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Mortgage Investments by Pension Funds After the Financial Crisis

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Disclaimer

Preliminary results of the analysis presented in this study, have already appeared in the bachelor thesis “Direct Residential Mortgage Investments in Dutch Pension Fund Portfolios” by Jakub Polansky, supervised by Mauro Mastrogiacomo. Mauro Mastrogiacomo is a co-reader of this paper.

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Abstract

The paper studies a cause of recent increases in mortgage investments by pension funds and finds it from their experiences in recovery process after the crisis as well as the new financial assessment framework(FTK) introduced in 2015. Pension funds that were subjected to recovery plans are identified as less-immunized funds, and I hypothesize that a low degree of immunization has motivated pension funds to invest more in mortgages after the crisis. They have been seeking better risk/return trade off, and mortgages have become even safer investments since the introduction of several new regulations, and they seek to further hedge their interest rate risks. This is the first academic paper using DNB (Dutch Central Bank)'s unique and new dataset, loan-level Data(LLD) on institutional investors, since it has never been collected before. Both descriptive statistics and the estimation results of the difference in difference approach reveals the validity of my hypothesis. Low immunization and new supervisory frameworks are the cause of the recent surge in mortgage holding by pension funds.

Chapter 1 Introduction

The residential mortgages market has traditionally been the playing field of banks. However, as of the end of 2015, only 48 percent of newly issued mortgages were funded by the three biggest banks in the Netherlands; instead, almost a quarter of new mortgages were provided by 'regiepartijen', "rapidly growing non-bank lending platforms that use brokers or websites to sell home loans on behalf of institutional investors" (Hale, 2016a). The main customers of 'regiepartijen' are pension funds and insurance companies[1]. This is a quite interesting and new phenomenon and motivates this study, where I enquiry the mortgage investment by pension funds after the crisis and the characteristics of these new loans compared with the previous loans they supplied. This study presents new empirical evidence on the housing debt held by pension funds using a new and unique dataset, the Mercurius loan-level Data of De Nederlandsche Bank (DNB). Such data have never been gathered before, and this is the first academic study to use them. This micro-dataset contains loan-by-loan information on mortgage debts written by insurance companies and pension funds. This work focuses on the latter and combines the micro data with the balance sheet information of the funds. In this way, it is possible to simultaneously observe the characteristics of the issued debt (for instance looking at the LTV (Loan To Value) or LTI (Loan To Income) of the borrower) and of the fund (age distribution of the participants or the funding ratio).

I test the hypothesis that the recent increases in mortgage investments by pension funds are due to their having experienced recovery modes in the past and being subject to the new assessment framework for pension funds after the financial crisis. The new supervisory framework introduced in the Netherlands in 2015, the so called new FTK (Financial Assessment Framework, Financieel Toetsingskader in Dutch), requires pension funds to maintain high performance (for instance by imposing a threshold on the required funding ratio), manage risk (by introducing risk assessment (risicohouding) requirements), and conduct stress-tests (haalbaarheidstoets)). My hypothesis is that Dutch mortgages are very safe products; therefore, they should be appealing investments for pension funds that need to rebalance their investment decisions in terms of the risk/return trade-off, due to the last two FTK requirements listed above. Moreover, mortgages are long-duration assets that well hedge against the interest rate risk of pension funds (due to their long-term liabilities); they

[1] Further research conducted by DNB (DNB, 2016f) shows that insurance companies tend to keep issued loans on the balance sheet of their bank branch. This nuances the view that most banks are rapidly dismissing their mortgage investments.

should be especially attractive investments to funds that suffered most during the recent recession and could be more penalized within the new FTK. Therefore, this study focuses on the combined effects of the recession and the introduction of this new supervisory framework.

I test my hypothesis by looking at the difference in mortgage investments in recent years by pension funds that had less-immunized investments before the crisis. The immunization strategies of the funds are not actually observed, but this study infer them by instead looking at the historical performances of pension funds around the crisis. Pension funds that were underfunded during the crisis and thus forced into a recovery plan afterwards are considered less-immunized. The link with the new FTK is built on two ideas. The first is that this framework became operative in 2015. The second is that the basic principle of the new framework is that only financially solid funds have autonomy in making their management decisions (e.g. indexing benefits or lowering premiums). Their financial solidity is linked not only to the level of their funding ratios, but also to their approach to risk in investment which is also stress-tested. In this regard, less(low)-immunized funds might want to make their investments safer and further hedge their interest rate risks by issuing more mortgages also as a consequence of the new FTK.

If that is the case, is the combined effect of the crisis and the new FTK the cause of the increased mortgage investments of pension funds? This study investigates this possibility by considering the changes in funding ratios (the ratio of assets to liabilities) and experience of undergoing recovery mode by most pension after the financial crisis due to the supervisory framework. In fact, after the crisis, almost three-quarters of all pension funds marked record-low funding ratios below the required minimum of 105% and have been in recovery modes (DNB, 2014a). Since the new regulation mandating the financial assessment of pension funds was introduced in 2015, the importance of pension fund sustainability in terms of the funding ratios has been more emphasized. In addition, the prolonged low interest rate period and the new discount rates set in the 3rd quarter of 2015 have undermined the financial position of pension funds. Moreover, Dutch mortgages, which were already subject to a full recourse system, have become even safer assets since the full amortization rules and a cap on LTV were introduced in 2013. In this regard, pension funds in 2015 might have been tempted to invest more in safer products; this would be particularly true for those funds that were in the recovery mode and had to take several financial actions (increasing premiums, reducing pension benefits or temporal discontinuity in indexation) or performed poorly during stress-test exercises. In these circumstances, they might have been more willing to hedge their

interest rate risks, and they might have been more risk-averse, under the condition that their funding ratios were not too low. In this regard, mortgages would be highly appealing to less-immunized pension funds.

In general, my results suggest that there is a combined effect of the original supervisory framework, exemplified by the imposition of recovery mode, and the new FTK introduced in 2015 on the mortgage investments of less-immunized funds. Also, the results show that pension funds tend to invest in safer debt (at lower LTV/LTI levels).

The rest of this study is organized as follows. Section 2 presents the literature review and background knowledge. The immunization strategies of pension funds and the mortgage investments of pension funds after the financial crisis will be examined in relation to the literature and through consideration of statistical evidence. Section 3 presents the unique dataset and methodology along with descriptive statistics. Section 4 reports empirical results and robust checks. Finally, Section 5 discusses the policy implications and provides conclusions.

Chapter 2 Literature Review and Background Knowledge

2.1 Immunization Strategy of Pension Funds

2.1.1 Immunization Strategy as Liability Driven Management

In this study the empirical proxy for less-immunized fund is based on the observation of the performance of pension funds during the recession. The concept of immunization strategy is actually more articulated and it is defined in the literature as follows. Leibowitz (1986) simply describes that it is a strategy of "portfolio construction" for an investor to "immunize a schedule of liabilities against a certain range of interest rate movements" (p.48). Before him, Grove (1974) reveals that "under the immunization rule, the decision maker always chooses equal values of the weighted durations of his asset and liability streams, i.e., he always acts to hedge his net worth against interest rate movements" (p.697). In addition to this duration matching, it also can be conducted by cash-flow matching. According to Inglis et al. (2013), immunization is achieved when the cash inflows of the portfolios are matched to the cash outflows of liabilities. In summary, it is an investment strategy immunizing liabilities against interest rate changes by matching the duration (or cash flow) of assets with those of liabilities. This strategy is especially attractive to insurers and pension funds, since their long-term liabilities are susceptible to interest rate changes. This will be demonstrated more in detail below especially with the case of pension funds.

According to Bauer et al. (2006), the future financial position (funding ratios: market value of assets divided by market value of liabilities) of pension funds is dependent on exogenous economic variables (interest rates and inflation), and policy variables (contribution, indexation, and investment policy). In relation to the asset liability management of pension funds, Bauer et al. (2006) also distinguish various factors affecting liabilities from those affecting assets. On the one hand, the values of their liabilities fluctuate due to interest rates, inflation, and demographic factors (retirement age, life expectancy). On the other hand, the changes in their assets are caused by pension payments, contributions, and investment returns. Among those factors, interest rates affect both side of the balance sheet through the discount rate (Bauer et al., 2006). Therefore, immunization strategy can be used to hedge the interest rate risk of pension funds in addition to derivatives (e.g. interest rate swaps). Actually, the simplest Liability-Driven Investment (LDI) is the one that exploits immunization strategy through duration matching to eliminate the effect of interest rate changes (Inglis et al., 2013).

The liabilities of pension funds are highly vulnerable to interest rate moves; the pension benefit itself has extremely long payment schedule, therefore downward(upward) changes in discount rates significantly and upwardly (downwardly) affect the present value of their liabilities. Furthermore, as stated in Keintz and Stickney (1980, p.224), downward interest rate changes have an impact on "the market value of the existing fund assets" in the opposite (downward) direction. Therefore, by properly coordinating the relationships between assets and liabilities, pension funds can be immunized from the market (interest rates) movements (Keintz & Stickney, 1980). There are several ways to achieve immunization of the liabilities of pension funds. Canadian Institute of Actuaries (1996) suggests four methods to match assets to liabilities: annuity purchase, cash flow matching, duration matching, and combination of cash flow and duration matching. Among those, duration matching is simply described by Keintz & Stickney (1980, p.225) as follows.

Assets of a PF × Duration of assets = Liabilities of a PF × Duration of Liabilities

PF indicates pension fund and all terms are evaluated at present value at time t. The equation above is called "a necessary condition for immunization of pension fund from interest rate change" (Keintz & Stickney, 1980, p.232). If a pension fund is immunized in this regard, its net assets (net liabilities) does not change irrespective of interest rate moves. If one assumes that the Present value of liabilities are twice as big as the Present value of assets, the duration of assets should be as twice as long as the duration of liabilities, following the example from Keintz & Stickney (1980, p.233). As the duration of the pension liabilities is quite long, the duration of their assets should be long as well. Bonds generally satisfy this condition since the holding period of bonds is mostly lengthy. One thing to note here is that, especially in this research scope, mortgages are appealing to the pension funds as bonds are because mortgages fulfill this condition as well. With regard to pension funds, this is an intersection point where the immunization strategy and the mortgage investment could meet each other. This will be further explained in the later section.

