Three Essays in Applied Empirical Economics

The Financing of Governments, Corporations and Households

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to my parents and my brother

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Preface

Financing, the process of raising funds for any kind of expenditure, plays a vital role in the economy. Governments, firms, and consumers often do not have or do not want to use their own funds for purchasing goods or services, repaying debt, or completing other transactions, but sell or borrow equity for this purpose. Financial markets such as the bond and equity market as well as financial intermediaries such as banks channel funds from savers to borrowers, helping to direct capital to its productive use. In this regard, financing conditions – represented by the cost of financing and the access to financing – are of crucial importance as they influence investment and consumption behaviour and consequently economic activity and prices.

Each of the three chapters of this thesis is related to a specific aspect of financing and concerns, respectively, governments, corporations, and households. The first chapter studies the determinants of euro-denominated Central and Eastern European (CEE) government bond spreads that reflect the financing costs incurred by these countries. In the second chapter we turn to the corporate sector and analyse whether corporate debt markets in the euro area are converging. In this way we assess whether corporations face similar financing conditions with respect to bank loan and bond interest rates. Chapter 3 investigates households' withdrawing of home equity to access their housing wealth as an additional source of finance. The following discussion introduces each chapter and summarizes the main results.

Besides using tax revenues, governments finance their expenditure by issuing securities such as government bonds. Depending on the creditworthiness of the country, investors demand a risk premium for holding these securities that is reflected by the yield spread with respect to a comparable "risk-free" investment. This spread measures the cost of external financing incurred by governments. Until the 1990s international sovereign bond markets were mainly dominated by debt securities of industrialized countries while the market for government bonds issued by emerging market economies

was rather illiquid and restricted to debt issued in hard currencies like the US dollar. This has changed now, and emerging market bonds have become an important asset class. Understanding the driving factors of yield spreads is important both for issuing governments and for investors. Governments try to keep their financing costs low and profit from a better understanding of the way financial markets valuate their debt securities, and this is equally true for investors wanting to earn money on their investments. Which factors drive the yield spread? Is it mainly the macroeconomic conditions in the country of interest or global market conditions like the "risk-free" interest rate, market liquidity and volatility that play a decisive role?

The first chapter empirically investigates the determinants of the spread between the yield of CEE euro-denominated government bonds and the corresponding German counterpart as the "risk-free" benchmark. This study is motivated by different reasons. First, there has been little research regarding government bond spreads in the CEE region and euro-denominated bonds in particular. Although emerging market bond spreads have been the subject of extensive analysis, research has mainly focused on Latin American and Asian emerging economies so far. Second, the countries that joined the European Union (EU) in 2004 and 2007 will adopt the euro sooner or later, with Slovenia, Malta, Cyprus, and Slovakia already being members of the European Monetary Union (EMU). Today, euro-denominated bonds comprise a substantial amount of the total outstanding long-term bonds in these countries, and their importance will increase over time. Third, euro-denominated government bonds make it easier to place bonds on international financial markets, as the market for debt in local currencies is relatively small, and eliminate currency risk for investors from the euro area.

To investigate the determinants of government bond spreads empirically, separate regressions are run for eleven countries. Particular attention is paid to the time-series properties of the variables and extraordinary political or economic events are accounted for by appropriate dummy variables. Depending on the country, the sample period starts between January 1999 and June 2004 and ends in May 2007.

The results indicate that virtually all CEE government bond spreads are influenced by market volatility and the "risk-free" interest rate proxied by the ECB reference rate. These common driving factors are also found in the existing empirical literature regarding other emerging markets and the EMU. In contrast, idiosyncratic risk captured by local macro fundamentals has very limited explanatory power. This suggests that,

overall, macroeconomic developments in a CEE country are less important drivers of bond spreads in the period under investigation. Governments should, however, pay attention to their budget and the macroeconomic stability of the country as spreads and therefore financing costs rise during periods of financial problems and uncertainty. Some important factors driving bond spreads, like overall market volatility, the level of the "risk-free" rate, and international events, cannot be influenced by the governments themselves, but the effects on their financing costs can be mitigated by a sound economic environment and political stability. To some extent, this may also be true with respect to the global economic crisis that has severely hit some CEE countries since mid 2007. Demand for emerging market bonds has temporary come to a standstill with CEE government bond spreads rising again after a period of declining risk premiums (see e.g. IMF 2008).

Similarly to governments, corporations often rely on external sources of finance like bank lending, bond or equity issuance, and the financing conditions they face influence their investment behaviour with repercussions on the economy. In an international comparison, financing through financial markets (equity and bonds) is more common in the US, whereas financing by banks is more widespread in Japan and the euro area (Allen and Gale 2000; Byrne and Davis 2003). Looking at the US, the UK, and the euro area, one observes rather similar debt-to-equity ratios of around 70% in 2004, with debt defined as the sum of bank loans and corporate bonds. Nevertheless, with respect to debt financing only, corporations in the euro area rely more heavily on bank loans than corporations in the US and the UK, where the issuance of corporate bonds is more widespread. In 2004, the share of debt securities in the outstanding amount of debt of non-financial corporations was 40% in the US, 25% in the UK, and 11% in the euro area (ECB 2006).

In the second chapter, which is joint work with Magdalena Morgese Borys and Rien Wagenvoort, we focus on debt financing by non-financial corporations and assess whether bank loan and bond interest rates as measures of financing costs are converging across the euro area. In the EU, a major objective of the creation of the common market was to ensure that corporations face the same conditions across member states to foster competition and innovation. One important aspect in this regard is to create a level playing field in financing costs and our analysis assesses the degree to which it has been achieved. This is also of particular interest to the European Central Bank, since financing

conditions are key for the monetary policy transmission operating mainly through the interest and bank lending channel.

To test for convergence in the bank loan and corporate bond market, we use monthly bank loan interest rates and quarterly primary corporate bond yields of a sample of euro area countries. Our main contribution to the literature is to apply a new convergence measure in addition to the commonly used concepts of α-, σ- and β-convergence. These last three concepts capture long-term trends and assess, respectively, whether median interest rates across countries are equal, whether the cross-country dispersion of interest rates declines over time and if the spreads of country interest rates over a common benchmark are stationary. However, there is also the question of whether rates move synchronously in their short-term fluctuations. This brings us to the concept of factor convergence. This measure uses factor analysis to extract common factors from the data and indicates that markets are integrated when the factor loadings of all the countries are significant and have the same sign.

Our results show that the primary euro-denominated bond market is already integrated. We find evidence of α-, β- and factor convergence and an absence of σ-convergence. In contrast, the market for bank loans remains segmented to different degrees depending on the type and size of loans. For all loan categories, median interest rates still differ significantly across the euro area even after adjusting the rates for macroeconomic conditions such as systematic risk and inflation. This is particularly true for small loans with a short rate fixation period, and there is little evidence that median rates are becoming more uniform over time. On the contrary, cross-country variance in loan rates increased in 2008 as a result of the global financial and economic crisis. However, we find evidence of factor convergence for large bank loans and long-term small loans, meaning that, up to a fixed effect, interest rates are driven by common factors. This does not hold for short-term small loans, which are still affected by country-specific factors. To the extent that loans with short rate fixation periods contain a larger share of working capital type of financing than loans with long rate fixation period, short-term small loans are more likely to be affected by information problems, which possibly lead to distortions in loan pricing.

Since small bank loans are likely to be dominated by small and medium-sized enterprises, small businesses do not face a level playing field in their financing costs, in particular with respect to the financing of working capital, and additional policy efforts

are needed to make retail bank markets more competitive. Our findings also indicate that the limited use of market-based debt financing by non-financial corporations in the euro area cannot be attributed to a lack of integration of the single corporate bond markets, since bond yields tend to fully converge.

The third chapter turns to the household sector, which accounts for the largest share of bank loans in the euro area. In 2004, bank loans to households represented 54% of the total outstanding bank loans to the non-financial private sector in the euro area, and household debt has risen sharply since 1998, although it is still below the levels in the US, the UK, and Japan (ECB 2005). A major driving factor of this development has been increased mortgage borrowing, which reflected sustained house price growth and declining financing costs in the euro area. Mortgages are not only taken out by first-time buyers, but also by owner-occupiers who want to finance house purchases or home improvements, as well as consumption, investments, and other expenditures. Borrowing against home equity is known as “home equity withdrawal” (HEW) and has been of increasing interest to economists in recent years. From a macroeconomic perspective it is important to understand the link between HEW, consumption, growth, and business cycle fluctuations as the aggregate amount withdrawn and its impact on the economy can be significant. Recently, mortgage borrowing in general and HEW in particular have attracted attention due to their role in the subprime crisis in the US, leading to the global economic downturn with sharply deteriorating financing conditions briefly mentioned in the above discussion of the first two chapters (see also IMF 2008). On the household level, HEW is a means to better financial management and it can expand the financial scope of otherwise credit-constrained households. To understand better how far households profit from HEW, and for what purpose the equity withdrawn is used, it is necessary to analyse micro data, which in turn offer useful insights into the way HEW feeds into the economy.

Chapter 3 addresses these questions by studying the factors driving HEW on the household level using Dutch survey data. In the European context the Dutch housing market has been one of the most dynamic since the early 1990s, characterized by an innovative and varied mortgage market and a very generous system of tax deductibility for mortgage interest rates, making it a particularly interesting case to study HEW. The empirical literature has tried to analyse for the US, the UK, and Australia when households withdraw home equity. This study adds evidence on continental Europe and

tests the implications from theoretical models incorporating home equity withdrawal. Economic theory has highlighted the importance of withdrawing equity to overcome negative income shocks (buffer motive), to benefit from more favourable financial conditions if it is used to refinance existing debt (financial motive) or to borrow against rising future income (life-cycle motive).

By estimating a household's propensity to withdraw home equity, the analysis assesses the empirical importance of these motives. For this, data from the Dutch National Bank Household Survey (DHS) is used, covering the period 2004 to 2007.

In contrast to previous studies, the analysis finds little evidence that HEW is used as a buffer against adverse income shocks. Financial efficiency motives and age effects turn out to be more important for a household's decision to withdraw home equity. The probability of withdrawing increases until the mid-50s, reflecting the necessity to build up home equity at a younger age to be able to use it at a later stage. There is also weak evidence that retirees access their home equity by remortgaging or taking out second mortgages, rather than by moving to cheaper accommodation. Furthermore, the study finds that credit-constrained or indebted households use HEW as a source of finance, supporting the idea that it is mainly the collateral channel through which HEW affects the economy. The analysis also provides some preliminary insights into the impact of supply-side conditions. The results indicate that tightening credit conditions represent a significant impediment for households facing a negative income shock.

These findings imply that HEW allows for better financial management as households are able to profit from favourable financing conditions and have the possibility to enlarge their financial scope. Although increased mortgage borrowing might has led to higher risk exposure of some households, overall, the Dutch data do not find evidence that HEW could introduce systematic risk to the economy. Moreover, by far the largest share of the equity withdrawn is reinvested into housing and not used to finance the consumption of durable goods or other expenses, suggesting that equity withdrawal feeds back to the economy mainly through the housing sector.

The three chapters of this thesis are self-contained and can be read independently of each other.

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Chapter 1

An Empirical Analysis on the Determinants of CEE Government Bond Spreads

1.1 Introduction

Bond spreads reflect the risk premium an investor demands for holding a specific bond compared to another. The determinants of sovereign bond spreads have already been studied quite extensively in economics, but still little is known about euro-denominated bonds issued by Central and Eastern European (CEE) countries. To overcome this lacuna and to contribute to a better understanding of the development in this region, this study investigates the yield difference between 10 year euro-denominated CEE government bonds and the 10 year government bond issued by the German government (the so called 10 year German Bund) as the "risk-free" benchmark. It analyses separately for each country how local macroeconomic conditions and the global market environment influence the bond spread over time.

Most of the empirical studies that investigate the determinants of sovereign bond spreads focus on Emerging Markets (EM) and the European Monetary Union (EMU). In the 1980s and 1990s much attention was paid to Latin American and Asian government bonds issued in US dollars and their spread over the US counterpart. Many of these countries, mainly in Latin America, had high debt burdens, were struggling with their economic development and finally defaulted. This is what led to the creation of the so called "Brady bonds" in 1989. At that time the market for sovereign bonds was rather small and illiquid, but this changed in the 1990s as more and more countries issued

bonds, not only denominated in US dollars but also in local currency. Emerging market bonds became a new asset class that attracted attention on financial markets.

Since the creation of the EMU, economists have also become interested in bond spreads between countries belonging to the euro area. Although spreads declined, they are still persistent, reflecting the fact that investors continue to differentiate between the member states.

So far there has, however, been little work on CEE government bonds. Although they are often regarded as belonging to the group of EMs, these countries are seldom included in existing studies on government bond spreads. They are in many respects quite different from other EMs (e.g. in terms of history, economic development and political environment), so these transition economies are sometimes regarded as an asset class on their own.

After the creation of the EMU some CEE countries began to issue euro-denominated bonds, but it is only recently that they have come to comprise a substantial amount of the total outstanding long-term bonds in these countries (see ECB 2008). Appendix 1.A shows that this ratio reaches a peak in Estonia, Lithuania, and Romania, where long-term bonds are almost entirely issued in euros. There has been a growing trend in most of the countries for the period between 2000 and 2006 for the importance of euro-denominated bonds to increase over time. These bonds and the risk premiums associated with them have been hardly studied so far, mainly because of small number of bond issuances and the lack of longer time series. However, economists should be interested in them for different reasons:

First, the countries that joined the EU in spring 2004 and 2007 are required sooner or later to join the EMU as well. Slovenia has already adopted the euro as the first CEE country in January 2007 and Malta and Cyprus followed in January 2008. The last country to join the EMU to date was Slovakia in January 2009. Therefore bond issuances in euros will have a growing importance as more and more countries join the EMU. Furthermore, low long-term interest rates are part of the Maastricht criteria. The treaty requires that in the year before the convergence examination a candidate's long-term interest rate does not exceed by more than two percent the average rate of the three EU member states experiencing the lowest inflation rates. As proxy the yield of a central government bond issued in local currency with remaining maturity of 10 years is recommended. Although this chapter does not look exactly at these reference yields, one

should keep in mind the importance of long-term bond yields and the attention paid to them by both euro area and CEE governments.

Second, euro-denominated government bonds ease access to international financial markets, since the market for bonds in local currency is small.

Finally, bonds issued in euros comprise fewer risk factors for investors from the euro area. This is not to say that they are less risky, but they do not have an explicit currency risk.

The analysis covers in total eleven countries: the new EU member states Poland, Hungary, Czech Republic, Slovakia, Slovenia, Lithuania, Romania, Bulgaria, and Cyprus, but excluding Estonia, Latvia, and Malta because of their lack of euro-denominated bonds or of too short time series. It includes the EU candidate countries Croatia and Turkey. From the plotted spreads one can see that yields have already converged in recent years, but this is not a unidirectional process.[1] In some countries spreads have risen again after a period of convergence and there was a common tendency towards increased risk premiums that started in the summer of 2007, mainly attributable to the global financial and economic crisis.

The integration of CEE countries in the EU and EMU raises the important question of how bond markets behave: whether bond spreads are mainly driven by the macroeconomic environment or if there are other sources like market sentiment or convergence expectations, which prevail.

Similar to the existing literature about EMs and EMU government bond spreads I find evidence for a common factor driving CEE bond spreads. Market volatility influences virtually all sovereign bond spreads in the analysis, whereas other factors play a minor role and differ more between countries.

Idiosyncratic country risk, captured by local macro fundamentals, helps only to a limited extent to explain bond spreads. Macro variables differ in their significance considerably from country to country and seem overall less important for explaining a country's bond spread over time. From this, however, one should not deduct that investors do not pay attention to macroeconomic stability. In periods of pronounced financial problems spreads rise sharply as captured by different dummy variables. CEE countries are affected by global risk factors as other EMs but also developed economies

[1] Bond spreads for the different countries are shown on page 33 f.

like the EMU members are, and a sound economic environment helps to mitigate negative effects in times of market turmoil.

The remaining part of the chapter is structured as follows: Section 1.2 defines bond spreads and what they reflect. In Section 1.3 an overview is given of the existing literature dealing with the determinants of bond spreads and how this study relates to it. Section 1.4 explains the empirical implementation, discussing time series properties, model specification and variable selection. Section 1.5 presents the data, while Section 1.6 shows the main results of the regression analysis. A robustness analysis is presented in Section 1.7 and Section 1.8 concludes by discussing and summarizing the findings of this chapter.

1.2 Definition of bond spreads

Bond spreads are calculated taking the difference between the yield to maturity (YTM) of a CEE 10 year government bond denominated in euro and the YTM of the respective 10 year German government bond.

$$s = i - i^* \qquad with\ i = CEE\ government\ bond\ yield\ and\ i^* = German\ government\ bond\ yield$$

In other words, the return on a risky bond equals the return on a riskless bond plus a risk premium, i.e. the spread, as the bondholder of a risky asset wants to be compensated for the risk he faces. Therefore, the spread reflects three different types of risk:

The default risk is the probability that the bondholder loses all or part of his money invested in the risky asset because of the insolvency of the borrower. This means that in the case of a government bond the issuing country cannot or refuses to repay its debt. A prominent example in recent history was the sovereign default of Argentina in December 2001.

If a bond is issued in a currency different from the one the investor calculates with, we speak about exchange rate (or currency) risk. It arises from the change in price of one currency against another. If we think about an investor from the euro area, who buys a Polish government bond issued in złoty, he faces not just the normal market risk associated to changes in demand for the traded asset, but the return on his investment will

also depend on the relative performance of the złoty with respect to the euro. Things become different when we look at CEE government bonds issued in euros as in this study. In that case there is no explicit exchange rate risk for an investor from the euro area, but the risk is rather incorporated into the default risk. If the złoty depreciates against the euro, it becomes more difficult for the Polish government to repay its debt issued in euros, leading to a higher probability of default.

Less attention is often paid to another risk component, the liquidity risk. It reflects the risk of selling less liquid assets at worse market conditions, as can be the case for bonds issued in small volumes and facing a weak market demand.

Finally, there are additional determinants of the spread apart from risk such as technical factors including taxation, issuance, clearing and settlement procedures. In the following I will abstract from the latter, since they are regarded as playing a minor role and are quite difficult to include in such an analysis.

1.3 Related literature

Two of the seminal papers in this research area were contributed by Edwards (1984, 1986). In his first study he analyzed the determinants of the spread between the interest rate charged to a particular country belonging to the group of LDCs and the LIBOR.[2] LDCs are viewed as small borrowers in perfectly competitive financial markets. In his model a country's fair value spread is a function of the probability that it will default on its external obligations. This probability depends on a set of macroeconomic fundamentals and external shocks. He found different variables to be significant like the debt-to-GNP ratio or the gross investment-to-GNP ratio. The second study dealt with the pricing of bonds and bank loans and finds again a positive effect of higher debt ratios on the risk premium.

Emerging Market bond spreads have been analysed in many studies since.[3] The empirical literature indicates that the yield of US government bonds, the slope of the US yield curve and risk indicators on the US bond market are the main driving factors of sovereign spreads between EMs and the US (see e.g. Arora and Cerisola, 2001; Barnes

[2] LDC: Least Developed Country; LIBOR: London Interbank Offered Rate.
[3] A more comprehensive list of studies especially concerning EMs can be found in Beck (2001).

and Cline, 1997; Eichengreen and Mody, 2000; Kamin and von Kleist, 1999; Min et al., 2003). Ferrucci (2003) also finds a strong empirical relationship between spreads and global liquidity conditions as well as US equity prices. Overall, external factors play an important role, while the evidence for local macro fundamentals seems to be weaker.[4]

Few studies include or deal specifically with CEE countries. The Global Financial Stability Report, issued by the International Monetary Fund (IMF), in 2003 included a short analysis of the determinants of local currency bond yields from the Czech Republic, Hungary, and Poland (see IMF 2003). The authors regress local currency bond yields on domestic fundamentals and German Bund yields and find the latter not to be significant, but show that yields are mainly driven by macroeconomic fundamentals and, in particular, inflation. Orlowski and Lommatzsch (2005) and Holz (2006) study the determinants of local currency bond spreads and yields in the Czech Republic, Hungary, and Poland. Their results indicate the importance of consumer price index (CPI) and reference rate differentials as well as exchange rate movements for explaining bond spreads. In a more recent paper, Strahilov (2006) uses a cointegrated VAR model to study the long-run relationship between the yield differential of Polish and Bulgarian bonds denominated in US dollars over a US treasury bond on the one hand and the countries' fundamentals as well as the US interest rate on the other hand. He finds that the spread moves with changes in the current account balance and the government budget balance. These findings suggest that macro fundamentals help to explain bond spreads, although there is also evidence for the importance of market variables like reference rates.

Apart from Emerging Markets, many studies look at government bond spreads in the EMU. Pagano and von Thadden (2004) provide an overview of the integration of European bond markets and conclude that yield differentials are still persistent. This seems to be related more to small differentials in fundamental risk than to liquidity factors. A related study by Codogno et al. (2003) uses single country regressions to estimate the impact of macro fiscal fundamentals and international risk factors on yield differentials and tests whether the impact of international factors depends on local fiscal fundamentals. Their results show that for most countries only international risk factors, and not domestic ones, have explanatory power. Liquidity factors play only a minor role according to their estimates. This latter result has been challenged by a growing literature

[4] For a different approach that tries to explain bond spreads by credit ratings instead of fundamentals see Cantor and Packer (1996).

on the relation between returns and liquidity. Two recent contributions are from Vayanos (2004) and Favero et al. (2008). Both models predict higher spreads for less liquid bonds, but come to different conclusions regarding the interaction term between liquidity and risk conditions. While in Vayanos's model liquidity becomes more important in riskier times, Favero et al. predict a diminishing importance of liquidity during periods of increased risk. The latter find empirical evidence in their data, but the results in Beber et al. (2009) lend more support to Vayanos's model.

