were to consider unemployment and foreclosure. As mentioned previously, the effect of unemployment rate is only up to three months and in the Netherlands foreclosure cannot occur within such a short period of non-payment. The Dutch banks customarily have good mediation processes in place which allow troubled debtors some time to take steps to mitigate their situation or be advised on voluntary sales (NVB, 2014). Unemployment may not therefore necessarily add significantly to foreclosure.

Another issue to consider is the role of house prices in combination with family break-up and the NHG scheme. It is important to recall that those signed up to the guarantee are insured against residual debts if foreclosure should occur due to divorce, redundancy or ill-health. In the years preceding the crisis in 2008, as house prices continued to rise significantly, a divorced or bereaved person could often sell off their home immediately and pay the mortgage to avoid any extra financial burden. However, after 2008, as house prices declined sharply and many people were suffering from negative equity, it is possible that these same individuals wishing to take advantage of the guarantee scheme to offset residual debt could relinquish their loan repayments completely. It is not surprising, then, that between 2008 and 2013, the number of foreclosure auctions increased to record levels, and many of these cases coincided with divorces (see, Van Dalen et al., 2013). However, the NHG scheme has a strict scrutiny process in order to qualify for such benefits and the situation may thus be different to that in the US where there is no recourse and the so-called 'equity theory' becomes operational. In fact, the influence of house prices on default is not significant when explicitly included in (6) or in a lagged regression where only house prices are considered.

6. Conclusion and discussions

The recent rising trend in mortgage arrears in the Netherlands needs urgent attention if the stability of the financial institutions and that of the wider Dutch housing market are to be maintained. Using monthly data from 2004 to 2013, this paper has analysed the risk factors associated with this phenomenon and traced the effects of the current financial crisis. As has been widely speculated, the paper revealed that neither the level of mortgage debt nor the interest rate play a significant role in mortgage defaults. This may be due in part to the structure of the housing market where individuals can obtain sizable loans but only when they are able to afford the monthly repayments. There is no such thing as 'predatory lending' in the Dutch housing market. The popularity of interest-only mortgage loans allowed higher LTV ratios, but it also reduced regular mortgage outlays so that repayments were not burdensome. It is true that higher mortgage debt may place the government in a situation where the cost of financing sovereign debt becomes excessive, but otherwise the level of mortgage debt may not be so much of an issue after all.

The most important risk factors are perhaps unemployment and the break-up of families. Despite the Netherlands' compulsory unemployment insurance and social security cover, it was found that those becoming redundant can suspend repayments temporarily. Nevertheless, any period of non-payment is normally brief and does not generally lead to foreclosure sales. On the other hand, the effect of family break-down on mortgage arrears goes much further. More specifically, the break-down of Dutch families has the longest-lasting effects on loan default in the context of this paper. It can lead to foreclosure in cases when the NHG is required to pay for residual debt or the banks bear the monetary consequences in cases of personal bankruptcy. One way to limit the impact may be to cap the maximum LTV ratio obtainable by couples. As discussed previously, at the beginning of their union Dutch couples usually obtain loans with higher LTV ratios for which the repayments would not be sustainable by one of the partners alone, in the unfortunate event of a break-up.

It is worth noting, however, that we have performed this analysis with aggregated data and individual situations have therefore been obscured. This weakness in the paper could be overcome using a thorough study using micro household-level data. We would also suggest that future research should compare the default rate amongst NHG and non-NHG debtors in order to determine definitively whether it is true that Dutch homeowners have not defaulted at will due to the loss of home equity.

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