2.1.2 Partial Immunization of Pension Funds

The identification strategy of the effect of the crisis and the new FTK on mortgage investments is based on the immunization status of the fund. In the previous section, I discussed why pension funds might want to immunize their investments before I mention the

supervisory requirement as a reason. However, do pension funds actually fully immunize their liabilities against interest rate risks? Why don't pension funds or insurers have portfolios made up 100% by bonds in order to perfectly immunize their liabilities and keep their funded status? In this subsection, those issues will be investigated. In fact, as of 2012, pension funds in the Netherlands hedged approximately half of their interest rate risks on average (DNB, 2013a). Their degree and the structure of interest rate hedging is well described in Figure 2.1 (DNB, 2013a) below. Short-term (less than 5 years of maturities) liabilities were fully hedged with the fixed income or interest rate derivatives while the long-term (more than 5 years of maturities) liabilities were only hedged by half. As noted in DNB (2011), the degree of hedging reduces as the maturities of future liabilities increase from 5 to 30 years, and with regard to those beyond 30 years, pension funds scarcely hedge against them.

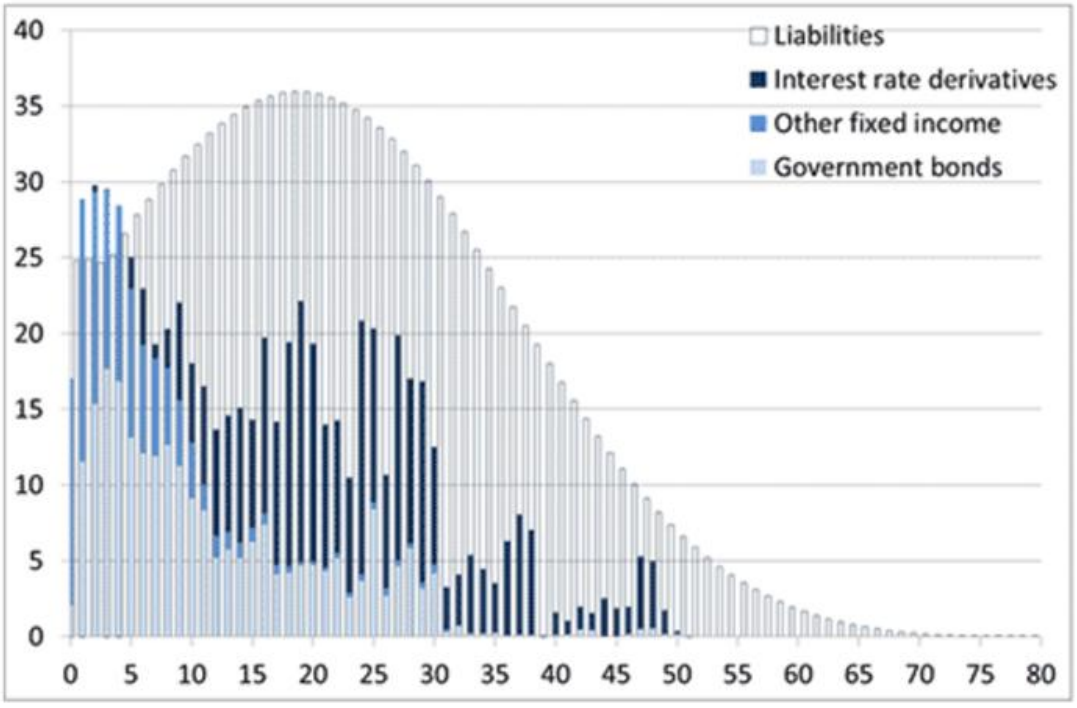

Figure 2.1. Cash outflows of pension benefits (liabilities) and expected cash inflows (redemptions and coupon payments) of investments in fixed-income securities (interest rate derivatives, sovereign bonds, and other fixed-income securities) in EUR billion per year for the next 80 years, year-end 2012. Reprinted from DNB 2013a Figure 1

There are several reasons for this partial immunization of pension funds. A full hedge through buying a series of long-term bonds is literally not feasible. According to Barnes (2012), the size of Dutch pension funds is immense (€800 billion as of 2012), therefore the government bond market cannot absorb those hedging demands. For this reason, large pension funds often rely heavily on derivatives such as swaps and swap options (swaptions)

to better match the interest rate risks they are individually exposed to (Barnes, 2012). The substantial role of interest rate derivatives in hedging can also be found in Figure 2.1. In particular, the maturities beyond 30 years, only derivatives can immunize super-long liabilities because there is no such a lengthy bond. However, small pension funds have less accessibility to those derivatives due to high costs of writing legal contracts, since the more complex the structure of derivatives, the higher the legal documentation costs (Barnes, 2012). Barnes (2012) also mentions that, therefore, small funds rather exploit government bonds and strips to hedge their interest rate changes. In addition, liquidity risk is inherent in the interest rate swaps, in case where interest rates go up. When interest rates increases, the value of the swaps decreases; pension funds should have enough high liquidity bonds (e.g. triple A bonds) or cash at hands as collateral (DNB, 2011). Swap options eliminate those problems but they also require costs (premiums). Other than those practical reasons above, there are also other critical motivations behind their partial hedge, such as risk diversification, yields, and liquidity risk (Inglis et al., 2013). If they put corporate bonds into their portfolios, they are automatically exposed to credit and default risks. Having only treasuries results in low investment returns. Moreover, once actuarial assumptions (life expectancy, working duration, etc.) unexpectedly change, pension funds also have to take the relevant liquidity risks.

For those reasons, institutions only partially immunize their future obligations with partially bond-like portfolio constructions. From a macro-economic perspective, as Clacher & Moizer (2011) note, it might create "bubble" in long-term bond markets if pension funds have too much weight on hedging their estimated liabilities when constructing their portfolios, and thus decrease their exposures in variable-income assets (e.g. equities). This genuinely fits the Dutch pension funds case where pension funds have a large share in Dutch financial market.

2.1.3 Funding Ratios and Immunization Strategy

Funding ratio of the pension fund is defined as "the market value of the fund's assets divided by the market value of the fund's liabilities" (Beetsma et al., 2015, p.16). Funding ratio is one of the most important measures of "financial health" of the pension fund (Beetsma et al, p.16). During the financial crisis, most of Dutch pension funds experienced substantial drops in their funding ratios. As Beetsma et al. (2015) mention, in the early stage of the financial crisis (from late 2007 to early 2008) the funding ratios dropped mostly due to decreases in asset(equity) values while in the later stages (from late 2008 to early 2009) the ratios

significantly tumbled as ‘flight to safety’ behavior was pervasive and interest rates plunged. By virtue of its purpose, an immunization strategy is effective under those sudden market changes, especially for the latter case. Therefore, more-immunized pension funds might have survived better in the financial crisis in terms of their funding ratios. On the contrary, pension funds which showed considerable declines in their funding ratios had to adopt corresponding recovery plans forced by the Dutch Central Bank (DNB): less-immunized pension funds. More-immunized pension funds could avoid this requirement. In this regard, it should be highlighted that less-immunized funds would have different crisis effect on their investment behaviors compared with more-immunized ones. Especially in this paper, the focus is on the mortgage investment by pension funds after the crisis. The intuition is that more-immunized funds must have already had well-structured immunized liabilities and optimized amounts of mortgages in line with their financial structure. Therefore, mortgage funding of those pension funds might have not been severely affected by the financial market conditions or the new FTK; they might have relatively stable mortgage investment behaviors (e.g. investment amount, original LTV ratio, etc.) irrespective of the crisis or new regulations.

2.1.4 Immunization Proxy

In this study, I proxy the (partial) immunization of pension funds based on whether or not they were under recovery mode after the financial crisis. As mentioned in earlier sections, the reasoning is that well-immunized pension funds would have not experienced significant drops in their funding ratios during the financial crisis, consequently not needing to be subjected to the recovery process. The pension funds whose funding ratios were below 105% in 2008 could choose what measures to take such as increasing premiums, reducing or stopping indexation, or cutting benefits, in order to improve their financial position. Therefore, pension funds with funding ratios below 105% in 2008 are defined as less-immunized pension funds, and the ones with funding ratios above 105% in 2008 are more-immunized funds in this study. As can be seen in Figure 2.2 below, the average funding ratios of both types of pension funds showed similar patterns. Even though there were sizable drops in funding ratios for both funds right after the burst of dotcom bubble in 2002, the gap between funding ratios of two types of funds was not very wide. However, in 2008, the average funding ratio of less-immunized one tumbled and almost hit 0.8 while that of more-immunized one showed limited drops (to 1.2), though both funding ratios were almost the same back in 2007; two types of funds showed a big difference in the magnitude of drops in

2008. After 2009, as a result of the recovery plans, the gap of funding ratios between two types of funds have gradually narrowed. Recently, after the new FTK, the average funding ratios of less-immunized one stayed around the required funding ratio (1.05).

Figure 2.2. Average funding ratios of pension funds from 2000 to 2016 categorized by two different types (more-immunized and less-immunized)

2.2 Mortgage Investment by Pension Funds and the Financial Crisis

2.2.1 Mortgage Investment by Pension Funds

Mortgages are often regarded as safe assets the same way as government bonds, due to a number of reasons. Specifically, Dutch mortgages are issued under a full recourse system, which means that legal devices are in place aimed at protecting mortgage lenders in case of default, thus relatively low default rates. For example, in case of inevitable repossession, Dutch mortgage lenders can sell the relevant houses without the court's help (see DNB, 2016d). Moreover, in this case, mortgage lenders have full recourse to borrowers including other assets and even future incomes in addition to the house (Leeuwen & Bokeloh, 2012). As can be seen in Figure 2.3 (Fitch, 2013), the default probability expectation of Dutch

mortgages was estimated as the second lowest (3.8%) among European countries as of January 2013.