To summarize, the literature on the EMU bond market finds that spreads are mainly influenced by a common risk factor (see Geyer et al. 2004; Favero et al. 2008) that can be approximated by the spread of corporate debt over government debt or similar risk factors.[5] The liquidity of the securities is less important, although it has a direct and an indirect effect on spreads. While liquidity lowers risk premiums, its interaction effect with risk is not yet clear.

This study contributes to the literature in several ways. First, it comprises for the first time a comprehensive analysis covering euro-denominated bonds issued in CEE. Second, it assess whether similar results as obtained by the few existing CEE studies hold for recent years and third, whether there is a common driving factor that could support the findings of EM and EMU studies carried out so far.

1.4 Empirical implementation

To assess the impact of market indicators and macro fundamentals on bond spreads, regressions are run separately for all eleven countries. The time period covered differs between countries, ranging in its maximum from January 1999 to May 2007.[6] Regarding the exact model specification two issues have to be addressed. First, one should assess the time series properties of the variables as the stationarity assumption is of crucial importance for inference from regression analysis. As Granger and Newbold (1974) showed in a simulation, spurious correlation can arise if one runs a regression of a nonstationary variable on a set of stationary or nonstationary variables. Second, the

[5] Other measures include the spread between the yield on fixed interest rates on swaps and the yield on US government bonds or stock market volatility indices.

[6] As the study includes just eleven countries, panel analysis would impose restrictions on the estimated parameters, rather than providing important efficiency gains.

explanatory variables to be included in the regression analysis have to be chosen, paying attention to both theoretical findings and the existing empirical literature.

1.4.1 Time series properties

Testing the stationarity assumption of time series can be quite tricky given the large set of different test specifications and the modest sample size for many countries in the analysis. In an interesting comment to a paper by Campbell and Perron (1991), Cochrane (1991) pointed out that it is very difficult to distinguish unit roots and stationary processes in finite samples and that tests should be treated with caution especially in small samples.[7] Given the importance of the question for both model selection and statistical inference, it is however necessary to obtain evidence for or against stationarity, keeping the limitations mentioned above in mind.

In the following, I performed unit root tests for bond spreads in levels, logs and first differences.[8] It is an important feature that most of the time series include the period of EU accession which represents a potential structural break. Omitting the possibility of such an event potentially biases test results. Although it seems plausible to assume that EU accession or the successful completion of accession talks are break points, unit root tests with such exogenously determined breaks have been criticised in the past, as this approach invalidates the distribution theory underlying conventional testing and led to the development of unit root tests with endogenously determined break dates. One such that seems most suitable for this case is the Zivot and Andrews (1992) endogenous structural break test. In their setup the break date is selected where the t-statistic from the Augmented Dickey-Fuller (ADF) test of unit root is at a minimum (most negative) and it also allows for an additional break in the trend (see also Glynn et al. 2007). These two features are very appealing, as a structural break with a subsequent change of the convergence process in the sample period is quite plausible.

[7] Cochrane (1991) further emphasizes that for any unit root process there exist "arbitrarily close" stationary processes, and vice versa, making it difficult to distinguish between them in small samples. According to his calculations, there is however a high probability of interest rates being stationary in levels. Looking at history, they were around 6% in ancient Babylon, around 6% in the Middle Ages and around 6% in 1991. The probability that a random walk process generates such a pattern is almost zero. However, for making inference from the estimation results, one has to be concerned about the sample under investigation.

[8] If the spread is stationary, but yields are not, than the latter are cointegrated with loadings (1;-1). This would in turn limit the benefits from long-run portfolio diversification.

Table 1.1 shows the results, which indicate nonstationary spreads for most of the countries, despite the inclusion of a structural break. There are however four countries, for which the test suggests a rejection of the unit root hypothesis: Poland, Slovakia, Slovenia, and Turkey. The endogenously determined break occurs for Poland in October 2002, shortly before the EU accession talks were successfully completed and for Slovakia in May 2003, i.e. in the interim period between the completion of the accession talks and the formal EU accession. As break date for Slovenia, April 2004 was located, just one month before the EU enlargement, whereas for Turkey the test suggests April 2003 as a break date that separates the former period of financial turmoil, including a currency crisis, from a subsequent period with falling spreads. Due to this endogenous determination, the break often does not coincide exactly with the date of an important event, but it can quite easily be associated to one as in the case of this study.

Next the same unit root test was carried out for the logarithmic transformation of the spread. Almost all spreads in logs were found to have a unit root. Therefore the logarithm of the time series, though commonly used in finance and in many studies regarding bond spreads, is not well suited for regression analysis of the sample period, but even worsens problems. As expected, results change if one looks at the differenced time series for which I performed the ADF test: the first differences of all spreads are stationary. [9]

[9] The ADF test seems to be the better choice for first differences, as the Zivot-Andrews test includes a time trend in its model specification. Furthermore, it is unclear if the break also affects the first differences. A graphical analysis does not support this hypothesis.

Table 1.1 Unit root tests

	Zivot-Andrews (with intercept and trend)		ADF (with intercept)
	level	log	first difference
Poland	st. *	nonst.	st. ***
Hungary	nonst.	nonst.	st. ***
Czech Republic	nonst.	nonst.	st. ***
Slovakia	st. ***	nonst.	st. ***
Slovenia	st. **	st. **	st. ***
Lithuania	nonst.	nonst.	st. ***
Romania	nonst.	nonst.	st. ***
Bulgaria	nonst.	nonst.	st. ***
Cyprus	nonst.	nonst.	st. ***
Turkey	st. *	nonst.	st. ***
Croatia	nonst.	nonst.	st. ***

Notes: Time series are spreads in level. *st.* stands for stationary, *nonst.* for nonstationary and *ADF* for Augmented Dickey Fuller. For the Zivot-Andrews test asymptotical critical values are used. Significance is indicated at follows: *** significant at 1% level, ** significant at 5% level, * significant at 10% level. Poland: break in October 2002; Slovakia: break in May 2003; Slovenia: break in April 2004; Turkey: break in April 2003

1.4.2 Model specification

The results from unit root tests give important hints regarding the model specification and suggest the following procedure. First, the model is estimated in first differences for all eleven countries, which delivers consistent estimates even if the variables in levels are nonstationary.

$$\Delta s_t = \alpha_0 + \sum_{i=1}^{k} \beta_i \Delta x_{ti} + \sum_{i=k+1}^{K} \beta_i \tilde{x}_{ti} + \varepsilon_t, \quad i = 1,...,K; \; t = 1,...,T \tag{1.1}$$

In the model Δs is the spread in first differences, Δx is a set of explanatory variables in first differences, $\tilde{x}$ indicates dummy variables, which enter the regression equation in levels, and ε is the error term.

This specification allows modelling of how a change in the spread over time depends on changes in the explanatory variables and on the set of dummy variables. Assume for a moment that ceteris paribus (c.p.) the government balance improves more quickly. As a

consequence, the change in the spread should react accordingly, i.e. decline more sharply. The estimated coefficient is the partial derivative of the dependent variable with respect to the explanatory variable, as displayed by the following equation:

$$\frac{\partial \Delta s}{\partial \Delta x} = \beta \tag{1.2}$$

The predicted sign in this case is the same as it would be for the variables in levels. Likewise, one can also see for other variables that the theoretical prediction does not change, which allows for an interesting model comparison: if a model estimated in levels delivers the same signs of the coefficients as the model in first differences, than this suggests that the time series in levels are likely to be stationary. However, a caveat concerns the dummy variables: depending on the event represented, their impact on the level of the spread or on its change must not necessarily go into the same direction. One can imagine that an event affects the level of the spread for a short time period, but that the volatility over this period is not significantly different from other periods.

In a second step a model in levels is estimated for the four countries that are shown to have stationary spreads. According to the Zivot-Andrews model, a structural break (b_{ZA}) is allowed for in intercept and trend. The model can be formalized as

$$s_t = \alpha_0 + \sum_{i=1}^{L} \beta_i x_{ti} + \partial t + \gamma b_{ZA} + \phi b_{ZA} t + \varepsilon_t, \quad i = 1,...,L; \; t = 1,...,T \tag{1.3}$$

where s is the spread in levels, x is a set of explanatory variables including dummy variables, t is a time trend and b_{za} a structural break dummy, which equals zero in the period before the break and one afterwards.

To obtain consistent estimates, both sides of equations (1.1) and (1.3) have to be integrated of the same order. Since the dependent variable is stationary in levels, i.e. I(0), the explanatory variables have to be stationary as well or cointegrated among themselves, if they are I(1). This is tested by running ADF tests on the residuals that have to be stationary.[10]

[10] N.B.: Since these residuals are estimates of the disturbance term, the asymptotic distribution of the test statistic differs from the one for ordinary series. The correct asymptotic values used in this study can be found in Davidson and MacKinnon (1993, Table 20.2).

A comparison of the models stated in (1.1) and (1.3) then allows conclusions to be drawn on the underlying time series characteristics and indirectly provides some evidence on the validity of the results from the Zivot-Andrews unit root test.

Assuming that the model specification is correct, both equations can be estimated consistently with OLS. In the presence of heteroskedasticity and/or serial correlation, robust standard errors calculated according to Huber-White or Newey-West allow for statistical inference.[11]

1.4.3 Explanatory variables

This study tries to assess the impact of market variables and macroeconomic fundamentals on bond spreads. Unfortunately, economic theory provides little guidance with respect to the specific variables the model should include. Evidence from the existing empirical literature suggests however a set of different variables which have been proven to influence bond spreads and are considered in the following.

One can roughly classify the variables used in the analysis into three groups. The first one describes the general market environment and comprises the European Central Bank (ECB) reference rate, the market liquidity measured as the difference between the ECB reference rate and the 3-month EURIBOR, the volatility proxied by the VDAX-NEW[12], and the consumer price index in the euro area. These variables can be regarded as exogenous to the government of the CEE country.

The second group consists of macroeconomic fundamentals which should be indicators for the economy's soundness and the third group includes dummy variables covering periods of interest. The latter refer to the specific month or period in which the event occurred. They are equal to one in the period of interest and zero otherwise, with the exception of three break dummies that equal one in all months subsequent to a specific event. They capture the effect of the enlargement report in 2001, the successful completion of the EU accession talks for Romania and Bulgaria and the endogenously determined break in the model in levels. Table 1.2 gives an overview of market variables

[11] Serial correlation leads to inconsistent estimates only in the presence of lagged dependent variables. In a robustness check outlined below, a model with lags of the dependent variable is estimated to remove serial correlation.

[12] The VDAX-NEW measures the implicit volatility of the German stock index DAX over a period of 30 days.

and macro fundamentals used in the analysis, while a detailed description of the dummy variables can be found in Table 1.7 in Appendix 1.C.

Table 1.2 Exogenous variables and their predicted impact

Market variables	Predicted impact on spread
ECB reference rate	+/-
Liquidity (ECB-3m EURIBOR)	- (decreasing)
Volatility index	+ (increasing)
CPI euro area	+
Local macro fundamentals	**Predicted impact on spread**
CPI local	+
Exchange rate (local currency/euro)	+
Industrial Production	-
External balance	-
Government balance	-
Debt to GDP	+
Reserves to GDP	-

The effect of the ECB reference rate on bond spreads is ex-ante ambiguous. A rate hike makes euro area bonds c.p. more attractive for potential investors by reducing the market price of bonds and increasing their yields. According to some models, e.g. the conventional model of risk premium by Edwards (1984), this not only causes emerging market bond yields denominated in euros to rise by the same extent, but rather by an incremental amount to compensate investors for the risk at the new reference rate level. An explanation could be that a rise of the ECB reference rate reduces investors' appetite for risk, leading them to reduce their exposure in risky markets, in turn reducing available financial resources in borrowing countries. Furthermore, a higher reference rate could

widen CEE government bond spreads because it tends to increase debt-service burdens in borrowing countries, which would reduce their ability to repay loans.

An opposite effect derives from the fact that governments of emerging market economies are more reluctant to issue new debt in periods of high interest rates. This reduces the supply of bonds, thereby lowering yields and increasing prices if demand does not decline by the same amount. Which effect prevails is mostly an empirical question that will be addressed in the regression analysis.

To see how market liquidity affects the spread, I look at the difference between the ECB reference rate and the EURIOBOR. The EURIBOR is the rate at which participant banks within the European Union money market will lend money to each other. If the market is liquid, the difference between the reference rate set by the European Central Bank (ECB) and the EURIBOR is small. When market participants become nervous or more risk averse as during the current global financial and economic crisis, this difference tends to get larger in absolute terms, reducing liquidity.[13] In such circumstances CEE bonds are supposed to face a more hostile market environment, leading to higher spreads over assets that are perceived to be (almost) risk-free.

Other indicators for investors' risk appetite are volatility indices like the VDAX-NEW. Higher market volatility is a sign of increased nervousness and risk aversion among investors, which demand higher risk premiums for holding risky assets.

Furthermore, the specification includes both the local and the euro area consumer price indeces. A rise in the euro area CPI increases the probability of a hike in ECB's policy interest rates that could lead to higher spreads. Likewise, an increase in the local CPI increases the probability of interest rate tightening by the national central bank, which puts local government bonds under pressure, raising their yield to maturity and widening the spread.

Finally, a stronger local currency (= decrease in the exchange rate as defined in the regressions[14]), improved government balance, GDP growth (proxied by the industrial production index), reserves, and external balance, as well as a lower debt-to-GDP ratio all foster investors' confidence in the economy and reduce bond spreads.[15]

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[13] The difference is negative, since the EURIBOR is usually higher than the reference rate.
[14] The exchange rate is measured as units of local currency per euro.
[15] Because of too little fluctuation, exchange rates are not included in the regressions for Lithuania and Bulgaria; their currencies are pegged to the euro through a currency board. Exchange rates for Slovenia and Cyprus, who have introduced the euro and also had a quite stable exchange rate to the euro before, are also

Ratings for foreign currency government debt are not used in this analysis. There are several reasons for this: first, there is not much variation in the rating grade over the sample period for many countries; second, ratings capture macroeconomic and political conditions that are already accounted for in the regression analysis and third, ratings are highly correlated with many other explanatory variables which causes multicollinearity problems in the estimation.[16]

Since investors are regarded as forward looking, one should use current values, or even better, forecasts of the variables in the regression.[17] Considering the frequency of the data and the difficulty of obtaining appropriate forecasts, I decided to stick to current values as the most viable approach.

1.5 Data

The period covered by the regression analysis is not equal for each country due to data availability, but starts between January 1998 (for Turkey) and August 2004 (for the Czech Republic) and ends in May 2007. This end of sample was chosen to avoid overlapping with the current financial and economic crisis that started as a subprime crisis in the US approx. by mid-2007. Because of this cut-off, the sample remains unaffected by a potential second structural break, at the cost of losing only a few observations at the time this analysis was carried out.

Yields, volatility indices and some macro fundamentals for different countries are taken from the Thomson Financial Datastream database. Where available however, macro data provided by Eurostat are used.

The frequency is monthly except for the debt-to-GDP ratio, which is provided on a quarterly basis by Eurostat, and the quarterly GDP level used for calculating the reserves-to-GDP ratio. Both these were linearly interpolated into monthly data with EViews 'linear

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not included. One may object that exchange rates are potentially endogenous, but this is not very likely especially during periods of pronounced devaluation as experienced e.g. by Turkey and to a lesser extent Hungary. Due to the monthly frequency the inclusion of a lagged value is not very useful. Because of lack of data, the government balance is excluded for Cyprus and Croatia.

[16] For an overview about the typology and construction of different ratings see Zaninelli (2007).

[17] Assuming on average perfect foresight would allow also working with leads of the variables. This assumption is, however, questionable and the data are furthermore subject to revisions.

match last' function. For most variables, including yields, end of period data are taken; the remaining variables were observed at the middle of the month.

If the fundamental data were not already seasonally adjusted, I adopted the Datastream built-in functions. To improve the seasonal adjustment for the early observations, a longer sample period than the one employed for regression analysis was used. No adjustment was adopted for yields and therefore also spreads. Although there is some evidence for seasonality in stock and bond markets, the question is not settled yet. However, it is highly unlikely that spreads follow seasonal patterns, which would justify a seasonal adjustment.[18]

Bond spreads for each country are plotted in Appendix 1.B. The figures show, for most countries, declining spreads over the sample period but a new increase since the beginning of the subprime crisis. From the descriptive statistics in Table 1.6 one can see that bond spreads differ substantially between countries and months, ranging from 10.83% in July 2002 for Turkey to 0.03% in May 2007 for Slovakia. Standard deviations are also quite heterogeneous, going from 2.53 for Turkey to only 0.03 for the Czech Republic. However, such comparisons have to be made with caution, since values are also influenced by the different sample periods.

1.6 Empirical results

This section presents the main findings of the two models presented in subsection 1.4.2, starting with the model in first differences. Since the specification differs between the two models, the size of the coefficients will not be the same, but the sign of a specific variable should be confirmed by both of them.

1.6.1 Model in first differences

Table 1.3 shows results for single country regressions in first differences. The main feature is that most of the significant parameters concern market variables like the ECB

[18] To check sensitivity of results, regressions were also carried out using seasonally adjusted spreads as dependent variables. No significant change in qualitative results was found, so these estimates are not included in the chapter. Results are available from the author on request.

reference rate, market liquidity, and volatility index, whereas almost none of the local macro variables show significant estimates with the exception of the exchange rate. Therefore, CEE bond spreads seem to be mainly market driven and only to a very small degree fundamentally determined by national factors.[19]

In the analysis the ECB reference rate and the volatility index VDAX-NEW turn out to be key to understanding bond spreads. The higher the increase in the interest rate or market volatility, the higher the rise in the spread. Following this result, the effect of rising risk premiums due to higher reference rates seems to dominate countervailing effects discussed in subsection 1.4.3. Virtually all countries react to changes in market nervousness, making the volatility index a common factor across countries.

Other important variables, though more country specific in their significance, are the market liquidity and the consumer price index in the euro area. A more pronounced worsening of liquidity conditions triggers a quicker widening of spreads in Hungary and Lithuania as investors demand a higher reward for taking risks. The same is true for the euro area price level, as a fast increase can be an indicator of future rate hikes. This variable is significant in Slovenia and Lithuania, but also carries the predicted sign in most of the other countries.

The only macro variable of some relevance appears to be the exchange rate. It is significant and positive for Hungary and Slovakia and positive, though not significant, for Poland, the Czech Republic, and Turkey. The Hungarian forint experienced some difficult periods in the past, the last one being in 2006, while the Slovak koruna was characterized by a considerable appreciation over the sample period.[20] The estimated coefficient for Turkey is extremely high, reflecting the pronounced volatility of the lira and its sharp depreciation during the Turkish financial crisis in February 2001. The insignificance of the coefficient may be due to the overlapping of this event with the Argentinean crisis, so that the dummy variable related to this event captures most of the exchange rate movements in Turkey at that time. Overall, however, macroeconomic developments in a country are less important for explaining government bond spreads over time. This may be attributed to the limited variation of some variables over time and to convergence expectations by investors. They take into account that EU accession countries have to

[19] This was also noted by the OENB Financial Stability Report 3, concerning the long-term stock market developments. See OENB (2002) p.19 for more details.
[20] See e.g. OENB (2006), pp. 17-18.

fulfil certain economic requirements if they want to join the EU, and that countries already being members of the EU have to meet the Maastricht criteria to adopt the euro.

Finally, there is strong evidence that bond spreads are influenced by political and economic events within and outside the country of interest. While the announcement of the EU enlargement in November 2001 did not have any noteworthy long-term impact on the spread of the first ten new member states, the attribution of the EU candidate status to Turkey and Croatia seemed to have exerted greater influence, at least on the specific date. In the respective month, the spread was significantly lower for both countries, indicating a change in investors' expectations.

The analysis also shows that CEE bond spreads remain vulnerable to financial crises such as the Argentinean sovereign default in December 2001, although it did not cause any lasting widening of euro-denominated spreads. Financial markets anticipated to a large extent the payment crisis, so that increased risk aversion and fear of contagion led worldwide to increased spreads or the breaking of narrowing spreads between July and October 2001, i.e. before the official announcement of sovereign default. This is reflected by positive and significant coefficients in the case of Cyprus and Croatia. In the subsequent months bond spreads of different CEE countries increased by less or started to decline as market participants differentiated between the situation in Argentina and other emerging market economies. Regression analysis shows significant negative coefficients of the respective dummy variable for Slovakia, Lithuania, Romania, and Croatia.

Specific to Cyprus and Turkey were the events of March 2003. The election of Recep Tayyip Erdogan as prime minister in Turkey and the failure of a series of reunification talks concerning Cyprus led to fear of political instability in the region and caused bond spreads of both countries to rise more sharply.

The regression analysis can explain 20% to 25% of the variation in bond spreads for most countries. A significantly better performance can be achieved for Lithuania, Turkey, and Croatia, explaining 40% to 50%. The negative value of the adjusted R^2 for the Czech Republic can be attributed to the small sample size compared to the number of explanatory variables. However, to make comparison between countries easier, I decided to adopt for each country the same model specification.