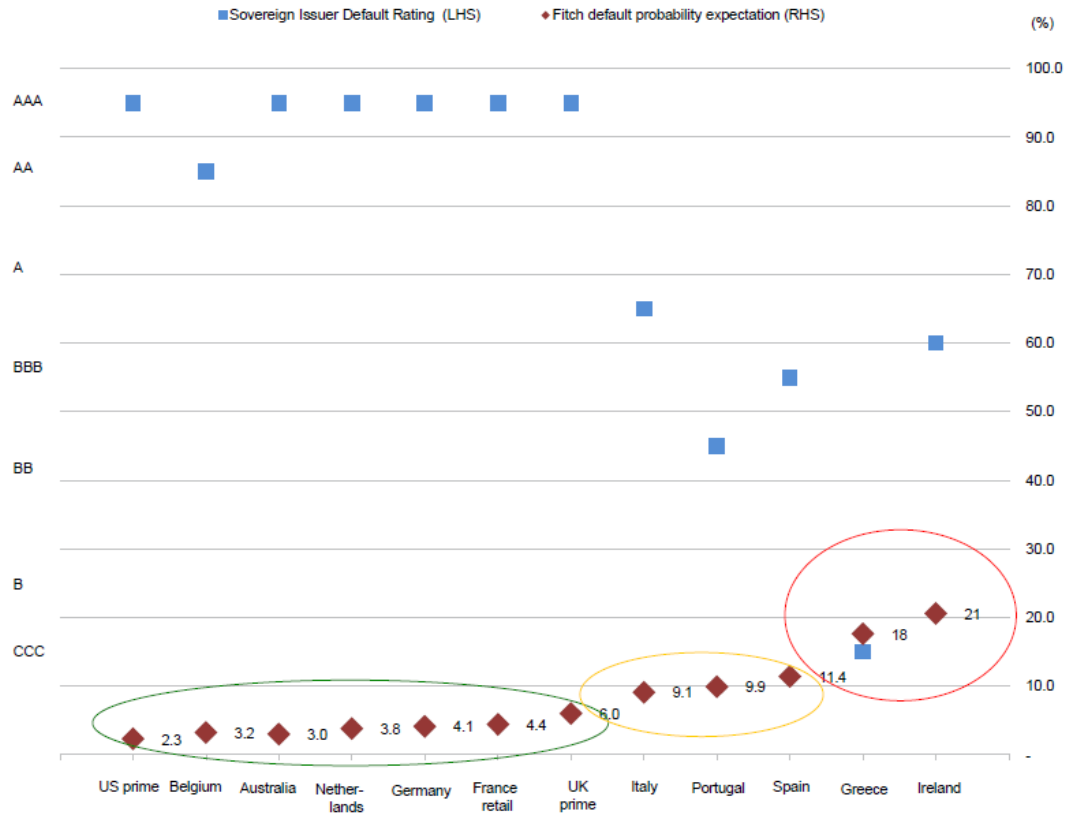

Figure 2.3. Fitch Default Probability Expectation vs. Sovereign Rating. Reprinted from Fitch 2013 Figure 1

Moreover, one third of Dutch mortgages is guaranteed by the state using an insurance called NHG (Nationale Hypotheek Garantie, see Hale, 2016b), which substantially reduces the losses given defaults. The duration of mortgages is considerably long, generally as long as the working life of borrowers. Given amounts of cash are received by mortgage investors every month by the name of mortgage interests just as fixed bond interests regularly come to hands of bond holders. Therefore, mortgages would be attractive to pension funds for two reasons; it could be part of good diversification strategy providing them with decent investment returns especially in the low interest rate era (as one of the safe asset classes along with fixed incomes, see Trappenburg, 2015); it could also be employed as hedging interest rate risks thanks to its cash flow structure as well as long duration. However, in the past, Dutch pension funds have preferred other types of investments, and only recently they realized that they have little choice but to risk their liquidity by putting mortgages into their investment baskets (Broeders et. al, 2017). However, mortgages are difficult to be taken off

from their balance sheets once they are written on. Pension funds must compare those pros and cons when considering mortgage investments.

2.2.2 Financial Crisis and New Regulations

After the financial crisis, almost 75% of all pension funds recorded poor funding ratios below the required minimum of 105% (DNB, 2014a) and thus had to carry out recovery programs. As stated earlier, worsening funding ratios were caused by two channels; increases in liability values and decreases in asset values. Low interest rates during the crisis significantly increased the liabilities of pension funds, while a dramatic plunge in stock prices melted down the assets of pension funds. In 2007, the FTK has been established for pension funds to "keep in reserve a certain level of capital (Regulatory Capital Requirement) in order to be able to absorb financial losses" (Spaan, 2012, p.10). Furthermore, underfunded pension funds of which funding ratios are below 105% had to submit their own recovery plans such that their funding ratios would improve within five years. Those first recovery plans were carried out between 2009 and 2013(DNB, 2014a). In the meanwhile, in 2010, right after the financial crisis, two committees were organized to investigate the sustainability of pension funds and drew a conclusion that a new assessment framework should be legislated (Spaan, 2012). They found out that the existing FTK was not enough to guarantee the finical stability. It put pension funds under the risk of sudden changes in their premiums or benefits. Two of the reasons for this are high sensitivity of pension funds to financial market turbulence and increasing life expectancy (DNB, 2014b).

Finally, in June 2014, the new FTK has been published and it was in effective from January 2015(DNB, 2014a). DNB also published new UFR (Ultimate Forward Rate) in July 2015 and actuarial rules of the new FTK began to be applied from July 2015. A new structure gave pension funds the possibility of temporary drops under the required funding ratios, but at the same time replaced the original UFR with the new UFR (initially 4.2%, currently 3.3% see DNB, 2015b). An interest rate curve starts at the current (low) level of the interest rate, and increases over time to a fixed amount afterwards. This lower rate is more realistic of future returns, but it increases sharply the value of future liabilities, thus deteriorating the funding ratios. In fact, discount rates applied to pension funds has been changed from 4% fixed rates (before 2007), the risk-free term structure of interest rates (2007-2011), three month moving average of the term structure (2011-2012), to UFR (2012 onwards) as stated in Beetsma et al (2015). The underfunded pension funds were once again required to submit

their recovery plans in July 2015 in line with the new FTK regulations (DNB, 2014a). In consequence of the changes above, under the new FTK, funding ratios became the most important criteria (Preesman, 2013), and pension funds were required to meet the minimum 105% but now with exploiting 12-month moving average and discounting with the new UFR (DNB, 2013b). Furthermore, the lower discount rates (new UFR) aggravated liabilities of pension funds. Two other important assessment criteria were also newly included in the new FTK, namely risk attitudes (risicohouding) and stress-testing (haalbaarheidstoets). Pension funds have to set their risk attitudes, and their policies including investment strategies should be based on those risk attitudes (Hoekert & Troost, 2015). The stress test shows the expected financial position or resilience of pension funds against several adverse scenarios under the given financial structure including the risk attitudes they set (DNB, 2016a). According to the stress tests performed in 2015 by EIOPA (European Insurance and Occupational Pensions Authority), Dutch pension funds are especially vulnerable to interest rate changes and shocks in variable-yield securities (e.g. stocks) (see DNB, 2016a). Therefore, on the one hand, the new FTK better supervises and remedies the financial weakness of pension funds. On the other hand, it ultimately gives stricter financial assessment measures to pension funds.

2.2.3 Less-immunized Pension Funds and Mortgage Investments

Dutch pension funds have significantly increased their mortgage investments since 2015 as can be seen in Figure 2.4. The exposure of the whole pension funds in the mortgage markets has been limited (not exceeded €500 million per quarter) until 2015. All elements taken together investigated in the earlier sections, one of the most plausible reasons why pension funds started investing in mortgages since 2015 is that it is one of their methods to improve their financial positions under the new regulations.

After the assessment of the first recovery plans between 2009 and 2013, it turned out that those pension funds, having hedged their interest rate risks and put more equities in their investment portfolios, were better off in the end in terms of their funding ratios (DNB, 2014a). Less-immunized pension funds might have learned this from their previous experiences and thus invested in mortgages for the sake of hedging interest rate risks. This was not occurred until 2015 when pension funds had to apply the new FTK; their recovery experiences combined with the new FTK might have resulted in their commencement of investing in mortgages in 2015.

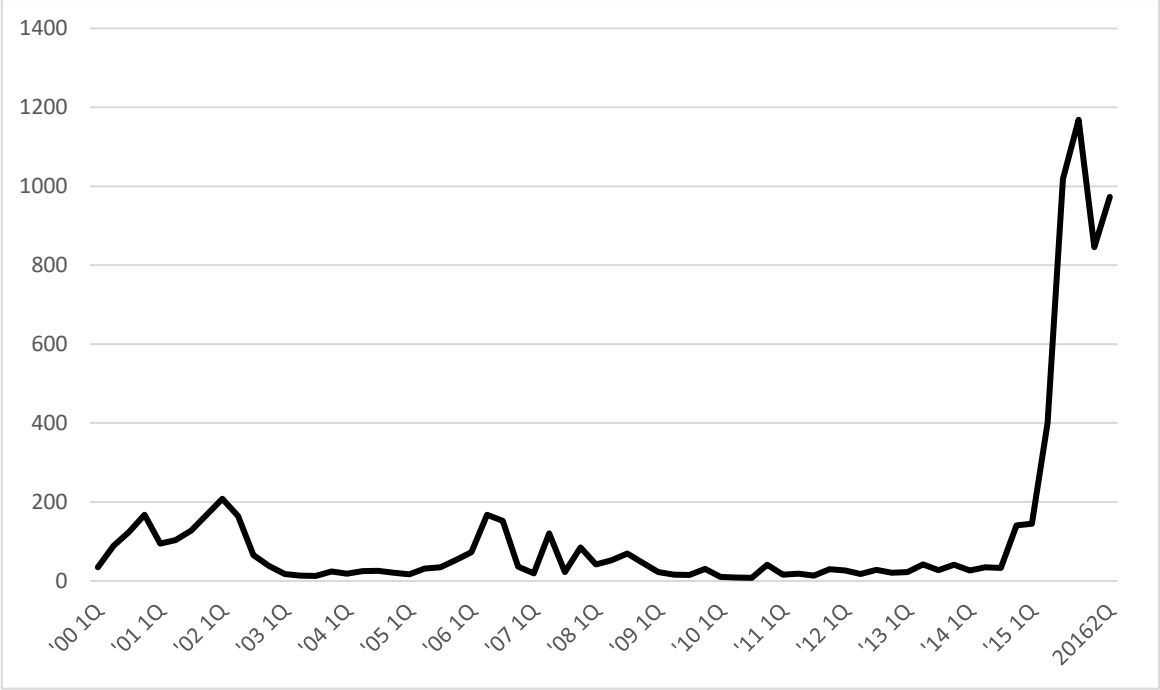

Figure 2.4. Amount of mortgage investment (in EUR million) by pension funds for each quarter from 2000 to 2016Q2

Furthermore, at this moment, mortgages already became safer assets than before in two aspects. First, since 2013, every new mortgage has been required to be fully amortized for borrowers to enjoy the generous mortgage interest deductibility (Pollack, 2013), and thus become further safer assets (Trappenburg, 2015). Before 2013, Dutch mortgage portfolios consisted of 60% of interest-only mortgages (Mastrogiacomo & Van der Molen, 2015). In addition, as full amortization was required, mortgages with longer duration (and a longer period of fixed interest rates) have been more in demand. This triggered greater participation of pension funds in mortgage markets. Second, as Dutch economy recovered, house prices have bounced back to its original level since 2014(Klein, 2016). Dutch house prices were strongly influenced by the financial crisis, where more than one third of all mortgages were underwater in 2013, while currently this percentage has dropped to less than 25% (DNB, 2016b). Those descriptive evidences as well as economic intuition stated earlier lead to hypothesize that less-immunized pension funds would take a greater role in substantial increases in mortgage investments by pension funds. The clue could be found in Liability-Driven Investment (LDI) approach presented in Ang et al (2013). They found out that if pension funds implement LDI with a downside risk penalty, they become risk averse once their funding ratios approach the fully funded level. In other words, pension funds take into account the situation where they need to take financial actions to recover their funding ratios in case of underfunding, and this in turn affects their risk aversion when making investment

decisions. Therefore, pension funds whose funding ratios are close to the minimum, end up losing a part of their risk appetite. On the contrary, pension funds with either far above or far below the required funding ratios will be willing to take more risks. In this regard, less-immunized pension funds which probably have the funding ratios near the minimum might be risk averse and might take more mortgage loans, and vice versa. This is also clarified by looking at their average funding ratios in 2015 shown in Figure 2.2. The condition of this story is that they have to regard mortgages as safe assets.

Chapter 3 Dataset and Methodology

3.1 Data and Descriptive Statistics

3.1.1 Loan-Level Data on Institutional Investors

The Mercurius loan-level Data of DNB is an unprecedented dataset on individual mortgage loan profiles held by financial institutions, since those details have never been obtained from the institutional investors, such as pension funds and insurers. It is also collected quite recently (2016), therefore this study is the first academic research to use and explore this dataset. Exploiting the new and unique data, this section will present the descriptive evidences of mortgage debts by different types of institutions, also categorized by various loan characteristics. The focuses will be on the mortgage supply by pension funds comparing with that of other institutions. Particularly, I put more weight on the recent profiles of mortgages issued by pension funds. In the next section (3.2), the empirical analysis will be conducted with the combined dataset (Mercurius loan-level Data with the balance sheet data of pension funds).

ECB requires financial institutions of European Union countries to report various level of information on their securitized mortgages, called loan-level Data (LLD), but DNB has also collected the same dataset for the whole mortgage portfolio including direct funding from Dutch financial institutions since 2012 (Mastrogiacomo & Van der Molen, 2015). However, this dataset was mostly obtained from banks hence lack of information on mortgage loans funded by non-bank sectors such as pension funds, insurers, and investment funds. However, as market shares of non-bank sector in the mortgage market increase, DNB started a new project(Mercurius) to gather LLD on the non-bank financial sector since 2016 (DNB, 2016c). It covers the period until the 2nd quarter of 2016. Therefore, the whole data on 2016 in this study only encompass the first half of the year of 2016. In addition, according to the reporting instructions published by DNB (2017), DNB choose 24 criteria among the same ECB LLD templates, consisting of loan, borrower, and collateral characteristics. The next section will cover the descriptive evidences of mortgage lending both by institutions and by loan characteristics based on the Mercurius LLD.

3.1.2 Descriptive Statistics

Thanks to the individual loan-level Data on the whole range of financial institutions, the historical mortgage exposure by institutions and their market shares can be captured in Figure

3.1 below. The whole market size has significantly grown since the 2000s, and this growing market has been dominated by banks. A dramatic plunge in mortgage debts in 2016 is only on account of data coverage of the LLD (until the 2nd quarter of 2016).

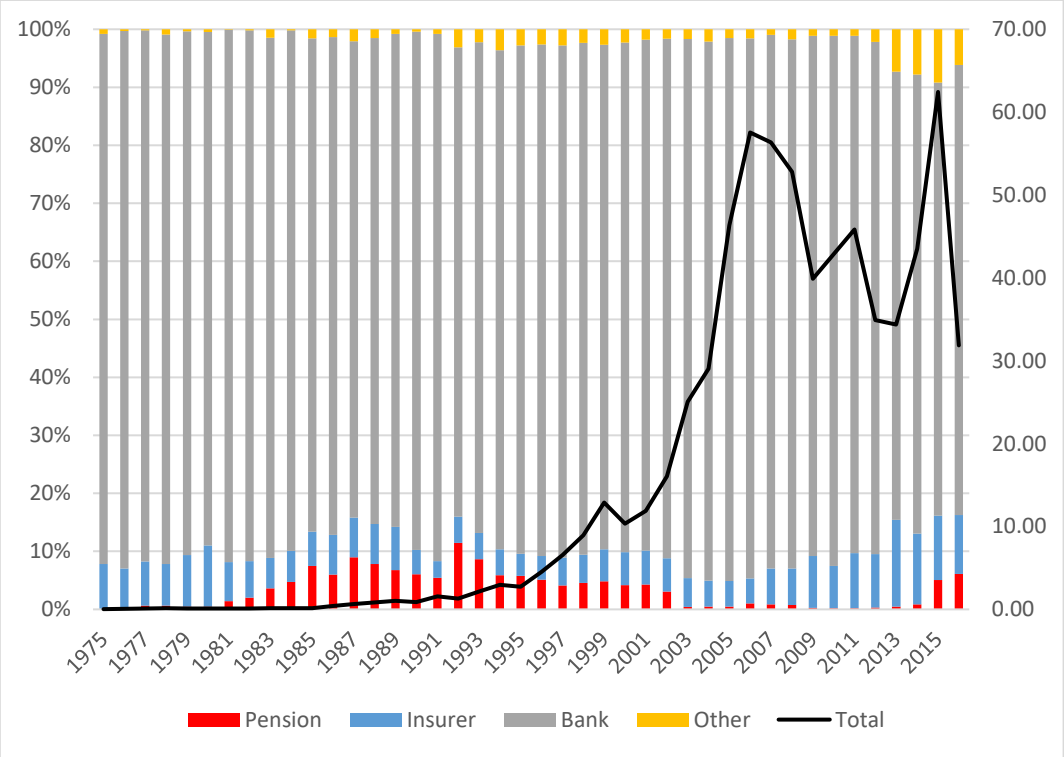

Figure 3.1. Mortgage debts by origination year and by mortgage originators in EUR billion from 1975 to 2016Q2

Looking at mortgage supply by pension funds, they re-entered the mortgage market in 2015. In fact, they first appeared on the market as an investor around 1981, but left the market in the aftermath of a burst of the dot-com bubble which occurred in 2002. After the financial crisis, institutional investors, mostly insurers and pension funds, have pushed traditional banks out of the mortgage markets. Pension funds have woken up in 2015 from their long sleep, possibly due to recovery modes from the financial crisis and the new FTK effective from 2015. As of 2015, pension funds supplied about 5% of the total mortgage debts in the market or took a share of 20% of the total debts invested from non-banks side. According to Dodds (2015), the institutional investments in mortgages are expected to grow and take 15~25% of the market shares over the next several years based on the 2015 prediction.

The LLD also helps capture the overview of the mortgage characteristics supplied by different types of financial institutions. For example, one could look at the debts by loan

payment type, NHG guaranteed ratio, LTV, and LTI. Those are often used as macro-prudential tools (DNB, 2016b), thus highly affected by changes in policies or regulations. Once the new legislations apply to the whole mortgage issuers, there should be common market movements towards them. However, reactions to those policy changes also vary depending on the types of financial institutions. Therefore, the recent response of the market and each institution towards the new regulations needs to be analyzed along with the average mortgage types they have historically preferred. From those observations, the risk exposure as well as risk appetites of mortgage investors can be evaluated.

Figure 3.2 below shows the mortgage debts by loan payment types. Each institution has two bar graphs, one for the stock (named Total) and the other for the flow in the last 3 years. In this way, the historical loan payment characteristics as well as the recently preferred payment types can be grasped.

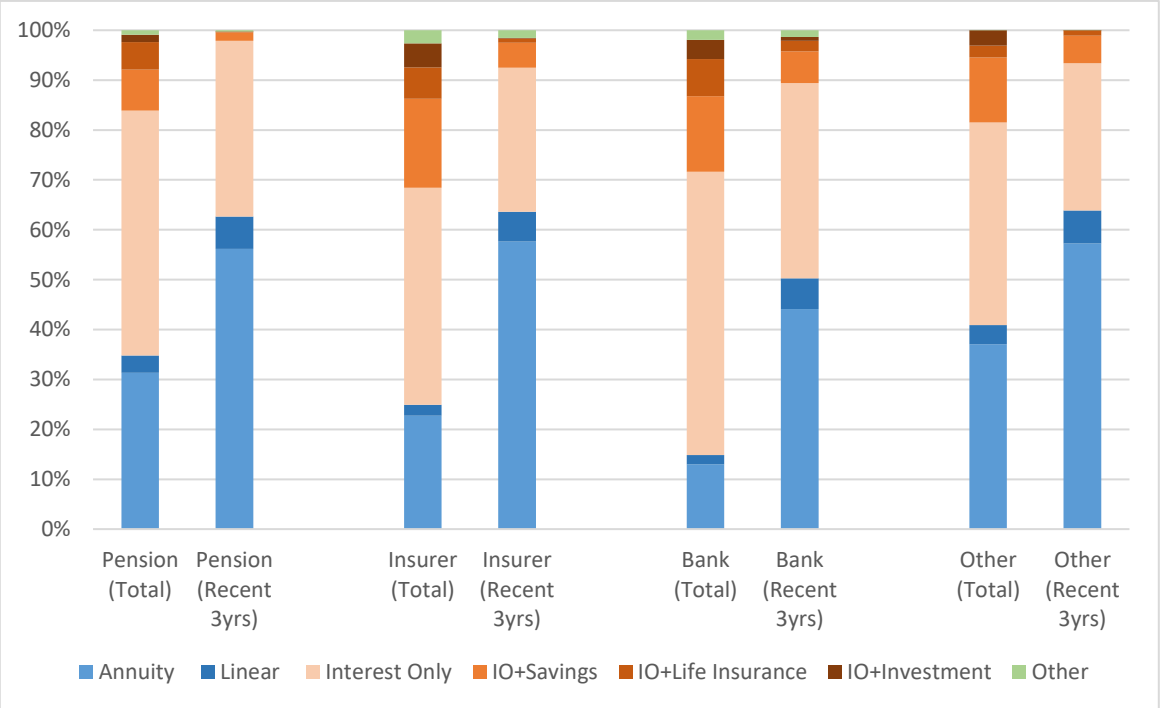

Figure 3.2. Mortgage debts by loan payment type from 2000 to 2016Q2: stock (the whole period) vs. flow (recent 3 years)

Since 2013, tax deductibility has become only applicable to full-amortization mortgages, where only annuity and linear loans fall into this category. For this reason, saving deposits, life insurance, and investment mortgages disappeared from the market afterwards, and the portion of interest-only loans has significantly dropped for all financial institutions; before the change, the interest-only type dominated (around 60%) the market

(Mastrogiacomo & Van der Molen, 2015). This can be seen comparing the two bars within each institution. In case of pension funds, more than 60% of the mortgages were issued to be fully-amortized in the last three years. Traditionally, pension funds have supplied more amortized loans in comparison to the other groups. After the application of new regulations, the share of amortized loans became comparable each other for all institutions, but pension funds still issue more amortized loans than banks.