Table 1.3 Model in first differences

	Poland	Hungary	Czech R.	Slovakia	Slovenia	Lithuania	Romania	Bulgaria	Cyprus	Turkey	Croatia
C	-0.033	-0.008 *	-0.009	-0.116 **	-0.020	-0.014 *	-0.041	-0.019	-0.019 **	-0.082	-0.009
ΔECB	0.097	0.124 ***	0.165 *	0.209 *	0.040	0.394 ***	-0.090	0.240	0.033	0.526	0.143
ΔLIQUIDITY	0.016	-0.140 **	-0.110	-0.081	0.043	-0.366 ***	-0.079	-0.254	0.032	-0.358	0.032
ΔCPI EURO	0.004	0.089	0.114	0.092	0.233 *	0.180 *	-0.773	0.592	-0.005	0.836	0.270
ΔCPI LOCAL	-0.049	-0.019	-0.013	-0.038	-0.028	0.011	0.149	-0.063	0.069 ***	0.036	-0.021
ΔVDAX NEW	0.005 ***	0.002 ***	0.001	0.013 ***	0.005 **	0.010 ***	0.015 **	0.020 ***	0.003 ***	0.094 ***	0.011 ***
ΔEXT BALANCE	0.000	0.008	0.000	0.000	0.000 ***	0.000	0.000	0.000	0.000	0.000	0.000
ΔEXCHANGE RATE	0.054	0.003 ***	0.009	0.071 **			-0.064			1.960	-0.228
ΔIND PROD	0.003	0.001	0.000	0.005	0.001	0.000	0.001	0.006	0.000	0.001	-0.007
ΔGOV BALANCE	0.000	0.010	0.000	0.000	0.000	0.001 *	0.000	0.000		0.000	
ΔDEBT TO GDP	-0.013	0.006	-0.009	0.007	-0.006	0.022	-0.096	0.089	-0.002		
ΔRESERVES TO GDP	-0.728	-0.156	0.381	-0.595	-0.609	0.019	-6.576	0.448	0.075	-11.763	-1.057
EU NOV 2001	0.016			0.110 *	0.011				0.012		
EU TALKS							0.065	0.028			
EU CANDIDATE										-1.737 ***	-0.193 ***
ARGENTINA '01	-0.039			0.134	0.009				0.048 **	0.149	0.150 ***
ARGENTINA '01/02	0.041 *	-0.008		-0.060 **	0.009	-0.092 ***	-0.458 **	-0.173	-0.001	0.198	-0.057 *
2001-09	0.027	0.009		0.012	-0.052 **				0.002	-0.208	-0.060
2003-03									0.025 *	3.679 ***	
2005-01											-0.031
Observations	84	70	34	84	86	58	58	58	86	101	72
Adjusted R^2	0.20	0.26	-0.10	0.25	0.21	0.42	0.25	0.23	0.22	0.50	0.40
Standard errors	Normal	NW-HAC	NW-HAC	NW-HAC	NW-HAC	NW-HAC	Normal	Normal	NW-HAC	NW-HAC	NW-HAC
J.-Bera p-val[normal]	0.302	0.677	0.772	0.000	0.000	0.000	0.713	0.000	0.004	0.000	0.471
ADF t-stat	-8.790	-9.729	-6.294	-11.634	-12.135	-9.947	-8.167	-8.821	-10.950	-12.303	-9.199
ADF crit.value 1%	-2.593	-2.599	-2.637	-2.593	-2.592	-2.606	-2.606	-2.606	-2.593	-2.588	-2.598

Notes: The dependent variable is ΔSPREAD. Δ indicates first differences, *EXT BALANCE* stands for external balance, *IND PROD GROWTH* for industrial production growth and *NW-HAC* for Newey-West heteroskedasticity and autocorrelation consistent standard errors. The Jarque-Bera (*J-Bera*) test indicates whether the residuals are normally distributed and *ADF crit. value 1%* refers to the asymptotic critical value for the ADF test applied to residuals (cointegration test) without trend. Estimates were obtained by single country OLS and parameters significantly different from zero at the 10%, 5% and 1% level are indicated with *, **, *** respectively.

1.6.2 Model in levels

Next I have re-estimated regressions for those countries with stationary spreads, using the level of the spread as dependent variable instead of the first difference. Table 1.4 shows the results and test statistics for Poland, Slovakia, Slovenia, and Turkey. ADF tests applied to the residuals reject the unit root hypothesis so that coefficients are estimated consistently.

Overall, qualitative results confirm the picture which resulted from the previous analysis. A higher ECB reference rate leads to increased spreads in three out of four countries, showing that investors demand higher risk premiums in periods of high interest rates. We likewise observe widening spreads when markets are more volatile, as displayed by an upward movement of the VDAX-NEW index. Its coefficient is significant in all four countries, emphasizing the importance of the general market environment for understanding bond spreads.

Again there is little evidence for the importance of local macroeconomic conditions. The national inflation rate seems to play some role for Slovakia and Turkey, where it triggered an increase in the spread. Surprisingly, the opposite is true for Slovenia, though the correlation coefficient between the national inflation rate and the spread is highly positive.

In comparison to the analysis of first differences, the significance of the exchange rate coefficient does not change. The coefficient for Slovakia remains positive and significant.

The only other macro variable carrying the expected sign and being significant is the Polish debt-to-GDP ratio. An increase in the ratio casts doubt on creditworthiness and leads to a widening in the spread.

In line with the model in first differences are the estimates for the event dummies. The period preceding the Argentinean sovereign default led to widened spreads in Turkey and Slovakia, and there was a negative effect of the political uncertainty in March 2003 on the Turkish bond spread.

Furthermore, the regressions include the structural break dummies suggested by the Zivot-Andrews test outlined in subsection 1.4.1. Although they are only significant for Slovakia, this does not invalidate the results. These endogenously determined breaks are probably reflected by other explanatory variables that faced this structural change, thereby influencing the spread.

Finally, an interesting feature of the analysis in levels is the possibility it offers to check the presence of an underlying time trend that characterises the development of the bond spreads. Indeed, this turns out to be the case for Slovakia and Slovenia, as their spreads have become smaller over time, whereas the negative coefficient for Poland is not significant and there is no evidence for Turkey. A negative time trend alludes in this context to ongoing convergence expectations that are not yet reflected by other data.

The explanatory power of these regressions is considerably higher compared to the ones in first differences, so that it seems easier to explain levels than changes. However, a direct comparison of the adjusted R^2 is not possible, since the models use different dependent variables.

Table 1.4 Model in levels

	Poland	Slovakia	Slovenia	Turkey
C	-0.082	-0.955	0.974 ***	-0.898
ECB	0.082 *	0.226 ***	0.137 ***	0.400
LIQUIDITY	0.033	-0.089	-0.073	0.450
CPI EURO	-0.181 *	0.051	0.054	-0.337
CPI LOCAL	-0.015	0.031 **	-0.082 **	0.081 **
VDAX NEW	0.005 ***	0.012 ***	0.003 **	0.098 ***
EXT BALANCE	0.000	0.000	0.000 **	0.000
EXCHANGE RATE	0.024	0.056 ***		1.256
IND PROD GROWTH	-0.040	0.067	-0.130	0.996
GOV BALANCE	0.000	0.000	0.000	0.000
DEBT TO GDP	0.020 **	-0.020	-0.003	
RESERVES TO GDP	1.167	1.571 ***	-0.156	-33.675
EU CANDIDATE				-1.020
ARGENTINA '01	-0.050	0.300 ***	0.029	1.198 ***
ARGENTINA '01/02	-0.053	0.247 ***	-0.033	0.731
2001-09	-0.125 ***	0.077	-0.001	-0.756
2003-03				3.287 ***
BREAK	-0.264	-1.951 ***	0.215	5.102
BREAK×TREND	-0.004	0.058 ***	-0.006	-0.072
TREND	-0.004	-0.057 ***	-0.009 ***	0.047
Observations	84	84	86	101
Adjusted R^2	0.959	0.986	0.962	0.919
Standard errors	NW-HAC	NW-HAC	NW-HAC	NW-HAC
J.-Bera p-val[normal]	0.001	0.000	0.000	0.614
ADF t-stat	-7.826	-7.265	-8.557	-5.923
ADF crit.value 1%	-3.900	-3.900	-3.900	-3.900

Notes: The dependent variable is SPREAD. *EXT BALANCE* stands for external balance, *IND PROD GROWTH* for industrial production growth and *NW-HAC* for Newey-West heteroskedasticity and autocorrelation consistent standard errors. The Jarque-Bera (*J-Bera*) test indicates whether the residuals are normally distributed and *ADF crit. value 1%* refers to the asymptotic critical value for the ADF test applied to residuals (cointegration test) without trend. Estimates were obtained by single country OLS and parameters significantly different from zero at the 10%, 5% and 1% level are indicated with *, **, *** respectively.

1.7 Robustness analysis

To check the stability of the results, the models in first differences, equation (1.1), and in levels, equation (1.3), are also estimated with a reduced number of exogenous variables. Those regressors that were insignificant in most of the countries in the original model or displayed changing signs are excluded from the regressions.

Estimates for first differences remain stable both qualitatively and quantitatively. Table 1.8 in the appendix shows for the first differences that the impact of the significant variables does not depend on the presence of other controls.

Likewise, the results for the model in levels are virtually unchanged, with the ECB reference rate and the market volatility remaining the main driving factors. We can now find some more evidence for exchange rates being important as the coefficient for Poland becomes significant, and moreover for a hostile market environment in the period preceding the Argentinean sovereign default. Again, results displayed in Table 1.9 confirm a negative and significant time trend for Slovakia and Slovenia.

As the problem of serial correlation is more pronounced in the regression in levels, a further robustness test was carried out.[21] Instead of using Newey-West standard errors, I controlled for the serial correlation in the residuals by introducing lagged dependent variables in the regression equation. The lags were chosen according to the correlogram of the residuals and ensure the absence of any serial correlation, as tested by Durbin's alternative statistic.[22]

A lagged dependent variable captures the information available to market participants at that point in time. The change in the spread results therefore from the evaluation of new or unexpected information that was not available earlier. The results shown in Table 1.10 and Table 1.11 remain essentially unaffected; therefore, estimates of the model without lagged dependent variables seem to be reliable.

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[21] Serial correlation in a regression without lagged dependent variables does not affect consistency, but makes estimation results less efficient and requires robust standard errors. This is particularly the case for small samples, if there is pronounced correlation in the residuals. First differencing removes part of the serial correlation and is therefore less affected by this problem.

[22] This test can be made robust to heteroskedasticity by using White standard errors. The consistency problem coming from serial correlation in the presence of a lagged dependent variable can however be less severe than commonly assumed. A recent Monte Carlo study by Keele and Kelly (2006) shows that also in the presence of AR(1) residuals, results can be valuable. The bias is rather small and surprisingly results are even better for small ($50<N<100$) than for larger sample sizes. Although the analysis in this chapter does not exactly replicate the framework of that estimation, one can draw the conclusion to not overestimate the consistency problem.

1.8 Conclusion

Summarizing, the contribution of this chapter is threefold: it gives an overview of the development of euro-denominated bonds in the CEE region, looks at the determinants of the spread over the German government bond and analyzes the sensitivity of results to different model specifications.

In recent years the share of euro-denominated bonds to the total amount of outstanding long-term bonds has increased considerably. For Estonia, Lithuania, and Romania bond issuances are almost entirely in euros and they also represent a significant fraction in other countries in Central and Eastern Europe. The importance of euro-denominated bonds is likely to increase further, as those countries are aiming to join the EMU.

Overall, spreads over comparable German government bonds have decreased over the period under investigation, although not to the same extent in all countries. Government bond spreads of Slovakia, Romania, Bulgaria, and Croatia narrowed considerably, but started from a higher level than the ones of Slovenia, Poland, and Hungary. Convergence is probably easier and faster to achieve at the beginning of the EU accession process than later on. This is also indicated by still persistent spreads even among EMU members.

Compared to other studies about EM bond spreads, the data confirm that international risk, captured in this case by the market volatility, is the single most important explanatory factor. This common factor drives bond spreads not only in Central and Eastern Europe, but according to the empirical literature also in other EMs and in the EMU as well. The macroeconomic development in a country turns out to be less important for explaining government bond spreads in the sample period.

Finally, important political and economic events contribute to a better understanding of sovereign spreads. Countries remain vulnerable to such developments inside their territory, but also to events with global effects such as the Argentinean crisis and the current global financial and economic crisis. Political instability or uncertainty worries investors and can have an important impact on bond spreads. As most of the countries have now joined the EU, the effect of political crises is likely to be somewhat curbed, but it should not disappear.

These results are robust to different model specifications used in the analysis. Two potential drawbacks of this study are the limited length of the time series and the natural limits of an analysis that tries to explain spreads with fundamental data. Bearing this in mind, the data now available nevertheless offer a first insight into the behaviour of euro-denominated CEE government bond spreads and will pave the way to future research as time series get longer. Interesting questions to be addressed concern the cointegration relationship between bond yields, the impact of the global financial and economic crisis that started in mid-2007 on bond spreads, and the effect coming from the successive introduction of the euro in CEE countries.

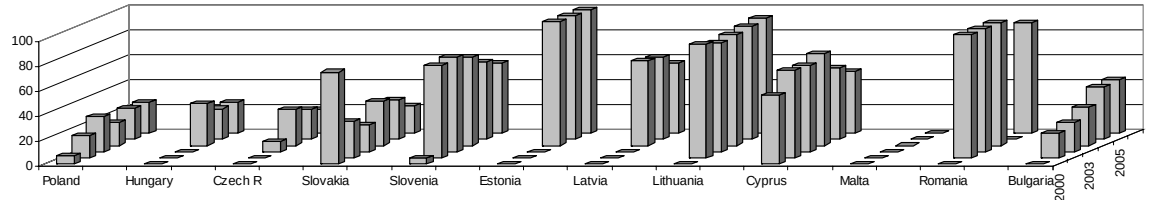
Appendix 1.A: Issuance of euro-denominated government bonds

Table 1.5 Euro-denominated long-term bonds as % of total amount outstanding of all long-term bonds

	Poland	Hungary	Czech R.	Slovakia	Slovenia	Estonia	Latvia	Lithuania	Cyprus	Malta	Romania	Bulgaria
2000	6.9	0.0	0.0	74.4	4.8	0.0	0.0	0.0	56.0	0.0	0.0	0.4
2002	18.4	0.0	0.0	29.9	74.5	0.0	0.0	91.7	70.5	0.0	99.6	20.0
2003	28.3	0.0	8.2	22.2	76.1	0.0	0.0	88.1	69.4	0.0	99.7	24.1
2004	18.8	34.1	29.4	35.7	71.1	100.0	69.0	90.2	74.6	0.0	99.7	30.8
2005	25.4	24.8	24.5	32.1	62.4	100.0	66.5	91.4	57.5	0.0	0.0	42.7
2006	25.5	24.7	19.2	22.6	56.7	100.0	56.8	93.4	50.0	0.0	89.0	43.4

Source: ECB 'Bondmarket and long term interest rates in non-euro area member states of the European Union and in accession countries'

Figure 1.1 Euro-denominated long-term bonds as % of total amount outstanding of all long-term bonds



Source: ECB 'Bondmarket and long term interest rates in non-euro area member states of the European Union and in accession countries'

Appendix 1.B: Descriptive statistics

Table 1.6 Bond spreads: descriptive statistics

	Poland	Hungary	Czech R.	Slovakia	Slovenia	Lithuania	Romania	Bulgaria	Cyprus	Turkey	Croatia
Mean	0.435	0.328	0.157	0.665	0.400	0.339	1.270	1.196	0.445	3.656	0.931
Median	0.408	0.312	0.154	0.181	0.353	0.193	0.609	0.654	0.372	3.116	0.820
Maximum	1.114	0.601	0.216	2.547	0.954	1.406	4.157	3.875	0.962	10.834	2.284
Minimum	0.080	0.131	0.106	0.033	0.111	0.088	0.251	0.235	0.128	0.340	0.214
Standard errors	0.281	0.126	0.032	0.771	0.246	0.300	1.014	0.922	0.272	2.535	0.543
Observations	84	70	34	84	86	58	58	58	86	101	72
Sample											
Begin	2000-06	2001-08	2004-08	2000-06	2000-04	2002-08	2002-08	2002-08	2000-04	1999-01	2001-06
End	2007-05	2007-05	2007-05	2007-05	2007-05	2007-05	2007-05	2007-05	2007-05	2007-05	2007-05

Source: Datastream

Figure 1.2[23]

Spread between 10 year Polish and German government bond

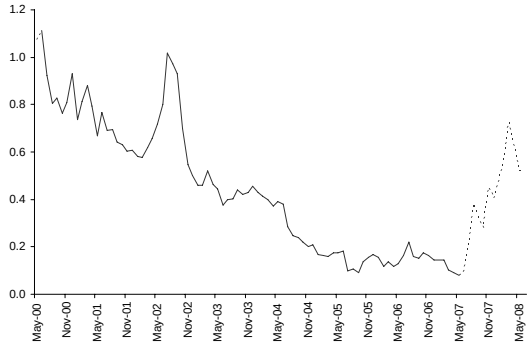


Figure 1.3

Spread between 10 year Hungarian and German government bond

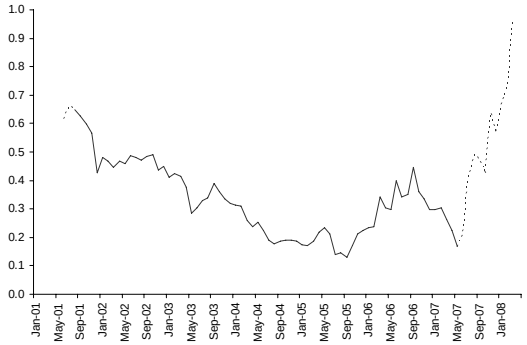


Figure 1.4

Spread between 10 year Czech and German government bond

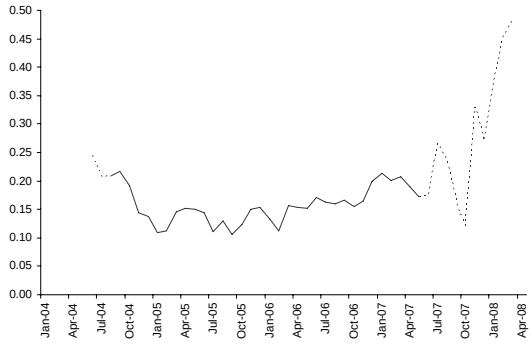


Figure 1.5

Spread between 10 year Slovak and German government bond

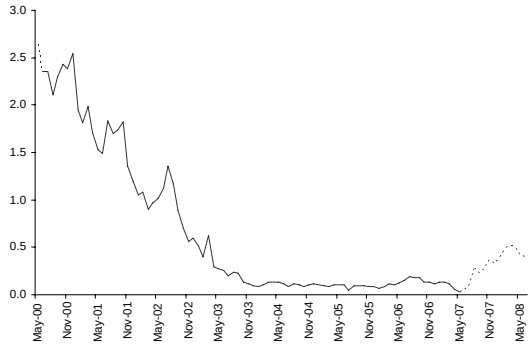


Figure 1.6

Spread between 10 year Slovenian and German government bond

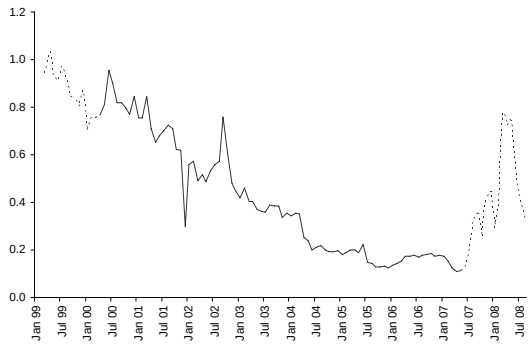
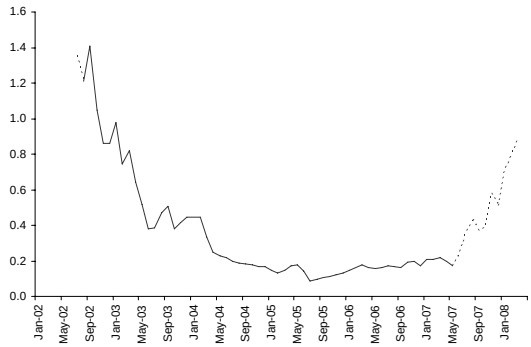


Figure 1.7

Spread between 10 year Lithuanian and German government bond



[23] Spread between euro-denominated government bonds in percentage points. Sample period highlighted in bold line. The effective sample period is shorter than the available time series of spreads, because of data availability of the explanatory variables. Source: Datastream.