Mortgage loans can be backed up by the State guarantee called NHG, even though only houses whose value below €245,000 qualify for it as of July 2015 (NVB, 2016). As Figure 3.3 indicates, a large portion of the mortgages are covered by NHG. Historically, banks and pension funds are those who have biased mortgage portfolio towards NHG guaranteed loans and show a similar degree of preference; around 70% of their mortgages were NHG backed ones. However, the recent trend is such that the NHG coverage mortgages have significantly decreased. One of the reasons is that the cap on house prices which can be guaranteed by NHG has been decreasing and thus reaching the current limit of €245,000 (see NBV (2016) and Leeuwen & Bokeloh (2012)).

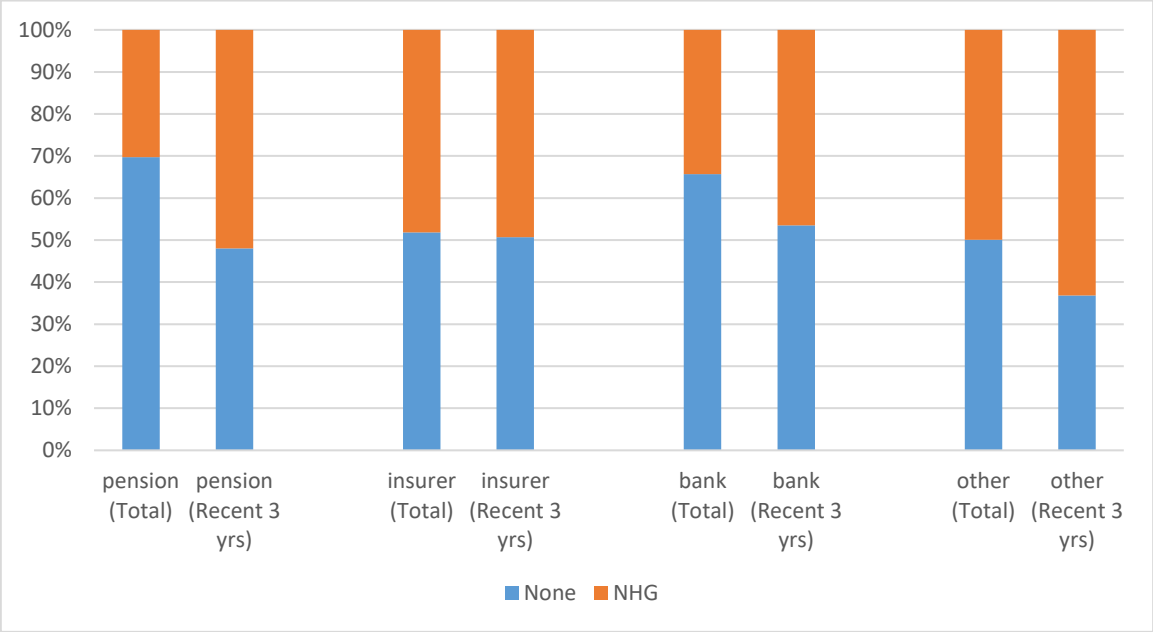

Figure 3.3. Mortgage debts by NHG coverage ratio from 2000 to 2016Q2: stock (the whole period) vs. flow (recent 3 years)

Figure 3.4 below confirms the fact that the Loan To Income(LTI) ratios are certainly lower for mortgages hold by pension funds compared with those by other financial sectors. In addition, within pension funds, newly issued mortgages reveal lower risk profiles in comparison with the old ones. Almost every mortgage held by pension funds in the last three

years is with LTI ratio below 5. Pension funds have hardly issued the top LTI ratio segment (high risk) mortgages. Since January 2013, LTI has been temporality capped and decided to be adjusted every year (DNB, 2016b). As of 2016, LTI-limit has used as macro-prudential instruments for mortgage lending and the limit has been set at 4 according to DNB (2016b).

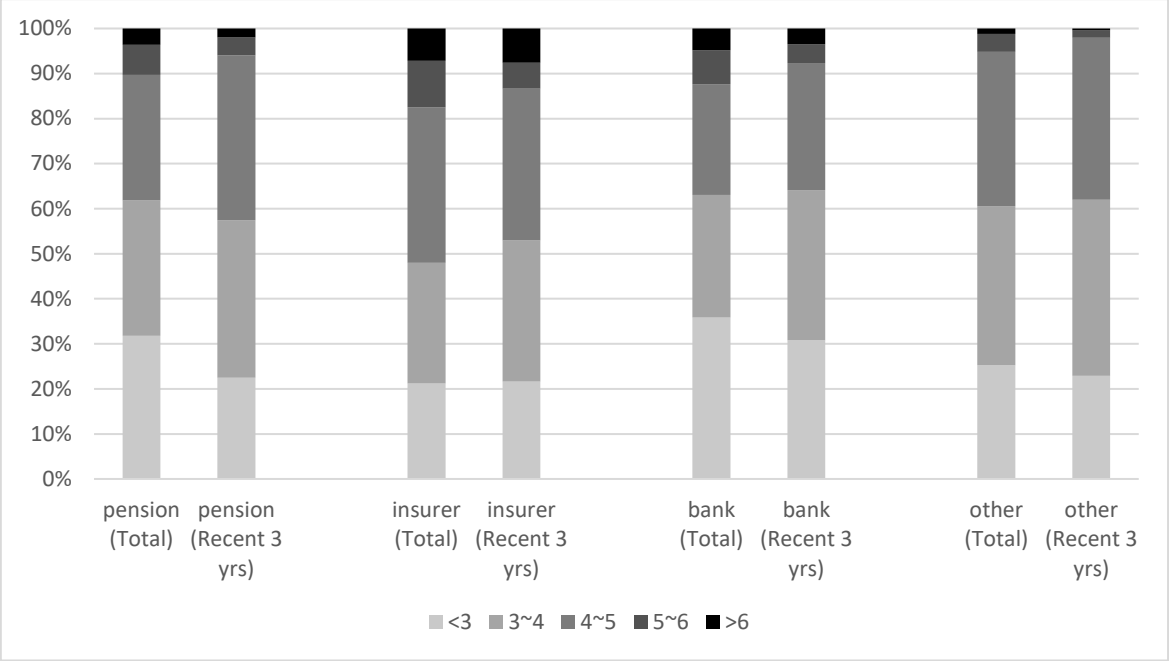

Figure 3.4. Mortgage debts by LTI ratio from 2000 to 2016Q2: stock (the whole period) vs. flow (recent 3 years)

By the new regulation introduced in 2011, LTV ratio of the mortgages were capped from 110% in 2011 to 106% in 2012 and then further by 1% every year onwards until reaching the maximum of 100% in 2018 (DNB, 2016b). Due to those limits, the average LTV ratio of recent mortgages are lower than the old ones issued before 2011. The stock bar (named Total) in Figure 3.5 for pension funds clearly shows that they have invested more in low-LTV mortgages relative to other lenders. Almost 90% of their mortgage investments fell into the low LTV mortgage categories (below 110%). Only 10% of them occupied the high risk LTV segment (above 110%). After the implement of new regulations, the mortgages categorized between 100% and 110% have substantially increased for all institutions. Nevertheless, pension funds are still the ones which have highly tilted portfolios to low LTV compared with the other players, implying that the recently engaged pension funds in the mortgage market have been willing to take low risk (risk-averse).

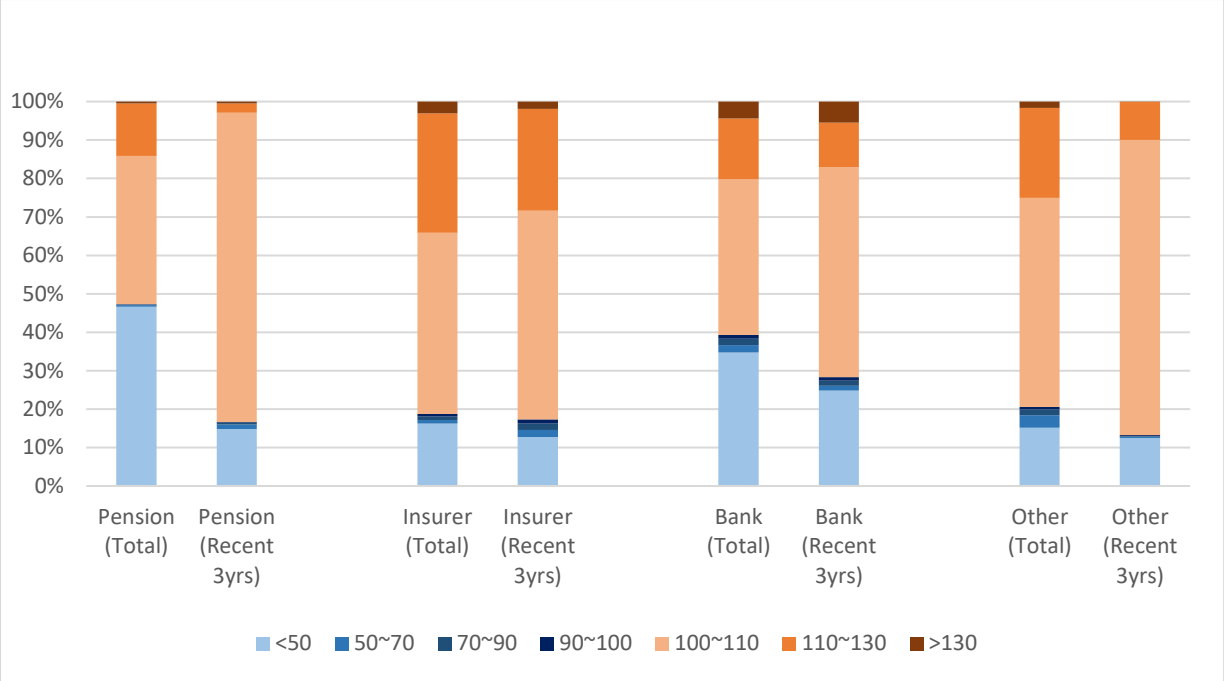

Figure 3.5. Mortgage debts by original LTV ratio from 2000 to 2016Q2: stock (the whole period) vs. flow (recent 3 years)