Figure 1.8

Spread between 10 year Romanian and German government bond

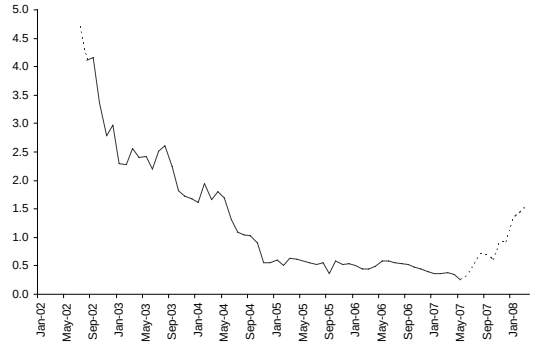


Figure 1.9

Spread between 10 year Bulgarian and German government bond

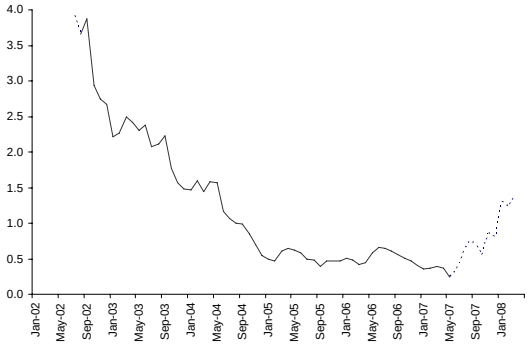


Figure 1.10

Spread between 10 year Cypriote and German government bond

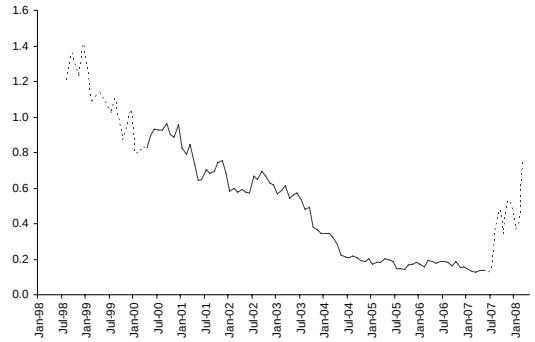


Figure 1.11

Spread between 10 year Turkish and German government bond

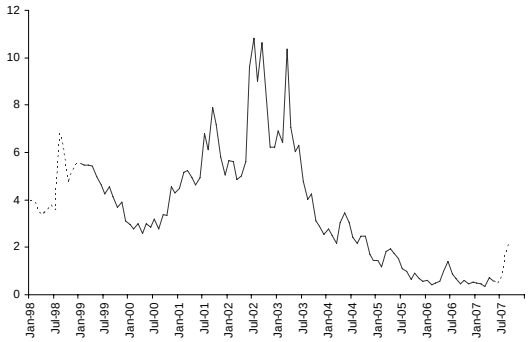
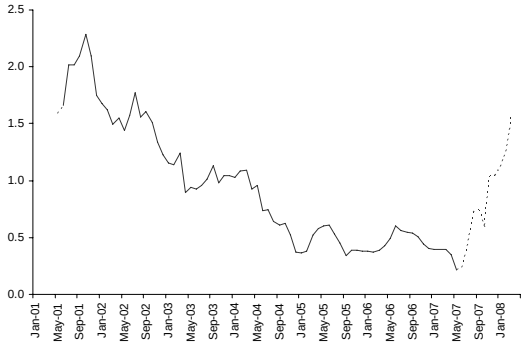


Figure 1.12

Spread between 10 year Croatian and German government bond



Appendix 1.C: Dummy variables

Table 1.7 Dummy variables

Dummy variable	Event
EU Nov 2001	The European Commission published its annual progress report on enlargement. It was significant because it listed the countries included in the first wave of enlargement and provided a timetable for enlargement.[24] Dummy equals one in November 2001 and all subsequent months.
EU talks	Dummy reflects the successful completion of EU accession talks. It equals one from the month of the successful completion onwards. June 2004: Bulgaria December 2004: Romania
EU candidate	Blip dummy that equals one in the month a country gained official EU candidate status. December 1999: Turkey June 2004: Croatia
Argentina ’01	Dummy equals one from July 2001 to October 2001. Re-evaluation of Argentinean debt securities on financial markets in July 2001 led spreads of euro-denominated Argentinean bonds to dramatically double. This caused a widening or the breaking of a narrowing spread trend in CEE countries between July and October 2001.[25]
Argentina ‘01/’02	Dummy equals one from November 2001 to August 2002. Period of capital flight, bank crisis and devaluation. In November 2001 the government announced that it couldn’t fulfil the IMF requirement of a balanced budget. After August 2002 first signs of economic recovery and exchange rate stabilization.
2001-09	Terrorist attacks of September 11. Dummy equals one in September and October 2001.
2003-03	Erdogan became prime minister, although contested by the Turkish army. One of the Cyprus reunification negotiations failed. Blip dummy that equals one in March 2003.
2005-01	Croatia: Mesic wins election against vice Prime Minister Kosor. There were doubts about Kosor’s willingness to cooperate with the International Crime Court for ex-Yugoslavia in Den Haag. Blip dummy that equals one in January 2005.

[24] See Dvorak and Podpiera (2006), p. 136.
[25] See OENB (2002), pp. 16-17.

Appendix 1.D: Robustness analysis

Table 1.8 Model in first differences (reduced number of exogenous variables)

	Poland	Hungary	Czech R.	Slovakia	Slovenia	Lithuania	Romania	Bulgaria	Cyprus	Turkey	Croatia
C	-0.015 **	-0.006	-0.007	-0.018 *	-0.009	-0.017 ***	-0.064 **	-0.053 **	-0.010 ***	-0.130 **	-0.015
ΔECB	0.078	0.103 ***	0.136 **	0.256 **	0.047	0.375 ***	0.402	0.329	0.054	0.710	0.191 *
ΔLIQUIDITY	0.027	-0.121 ***	-0.084	-0.156	0.040	-0.327 ***	-0.419	-0.311	0.013	-0.529	-0.034
ΔCPI EURO	-0.059	0.114	0.101	-0.198	0.236	0.109	-0.528	0.279	-0.003	1.087	0.204
ΔVDAX NEW	0.005 ***	0.002 **	0.001	0.012 ***	0.005 **	0.010 ***	0.019 ***	0.020 ***	0.003 ***	0.098 ***	0.011 ***
ΔEXCHANGE RATE	0.053	0.003 ***	0.010	0.069 **			-0.209			2.158 *	-0.251 **
EU CANDIDATE										-1.679 ***	-0.173 *
ARGENTINA '01	-0.037			0.064	-0.023				0.027 **	0.110	0.153 ***
ARGENTINA '01/'02	0.048 **	-0.001		-0.050 *	0.010	-0.106 ***	-0.487 **	-0.167 ***	0.001	0.257	-0.053 *
2003-03									0.046 ***	3.677 ***	
Observations	84	70	34	84	86	58	58	58	86	101	72
Adjusted R^2	0.208	0.304	0.114	0.267	0.095	0.418	0.252	0.255	0.156	0.525	0.401
Standard errors	Normal	Normal	Normal	NW-HAC	NW-HAC	NW-HAC	Normal	White	NW-HAC	NW-HAC	Normal
J.-Bera p-val[normal]	0.009	0.336	0.651	0.000	0.000	0.000	0.057	0.000	0.010	0.000	0.336
ADF t-stat	-9.196	-9.144	-5.851	-11.588	-13.279	-10.103	-7.610	-7.749	-9.552	-12.240	-8.511
ADF crit. value 1%	-3.900	-3.900	-3.900	-3.900	-3.900	-3.900	-3.900	-3.900	-3.900	-3.900	-3.900

Notes: The dependent variable is ΔSPREAD. Δ indicates first differences,. *NW-HAC* stands for Newey-West heteroskedasticity and autocorrelation consistent standard errors. The Jarque-Bera (*J-Bera*) test indicates whether the residuals are normally distributed and *ADF crit. value 1%* refers to the asymptotic critical value for the ADF test applied to residuals (cointegration test) without trend. Estimates were obtained by single country OLS and parameters significantly different from zero at the 10%, 5% and 1% level are indicated with *, **, *** respectively.

Table 1.9 Model in levels (reduced number of exogenous variables)

	Poland	Slovakia	Slovenia	Turkey
C	-0.164	-0.638	1.010 ***	-1.794
ECB	0.068 **	0.070 **	0.131 ***	0.412 *
CPI LOCAL	-0.012	0.011	-0.077 ***	0.028
VDAX NEW	0.005 ***	0.013 ***	0.003 ***	0.094 ***
EXCHANGE RATE	0.191 ***	0.057 ***		3.178 ***
ARGENTINA '01	-0.180 ***	0.164 ***	0.034 *	0.969 **
ARGENTINA '01/02	-0.059	0.067	-0.008	1.017
2003-03				3.073 ***
BREAK	-0.341	-2.460 ***	0.060	2.171
BREAK×TREND	-0.001	0.071 ***	-0.003	-0.027
TREND	-0.004	-0.062 ***	-0.010 ***	-0.055
Observations	84	84	86	101
Adjusted R^2	0.955	0.985	0.962	0.896
Standard errors	NW-HAC	NW-HAC	NW-HAC	NW-HAC
J.-Bera p-val[normal]	0.000	0.000	0.000	0.942
ADF t-stat	-7.107	-6.385	-9.119	-4.484
ADF crit. value 1%	-3.900	-3.900	-3.900	-3.900

Notes: The dependent variable is SPREAD. *EXT BALANCE* stands for external balance, *IND PROD GROWTH* for industrial production growth and *NW-HAC* for Newey-West heteroskedasticity and autocorrelation consistent standard errors. *ADF crit. value 1%* refers to the asymptotic critical value for the ADF test applied to residuals (cointegration test) without trend. Estimates were obtained by single country OLS and parameters significantly different from zero at the 10%, 5% and 1% level are indicated with *, **, *** respectively.

Table 1.10 Model in levels (lagged dependent variable)

	Poland	Slovakia	Slovenia	Turkey
C	-0.929 *	1.602 *	1.326 ***	0.291
SPREAD(-i)	0.354 ***	0.118	-0.296 ***	0.403 ***
SPREAD(-n)	-0.247 ***	-0.247 **	-0.255 *	
ECB	0.098 ***	0.178 ***	0.118 ***	0.352 **
LIQUIDITY	-0.095	-0.178 *	-0.046	-0.265
CPI EURO	-0.003	-0.103	-0.028	-0.548
CPI LOCAL	0.009	0.028 **	-0.027	0.058 *
VDAX NEW	0.004 ***	0.008 ***	0.002 **	0.057 ***
EXT BALANCE	0.000	0.000	0.000 *	0.000
EXCHANGE RATE	0.081	0.038 ***		0.603
IND PROD GROWTH	0.097	0.208	-0.253	-0.113
GOV BALANCE	0.000	0.000	0.000	0.000
DEBT TO GDP	0.006	-0.033 **	-0.004	
RESERVES TO GDP	2.673 *	1.339 ***	-0.079	-35.976 **
EU CANDIDATE				-0.645 *
ARGENTINA '01	-0.040	0.318 ***	-0.045 *	1.072 ***
ARGENTINA '01/02	0.004	0.213 ***	-0.015	0.683
2001-09	-0.076 **	0.029	0.043	-0.409
2003-03				3.577 ***
BREAK	0.269	-2.300 ***	-0.083	3.529
BREAK×TREND	-0.014 **	0.065 ***	0.000	-0.056
TREND	0.007	-0.072 ***	-0.012 ***	0.057
Observations	81	81	86	101
Adjusted R^2	0.975	0.987	0.971	0.942
Standard errors	White	White	White	White
J.-Bera p-val[normal]	0.284	0.000	0.026	0.000
Durbin's alt. stat. p-val[no AR(4)]	0.551	0.211	0.793	0.107
ADF t-stat	-9.703	-8.433	-9.372	-8.706
ADF crit. value 1%	-3.900	-3.900	-3.900	-3.900
Spread(-i)	-1	-1	-4	-1
Spread(-n)	-4	-4	-9	-

Notes: The dependent variable is SPREAD. *EXT BALANCE* stands for external balance, *IND PROD GROWTH* for industrial production growth and *White* for White heteroskedasticity consistent standard errors. *Durbin's alternative statistic* indicates the probability that the residuals do not follow an AR(4) process. *ADF crit. value 1%* refers to the asymptotic critical value for the ADF test applied to residuals (cointegration test) without trend. *Spread(-i)* and *spread(-n)* indicate the lags of the dependent variable included as regressors. Estimates were obtained by single country OLS and parameters significantly different from zero at the 10%, 5% and 1% level are indicated with *, **, *** respectively.

Table 1.11 Model in levels (lagged dependent variable and reduced number of exogenous variables)

	Poland	Slovakia	Slovenia	Turkey
C	-0.284	0.035	1.298 ***	-0.114
SPREAD(-i)	0.425 ***	0.124	-0.283 **	0.466 ***
SPREAD(-n)	-0.121 *	-0.192 *	-0.262 **	
ECB	0.059 ***	0.147 ***	0.121 ***	0.256 **
CPI LOCAL	0.000	0.012	-0.042 **	0.002
VDAX NEW	0.003 ***	0.012 ***	0.002 ***	0.058 ***
EXCHANGE RATE	0.132 ***	0.035 ***		1.574 *
EU CANDIDATE				-1.296 ***
ARGENTINA '01	-0.114 ***	0.141 *	0.029	0.783
ARGENTINA '01/02	-0.022	0.191 **	-0.032	0.942
2003-03				3.515 ***
BREAK	-0.078	-2.493 ***	-0.156	0.131
BREAK×TREND	-0.005	0.073 ***	0.000	-0.001
TREND	0.001	-0.068 ***	-0.014 ***	-0.040 *
Observations	81	81	86	101
Adjusted R^2	0.974	0.986	0.971	0.936
Standard errors	White	White	White	White
J.-Bera p-val[normal]	0.000	0.000	0.000	0.000
F-stat[no AR(4)] Wald	0.195	0.286	0.919	0.529
ADF t-stat	-8.931	-7.588	-10.365	-8.034
Asymp. crit. value 1%	-3.900	-3.900	-3.900	-3.900
Spread(-i)	-1	-1	-4	-1
Spread(-n)	-4	-4	-9	-

Notes: The dependent variable is SPREAD. *EXT BALANCE* stands for external balance, *IND PROD GROWTH* for industrial production growth and *NW-HAC* for Newey-West heteroskedasticity and autocorrelation consistent standard errors. *Durbin's alternative statistic* indicates the probability that the residuals do not follow an AR(4) process. *ADF crit. value 1%* refers to the asymptotic critical value for the ADF test applied to residuals (cointegration test) without trend. *Spread(-i)* and *spread(-n)* indicate the lags of the dependent variable included as regressors. Estimates were obtained by single country OLS and parameters significantly different from zero at the 10%, 5% and 1% level are indicated with *, **, *** respectively.

Appendix 1.E: Government bonds

Table 1.12 Government bonds

Country	Bond	ISIN
Poland	POLAND 2000 6% 22/03/10	XS0109070986
	BUNDESREPUB.DTL. AN 2000 5 1/4% 04/07/10	DE0001135150
Hungary	HUNGARY 2001 5 5/8% 27/06/11	XS0131593864
	BUNDESREPUB.DTL. 2001 5% 04/07/11	DE0001135184
Czech Republic	CZECH REPUBLIC 2004 45/8% 23/06/14	XS0194957527
	BUNDESREPUB.DTL. 20044 1/4% 04/07/14	DE0001135259
Slovakia	REP.OF SLOVAKIA 2000 7 3/8% 14/04/10	DE0001074763
	BUNDESREPUB.DTL. AN 2000 5 1/4% 04/07/10	DE0001135150
Slovenia	REP.OF SLOVENIA 1999 4 7/8% 18/03/09	XS0095561683
	BUNDESREPUB.DTL. AN 1999 3 3/4% 04/01/09	DE0001135101
Lithuania	LITHUANIA 2002 5 7/8% 10/05/12	XS0147459803
	BUNDESREPUB.DTL. 20025% 04/07/12	DE0001135200
Romania	ROMANIA 2002 8 1/2% 08/05/12 REGD.	XS0147466501
	BUNDESREPUB.DTL. 20025% 04/07/12	DE0001135200
Bulgaria	BULGARIA 2002 7 1/2% 15/01/13 S	XS0145624432
	BUNDESREPUB.DTL. 20025% 04/07/12	DE0001135200
Cyprus	REPUBLIC OF CYPRUS 1998 5 3/8% 28/07/08	XS0089349590
	BUNDESREPUB.DTL. AN 1998 4 3/4% 04/07/08	DE0001135077
Turkey	TURKEY 1997 8 1/8% 22/10/07 -	DE0001955250
	BUNDESREPUB.DTL. AN 1998 5 1/4% 04/01/08	DE0001135051
Croatia	CROATIA 2001 6 3/4% 14/03/11	XS0126121507
	BUNDESREPUB.DTL. 20015% 04/07/11	DE0001135184

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Chapter 2

A factor analysis approach to measuring European loan and bond market integration*

2.1 Introduction

One of the key objectives of the creation of a single market in Europe has been to level the playing field in the corporate sector in order to enhance competition and innovation. This is equally true with respect to finance. Despite the introduction of the euro and the liberalisation and harmonisation of the regulatory side of the financial services industry as a result of two banking directives and the Financial Services Action Plan (FSAP), retail banking remains, however, largely a national affair. Cross-border retail lending generally accounts for less than one percent of total lending (see Gropp and Kashyap 2009). This de facto national segmentation justifies the use of national bank lending rates to assess whether or not the costs of corporate debt financing are converging across the euro area. This paper aims at precisely that.

Previous studies (see, among others, Adam et al. 2002, Baele et al. 2004, Kleimeier and Sander 2006, and Vajanne 2007) so far have found evidence for falling cross-country variance in loan rates (σ-convergence) but little or ambiguous evidence for stationarity of loan rate spreads to a benchmark (lack of β-convergence). On the one hand, σ-convergence suggests that the process of bank market integration is ongoing. On the other hand, the β-convergence results do not exclude the fact that loan rates may drift

* This chapter is joint work with Magdalena Morgese Borys from the University La Sapienza and Rien Wagenvoort from the European Investment Bank.

apart. For example, by estimating cointegration relationships Kleimeier and Sander (2006) find that all bi-lateral relationships between German rates and other national rates are unstable, showing absence of convergence.

We introduce an additional convergence measure to reassess whether retail bank market integration is absent, ongoing, or complete. Note that both the σ-convergence and β-convergence criteria capture long-term trends. There is also the question of whether rates move synchronously in their short-term fluctuations. Such correlation would be the result of national rates following common external factors, for example the European Central Bank (ECB) re-financing rate. In an integrated market national factors should not play a significant role, insofar as they are unrelated to country-specific risk or heterogeneity in demand for financial services.

This brings us to the concept of factor convergence. Factor analysis is applied to decompose the loan rates in a number of latent factors where each factor is multiplied by country-specific factor sensitivities, so-called 'factor loadings'. Loan rates are said to exhibit (weak) factor convergence when all factor loadings are significant and all loadings associated with one common factor have the same sign. There are, then, no statistically significant country-specific dynamic factors. Convergence is complete when factor loadings are the same for all countries (= strong factor convergence). Factor convergence is absent when some factor loadings (of a significant factor) are insignificant or of different sign. The latent factors are found by maximum likelihood factor analysis following Jöreskog (1969). Strong factor convergence implies complete β-convergence, and vice versa, in the sense that one can find a benchmark rate for which all spreads are stationary and white noise. In contrast, weak factor convergence does not necessarily imply β-convergence, neither complete nor incomplete. Nor does incomplete β-convergence, i.e. when spreads are stationary but auto-correlated, imply weak factor convergence.

Factor convergence captures the synchronisation of interest rate movements but ignores time-invariant differences in the absolute levels. These differences are still important and may stem from a variety of factors. First, national bank loan portfolios may differ in their risk profile. Idiosyncratic risk is diversified but systematic (countrywide) risk may differ, especially when the share of small businesses in the loan portfolio is high. Second, differences in inflation expectations may affect nominal rates.

This effect is likely to be increasing in the share of local bank investors, because real returns must take into account consumer price inflation in the investor's country of residence. International investors holding well-diversified portfolios are less affected by cross-country differences in both inflation and risk. Third, there can be heterogeneity in loan products across countries due, for instance, to differences in collateral practices (see ECB 2006). Fourth, there can be differences in deposit rates. This could lead to differences in loan rates even if the interest mark-up was the same.

Since the objective of this chapter is to assess whether there is a level playing field in firm debt financing, and not to explain differences (as Affinito and Farabullini 2009 do), loan rates should not be adjusted for differences in competitive conditions (see Maudos and Guevara 2004) or cost efficiency (see, among others, Casu et al. 2004, Schure et al. 2004) in banking. However, we adjust loan rates for differences in systematic risk (first factor) and inflation (second factor) to the extent that these variables can explain variation in loan rates across countries and over time. Unfortunately there is no obvious way of adjusting national loan rates for heterogeneity in loan products (third factor). Country fixed effects could capture at least part of such heterogeneity but could also be attributed to many other factors, including those for which one should not adjust such as bank inefficiency. Hence, no adjustment is made for the third factor. Finally, in many cases differences in rates on Non-Financial Corporations' (NFCs) deposits (fourth factor) cannot account for differences in loan rates. In fact for some countries where loan rates are relatively high, deposit rates are relatively low. This means that mark-up differences can be even bigger than differences in loan rates. The cross-country relationship between deposit rates and loan rates is statistically insignificant, which made us decide to ignore deposit rates.

This study tests the law of one price in the corporate loan market. Gropp and Kashyap (2009) suggest analysing the convergence of bank profits rather than prices of financial products. They argue that the absence of homogeneous loan pricing does not imply absence of retail banking integration due to differences in tax systems, preferences, etc., meaning that the reason for price differences should not necessarily be sought on the supply side. This seems a valid point concerning part of the cross-country differences in loan rates. Absence of α-convergence, i.e. presence of significant differences in the time-averages of the loan rates, is indeed not necessarily a proof of monopolistic pricing or bank inefficiency. We suggest evaluating market integration against various measures

of price convergence. The α-convergence measure captures time-invariant differences such as those caused by the tax and legal system. The σ-convergence and β-convergence measures capture some of the long-term aspects of the integration process while factor convergence also accounts for short-term movements. In principle, these four convergence measures could also be applied to the profit margins on corporate loans rather than to loan prices if the data were available. However, total bank profitability may not be informative about the corporate loan market since bank profitability is also driven by other business lines such as investment banking, residential mortgages, deposits and other financial services.

We distinguish between small and large bank loans because small loans are dominated by small businesses which are more likely to suffer from monopolistic loan pricing than large scale enterprises (LSEs). In comparison to LSEs, small and medium-sized enterprises (SMEs) are often more information opaque. This makes the financing of SMEs especially challenging since asymmetric information may create adverse selection and moral hazard problems. Wagenvoort (2003) finds that the sensitivity of firm growth to cashflow rises as firm size falls, which may suggest that SMEs encountered finance constraints that prevented them from fully exploiting their growth potential. One way of reducing asymmetric information is to build long relationships with creditors. However, these bank-firm relationships can be exploited to extract monopoly rents from the firms.[26] For instance, Degryse and Van Cayseele (2000) find for small European businesses that interest rates on loans tend to increase with the duration of a bank-firm relationship.