3.2. Mortgage Amounts Funded by Less-immunized Funds After the Crisis

3.2.1 Motivation and Hypothesis

As shown in Figure 3.6 below less-immunized funds have invested far more in mortgages since 2015 relative to more-immunized ones. Historically, both less-immunized and more-immunized pension funds showed a common trend in mortgage investments before 2015. In fact, both had hardly invested in mortgage loans in the past. However, less-immunized pension funds, which underwent the first financial recovery modes from 2009 to 2013, started investing in a vast amount of mortgage loans from 2015, which is after the financial crisis and under the new FTK. On the contrary, more-immunized pension funds were not subjected to recovery plans and got more limited exposures. This big difference can be easily captured by looking at historical mortgages investments by two types of pension funds as below (Figure 3.6.)

Since this situation satisfies the common trend assumption for a quasi-natural experiment, the study exploits the difference in difference method in investigating the cause of mortgage investments of pension funds. The hypothesis tested is:

Hypothesis: Recovery mode due to underfunding during the financial crisis and the new FTK motivated less-immunized funds to invest more in mortgages relative to more-immunized pension funds after the crisis.

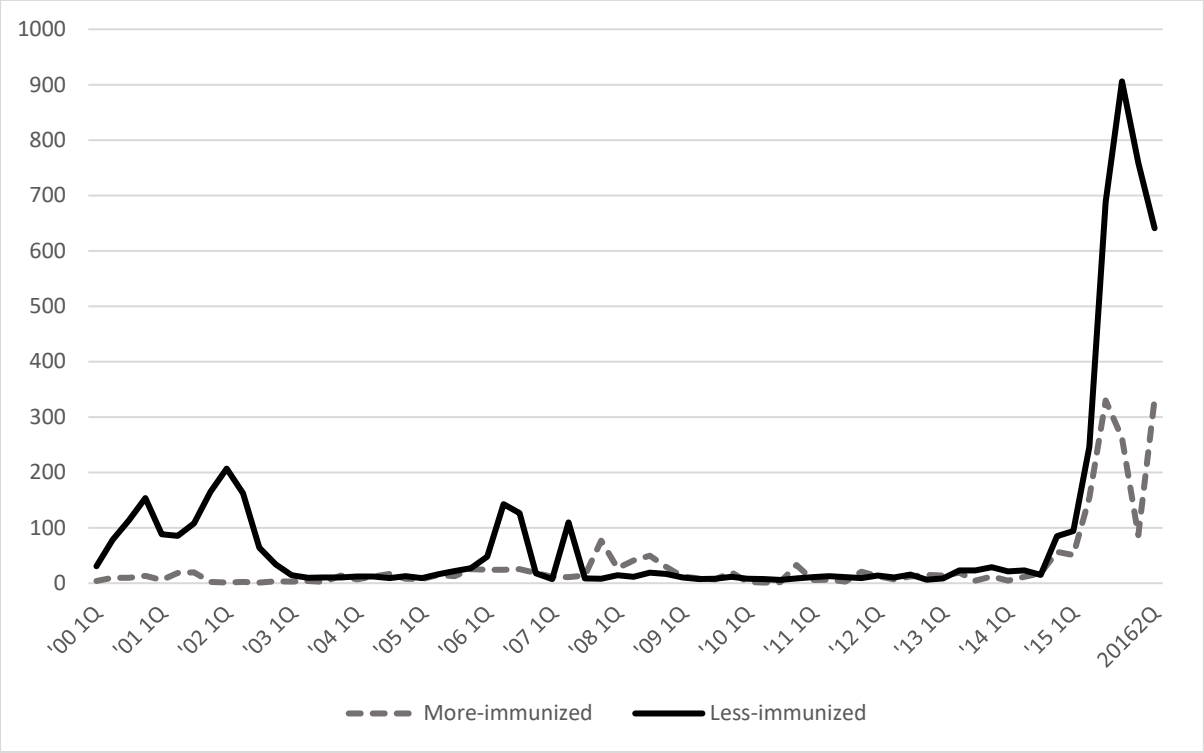

Figure 3.6. Amount of mortgage investment by two types (more-immunized and less-immunized) of pension funds in EUR million per quarter from 2000 to 2016Q2

3.2.2 Fixed Effects with Difference in Difference

The unique individual loan-level Data, combined with the balance sheet data of pension funds, enables me to conduct a quasi-natural experiment. I aim to test whether the recovery mode pushed pension funds to supply a large amount of funds to mortgage loans after the crisis. On the one hand, the LLD includes details of each individual loan, such as borrower (age, employment status, etc.), collateral (valuation amount, property postcode, etc.), and loan characteristics (loan origination date, original balance, original LTV, type of guarantee provider, loan payment type, maturity, debt to income, etc.). On the other hand, pension fund characteristics (funding ratios, total assets, total number of participants, etc.) are provided by balance sheet data of pension funds. I construct a panel dataset by assigning to each pension fund the mean borrowers and loan characteristics at origination for all quarters retrospectively and the fund balance-sheet-characteristics. Thanks to quasi-natural experiment setup, I use a

Diff-in-Diff approach to enquiry the causality between the recovery mode and mortgage investments. Furthermore, fixed effects model is estimated in order to take into account unobserved heterogeneity among individual pension funds and will be compared to a random effect model.

The fixed effects linear model with Diff-in-Diff is used to estimate the causal effect of treatment (recovery mode) on the amount of mortgage investment of pension funds after the financial crisis. The regression model is defined as

$$y_{it} = \beta_0 + \beta_1 D_i^{treat} D_t^{post} + \beta_2 D_i^{treat} + \beta_3 D_t^{post} + X'_{it}\beta_x + \alpha_i + \varepsilon_{it}$$

where *y* is amount of mortgages loans funded by pension funds, *i* indicates individual pension funds, and *t* indicates loan origination quarter. The interaction dummy between D_i^{treat} and D_t^{post} is a major variable, which uncovers the causal effect the study is most interested in. It is expected to obtain a positive β_1 under the hypothesis. 1 is assigned to D_i^{treat} if the funding ratio of i pension fund recorded below 105% in 2008 and thus implemented recovery plans(treatment) 2009 onwards, which proxies less-immunized pension fund in this research. On the contrary, 0 is assigned to D_i^{treat} if i pension fund is more-immunized. There are two specifications for D_t^{post}, since the study assumes the combined effects of financial crisis and the new FTK on the mortgage investments of pension funds. The First D_t^{post}, named D_t^{post1} or $D_t^{post2009}$, is 1 when the loan origination quarter is later than the financial crisis or after the inception of treatment (recovery modes), which is the first quarter of 2009. The second D_t^{post}, indicating D_t^{post2} or $D_t^{post2015q3}$, is 1 once origination quarter is after the new FTK as well as the new UFR. The First Post dummy(D_t^{post1}) measures the effect of recovery modes of pension funds on their mortgage investments right after the crisis as well as right after the inception of recovery plans. This will show whether or not pension funds changed their mortgage investments in order to improve their financial positions under the recovery process. They might have changed their investment strategies in terms of mortgages funding along with the other policy changes (increasing contributions, deferring or suspending the indexation, or decreasing benefits) they made. In short, the first dummy is expected to capture the imminent effect of the financial crisis and recovery modes on mortgage investments of pension funds. On the other hand, The second specification(D_t^{post2}) assess the

same crisis effect but with the time lag as well as the effect of the introduction of the new FTK and new UFR. Since increases in mortgage investments are not the target outcomes of the recovery plans, it is possible that there is a time lag between recovery modes and commencement of mortgage investments. The Diff-in-Diff is valid when the policy change immediately affects the outcome variables (Gertler et al, 2010). Therefore, D_t^{post2} will capture the effect of the new FTK, which is also combined with the recovery mode due to financial crisis and with the immunization status of pension funds. In fact, even though the first recovery periods ended in 2013, a number of pension funds had still been not fully recovered from the crisis at the time of 2013. Therefore, even after 2013, they were still taking their own recovery actions. In addition, even after 2013, they were likely to wait for the new FTK with no clear idea of its details including the effective date, since the new FTK had already been discussing since 2010. For this reason, they might have been unwilling to plan their new investment strategies until new FTK was published in 2014. Even after the announcement of new FTK, it has not been effective until January 2015. Moreover, a part from this, the new (lower) UFR has been only applied since July 2015. Hence, the second Post dummy is assigned 1 after the 3rd quarter of 2015, which not only allow pension funds give time to change their investment behavior after the crisis and the first recovery modes, but also to put weight on the new FTK (new UFR) in explaining their mortgage investments.

The vector of control variables (X'_{it}) catches other effects of i pension fund characteristics at quarter t on their mortgages investment amounts at quarter t, including some mean borrowers characteristics of the mortgage that they invested in. The fund characteristics concerned in this study are total assets, the number of total participants, and the share of active participants. The choice of those control variables are motivated by the literature. According to Kakes (2006), in the pension literature it is often found that large pension funds hold more equities, real estate, and foreign assets while small pension funds take a large position in fixed income investments. Therefore, for the control variables, pension fund sizes in terms of their assets and participants as well as share of active participants are included in order to uncover the relationship between mortgage investments and pension fund characteristics. From the background knowledge, the coefficients of total assets and the number of total participants are expected to be negative, while those of share of active participants will be likely to be positive.