Overall, our results show that the market for bank loans remains segmented albeit to various degrees depending on the type and size of the loan. Small loans are least integrated, indicating that SMEs do not experience a level playing field in their debt financing costs.

For the purpose of benchmarking, we also apply the various convergence measures to the primary euro-denominated corporate bond market. A sample of 828 plain-vanilla fixed coupon bonds issued between January 1999 and October 2008 by Non-Financial Corporations (NFCs) in France, Germany, Italy, the Netherlands, and the United Kingdom is compiled from the Dealogic Bondware data set. The yield-to-maturity of

[26] Boot (2000) provides a survey of relationship banking.

these bonds is adjusted for differences in credit risk before applying the convergence measures. In accordance with the findings of Gabbi and Sironi (2005), our empirical results suggest that the expected secondary market liquidity is not a significant determinant of primary market bond yields when liquidity is measured by bond size. Hence, despite finding evidence for a negative relationship between transaction issuance costs and bond size, there is no need to adjust the bond yields for liquidity.

Our analysis indicates that the primary euro-denominated bond market can be considered fully integrated since the introduction of the euro. Bond yields tend to fully converge and are on average equal across countries.

The plan of the chapter is as follows. Section 2.2 formalises the different convergence measures and presents the adopted econometric approaches. Section 2.3 describes the data sets. The risk and inflation adjustment regressions are shown in Section 2.4 and Section 2.5 presents the convergence analysis. Section 2.6 concludes by summarizing the main findings.

2.2 Convergence measures and econometric approaches

Interest rate convergence can be viewed in different ways which together provide us with a more complete picture of the process. One approach is to test whether the median interest rate level is the same across countries (α *-convergence*). Another approach is to test whether differences between rates are becoming smaller over time (σ *-convergence*) and/or whether these differences are stationary (β *-convergence*), i.e. do not contain long-term trends. Finally, this chapter introduces a new approach by testing for the irrelevance of country-specific factors in the short- and long-term evolution of interest rates (*factor convergence*).

2.2.1 α-convergence

Let $r_i = median(r_{1i},...,r_{Ti})$ where r_{ti} is the interest rate in period t $(t = 1,...,T)$ of country i $(i = 1,...,N)$. Then, differences in interest rate levels can be measured by:

$$\alpha_i = r_i - median(r_1,...,r_N), \quad i = 1,...,N \tag{2.1}$$

The non-parametric Kruskal-Wallis (1952) test of median equality is applied to infer the joint statistical significance of α_i $(i = 1,...,N)$. We speak of α *-convergence* when the median interest rates are equal across countries.

2.2.2 σ-convergence

Let $\sigma_t = \sqrt{\text{var}(r_{t1},...,r_{tN})}$. The trend in σ_t can be estimated by OLS of the regression model:

$$\sigma_t = a + bt + \varepsilon_t, \quad t = 1,...,T \tag{2.2}$$

where *t* is a time trend, a is a constant and ε_t is an error term. We speak of σ *-convergence* when the estimate of parameter *b* on the time trend is significantly negative, which would suggest that the process of integration is ongoing.

2.2.3 β-convergence

Let $s_{ti} = r_{ti} - B_t$ where B_t is a benchmark rate in period *t*. The stationarity of the spreads s_{ti} can be tested by OLS estimation of the error correction model:

$$\Delta s_{ti} = \eta_i + \beta_i s_{t-1,i} + \sum_{j=1}^{L} \delta_j \Delta s_{t-j,i} + \varepsilon_{ti}, \quad t = 1,...,T \tag{2.3}$$

where η_i is a country-specific fixed effect, ε_{ti} is an error term, δ_j are parameters on the time-lagged change in spreads and β_i is the unit root parameter. In the setup of the Augmented Dickey-Fuller (ADF) test (see Dickey and Fuller 1979), equation (2.3) is estimated country by country. The spreads are stationary when β_i $(i = 1,...,N)$ are in the domain [-1, 0) while there is a unit root when at least one of the β_i is zero. Convergence is complete when β_i equal -1 for all countries. In this case interest rate deviations from

the benchmark rate are white noise. We speak of β*-convergence* when all spreads are stationary. Sooner or later loan rates will then return to the benchmark rate up to the fixed country-specific effect. Complete β-convergence implies complete market integration. Under complete β-convergence, shocks to loan rates do not persist for more than one period.

A known weakness of the ADF test for single time series is its low power in small samples. Simulations have shown that the power of panel unit root tests can be considerably higher. We therefore apply recently developed panel unit root tests, i.e. the Hadri (2000) test, the Levin, Lin and Chu (2002) test and the Im, Pesaran and Shin (2003) test. These tests differ especially in the null (H_0) and alternative (H_1) hypotheses. In the case of the Hadri test all time series are stationary under H_0 while all series have unit roots under H_1. In contrast, in the case of the LLC and IPS tests all series have a unit root under H_0. The LLC test rejects H_0 only when all series are stationary whereas the IPS test rejects H_0 when at least one series is stationary.

2.2.4 Factor convergence

Incomplete β-convergence may be the result of short-term movements in interest rates due to country-specific dynamic factors. To test for the statistical significance of common and non-common factors we perform maximum likelihood factor analysis (see Jöreskog 1969). That is, the interest rates are decomposed into:

$$r_{ti} = a_i + l_{1i}F_{1t} + l_{2i}F_{2t} + ... + l_{Ki}F_{Kt} + \varepsilon_{ti}, \quad i = 1,...,N; \;\; t = 1,...,T \tag{2.4}$$

where a_i is a country-specific constant, $F_1,...,F_K$ are K latent factors, $l_{1i},...,l_{Ki}$ are the associated country-specific factor loadings and ε_{ti} denotes white noise error. We use the EM algorithm (see Rubin and Thayer 1982) to maximise the likelihood function. Confidence intervals are estimated by Efron's (1979) bootstrap. Factor *k* is considered statistically insignificant when the 99% confidence intervals of all loadings $l_{k1},...,l_{kN}$ include zero. Loading l_{ki} on factor *k* associated with country i is considered statistically

significantly different from loading l_{kj} associated with country *j* when at least one of the two loadings is outside the 99% confidence interval of the other loading.

Interest rates are said to exhibit (weak) *factor convergence* when all factor loadings are significant and all loadings associated with one factor have the same sign. There are then no statistically significant country-specific factors. However, interest rates may not respond with the same strength to the common factors. For example, when the ECB refinancing rate goes down, loan rates in all countries go down but by more in some countries than in others. Convergence is complete when factor loadings are the same for all countries, in which case there can be only one significant factor. We then speak of strong factor convergence. Under strong factor convergence interest rates move fully synchronously both in the short and long run in the sense that there are no systematic effects in bi-lateral interest rate differences up to a constant.

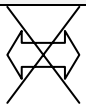
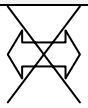
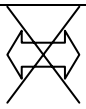
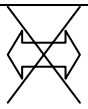
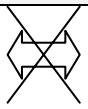
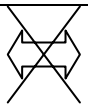
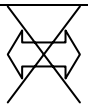
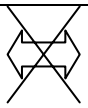
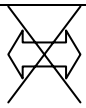
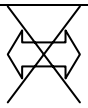
Definition 1 (weak factor convergence): For all statistically significant factors $k \in [1,...,K]$, sign (l_{ki}) = sign (l_{kj}) $\forall i, j \in [1,...,N]$ and $l_i \neq 0 \; \forall \; i \in [1,...,N]$.

Definition 2 (strong factor convergence): For all statistically significant factors $k \in [1,...,K]$, $l_{ki} \in \left[l_{kj}^{p}, l_{kj}^{1-p}\right]$ $\forall i, j \in [1,...,N]$ and $l_i \neq 0 \; \forall \; i \in [1,...,N]$, where $\left[l_{kj}^{p}, l_{kj}^{1-p}\right]$ is the $(1-2p)$ percent confidence interval associated with the estimate of the loading l_{kj}.

Table 2.1 provides an overview of the relationships between the various convergence measures. We first compare factor convergence with existing measures. Strong factor convergence implies complete β-convergence, and vice versa, in the sense that one can find a benchmark rate for which all spreads are stationary and white noise. In contrast, weak factor convergence does not necessarily imply β-convergence, neither complete nor incomplete. Indeed, loan rates may exhibit weak factor convergence but still drift apart due to differences in factor loadings. Nor does incomplete β-convergence, i.e. when spreads are stationary but auto-correlated, imply weak factor convergence. Stationary loan rates may still have persistent country specific components in short-term interest rate movements. Strong factor convergence further implies the absence of σ-convergence, for σ-convergence requires differences in factor loadings. When all factor

loadings are equal then there is no σ-convergence. Going in the other direction, the absence of σ-convergence, however, is not a sufficient condition for either weak or strong factor convergence, again due to possible persistent country specific components in short-term interest rate movements. Factor convergence and α-convergence are unrelated in the sense that one can hold with or without the other.

Table 2.1 Relationships between convergence measures

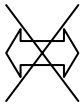
	α	σ	*Absence of* σ	*Incomplete* β	*Complete* β	*Weak Factor*	*Strong Factor*
α							
σ							
Absence of σ							
Incomplete β							
Complete β							
Weak Factor							
Strong Factor							

Notes:

X  Y: X implies Y but Y does not necessarily imply X.

X  Y: Y implies X but X does not necessarily imply Y.

X  Y: X implies Y, and Y implies X.

X  Y: X does not necessarily imply Y, and Y does not necessarily imply X.

We next compare the existing measures only. Complete β-convergence implies the absence of σ-convergence because in that case interest rate deviations from the benchmark are white noise with constant variance for all rates. This relationship does not hold in the other direction since the absence of σ-convergence does not necessarily imply that all interest rates are stationary. For example, some interest rates may converge to the benchmark rate which lowers the cross-sectional variance, while other rates may diverge from the benchmark which increases the cross-sectional variance. These effects on the cross-sectional variance may offset each other while some interest rates are non-stationary. Incomplete β-convergence is not a sufficient condition for the absence of σ-convergence since stationary interest rates may still converge. Indeed, a (non-linear) trend in the interest rate spread that dies out over time is stationary. σ-convergence is thus unrelated to incomplete β-convergence. There can be σ-convergence even when some of the interest rates are non-stationary. Finally, both β-convergence and σ-convergence are unrelated to α-convergence.

2.3 Data description

2.3.1 Bank loan interest rates

This chapter analyses monthly interest rates on new business lending to Non-Financial Corporations (NFCs) in eleven euro area countries. New lending includes re-negotiated loans but excludes previously negotiated loans with automatic rate re-setting. Since January 2003 the ECB has reported harmonised interest rates of Monetary Financial Institutions (MFIs) in the euro area. To get more history, non-harmonised interest rates compiled by the National Central Banks (NCBs) are chain linked with the harmonised MFI interest rates compiled by the ECB. This allows us to construct (risk-adjusted) series that go back to October 1997. Appendix 2.A contains a methodological note with the details of the variable construction.

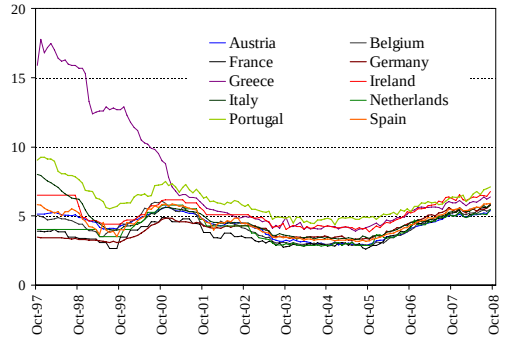
Loan rates are separately reported for loans with an initial rate fixation period up to one year, hereafter called *short* loans (STL = Short-Term and variable rate Loans and long-term loans with short rate fixation periods), and loans with rate fixations periods of

more than one year, hereafter called *long* loans (LTL = Long-Term Loans with long rate fixation periods). Note that short loans include long-term variable rate loans but exclude overdrafts. Interest rates for different loan sizes are only available for the harmonized ECB statistics. *Small* loans do not exceed EUR 1 million. To some extent *large* loans (above EUR 1 million) are dominated by large firms with 250 employees or more. Short-Term and variable rate Small Loans (STSL) and Short-Term and variable rate Large Loans (STLL) are available for all eleven countries. Portuguese rates on Long-Term Small Loans with long rate fixation periods (LTSL) and Belgian, Greek and Portuguese rates on Long-Term Large Loans with long rate fixation periods (LTLL) are missing. Table 10 of Appendix 2.B contains basic descriptive statistics of the bank loan interest rate series (before risk adjustment).

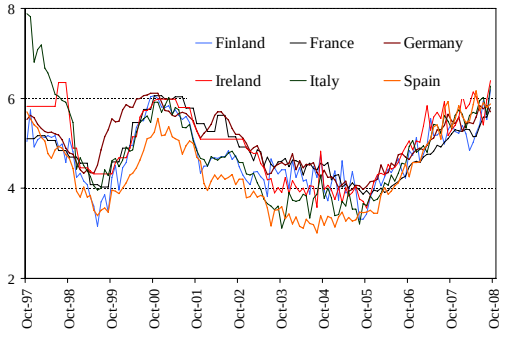
Figure 2.1a shows the evolution in short- and long-term interest rates on NFC loans between October 1997 and September 2008. There is clear evidence of short- and long-term interest rate convergence until the end of the year 2000. Convergence of loan rates during this period partly reflects the anchoring of inflation expectations at lower and more similar levels thanks to the single currency and the common monetary policy. However, even after correcting the series for differences in inflation (see next section), the ending of a period of strong interest rate convergence in some countries leads to structural breaks. Visual inspection of Figure 2.1a seems to indicate that, since 2001, interest rates have been moving almost in parallel, suggesting that convergence is nearly complete up to a constant difference in average rates. By applying the convergence measures discussed in the previous section over the period January 2001 – September 2008 this is tested formally in Section 2.5.

Figure 2.1a Developments in NFC loan rates (in %), non-harmonised series

Panel A: Short loans (STL)



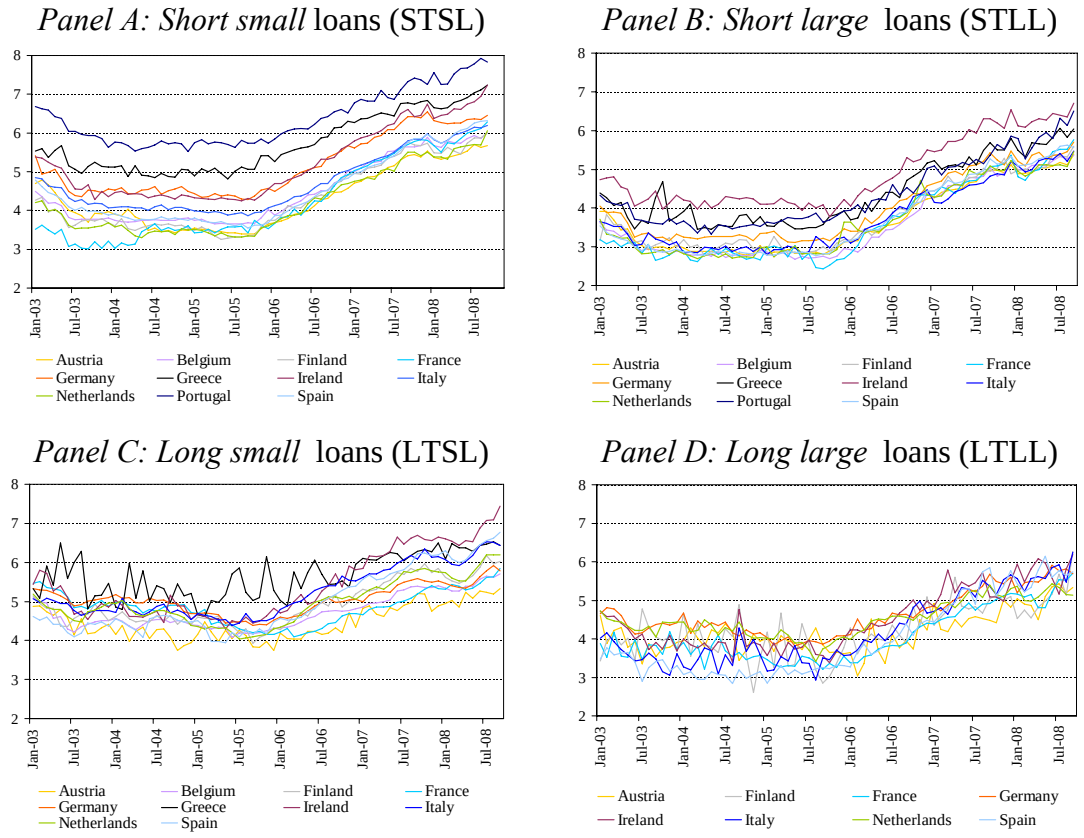
Panel B: Long loans (LTL)



Source: National Central Banks and European Central Bank. See Appendix 2.C for a glossary.

Figure 2.1b depicts the evolution in harmonized interest rates by rate fixation period and loan size. Two broad patterns can be detected by comparing loan sizes (Panel A with panel B and Panel C with Panel D): first, small loan rates are substantially higher than large loan rates. On average, small loan rates exceed large loan rates by about 75 basis points (b.p.) on both short and long loans. The empirical findings of both Dietsch (2003) and Wagenvoort (2003) suggest that from a portfolio credit risk viewpoint this may not be justified. A portfolio of loans to small firms is not necessarily riskier than a portfolio of loans to large firms, even when small firms individually are riskier than large firms. Second, the cross-country variance of small loan rates is higher than the variance of large loan rates. Rates on large loans are thus more uniform across the euro area than rates on small loans. Comparing rate fixation periods (Panel A with Panel C and Panel B with Panel D), we find that rate levels are generally lower, but that cross-country variances are higher on short than on long loans. Long-term rates are thus more uniform than short-term rates.

Figure 2.1b Developments in NFC loan rates (in %), harmonised series



Source: European Central Bank. See Appendix 2.C for a glossary.

There is no single country that persistently has the lowest rate for any of the loan categories. Loan rates are generally higher in Germany, Greece, Ireland, Italy and Portugal than in Austria, Belgium, Finland, France, the Netherlands and Spain. Part of these cross-country differences in nominal loan rates can be explained by differences in macroeconomic risk and inflation. In Section 2.4 we adjust the loan rates for these conditions.

2.3.2 Primary bond yields

From the Dealogic Bondware data warehouse we construct a data set of primary market yields on euro-denominated bonds issued by NFCs between January 1999 and October 2008. After risk adjustment (see next section), quarterly averages of the yield to maturity are computed by nationality of the companies. Our sample of 828 plain-vanilla fixed coupon bonds has 0, 3, 9, 4, and 3 missing quarters for France, Germany, Italy, the Netherlands, and the United Kingdom respectively, out of a total of 40 quarters per country. We decided to restrict the number of countries to these five so that the share of missing quarters would not exceed 25 percent of observations per country. By enlarging this group with other euro area countries, the share of missing quarters in the country with the least frequent bond issuance would exceed that figure. Note that in four out of the five countries only 10 percent or less of the observations are missing. Missing values in the quarterly series are estimated by inter- and extrapolation of the neighbouring observations. Table 2.11 of Appendix 2.B shows the main characteristics of the 828 bonds for which face values vary between EUR 20 million and EUR 20 billion.

2.4 Adjusting interest rates for risk

2.4.1 Adjusting bank loan rates for systematic risk and inflation

We measure systematic risk (R_{ti}) by the standard deviation of (year on year) GDP growth rates over the last twelve quarters. Actual inflation over the last twelve months is

taken as a proxy for inflation expectations (I_{ti}).[27] In a first step the loan rates (r_{ti}) are regressed on these two macroeconomic variables and a set of year dummies in a single equation:

$$r_{ti} = c + b_1 R_{ti} + b_2 I_{ti} + b_3 D_t + \varepsilon_{ti}, \quad i = 1,...,N; \;\; t = 1,...,T \tag{2.5}$$

where c is a constant, D_t is a matrix of year dummies, b_1 and b_2 are parameters, b_3 is a $(T-1)$-vector of parameters, and ε_{ti} is an error term. The loan rates are then adjusted as follows:

$$\tilde{r}_{ti} = r_{ti} - \tilde{b}_1 (R_{ti} - R_{tj}) - \tilde{b}_2 (I_{ti} - I_{tj}) \tag{2.6}$$

where $\tilde{r}_{ti}$ is the adjusted loan rate, $\tilde{b}_1$ and $\tilde{b}_2$ are OLS estimates of equation (2.5) and country *j* is chosen as benchmark country.

Table 2.2 OLS regression results used for the risk adjustment of bank loan rates

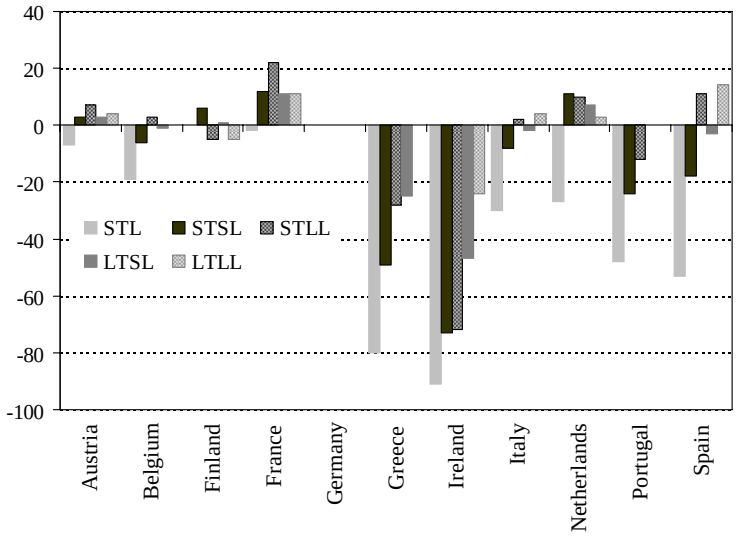
	STL	LTL	STSL	STLL	LTSL	LTLL
	Oct. 1997 - Sept. 2008		Jan. 2003 - Sept. 2008			
Constant	3.99***	5.63***	4.67***	4.32***	5.02***	5.32***
Systematic risk	0.21***	0.06	0.45***	0.58***	0.33***	0.24***
Inflation	0.41***	0.01	0.30***	0.15***	0.15***	-0.04
N	10	6	11	11	10	8
T	132	132	69	69	69	69
Observations (NxT)	1320	792	759	759	690	552
Adjusted R^2	0.56	0.70	0.64	0.86	0.66	0.72

Notes: Parameters that are significantly different from zero at the 10%, 5% and 1% level are indicated with *, **, and *** respectively. The regressions include year dummies (not shown). In the case of LTL and LTLL, two additional variables are included: the systemic risk variable and the inflation variable both interacted with a dummy variable for Spain (not shown).

Table 2.2 contains the regression results. Both systematic risk and inflation affect loan rates significantly and positively except in the case of Long-term Large Loans (LTLL) where the parameter on inflation is not significantly different from zero at the 10% level. Our model explains between 64% (STSL) and 86% (STLL) of the variation in harmonised loan rates.

[27] Both inflation and GDP growth data are from Eurostat. The frequency of the data is monthly and quarterly respectively.

Figure 2.2 Average systematic risk and inflation adjustment of loan rates (in b.p.)



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Using Germany as a benchmark, average adjustments are relatively small (i.e. less than 25 basis points) for all but two countries (see Figure 2.2). Harmonized rates are negatively adjusted by more than 25 b.p. in the cases of Greece and Ireland only, bringing those high-rate countries closer to the other countries. Depending on the loan category, French rates are positively adjusted between 11 b.p. and 22 b.p. This reduces the bi-lateral differences in loan rates between France and Germany. In the case of STL (non-harmonized) rates, the risk adjustment exceeds 25 b.p. for Greece (-80 b.p.), Ireland (-91 b.p.), Italy (-30 b.p.), Netherlands (-27 b.p.), Portugal (-48 b.p.) and Spain (-53 b.p.). No adjustment is made for the LTL category as neither risk nor inflation are statistically significant in Table 2.2.

The bank market integration analysis of the Section 2.5 is performed on the risk and inflation adjusted rates.

2.4.2 Adjusting bond yields for credit risk and liquidity

Let $Spread_i$ be the difference between the yield to maturity (y_i) of bond i and the corresponding swap rate with the same maturity, both at the bond issuance date. The unbalanced sample of 828 bonds is used to regress the bond spread on variables that capture expected secondary market liquidity and credit risk. The liquidity of bond i is measured by the natural logarithm of its face value (F_i). Credit risk is picked up by various variables including the bonds' credit rating at issue, time to maturity (M_i), and coupon (C_i). We expect higher credit risk on bonds with higher coupon and longer maturities.

Table 2.3 shows the OLS estimates of the following linear model:

$$Spread_i = c + b_1 A + b_2 BBB + b_3 BB + b_4 NR + b_5 M_i + b_6 C_i + b_7 F_i + b_8 D_t + \varepsilon_i, \quad i = 1,...,N \quad (2.7)$$

where c is a constant, D_t is a matrix of year dummies, $b_1,...,b_7$ are parameters, b_8 is a $(T-1)$-vector of parameters, A is a dummy variable for bonds rated A, BBB is a dummy variable for bonds rated BBB, BB is a dummy variable for bonds rated BB or lower, NR is a dummy variable for bonds without rating or bonds for which ratings are missing in Bondware, and ε_{ti} is an error term. Rating dummies are defined with respect to bonds rated AA and AAA. In accordance with the findings of Gabbi and Sironi (2005), we find that bond spreads rise significantly with lower credit ratings and higher coupons, and that bond size is not a significant determinant of bond spreads. However, in contrast with Gabbi and Sironi (2005) and with our expectations, bond spreads fall with higher maturity.[28] This effect is only significant when ratings and coupons are included in the regression and when bonds with maturities of longer than 10 years are included in the sample.

[28] The most important differences between our sample and model specification and those of Gabbi and Sironi (2005), hereafter abbreviated as GS, are as follows. First, our sample is restricted to bonds denominated in euros while the GS sample is restricted to Eurobonds but denominated in different currencies. We compute bond spreads to the corresponding swap rates while GS compute bond spreads to the corresponding Treasury bond rates. Finally, GS include a larger number of explanatory variables. Our more condensed model, however, is sufficiently developed to capture the key differences in credit risk.

Table 2.3 OLS regression results used for the risk adjustment of bond yields

	Parameter	t-value
Constant	-2.89	-9.55
A	0.22	5.48
BBB	0.35	8.25
BB,B	0.92	7.72
No rating	0.48	7.85
Years to maturity	-0.03	-8.60
Coupon spread to swap	0.72	35.39
Natural log of face value	-0.02	-1.32
Observations	828	
Adjusted R^2	0.81	

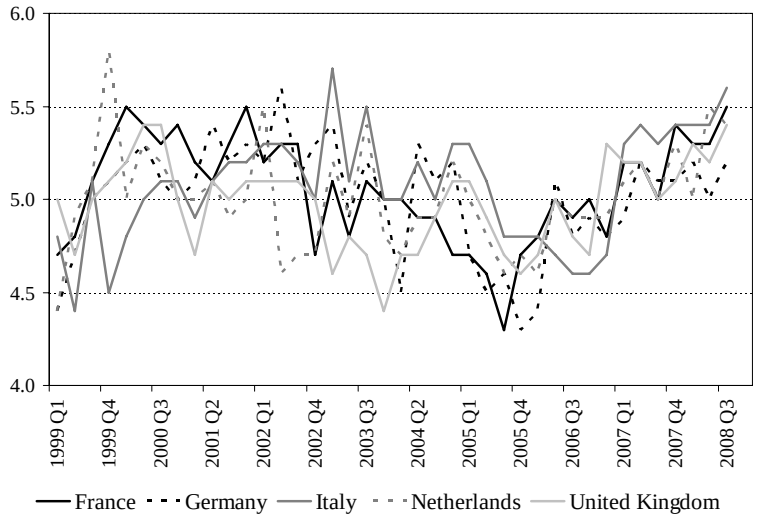
Notes: The regressions include year dummies (not shown). Dummy variables for ratings are defined with respect to the class of AA and AAA. Period: January 1999 – October 2008.

Using only the statistically significant variables in Table 2.3, the bond yields are adjusted for credit risk as follows:

$$\tilde{y}_i = y_i - \tilde{b}_1 A - \tilde{b}_2 BBB - \tilde{b}_3 BB - \tilde{b}_4 NR - \tilde{b}_5\left(M_i - \frac{1}{n}\sum_{i=1}^{n} M_i\right) - \tilde{b}_6\left(C_i - \frac{1}{n}\sum_{i=1}^{n} C_i\right) \quad (2.8)$$

where $\tilde{y}_i$ is the adjusted yield to maturity, and $\tilde{b}_1,...,\tilde{b}_6$ are OLS estimates of equation (2.7). Figure 2.3 depicts the quarterly averages of the risk-adjusted bond yields that are used in the convergence analysis of the next section. As shown by the figure, there are no apparent systematic differences in risk-adjusted yields across countries, neither in the short-term nor in the long-term.

Figure 2.3 Quarterly averages of risk-adjusted bond yields (in %)



2.5 Measuring financial market integration

In the following we apply the four convergence measures outlined in Section 2.2 to the balanced samples of monthly (risk and inflation adjusted) bank loan rates and quarterly (credit risk adjusted) bond yields.

2.5.1 α-convergence: are borrowing costs on average equal across countries?

To assess whether corporate borrowers in Europe pay on average the same interest rate, we compare the median level of interest rates across countries using the Kruskal-Wallis (KW) test. The KW test converges asymptotically to the chi-squared distribution with *N*-1 degrees of freedom where *N* denotes the number of interest rates. The critical percentiles associated with the one percent significance level are shown in the last row of Table 2.4.

Table 2.4 Differences in median risk-adjusted rates (α in b.p.)

	Bonds	Bank loans					
		STL	LTL	STSL	STLL	LTSL	LTLL
	Jan. 99 - Oct. 08	*Jan. 2001 – Sept. 2008*		*Jan. 2003 – Sept. 2008*			
Austria		18		-6	0	-48	-1
Belgium		-7		4	-15	-32	
Finland			-6	-2	-3	-5	2
France	0	-57	6	-23	-28	9	-22
Germany	1	27	22	76	25	24	35
Greece		19		78	23	56	
Ireland		-1	28	0	31	-21	1
Italy	3	1	-8	19	-4	6	-13
Netherlands	-10	-58		-33	2	5	32
Portugal		91		160	31		
Spain		-44	-51	-20	-9	-31	-37
UK	-6						
Groups (N)	5	10	6	11	11	10	8
T	40	93	93	69	69	69	69
Kruskal – Wallis	3.69	127.99	43.31	161.53	46.56	87.41	39.04
$\chi^2_{0.01}(N-1)$	13.28	21.67	15.09	23.21	23.21	21.67	18.48

Notes: For the definition of the Kruskal-Wallis test see equation (2.1). $\chi^2_{0.01}(N-1)$ denotes the chi² critical value at the 1% significance level with *N-1* degrees of freedom. The null hypothesis of equal medians is rejected if the test statistic is greater or equal the critical value.

As is evident from Table 2.4, the corporate bond market exhibits α-convergence since differences between median bond yields are not statistically significant at commonly applied significance levels. In addition to interest expenses, NFCs also bear transaction costs on their bond financing. Box 2.1 mentions the main cost components of bond issuance and provides some basic descriptive statistics. In accordance with the results on interest expenses, transaction costs also are the same across countries when bond size is considered.

Box 2.1 Transaction costs on bond financing

Bond transaction costs possibly consist of four components: the *management fee* (i.e. the cost of structuring the bond by the underwriter), the *selling concession* (i.e. the difference between the guaranteed price to the issuer and the offer price to the investors), *underpricing* (i.e. the difference between the offer price and the secondary market price) and *other expenses* (i.e. legal and administration costs). The management fee and selling concession make up the bulk of the total transaction cost. A recent study (Melnik and Nissim 2006) finds that, since EMU, underpricing has basically disappeared for most bonds.

Table 2.5 Transaction costs (in b.p.) applied to the face value

	Average	Median	S.D.[a]	Maximum
France	52	35	54	200
Germany	52	34	57	275
Italy	67	40	54	200
Netherlands	73	35	70	275
United Kingdom	42	35	34	188

Notes: Period: January 1999 - October 2008. [a] Standard deviation. Source: Dealogic Bondware.

The sum of the management fee and selling concession, expressed in basis points, is shown by country in Table 2.5. The transaction costs for the median bond are basically the same across countries except for Italy where costs are about five b.p. higher. This is possibly due to the smaller size of Italian bonds. The median Italian bond size of EUR 350 million is almost half the median bond size in the other four countries (see Appendix 2.B, Table 2.11). Transaction costs are thus about the same across countries when bond size is considered.

In sharp contrast, α-convergence has not been achieved in the bank loan market. The Kruskal-Wallis test rejects the equality of medians at the 1% significance level for all bank loan categories. Comparing bank loan rates since January 2003, thus focusing on the period since which the euro has been well established and national data have been harmonised, absolute differences in median levels of risk-adjusted bank loan rates are generally larger for small than for large loans, in particular for short loans. Short small (STSL) loans were about 100 b.p. more expensive for German than for French firms. The median German STSL rate was 76 b.p. above the median country (=Ireland) whereas the median French STSL rate was 23 b.p. below. Portuguese firms paid the most ($\alpha = 160$) whereas Dutch firms paid the least ($\alpha = -33$), leading to a difference of almost 200 b.p. between minimum and maximum levels. For short large (STLL) loans the differences are smaller but German STLL rates are still about 50 b.p. more expensive than those of France. Differences of a similar magnitude are observed for long large loans (LTLL).

Given that the average bank loan rate still varies considerably across the euro area, is there evidence that the differences in borrowing costs are diminishing over time and if so, how fast?

2.5.2 σ-convergence: are borrowing costs becoming more uniform over time?

Between January 1999 and October 2008 σ-convergence was absent in the bond market. The coefficient on the time trend in equation (2.2) is not statistically significant at the 10 percent or lower significance level (see Table 2.6).

Turning to bank loans, Figure 2.4a shows the evolution of the cross-country standard deviation of loan rates. There is evidence of strong σ-convergence until December 2000 and weak σ-convergence thereafter. σ-convergence was significant at the 95% level for both short (STL) and long (LTL) loans between January 2001 and September 2008. The speed of convergence for this period averaged -2 and -3 b.p. per annum respectively (see Table 2.6). At such speed (say -3 b.p.) and σ-level (say 50 b.p.) at the end of 2000 it

would have taken 25 more years before 95 percent of the loan rates would have had differences smaller than 25 basis points.[29]

Figure 2.4b depicts the evolution of σ by size category. The STSL σ-line is clearly above the lines of the other categories, suggesting that the short small loan segment is the least integrated. There are breaks in the series as from January 2008, for short rates in particular. As suggested by the graph, σ is increasing rapidly due to the financial crisis. Before the crisis, some series had a weak negative trend. We therefore run the σ-convergence regression also for the harmonized series separately for different periods: one covering the pre-crisis period up to and including December 2007, one covering the first nine months of 2008, and one for the whole period between January 2003 and September 2008.

In the five years before the crisis σ-convergence was significant at the 95% level in the case of short small and long large loans only. The speed of convergence for this period averaged -2 and -4 b.p. per annum respectively which correspond to the trends found for the aggregate STL and LTL series starting from 2001. Rather than becoming more uniform over time, during 2008 the standard deviation of loan rates actually increased rapidly in most cases. Both STSL and STLL σ-levels are now back to pre-2003 values. The modest σ-convergence in STSL rates registered for the period 2003-2007 has thus been entirely offset by recent developments. For the full period, σ-convergence is statistically insignificant for STSL rates. In contrast, in the case of LTLL σ-convergence is insignificant in 2008 but remains statistically significant for the full period.

[29] Under the assumption that loan rates in period *t* follow a normal distribution, 95% of the rates have differences smaller than 100 b.p., which is reduced to 100-3*25=25 b.p. after 25 years.

Figure 2.4a Standard deviation of loan rates (σ in b.p.), non-harmonised series

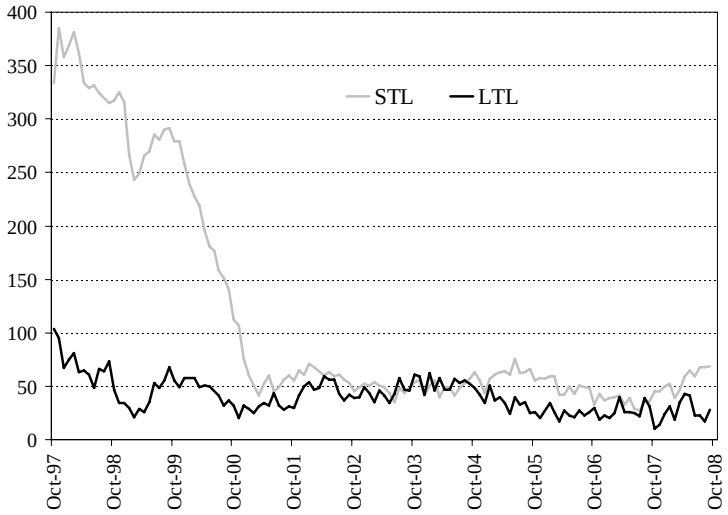


Figure 2.4b Standard deviation of loan rates (σ in b.p.), harmonised series

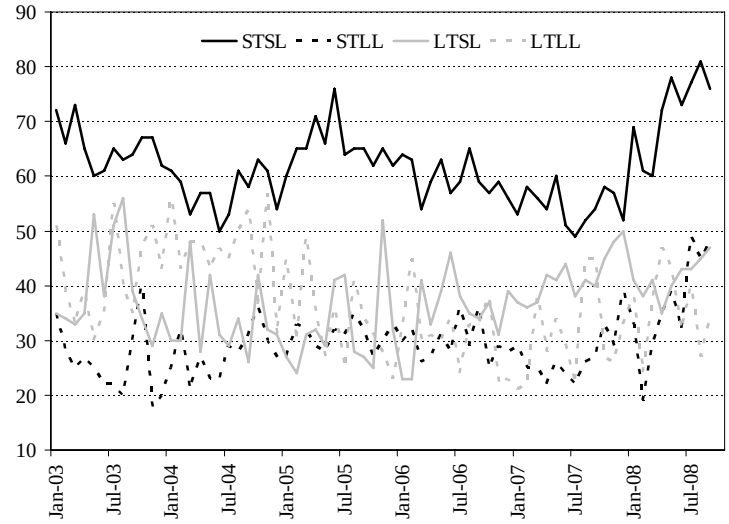


Table 2.6 Annual speed of sigma convergence (in b.p.)

	Bonds	Bank loans					
		STL	LTL	STSL	STLL	LTSL	LTLL
Jan. 99 - Oct. 08	0						
Oct. 97 - Dec. 00		-79	-12				
Jan. 01 - Sept. 08		-2	-3				
Oct. 97 - Sept. 08		-27	-3				
Jan. 03 - Dec. 07		-2	-7	-2	0	0	-4
Jan. 08 - Sept. 08		40	0	24	35	11	0
Jan. 03 - Sept. 08		0	-5	0	1	1	-3

Notes: The annual speed is computed as *b*12* where *b* is the regression coefficient on the time trend of equation (2.2). Insignificant coefficients at the 95% confidence level are set to zero.

In sum, there are few signs that bank loan rates continue to converge. Whether or not there are long-term trends in the rate differences is our next convergence criterion.

2.5.3 β-convergence: are differences between borrowing costs mean-reverting?

The β-convergence measure (see equation 2.3) requires the choice of a benchmark rate. The empirical findings of Vajanne (2007) underline the difficulty of finding an appropriate benchmark. In her study for example, at the 10 percent significance level short small bank loans are stationary when the lowest loan rate is taken as the benchmark but have a unit root when a market-based swap rate is used. The lowest rate is not necessarily the best choice when the idiosyncratic component of this rate is relatively high.[30] Nor are market rates necessarily a good choice because bank loan rates may wander away from market rates without affecting cross-country differences in bank loan rates.

We choose the benchmark rate in period *t* to be the average interest rate of that period. The function of our benchmark rate is to minimize the measured differences between the interest rates rather than to set optimal levels to which interest rates are expected to converge.

For this benchmark choice the cross-country differences in risk-adjusted bond yields are stationary. Table 2.7a shows the *p*-values associated with the different panel unit root tests. Both the LLC and the IPS tests reject a unit root in the bond spreads whereas the Hadri test does not reject their being stationary at 10 percent or lower significance levels. There is thus clear evidence for β-convergence of the bond market.

[30] Based on this argument, Dunne et al. (2007) for instance propose France as the benchmark for the Euro-denominated sovereign bond market at most maturities although German bonds have the lowest yields.

Table 2.7a Panel unit root test results for interest spreads (*p*-value)

	Bonds	Bank loans					
		STL	LTL	STSL	STLL	LTSL	LTLL
	Jan. 99 – Oct. 08	*Jan. 2001 – Sept. 2008*		*Jan. 2003 – Sept. 2008*			
Levin, Lin and Chu (2002)	0.000	0.001	0.004	0.001	0.000	0.000	0.000
Im, Pesaran and Shin (2003)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hadri (2000)	0.140	0.000	0.000	0.000	0.000	0.000	0.000
N	5	10	6	11	11	10	8
T	40	93	93	69	69	69	69
Observations	200	930	558	759	759	690	552

Notes: In the case of the Hadri test, all time series are stationary under H_0 while all series have unit roots under H_1. In contrast, in the case of the LLC and IPS tests all series have a unit root under H_0. The LLC test rejects H_0 only when all series are stationary whereas the IPS test rejects H_0 when at least one series is stationary.

Table 2.7b: β-estimates of the Augmented Dickey-Fuller equation (2.3)

	Bonds	Bank loans					
		STL	LTL	STSL	STLL	LTSL	LTLL
	Jan. 99 – Oct. 08	*Jan. 2001 – Sept. 2008*		*Jan. 2003 – Sept. 2008*			
Austria		-0.048 *		-0.081 *	-0.218	-0.382	-0.553
Belgium		-0.043 *		-0.103 *	-0.176 *	-0.243	
Finland			-0.525	-0.119 *	-0.046 *	-0.390	-0.898
France	-0.609	-0.224	-0.039 *	-0.038 *	-0.262	-0.091 *	-0.789
Germany	-0.848	-0.092 *	-0.126 *	-0.185	-0.116 *	-0.049 *	-0.251 *
Greece		-0.406		-0.600	-0.635	-0.818	
Ireland		-0.040 *	-0.625	-0.226	-0.118 *	-0.085 *	-0.669
Italy	-0.462	-0.316	-0.179 *	-0.318	-0.299	-0.127 *	-0.341
Netherlands	-1.021	-0.114 *		-0.159 *	-0.471	-0.189 *	-0.189 *
Portugal		-0.349		-0.109 *	-0.003 *		
Spain		-0.135 *	-0.071 *	-0.084 *	-0.170 *	-0.093 *	-0.089 *
UK	-0.758						
Median	-0.758	-0.124	-0.153	-0.119	-0.176	-0.158	-0.447
T	40	93	93	69	69	69	69

Notes: Cases for which the Augmented Dickey Fuller (ADF) test rejects the stationarity of the interest rate spread at the five percent or higher level are indicated with an asterisk. ADF tests were performed for each country separately, using the Schwarz information criterion for lag length selection.