The validity and the limitation of the methodology are as follows. The Diff-in-Diff method is validated in this study since the treatment and control group show parallel trends in

mortgage investments before the new FTK (the crisis) but diverge afterwards. The treatment (recovery mode) could be regarded as exogenous shock since the crisis is apparently exogenous to their mortgage investment policies. Actually there are two critical conditions for a natural experiment setting to be valid, which called relevance and exogeneity (Derrien & Kecskés, 2013). The latter condition is satisfied in this study. The reverse causality cannot be happened in the study setting because both groups hardly invested in mortgage loans at the moment of the financial crisis. Moreover, in order to avoid the omitted variable bias, the study not only controls the critical characteristics of pension funds but also perform fixed effects model. The former condition (relevance) is implicitly validated throughout the academic literature and descriptive statistics in the previous sections. Diff-in-Diff could also be carried out after matching the treatment group (less-immunized funds) to the control group (more-immunized funds) by size of pension funds, the share of active participants, etc., as Derrien & Kecskés (2013) did in their Diff-in-Diff study. This is called propensity score matching and with this method the fund characteristics other than the treatment can be controlled. However, in this study, there are only thirteen number of pension funds, thus only three propensity score blocks or no block was found after the matching process. Therefore, fixed effects model will be performed in the next chapter.

Chapter 4 Empirical Results

4.1 Estimation Results of Fixed effects with Difference in Difference

Table 4.1 shows the estimation results of fixed effects linear model with the Diff-in-Diff method along with other estimation results from OLS and random effects model. What this study pay attention to is the coefficient of Diff-in-Diff interaction term in order to look at whether or not immunization motivates mortgage investment by pension funds after the crisis. As stated earlier, there are two specifications for the post dummy, post crisis (2009) and post new FTK(2015Q3), to capture their effects on mortgage investments especially by less immunized pension funds.

The first panel (Panel A) shows that the results obtained from the first post dummy (after 2009) specification. When looking at the coefficients of interaction term between post dummy and treatment dummy (Treatment× Post1), none is statistically significant except for the one estimated from the random effect model. Moreover, the signs of those coefficients are negative, which implies that less-immunized funds rather reduce their mortgage investments right after the crisis compared with more-immunized funds. This possibly suggests that they rather concentrate on their policy changes to improve their funding positions, such as contributions, benefits and indexations. Otherwise, mortgages might have not been appealing to them in terms of riskiness at that period of time.

The second panel (Panel B) indicates the estimation results of the second specification, where the post dummy1(after 2009) is replaced by the post dummy2(after 2015Q3) from the first specification. Several different models are also shown in Table 4.1. Among those, the most preferred model is fixed effects model. The fixed effects model allows partial endogeniety meaning that explanatory variables can be correlated with the invariant components of the error terms. On the contrary, the random effects model assumes that explanatory variables are exogenous and thus the invariant part of the error terms (individual effects) is assumed to be random. In my sample, the number of individuals (pension funds) is quite small (13), while the number of quarters (time span) is relatively large (62). Hence, it is better to capture the unobserved time-invariant heterogeneity exploiting fixed effects model. Variance analysis also shows that there is sizable within variation in the variables of the model.

Table 4.1. The effect of the low immunization (recovery modes) and the new FTK on the amount of mortgage investments by pension funds after the crisis

VARIABLES	(1) OLS	(2) FE	(3) FE (cluster)	(4) RE
		Panel A: Post Crisis		
Post1(2009)	18.17	19.04	19.04	30.80*
	(14.06)	(16.79)	(16.54)	(16.43)
Treatment	36.69			270.2***
	(44.67)			(68.27)
Treatment× Post1 (2009)	39.01	-19.28	-19.28	-51.26**
	(62.33)	(24.90)	(28.51)	(24.00)
Total Assets	-1.444*	0.0778	0.0778	-0.369*
	(0.693)	(0.215)	(0.0726)	(0.211)
Total Participants	0.000129*	-0.000430***	-0.000430***	0.000000
	(6.61e-05)	(7.42e-05)	(1.97e-05)	(3.94e-05)
Share of Active Participants	-16.11	138.8	138.8	247.8
	(79.54)	(187.0)	(94.64)	(168.6)
Observations	326	326	326	326
R-squared	0.221	0.180	0.180	
Number of funds		13	13	13
		Panel B: Post new FTK		
Post2(2015Q3)	84.15	108.5***	108.5	113.0***
	(52.96)	(20.77)	(70.73)	(21.40)
Treatment	30.85			215.7***
	(18.67)			(71.98)
Treatment × Post2 (2015Q3)	117.6	**65.29****	65.29	64.83**
	(90.78)	(31.22)	(113.8)	(32.05)
Total Assets	-1.262***	-0.289	-0.289	-0.747***
	(0.322)	(0.185)	(0.200)	(0.175)
Total Participants	0.000115***	-0.000384***	-0.000384***	-0.000000*
	(3.15e-05)	(6.49e-05)	(2.84e-05)	(3.93e-05)
Share of Active Participants	37.01	162.1	162.1***	246.9*
	(60.35)	(128.5)	(44.66)	(126.0)
Observations	326	326	326	326
R-squared	0.411	0.349	0.349	
Number of funds		13	13	13

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Looking at Table 4.1, there are two columns for fixed effects models, with and without cluster-robust standard errors. The study prefers Fixed effects model without adjusting clustering errors (named (2)), because of too few numbers of clusters (13) in the dataset. Cameron and Miller (2015) mention that one of the two major problems with few clusters is "over-rejection (too narrow confidence interval)" (p.24), which is the exact case of this study. The reason is that asymptotic properties ($N \to \infty$) cannot be applied for the small number of clusters. In addition, only 4 out of 13 pension funds data points exist from 2000 to

the second quarter of 2016, which further reduces the N. In general, in panel data clustered errors are used because within individuals (i) one error term is likely to be correlated with the other at different period (Cameron & Trivedi, 2010). Since fixed effects model does not take account of those potential autocorrelations, clustered errors often used with fixed effects model. However, the mortgage investments of pension funds in my sample are either very little for the whole period or sudden increase only after 2015. For this reason, there might be a problem having both clustered errors and fixed effects in one model. Once I define the cluster as degree of immunization (less-immunized and more-immunized) and run a fixed effects model with cluster-robust errors, t statistics are computed as significantly high. For this reason, the estimation results of fixed effects without clustering errors are selected as preferred one and discussed here. As can be seen in Table 4.1, the major coefficient (Treat× Post2 (2015Q3)) is positive as well as statistically significant, which implies that less-immunized funds were on average expected to more invest in mortgages by €65 million after 2015Q3 compared with more-immunized ones. This is quite appealing result which is in line with the hypothesis. Based on this empirical evidence, one can infer that both the financial crisis and the new assessment framework certainly motivated less-immunized pension funds to have more exposure in mortgage lending markets compared with more-immunized ones. The coefficient of the Post 2015Q3 dummy itself also shows significantly positive values of 108.5. This is easily captured by earlier Figure 2.4. showing the mortgage investments by pension funds. Among the control variables, the number of total participants is expected to have a negative impact on mortgage investments with a high statistical significance (1%); pension funds are on average expected to decrease their mortgage investment by €3.84 million for an increase in every 1,000 participants, ceteris paribus. This indicates that large pension funds in terms of the number of total participants are on average less invested in mortgages. This is accordance with the finding of Kakes (2006). Along with the Fixed effects model, the OLS model is also conducted with clustered standard errors. Within correlations are taken into account in this model, and the magnitude and the sign of each coefficient is comparable with those estimated with fixed effects model (2). The coefficient of the interaction term in the OLS model is also quite similar with the one in Fixed effects model. Unlike Fixed effects model, the coefficient of the total assets is highly significant at 1% level. The negative coefficient suggests that the greater the pension funds are in terms of the asset sizes, the less mortgage lending they supply when other factors are constant. This result is in line with the literature as well.

In the Fixed effects model with clustering standard errors, the positive coefficient of the share of active participants implies as follows; the younger the pension funds are, the more they invest in mortgage loans, with a 1% of statistical significance. If there is an 1% increase in the share of active participants within the pension funds, additional €1.62 million are on average expected to be put into mortgage loans. It is reasonable since more liabilities have to be reserved for the funds with more young participants, and consequently those funds must be more susceptible to interest rate risks. They might have more incentives to put mortgages into their portfolios in accordance with duration matching strategy.

Finally, the results of the random effects models are introduced in the last column. Without considering the fixed pension fund effects and within cluster correlation, the coefficients of most variables turn out to be statistically significant. The coefficient of interaction dummy has a similar magnitude and the same sign with that of fixed effects model. The signs and magnitude of other coefficients are also not much different from those of Fixed effects models. However, as stated earlier, the fixed effect model is more preferred here due to the small number of individuals and plausible correlations between explanatory variables and time-invariable error components. All in all, the empirical results show that the low degree of immunization combined with the new FTK motivated the mortgage investment of less-immunized pension funds after the crisis compared with the more-immunized ones.

4.2 Robust Checks

4.2.1 Placebo Effect and Anticipation Effect

This session shows the robust check tests with regard to the positive and significant coefficient of Diff-in-Diff term estimated in the previous section. Gertler et al. (2010) suggest frequently encountered issues in Diff-in-Diff in practice as well as a couple of sensitivity analysis for Diff-in-Diff approach. Among them, the placebo effect and anticipation effect will be tested in the sphere of this study. This can be done by changing treatments(placebo) or bring the post dummy forward (anticipation).

The placebo effect will be tested by making use of “fake” treatment group as Gertler et al. (2010) suggest. Once the coefficient of Diff-in-Diff turns out to be significantly non zero, the results in the previous section might not be reliable. After specifying false treatments, the test can be achieved by estimating the same model but now with the false treatment rather than the true one. The assumed true treatment here is pension funds whose funding ratios are below 105% in 2008. The false treatment is chosen as pension funds which

had funding ratios below 100% and 95% in 2008, as well as the ones with the funding ratios below 105% and 110% in 2002. The reason for the latter two false treatments (based on 2002) is that no pension fund in 2002 had affected by the recovery plans initiated in 2009. Moreover, right after a burst of the dot-com bubble, pension funds experienced substantial drops in their funding ratios, thus 2002 could be a good reference year for testing the placebo effect. The former two placebo treatments (based on 2008) are selected since it is the same year but different thresholds (funding ratios) comparing with how the true treatment is defined thus certainly different from the true ones even some of treatment groups are inevitably overlapped.