Regarding bank loans, it turns out that our β-convergence results are sensitive to the type of test used. Both the LLC and the IPS tests reject the null hypothesis of a unit root in the loan spreads at commonly used significance levels for all loan categories. In sharp contrast the Hadri test rejects the stationarity of all series. Even if there was β-

convergence, the speed of convergence is low as many β-estimates are close to zero (see Table 2.7b). The absolute value of the median β-estimate is higher for large than for small loans and higher for long than for short loans suggesting in line with the α-convergence results, that the market for large loans, long loans in particular, is more integrated than the market for small loans.

Up to this point we have looked at convergence criteria that capture long-term differences and trends. Our next and last criterion measures short-term as well as long-term systematic differences in the evolution of loan rates.

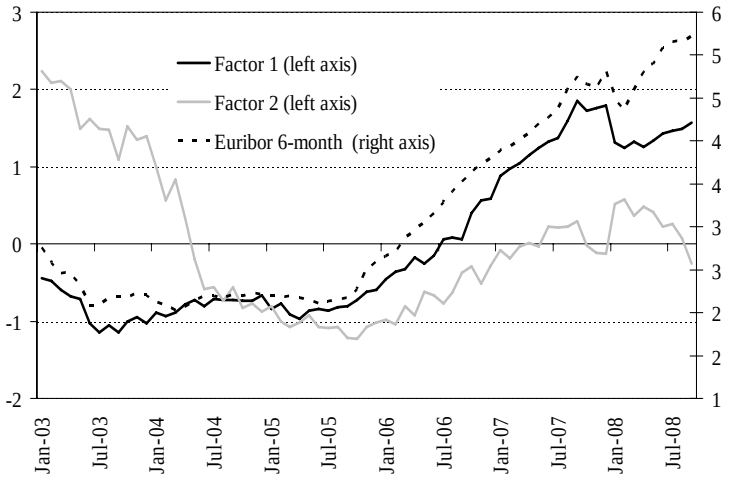
2.5.4 Factor convergence: are borrowing costs moving synchronously?

The appealing feature of factor analysis is that factors do not have to be specified *ex ante* as they are estimated jointly with the factor loadings. We increase the number of latent factors until the last added factor is statistically insignificant for all countries at the 1% significance level. No more than two factors can explain all systematic variation in the bond yields and the bank loan rates. Our results for a model with two factors are shown in Appendix 2.B. Table 2.12a of Appendix 2.B shows the Maximum Likelihood estimates of the factor loadings for the bank loan rates; Table 2.12b and Table 2.12c show the corresponding 0.5^{th} and 99.5^{th} percentiles of the bootstrapped factor loadings respectively. Table 2.13 contains the factor analysis results for the bond yields.

In the case of the bond market, a single factor can account for all systematic variation in the risk-adjusted bond yields. Furthermore, each factor loading is in the 99 percent confidence interval of the other factor loadings. The bond market thus exhibits strong factor convergence. There is no systematic deviation of borrowing cost of companies in one European country in comparison to the borrowing cost of companies in other European countries.

In the case of bank loan rates, for some countries, but not all, two factors are statistically significant for the non-harmonized STL and LTL series, even when only observations since January 2001 are selected, i.e. after the structural break in σ-convergence. Factor convergence is thus here absent.

Figure 2.5 Factors driving STSL rates and the Euribor rate (in %)



There is however evidence for weak factor convergence of bank loan rates for some of the harmonized series since January 2003. We find that a single factor can account for all systematic variation in the interest rates of loan categories STLL, LTSL and LTLL. In these cases factor loadings are all significant and have the same sign. Convergence here is weak and not strong since some of the factor loadings are outside the 99 percent confidence interval of the other loadings. In other words, although there are no country-specific dynamic factors that can explain the evolution in the respective series, the sensitivities to the common factor are different, leading to systematic differences in the evolution of borrowing costs across countries. In the case of short small loans (STSL) two factors are statistically significant. Figure 2.5 depicts the evolution of these factors. The first STSL factor is strikingly similar to the 6-month Euribor inter-bank rate. The unique factors that can explain the STLL, LTSL, and LTLL loan rates are almost identical to the first STSL factor. The factor loadings on the second STSL factor are, in some cases, statistically insignificant while in other cases they are significantly positive or negative. This means that STSL loan rates are driven by dynamic factors that are not common to all countries. Table 2.8 summarizes the factor convergence analysis results.

Table 2.8 Factor convergence results

	Bonds	Bank loans					
		STL	LTL	STSL	STLL	LTSL	LTLL
	Jan. 99– Oct. 08	*Jan. 2001 – Sept. 2008*		*Jan. 2003 – Sept. 2008*			
Factor convergence	Strong	None	None	None	Weak	Weak	Weak
N	5	10	6	11	11	10	8
T	40	93	93	69	69	69	69
Observations (NxT)	200	930	558	759	759	690	552

Why is the market for short small loans less integrated than the market for long small loans? Long-term loans presumably provide financing for investment whereas short-term loans usually provide working capital. The former loans are more often backed up by collateral than the latter. To the extent that loans with short rate fixation periods contain a larger share of working capital type of financing than loans with long rate fixation periods, short small loans are more susceptible to information problems and, therefore, possibly to distortions in loan pricing.

The explanatory power of the factors is in most cases higher for the bank loan rates than for the bond yields. The adjusted R^2 showing the share of the variance in risk-adjusted rates (centred on their mean) that can be explained by the statistically significant factors is between 0.67 and 1.00 for the loans (see Table 12a) and between 0.42 and 0.70 for the bonds (see Table 13). There are two explanations for these differences. Firstly, national loan rates are based on a very large number of individual loan rates whereas some of the quarterly bond rates represent just one firm. Company specific components are thus more important for bonds than for loans. A second and related explanation is the fact that a bond yield on a particular day is likely to give an imprecise estimate of the average funding conditions during a quarter. Although this should not introduce systematic biases, measurement errors are expected to be larger for bonds than for loans.

2.6 Conclusion

The novelty of this study is the use it makes of factor analysis to compare NFC borrowing costs in the euro area. Our sample of 828 bond issues suggests that integration of the primary euro-denominated bond market is complete; there is evidence of α-convergence, β-convergence, strong factor convergence, and absence of σ-

convergence. In contrast, the market for bank loans remains segmented albeit to various degrees depending on the type and size of the loan.

We find that rates on large bank loans and long-term small bank loans exhibit weak factor convergence in the sense that, up to a fixed effect, they are driven by common factors only. In contrast, the evolution of short small loan rates is still affected by country-specific factors. To the extent that loans with short rate fixation periods contain a larger share of working capital type of financing than loans with long rate fixation periods, short small loans are more susceptible to information problems and, therefore, possibly to distortions in loan pricing.

The factor convergence results resolve some of the ambiguity that follows from β-convergence results which are sensitive to the type of the panel unit root test used.

Notable differences remain in the average cost of bank loans across the euro area, in particular for small loans with short rate fixation periods where some differences are to the order of almost 200 basis points even after adjusting rates for macroeconomic conditions such as systematic risk and inflation. α-convergence is rejected for all loan categories.

There are few signs that bank loan rates are becoming more uniform with time. In 2008 the cross-country variance in loan rates increased as a result of the financial and economic crisis, bringing σ-levels on short-term loans back to pre-2003 values. There is some evidence of σ-convergence for long-term large loans albeit with rates converging at low speed.

To conclude, small businesses do not experience a level playing field in their debt financing costs, in particular with respect to the financing of working capital, and there are few signs of improvement. Additional policy efforts are therefore needed to make retail bank markets more competitive.

Appendix 2.A Methodological note on chain linking NCB and ECB interest rates

This study uses and extends the interest rate time series constructed by Van Leuvensteijn et al. (2008).[31] Non-harmonised National Retail Interest Rates (NRIR) compiled by the National Central Banks are chain linked with more recent harmonised Monetary financial institution Interest Rate statistics (MIR) compiled by the ECB.[32] NRIR data predominantly feature interest rates on new business loans. For consistency, new business rates are therefore also chosen in the MIR data set. New business loans in the MIR data set include re-negotiated credits but exclude previously negotiated credits with automatic rate re-setting. There can still be some differences between NRIR and MIR data. For example, we exclude overdraft rates from our MIR series while they are included in most of the NRIR series. Secondly, most of the NRIR series are classified according to the remaining time to maturity of the loan while MIR series are classified according to the rate fixation period. A level shift is carried out for the NRIR rates to partly account for some of these differences. In a nutshell, chain linking NRIR to MIR rates consists of three consecutive steps: (i) Construct short and long corporate loan categories, (ii) Construct small and large loan categories, and (iii) Apply a level shift to the NRIR series.

(i) Construction of short and long corporate loan categories

MIR data categories need to be aggregated to make them comparable to NRIR data categories as the MIR data set offers a more detailed breakdown than does the NRIR data set. Loans with an initial rate fixation period of up to one year, including variable rate loans, are merged with the NRIR category of *short* loans with a maturity of up to one year. Loans with an initial rate fixation period of more than one year are merged with the NRIR category of *long* loans with a maturity of more than one year. The long MIR rate is a weighted average of the rate on loans with rate fixation periods over one year and up to five years and the rate on loans with rate fixation periods over five years based on their

[31] We are grateful to Christoffer Kok Sørensen from the ECB who kindly provided their data.
[32] See ECB (2002) and ECB (2003) for further information on the NRIR and MIR data sets respectively.

shares in the volume of new business lending. The euro area volumes are used to estimate the respective shares for countries for which rates are available but volumes are missing, i.e. Austria, Belgium, Finland, France, Ireland and Italy.

(ii) Construction of small and large loan categories

NRIR rates include interest on both *small* loans, which do not exceed EUR 1 million, and *large* loans above EUR 1 million. MIR rates on small and large loans are aggregated based on their respective shares in new business volume. In cases where loan volumes are not available, we extract the small and large loan shares from the available aggregated interest rate in Van Leuvensteijn et al. (2008), using the following equation:

$$i^a = i^s s^s + i^l s^l \tag{2.9}$$

where i^a is the aggregate interest rate, i^s is the interest rate on small loans, i^l is the interest rate on large loans, s^s is the share of small loans, and s^l is the share of large loans in the volume of new lending. Since

$$s^s + s^l = 1 \tag{2.10}$$

substituting and rearranging (2.9) gives

$$s^s = \frac{i^a - i^l}{i^s - i^l} \quad \text{and} \quad s^l = \frac{i^a - i^s}{i^l - i^s} \tag{2.11}$$

Averages of the shares in (2.11) are computed for the period from January 2003 until the end of the Van Leuvensteijn et al. series, i.e. December 2004. Those average shares are then used to extend the aggregate MIR series beyond 2004.

(iii) Application of a level shift

In cases where there is a methodological change between NRIR and MIR data, the NRIR rates are adjusted by a level shift based on the difference between the NRIR and MIR rates as of January 2003 for all countries except Portugal. In the latter case, the level shift is based on the difference between the December 2002 NRIR rate and the January 2003 MIR rate since Portuguese NRIR data end in 2002.

Table 2.9 shows the available bank loan rates after the risk-adjustment of Section 2.4 has been carried out. STL (Short-Term and variable rate Loans) and LTL (Long-Term Loans) are chain-linked series that are available from October 1997. Harmonised MFI interest rates by size and rate fixation period, i.e. STSL (Short-Term and variable rate Small Loans), STLL (Short-Term and variable rate Long Loans), LTSL (Long-Term Small Loans) and LTLL (Long-Term Large Loans), are available only since January 2003. The frequency of all loan rate series is monthly.

Table 2.9 Availability of bank loan rates

	STL	LTL	STSL	STLL	LTSL	LTLL
	Oct. 97 – Sept. 08		*Jan. 03 – Sept. 08*			
Austria	A	NA	A	A	A	A
Belgium	A	NA	A	A	A	NA
Finland	NA	A	A	A	A	A
France	A	A	A	A	A	A
Germany	A	A	A	A	A	A
Greece	A	NA	A	A	A	NA
Ireland	A	A	A	A	A	A
Italy	A	A	A	A	A	A
Netherlands	A	NA	A	A	A	A
Portugal	A	NA	A	A	NA	NA
Spain	A	A	A	A	A	A

Notes: A = Available; NA = Not Available.

Appendix 2.B Results

Descriptive statistics

Table 2.10 Bank loan rates[a] (in %)

	AT	BE	FI	FR	DE	GR	IE	IT	NL	PT	ES
Short-Term or variable rate Loans (STL), Oct. 1997 – Sept. 2008											
Min.	2.9	2.9		2.6	3.1	3.9	3.9	3.3	2.8	4.4	3.2
Max.	5.6	6.1		5.9	5.8	17.8	6.8	8.0	5.8	9.2	5.9
Mean	4.3	4.2		3.8	4.0	7.5	5.2	4.7	4.1	6.1	4.5
Med.	4.5	4.4		3.5	3.9	5.6	5.1	4.5	4.0	6.0	4.5
S.D.[e]	0.8	0.9		0.8	0.7	4.1	0.9	1.1	0.9	1.1	0.9
Long-Term Loans (LTL), Oct. 1997 – Sept. 2008											
Min.			3.2	3.9	3.9		3.6	3.1			3.0
Max.			6.2	6.1	6.1		6.4	7.9			6.2
Mean			4.7	4.9	5.0		5.0	4.8			4.3
Med.			4.6	4.8	5.1		5.0	4.7			4.2
S.D.[e]			0.7	0.6	0.6		0.8	1.0			0.8
Short-Term or variable rate Small Loan (STSL), Jan. 2003 – Sept. 2008											
Min.	3.4	3.7	3.3	3.0	4.3	4.8	4.3	3.9	3.3	5.5	3.6
Max.	5.7	6.0	6.0	6.3	6.6	7.2	7.2	6.2	6.1	7.9	6.3
Mean	4.3	4.5	4.3	4.2	5.1	5.7	5.2	4.7	4.2	6.4	4.5
Med.	4.0	4.1	4.0	3.7	4.8	5.5	4.9	4.4	3.9	6.1	4.1
S.D.[e]	0.8	0.8	0.9	1.0	0.8	0.7	0.9	0.8	0.8	0.7	0.9
Short-Term or variable rate Large Loan (STLL), Jan. 2003 – Sept. 2008											
Min.	2.8	2.7	2.8	2.4	3.1	3.5	3.8	2.8	2.7	3.3	2.8
Max.	5.4	5.4	5.6	5.8	5.7	6.1	6.7	5.5	5.5	6.5	5.6
Mean	3.7	3.6	3.8	3.6	4.0	4.4	4.9	3.7	3.7	4.4	3.7
Med.	3.4	3.3	3.4	3.1	3.6	4.1	4.5	3.5	3.4	4.1	3.2
S.D.[e]	0.9	0.9	0.9	1.0	0.9	0.8	0.9	0.8	0.9	0.9	1.0
Long-Term Small Loan (LTSL), Jan. 2003 – Sept. 2008											
Min.	3.7	4.1	3.9	4.1	4.4	4.6	4.3	4.4	4.0		3.9
Max.	5.3	5.7	6.2	5.8	5.9	6.5	7.4	6.5	6.2		6.8
Mean	4.5	4.7	4.9	4.8	5.0	5.7	5.4	5.2	5.0		5.0
Med.	4.3	4.6	4.7	4.9	5.0	5.7	5.1	5.0	4.9		4.6
S.D.[e]	0.4	0.4	0.6	0.4	0.4	0.6	0.9	0.6	0.6		0.8
Long-Term Large Loan (LTLL), Jan. 2003 – Sept. 2008											
Min.	3.0		2.6	3.2	3.8		3.4	2.9	3.4		2.8
Max.	5.4		6.3	5.7	5.9		6.2	6.3	5.4		6.1
Mean	4.2		4.2	4.1	4.6		4.5	4.2	4.5		4.0
Med.	4.1		4.2	3.8	4.5		4.3	3.9	4.4		3.6
S.D.[e]	0.5		0.7	0.7	0.6		0.8	0.9	0.5		1.0

[a] Non-adjusted for risk. [b] Minimum; [c] Maximum, [d] Median, [e] Standard deviation
Source: National Central Banks and European Central Bank.

Table 2.11 Descriptive statistics of 828 bond issues (1999 – 2008)

	France	Germany	Italy	Netherlands	UK
			Yield to maturity (in %)[a]		
Minimum	2.47	3.05	3.29	2.84	3.09
Maximum	8.94	12.36	8.71	10.77	7.30
Mean	5.09	5.32	5.95	5.24	5.19
Median	5.08	5.15	5.90	5.05	5.19
Standard deviation	0.95	1.25	1.03	1.34	0.89
			Years to maturity at issue		
Minimum	2.4	2.0	2.0	3.0	1.5
Maximum	30.0	30.0	50.0	30.0	40.0
Mean	8.8	8.2	7.4	7.5	7.0
Median	7.0	7.0	5.0	7.0	7.0
Standard deviation	5.0	4.2	6.5	3.7	4.0
			Coupon (in %)		
Minimum	3.00	3.00	3.42	3.25	3.00
Maximum	8.75	12.00	8.38	10.50	7.25
Mean	5.03	5.27	5.92	5.20	5.15
Median	5.00	5.13	6.00	5.00	5.13
Standard deviation	0.93	1.22	1.00	1.33	0.87
			Face value (in EUR million)		
Minimum	50	20	25	70	119
Maximum	20241	7311	6495	4970	3500
Mean	542	632	383	619	699
Median	500	600	350	750	650
Standard deviation	1754	1450	1228	679	685
			Number of rated bonds		
AAA, AA	97	35	9	15	14
A	84	67	23	44	63
BBB	101	46	48	17	50
BB,B	4	6	2	4	0
No rating	22	25	45	5	2
Total	308	179	127	85	129

[a] Non-adjusted for risk.

Source: Dealogic Bondware.

Factor analysis

Table 2.12a Estimated factor loadings for bank loans

	a	l_1	l_2	Ad. R^2	a	l_1	l_2	Ad. R^2
	STL (Jan. 01 – Sept. 08)				*LTL (Jan. 01 – Sept. 08)*			
Austria	3.98*	0.81*	0.29*	0.98				
Belgium	3.84*	0.88*	0.31*	0.97				
Finland					4.65*	0.55*	-0.03	0.79
France	3.78*	1.06*	-0.08*	0.97	4.83*	0.52*	-0.32*	0.99
Germany	4.23*	0.69*	0.06	0.90	4.91*	0.53*	-0.15*	0.94
Greece	4.38*	0.92*	0.03	0.93				
Ireland	4.25*	0.92*	-0.40*	0.99	4.84*	0.74*	0.01	0.94
Italy	4.12*	0.90*	0.05*	0.97	4.54*	0.80*	0.08*	0.97
Netherlands	3.77*	0.96*	-0.29*	0.97				
Portugal	5.15*	0.88*	-0.06	0.89				
Spain	3.81*	0.98*	0.17*	0.98	4.27*	0.85*	0.23*	0.99
	STSL (Jan. 03 – Sept. 08)				*STLL (Jan. 03 – Sept. 08)*			
Austria	4.32*	0.83*	0.26*	0.90	3.75*	1.01*	0.14	0.98
Belgium	4.40*	0.93*	0.13*	0.97	3.64*	1.07*	0.16	0.99
Finland	4.38*	0.82*	-0.07*	0.96	3.73*	0.90*	-0.08	0.98
France	4.34*	1.24*	-0.17*	0.97	3.84*	1.18*	-0.01	0.98
Germany	5.14*	0.76*	0.13*	0.98	4.01*	0.85*	0.12	0.99
Greece	5.22*	0.96*	-0.04	0.98	4.11*	1.04*	0.03	0.96
Ireland	4.47*	1.01*	-0.18*	0.98	4.17*	0.96*	-0.23	0.98
Italy	4.61*	0.90*	-0.05*	0.99	3.77*	0.97*	-0.08	0.98
Netherlands	4.32*	1.04*	-0.01	0.98	3.78*	1.11*	-0.02	0.99
Portugal	6.13*	1.04*	-0.05	0.96	4.25*	1.23*	-0.07	0.96
Spain	4.34*	0.95*	0.17*	0.99	3.83*	1.07*	0.05	1.00
	LTSL (Jan. 03 – Sept. 08)				*LTLL (Jan. 03 – Sept. 08)*			
Austria	4.49*	0.45*	-0.11	0.80	4.20*	0.47*	0.06	0.67
Belgium	4.72*	0.51*	-0.08	0.96				
Finland	4.94*	0.53*	0.02	0.91	4.19*	0.59*	-0.41	1.00
France	4.95*	0.39*	-0.23	0.69	4.16*	0.71*	-0.01	0.92
Germany	5.05*	0.31*	-0.18	0.96	4.63*	0.55*	0.02	0.91
Greece	5.41*	0.56*	0.09	0.71				
Ireland	4.95*	0.88*	0.09	0.97	4.27*	0.73*	0.04	0.88
Italy	5.21*	0.72*	0.10	0.99	4.26*	0.90*	0.06	0.95
Netherlands	5.04*	0.68*	-0.07	0.97	4.54*	0.51*	0.00	0.90
Portugal								
Spain	4.95*	0.86*	0.03	0.98	4.14*	1.01*	0.11	0.98

Notes: Estimates that are significantly different from zero at the 1% level are indicated with an asterisk. a is a constant, l_1 and l_2 are the loadings on the first and second factors respectively. The adjusted R^2 shows the share of the variance in risk-adjusted bank loan rates (centred on their mean) that can be explained by the statistically significant factors. See Appendix 2.C for a glossary.