Another test is for the anticipation effect. The necessity of a new framework has been discussed since 2010 immediately after the crisis. Thus, pension funds must have known about the changes in assessment criteria beforehand. Moreover, before an official publication of the new FTK, the contents of it were already disclosed to public while going through the parliament and the Dutch governments, even though the details were not confirmed yet at that point of time. Therefore, even before the introduction of the new assessment, pension funds might have changed their investment policies towards mortgages funding before the post dummy (2015Q3) expecting the future direction of changes in new policies.

Table 4.2 below shows both placebo and anticipation effects for the robust checks of the estimated Diff-in-Diff coefficient. The coefficients estimated from the original model in previous section are expressed as preferred at the first row in Table 4.2. It is statistically significant at 5% level and the value is 65.29. The Diff-in-Diff coefficients of placebo and anticipation effect model appear in Table 4.2 below the true one with their values and corresponding statistical significances.

The Placebo effect model 1 and 2 show insignificant Diff-in-Diff coefficients meaning that cannot reject the non-zero coefficients. The Diff-in-Diff coefficients in third and fourth placebo effects models are highly statistically significant, but their signs are opposite. The placebo effect can be identified by drawing figures as well. As an example, the model with placebo effect 2 and 3 are shown in Appendix 1; the common trend assumption is violated (placebo 2) and no diverging phenomenon (differences) between two groups is observed after the treatment (placebo 3). The first robust test certainly shows that there is no placebo effect; it suggests that the original treatment is valid or previous estimation results are reliable in this regard.

Table 4.2. Robust checks for the Diff-in-Diff coefficients: testing placebo and anticipation effect by comparing with the coefficients estimated from the original model (expressed as preferred)

	β_1(Treat× Post2)	significance
Preferred	**65.29**	****
Placebo1(below 110 in 2008)	-27.09	-
Placebo2(below 95 in 2008)	28.34	-
Placebo3(below 105 in 2002)	-85.63	***
Placebo4(below 110 in 2002)	-88.19	***
Anticipation1(2015Q2)	46.10	-
Anticipation2(2015Q1)	10.77	-
Anticipation3(2014Q3)	-55.63	-
Anticipation4(2014Q1)	-38.86	-
Anticipation5(2013Q1)	-32.70	-

Notes: *** p<0.01, ** p<0.05, * p<0.1

With regard to the anticipation effect, no coefficient is produced as significant. As deviating from the 3rd quarter of 2015, their values also become negative. This implies that the less-immunized pension funds did not increase their mortgage exposure beforehand in anticipation of the new FTK and new UFR. In addition, those test evidences show that pension funds had have not reacted to the new FTK in terms of mortgage lending until the new UFR was applied. This also implies that they invested in mortgages also because of interest rate risk hedging from the lower discount rates introduced by the new UFR.

Chapter 5 Policy Implications and Conclusions

5.1 Policy Implications Contributions of the Study

First and most importantly, the study reveals the significant influence of the supervisory framework on investment decisions of pension funds in terms of mortgage funding. The financial crisis itself as well the recovery and assessment policies applied and introduced after the crisis have led to the recent increases in mortgage investment by pension funds, especially by those that have been subjected to those policies most, that is, less-immunized funds.

Strict recovery plans might lead to unequal redistribution of wealth among pension participants. In the aftermath of the financial crisis, pension funds reveals that they are highly susceptible to sudden changes in economic conditions and they are highly correlated with each other (Beetsma et al., 2015). According to Beetsma et al. (2015), if individual pension funds are not correlated, the recovery plans forced on each fund will not have macro-economic impact. In fact, this paper, going one step further, divides pension funds into two groups and finds that they are more associated within each group. This suggests several important policy implications for supervisors. The first group was more swayed by the economic downturn than the second group; thus, only the first group was subjected to the recovery plans. The macro economic effects of recovery mode are such that the income level deteriorates for both employees and pensioners through a channel of increased contributions or reduced indexation (pension benefits) respectively. This also decreases their amount of consumption and ultimately slows down the recovery speed of the whole economy. As can be seen in this study, if only one type of pension funds is subject to recovery plans, only participants in that specific group would be in subject to those macro-economic influences. This could be a substantial social problem when the difference and the impact are substantial. To avoid the unequal (re)distribution of wealth, regulators need to provide guidelines, for example, the desirable degree of interest rate hedges and investment strategies depending on the characteristics of pension funds. However, with less strict rules, unequal inter-generational rather than intra-generational wealth redistribution might occur.

There are several attributes of pension funds which make them to more susceptible to interest rate risks. As the result of this study indicates, the higher the share of active(young) participants in a pension fund, the more vulnerable their liabilities are to interest rate changes. In addition, if there are a lot of baby boomer generation participants in a certain pension fund,

that pension fund might put more weights on liquidity risk rather than interest rate risks. Moreover, if regulations on funding ratios are too strict, pension funds would take less risk and abandon upward potential returns as well. Furthermore, as Beetsma et al. (2015) note, an offer of longer recovery periods would reduce the adverse-macroeconomic effect and would discourage the participation of the younger generation.

In addition, the financial assessment framework, which strongly focus on the certain criteria, might cause surges in demand for a specific type of asset. This could result in for example poor investment returns or risk concentration on that particular asset class, considering the substantial portion of pension funds in the financial market and their high correlations with each other. It also may give rise to an undesirable situation in which certain assets are overwhelmed by one or two types of investors. As shown in the study, a sudden stampede to buy mortgages by pension funds might cause other types of risks that are still unknown to supervisors. From a regulatory point of view, for this reason, the new phenomenon of increased mortgage investment by pension funds should be watched closely. The reasons behind this trend as well as the types of pension funds and mortgages involved should be well clarified.

5.2 Conclusions

This study focuses on the recent trend of increased mortgage investments by pension funds, which were found to be due to the combined effect of recovery experiences after the financial crisis and the new financial assessment framework introduced in 2015. Less-immunized pension funds that underwent recovery mode after the crisis have supplied more mortgages after the crisis compared with more-immunized ones. The unique Mercurius loan-level Data recently gathered by DNB enables analysis of this trend not only through descriptive statistics but also through empirical estimations (difference in difference methods). Less-immunized pension funds may have been willing to try to improve their financial positions while further hedging their interest rate risks by holding more mortgages. They may have preferred mortgages since they would have become more risk-averse and would have been more willing to hedge the interest rate movements after experiencing recovery mode from 2009 to 2013. Moreover, mortgages became more appealing in terms of riskiness thanks to stricter mortgage policies applied recently. Moreover, the new FTK introduced in 2015 put greater weight on the financial sustainability of pension funds, making them seek a better risk return trade off and more risk hedging.

The degree of immunization of pension funds is defined by empirical proxy based on whether or not they experienced significant drops in their funding ratios below the required minimum after the crisis and thus were in the recovery mode afterwards. Based on this, the pension funds are classified into two categories, less-immunized and more-immunized ones and are ready for the Diff-in-Diff approach. On the other hand, descriptive statistics reveal the historical mortgage investments by financial institutions and their profiles in terms of various loan characteristics, such as LTV, NHG coverage ratios, LTI, and loan payment types. The study focuses on the mortgage holding of pension funds and finds that they have traditionally preferred low-risk mortgages and have put additional safer mortgages in their portfolios in recent years.

This supports the assumption that they have increased their investments in mortgages because they have become more risk-averse after the crisis and under the new assessment regulations. Regulators need to provide guidelines to pension funds regarding the desirable degree of interest rate hedges depending on the funds' characteristics. Moreover, supervisors should be aware that regulations on mortgage markets and those on pension funds are highly correlated each other.

Even though pension funds' exposures in mortgage markets is expected to significantly increase over the next several years, this trend will stop at the point where more mortgages assets are undesirable for pension funds from their risk diversification point of view (DNB, 2016e). DNB (2016e) also notes that the growth rates of pension fund assets are restricted due to the ageing of Dutch society. However, this does not mean that the new mortgage investment trend by pension funds could be ignored. Pensions and mortgages are two very important foundations of household finance and the of financial market.

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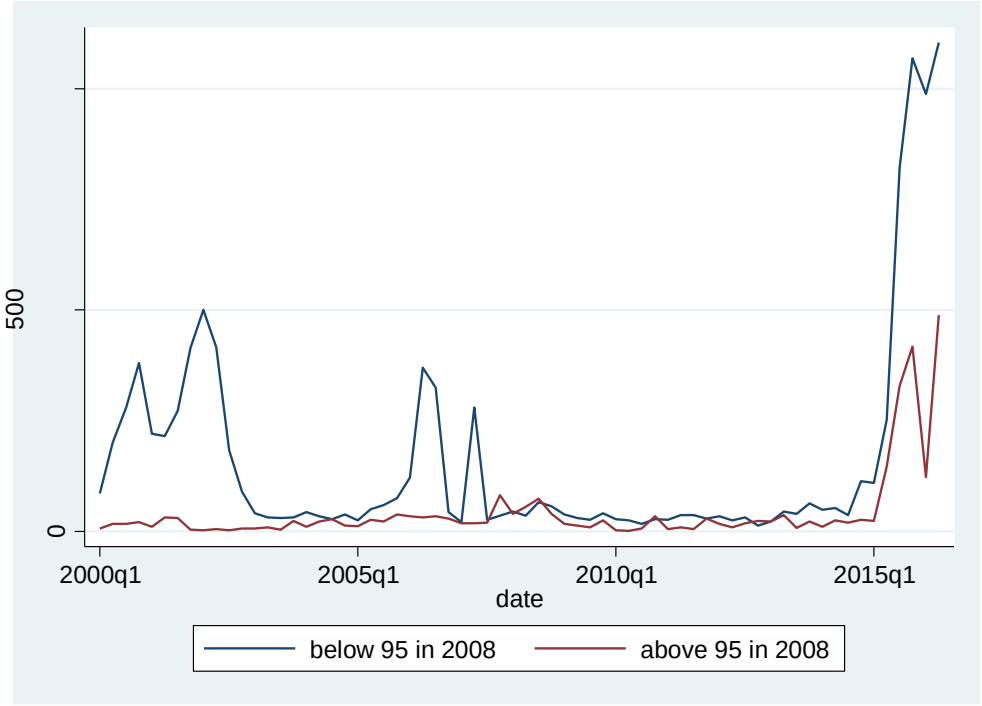
Appendices

Appendix 1

Placebo effect 2

(False) treatment group is assumed as pension funds with funding ratios below 95% in 2008



Placebo effect 3

(False) treatment group is assumed as pension funds with funding ratios below 105% in 2002