Table 2.12b 0.5^{th} percentile of bootstrapped factor loadings for bank loans

	a	l_1	l_2	a	l_1	l_2
	STL (Jan. 01 – Sept. 08)			*LTL (Jan. 01 – Sept. 08)*		
Austria	3.75	0.70	0.24			
Belgium	3.59	0.75	0.24			
Finland				4.49	0.43	-0.12
France	3.50	0.91	-0.14	4.66	0.41	-0.35
Germany	4.03	0.58	-0.03	4.76	0.46	-0.20
Greece	4.13	0.79	-0.04			
Ireland	3.99	0.74	-0.45	4.64	0.64	-0.05
Italy	3.87	0.77	0.00	4.32	0.69	0.04
Netherlands	3.51	0.77	-0.35			
Portugal	4.91	0.73	-0.15			
Spain	3.54	0.86	0.12	4.03	0.71	0.17
	STSL (Jan. 03 – Sept. 08)			*STLL (Jan. 03 – Sept. 08)*		
Austria	4.05	0.68	0.16	3.45	0.86	-0.08
Belgium	4.12	0.76	0.06	3.32	0.90	-0.08
Finland	4.13	0.67	-0.13	3.46	0.75	-0.15
France	3.97	1.04	-0.21	3.49	1.00	-0.07
Germany	4.91	0.63	0.06	3.75	0.71	-0.12
Greece	4.93	0.81	-0.09	3.79	0.87	-0.09
Ireland	4.16	0.83	-0.23	3.87	0.79	-0.31
Italy	4.34	0.74	-0.08	3.48	0.82	-0.13
Netherlands	4.00	0.86	-0.05	3.44	0.94	-0.07
Portugal	5.82	0.85	-0.12	3.87	1.03	-0.18
Spain	4.05	0.77	0.12	3.51	0.90	0.00
	LTSL (Jan. 03 – Sept. 08)			*LTLL (Jan. 03 – Sept. 08)*		
Austria	4.34	0.35	-0.19	4.04	0.34	-0.35
Belgium	4.56	0.42	-0.14			
Finland	4.77	0.42	-0.05	3.97	0.43	-0.49
France	4.81	0.29	-0.29	3.94	0.57	-0.16
Germany	4.93	0.22	-0.22	4.45	0.44	-0.12
Greece	5.20	0.43	-0.42			
Ireland	4.68	0.73	-0.12	4.03	0.60	-0.21
Italy	4.99	0.60	-0.11	3.98	0.74	-0.11
Netherlands	4.83	0.55	-0.12	4.38	0.42	-0.07
Portugal						
Spain	4.69	0.71	-0.01	3.83	0.82	-0.01

Notes: a is a constant, l_1 and l_2 are the loadings on the first and second factors respectively. Estimates are based on 10000 draws.

Table 2.12c 99.5th percentile of bootstrapped factor loadings for bank loans

	a	l_1	l_2	a	l_1	l_2
	STL (Jan. 01 – Sept. 08)			*LTL (Jan. 01 – Sept. 08)*		
Austria	4.21	0.90	0.33			
Belgium	4.10	0.99	0.38			
Finland				4.81	0.66	0.04
France	4.07	1.18	-0.03	4.99	0.61	-0.26
Germany	4.43	0.79	0.13	5.07	0.59	-0.09
Greece	4.64	1.02	0.12			
Ireland	4.53	1.07	-0.33	5.05	0.83	0.05
Italy	4.36	0.99	0.10	4.76	0.89	0.12
Netherlands	4.05	1.10	-0.22			
Portugal	5.40	1.02	0.02			
Spain	4.07	1.07	0.22	4.51	0.96	0.29
	STSL (Jan. 03 – Sept. 08)			*STLL (Jan.03 – Sept. 08)*		
Austria	4.59	0.94	0.32	4.07	1.12	0.19
Belgium	4.70	1.04	0.18	3.98	1.18	0.21
Finland	4.64	0.95	0.00	4.01	0.99	0.11
France	4.73	1.37	-0.11	4.22	1.30	0.06
Germany	5.38	0.85	0.18	4.28	0.95	0.16
Greece	5.53	1.07	0.01	4.44	1.16	0.14
Ireland	4.79	1.15	-0.10	4.48	1.10	0.30
Italy	4.89	1.01	-0.01	4.07	1.07	0.05
Netherlands	4.66	1.16	0.05	4.13	1.22	0.03
Portugal	6.46	1.17	0.04	4.64	1.37	0.06
Spain	4.64	1.05	0.21	4.17	1.18	0.09
	LTSL (Jan. 03 – Sept. 08)			*LTLL (Jan. 03 – Sept. 08)*		
Austria	4.65	0.53	0.12	4.39	0.59	0.32
Belgium	4.88	0.58	0.10			
Finland	5.11	0.62	0.14	4.40	0.76	0.13
France	5.10	0.47	0.24	4.40	0.82	0.13
Germany	5.16	0.38	0.20	4.81	0.65	0.13
Greece	5.62	0.67	0.32			
Ireland	5.23	1.00	0.17	4.51	0.83	0.28
Italy	5.44	0.80	0.15	4.56	1.02	0.17
Netherlands	5.26	0.77	0.13	4.71	0.59	0.06
Portugal						
Spain	5.23	0.96	0.10	4.46	1.14	0.20

Notes: a is a constant, l_1 and l_2 are the loadings on the first and second factors respectively. Estimates are based on 10000 draws.

Table 2.13 Factor loadings for bonds

	France	Germany	Italy	Netherlands	UK
	Estimated factor loadings (Jan. 99 – Oct. 08)				
a	5.05*	5.01*	5.07*	5.01*	4.98*
l_1	0.24*	0.24*	0.21*	0.21*	0.16*
l_2	0.08	0.02	-0.21	0.06	0.05
	0.5th percentile of bootstrapped factor loadings (Jan. 99 –Oct. 08)				
a	4.94	4.88	4.95	4.9	4.88
l_1	0.13	0.11	0.05	0.09	0.05
l_2	-0.15	-0.2	-0.29	-0.23	-0.17
	95.5th percentile of bootstrapped factor loadings (Jan. 99 – Oct. 08)				
a	5.16	5.12	5.19	5.12	5.08
l_1	0.33	0.34	0.32	0.32	0.24
l_2	0.16	0.17	0.28	0.24	0.24

Notes: Estimated factor loadings that are significantly different from zero at the 1% level are indicated with an asterisk. a is a constant, l_1 and l_2 are the loadings on the first and second factors respectively. Estimates are based on 10000 draws.

Appendix 2.C Glossary

STL = Short-Term or variable rate Loans and long-term loans with short rate fixation periods.

LTL = Long-Term Loans with long rate fixation periods.

STSL = Short-Term or variable rate Small Loans and long-term small loans with short rate fixation periods.

STLL = Short-Term or variable rate Large Loans and long-term large loans with short rate fixation periods.

LTSL = Long-Term Small Loans with long rate fixation periods.

LTLL = Long-Term Large Loans with long rate fixation periods.

ECB = European Central Bank

MFIs = Monetary Financial Institutions

NCBs = National Central Banks

NFCs = Non-Financial Corporations

SMEs = Small and Medium-sized Enterprises

LSEs = Large Scale Enterprises

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Chapter 3

A micro view on home equity withdrawal and its determinants. Evidence from Dutch households*

3.1 Introduction

In the Netherlands as well as in other countries like the USA and the UK, housing represents the largest share of assets and liabilities of a household's balance sheet. In the last two decades it has become easier and less costly to access home equity due to new mortgage products, financial deregulation, and increased competition in the provision of financial services (see Scanlon et al. 2008), making it a potentially important source of finance. Due to the shortage of informative micro datasets, only few and very recent studies analyse empirically for the USA, the UK, and Australia (see e.g. Hurst and Stafford 2004; Banks 2009; Schwartz et al. 2008), when households withdraw home equity.[33] This study adds evidence on continental Europe and tests the implications from theoretical models incorporating home equity withdrawal (HEW), using information from the Dutch National Bank Household Survey (DHS) for the period 2004 to 2007. In the European context the Dutch housing market has been one of the most dynamic since the early 1990s, characterised by an innovative and varied mortgage market and a very generous system of tax deductibility for mortgage interest rates, making it a particularly interesting case to study HEW.

* Acknowledgment: This chapter makes use of data of the DNB Household Survey.
[33] Box 3.1 in Appendix 3.A defines HEW in more detail.

The concentration of wealth in housing is likely to have major implications for households and on an aggregate level for the economy. From a macro perspective it is therefore important to understand how fluctuations in home equity feed into the economy, with potential channels reaching from direct wealth effects to collateral effects (see Buiter 2008; Iacoviello 2005; Aoki et al. 2004). Recently, aggregated data have shown a positive correlation between HEW and consumption, but there is no consensus whether there is a causal relationship.[36]

While the impact of housing wealth and HEW on consumption, growth[37] and business cycle fluctuations have been the subject of extensive analysis (e.g. Campbell and Cocco 2007; Case et al. 2005; Dvornak and Kohler 2003; Boone et al. 2001; Muellbauer and Murphy 1997, 1990; Attanasio and Weber 1995), there is a smaller, but recently growing literature studying the determinants of HEW on the household level. A microeconomic analysis is not only necessary to better understand aggregate developments, but it also takes into account that HEW has direct consequences for the withdrawing household itself. It can be used to smooth consumption, finance investments, or pay off more expensive debt, thereby allowing to adjust income and saving streams. In this sense it can be a means to better financial management and expand a household's financial scope when it would otherwise be credit constrained. Analysing the factors and motivation driving HEW is therefore essential to understand the way households benefit from accessing this important wealth component and sheds some light on potential risks arising from this type of financing.[38]

Economic theory has highlighted different reasons why households withdraw home equity (e.g. Hurst and Stafford 2004; Angelini and Simmons 2005; Angelini 2006). It allows them to overcome negative income shocks (buffer motive), to benefit from more favourable financial conditions if it is used to refinance existing debt (financial motive), or to borrow against rising future income (life-cycle motive). This study investigates how far these theoretical predictions are supported by the data.

[36] The major question is if spending would have occurred independently of home equity withdrawal, or if it is crowding out spending from other financing resources. Manchester and Poterba (1989) find evidence that increased access to second mortgages reduced personal savings what would point towards increased spending due to equity withdrawal, while Klyuev and Mills (2007) do not find a significant effect in the short- or long-run.

[37] According to the Dutch National Bank (DNB), HEW contributed to economic growth with 1% in 1999 and 2000, -0.5% in 2001 and 2002 and -0.25% in 2003 (DNB 2003).

[38] While the focus of this study is on the economic and financial aspects of HEW, there are also implications for housing and social policy. Money that is withdrawn but not reinvested into housing could lead to 'equity leakage'. For a discussion see Smith and Searle (2008).

From a probit analysis of the choice between withdrawing home equity and not altering home equity, we draw three main conclusions. First, the Dutch data does not support findings from earlier studies about the USA and the UK that home equity withdrawal is used as a financial buffer against negative income shocks. Second, financial motives seem to be important for the decision to withdraw home equity. Individuals expecting increasing mortgage interest rates in the future or having a high outstanding mortgage value are more likely to withdraw. Third, age effects turn out to be significant, as the probability of HEW increases until the mid-50s, showing that households have first to build up home equity before they are able to use it later on. The study finds also weak evidence that retirees access their home equity, but rather through re-mortgaging or second mortgages than by moving to cheaper accommodation.

Although withdrawers have on average higher debt ratios and find it more difficult to obtain credit, the analysis dispels some worries that HEW could pose systematic risk to the economy. It is not those households at severe financial risk which use their home equity. Neither income nor net-worth has a significant impact on the decision to withdraw, and households with very high home expenditure ratios are significantly less likely to borrow against their home equity.

The analysis also provides some preliminary insights on the impact of supply side conditions on equity withdrawal that has been widely neglected by the existing empirical literature. Results indicate that tightening credit conditions represent a significant impediment for households facing a negative income shock.

The remainder of the chapter is organized as follows. Section 3.2 gives a short overview of theoretical models incorporating the decision to withdraw home equity and summarizes the main results of the empirical evidence so far. Section 3.3 describes important characteristics and developments of the Dutch housing and mortgage market, the framework in which HEW takes place. Section 3.4 turns to the data and econometric approach and Section 3.5 presents the main results. Section 3.6 concludes by summarizing the main results.

3.2 Theoretical background and empirical evidence

Recently, a few economic models on household consumption have suggested different motives driving HEW.

One reason why households might withdraw home equity is to overcome negative income shocks and to smooth consumption. In Hurst and Stafford (2004) households maximise the present value of their utility from consumption by choosing the level of consumption and liquid assets as well as mortgage borrowing, given housing equity and collateral constraints. If households face a negative income shock and have little liquid assets, the probability to refinance and access home equity increases. These in a broader sense liquidity constrained households will refinance even when interest rates are stable or rising to smooth consumption. The model also highlights a second motivation for HEW, which is refinancing an existing mortgage for a higher amount to benefit from better financing conditions in a world of low interest rates.

This financial motive is also at the core of a model about mortgage refinancing by Angelini and Simmons (2005). Households are assumed to pay an interest rate on mortgage borrowings that differs from the one received on financial assets and they face a fixed cost when adjusting the amount borrowed. Given these assumptions, it is optimal to withdraw home equity and to invest the proceeds in financial assets when the interest earned exceeds the sum of mortgage interest rates and fixed cost. In a different framework, Angelini (2006) models the HEW decision of homeowners who cannot save and who can borrow only using home equity as collateral. Under these constraints households withdraw home equity to smooth consumption when current income is low compared to future income. This is consistent with the prediction from life-cycle models, where households borrow against home equity to bring forward consumption if they expect their future income to rise. However, life-cycle considerations also require that households inject equity into their homes until full ownership, while later on they might stop injecting and withdraw equity if they move to smaller homes. These factors make it difficult ex-ante to predict how the propensity to withdraw will look like over the life-cycle.

Households could also withdraw or inject equity for reasons other than consumption smoothing and financial efficiency. Banks et al. (2004) point out that owning a home

insures against buying at higher prices in the future.[39] In a multi period model they show that home equity acts as insurance against house price volatility, with owner-occupiers living in areas with volatile house prices being more reluctant to withdraw home equity. They also bring their model to the data and find supporting empirical evidence for the UK and the USA.

So far only a few studies have tried to test the relative importance of the different motivations brought up by the theoretical models. Hurst and Stafford (2004) find supporting evidence for the predictions of their theoretical model using US data for 1991-1996 from the Panel Study of Income Dynamics (PSID). A financial shock defined as an unemployment spell increased the probability of withdrawing equity for otherwise liquidity constrained households, as did a higher present value of the wealth gain from refinancing. This financial motive is also supported by Canner et al. (2002) who analyse the monthly Surveys of Consumers in 2002. Interestingly, the self-assessed likelihood of becoming unemployed was not important for the refinancing decision. While these studies focus on gross HEW through refinancing, Schwartz et al. (2008) analyse net injections or net withdrawal in 2004 using a survey of Australian households. They are able to distinguish between HEW through refinancing and through property transactions, with the latter comprising the bulk of equity injections and withdrawals in monetary terms, and find support for life-cycle, financial and income factors driving the decision to withdraw or inject home equity.

The importance of different motives is also shown by Benito (2009), who uses information regarding gross HEW from the British Household Panel Survey (BHPS) for 1992-2003. Households are more likely to withdraw home equity if they face a negative income shock, get divorced or married, or have higher home equity. In contrast to the finding by Schwartz et al. (2008), younger households are more likely to withdraw, suggesting that for this data and definition of HEW, consumption smoothing considerations dominate among life-cycle effects.

The following study contributes to the literature in two ways. First, it provides empirical evidence on the factors driving the decision to withdraw home equity in the continental European context, looking at the Dutch housing market between 2003 and

[39] Similarly, Sinai and Souleles (2005) emphasize that homeownership provides a hedge against fluctuations in housing costs. Their model does, however, not incorporate the decision to withdraw home equity.

2007. Second, it assesses which theoretical predictions about HEW are supported by the data, controlling for households' expectations, habits and financial risk aversion.

3.3 Dutch housing market

To understand home equity withdrawal, it has to be seen in the context of the housing and mortgage market. This section gives a short overview of the main developments in the Netherlands in recent years.

In the last decade the Dutch housing market has been one of the most dynamic in Europe, characterised by sharp house price rises in the late 1990s, innovations on the mortgage market and increased household debt. Although the developments have been in some respect similar to other countries, they have been more pronounced, making the Netherlands an interesting case to study. The following points are important:

First, house prices have risen sharply both in nominal and real terms before and around the turn of the century, with annual growth rates peaking at 18% in 2000. Since then, growth rates have cooled down and prices have increased slightly above the inflation rate.[40] The house price boom of the 1990s can be explained by favourable cyclical conditions, low mortgage interest rates, low supply elasticity of new housing, demographic developments like immigration and the trend towards smaller households, the fiscal regime, and liberalisation, competition and innovation on the mortgage market (Van Dijkhuizen 2005). This has increased home equity and the scope of its withdrawal.

Second, due to the rise in house prices and home ownership ratio, residential property has become the most important asset of Dutch households, while mortgage debt dominates the liability side.[41]

Third, the outstanding amount of mortgages has increased rapidly, with the ratio of outstanding residential mortgage to GDP reaching 100% in 2003, up from 46% in 1994,

[40] See Figure 3.5 in Appendix 3.B. Lately house prices started to decline due to the global economic crisis. According to the Dutch Central Bureau of Statistics (CBS) prices of existing houses sold in June 2009 were on average 3.7% lower than twelve months previously.

[41] Owner occupancy has gradually increased in the Netherlands from 29% in 1950 to 42% in 1980 and 55% in 2003 (see National Board of Housing, Building and Planning Sweden and Ministry for Regional Development of the Czech Republic 2005). For international evidence that borrowing for housing accounted for the bulk of the increase in household debt see Debelle (2004).

one of the highest ratios in Europe.[42] A fiscal regime that allowed full deductibility of mortgage payments at the marginal tax rate has clearly favoured this development. In an attempt to discourage excessive mortgage growth, deductibility for mortgages used for non-housing consumption or investments and second home purchases has been removed in 2001. As a further limitation, interest rate deductibility was limited to 30 years in 2002, and since 2004 homeowners moving to more expensive homes have had to use capital gains on their former homes as down payment by law.[43] This might have curbed the use of HEW to finance consumption, although it remains attractive due to the usually lower level of mortgage interest rates compared to other loans.

Finally, taking out mortgages has become easier and cheaper. Average mortgage interest rates have fallen consistently over the past two decades, which can be accounted for by increased market competition, liberalisation, and the macroeconomic environment.[44] The Dutch mortgage market is still dominated by banks, which in 2003 accounted for 74% of the market, but recently there has been a tendency to sell mortgages through intermediaries (Boelhouwer 2002). The typical maturity of a mortgage in the Netherlands is 30 years, with interest rates fixed for 5 to 10 years. The fiscal regime has spurred the development of new mortgage products that maximise the fiscal deductibility of mortgage interest such as interest-only mortgages, while traditional annuity and linear mortgages have lost ground. Furthermore, the popularity of savings and investment mortgages as well as endowment mortgages has increased. The latter allows borrowers to get a new loan on (part of) the amount that already has been paid off during the term of the mortgage, facilitating home equity withdrawal.

When granting mortgage credits, lenders assess the repayment capacity and reliability of the client together with the collateral. In the Netherlands, the main criterion is the home expenditure ratio that is the ratio between mortgage expenses, which includes interest, premiums and repayments, and household income. Up to a value of 25% housing is considered affordable, between 25 and 35% households are able to afford their housing under normal circumstances, but adverse financial shocks can represent a problem, and ratios above 35% indicate that homeownership is likely to be unsustainable

[42] See Table 3.6 in Appendix 3.B

[43] Besides fiscal deductibility of mortage interest rates, capital gains on own property are not subject to taxation. Only the imputed market based rental value of property is added to taxable income and local property tax has to be paid. Finally, own property movers have to pay a transfer tax of 6% of the purchase price.

[44] See Figure 3.6 in Appendix 3.B.

in the future (Dol and Neuteboom 2008). In this regard, the National Mortgage Guarantee (NHG) plays a specific role. For mortgages sold under its norm, the NHG will cover the mortgage payments to the bank should structural repayment problems arise.[45] Borrowers using this scheme have to pay a one-time upfront fee of 0.4% of the outstanding mortgage and receive a limited interest rate discount (up to 0.6%) on the current rate. Furthermore, they can apply for a top-mortgage including the transaction costs, while the lender has the advantage that mortgages covered by the NHG enter the solvency requirements with a risk weighting of zero (Dol and Neuteboom 2008, Van Dijkhuizen 2005; Boelhouwer 2002). In general, mortgages can be refinanced at the cost of a penalty, but in practice prepayment is likely to result in additional costs for lenders, because only a proportion of yield maintenance fees can be recovered (M. O. Wyman 2003).[46]

3.4 Data and econometric approach

3.4.1 Data

The data used in this study come from survey waves from 2002 to 2008 of the Dutch National Bank Household Survey (DHS). It represents a rich panel dataset, providing information regarding gross HEW, mortgages and a household's economic and financial situation in general. Socio-demographic characteristics and expectations about price and interest rate developments are retrieved as well. The survey collects information about two different channels of HEW. First, it asks if during a certain year home equity was withdrawn by taking out an additional mortgage or by re-mortgaging with a higher principal without moving home.[47] It also contains information concerning the amount withdrawn and its use, although for the latter this is not available separately for each year. Second, households which have recently moved are asked whether they withdrew

[45] In the Netherlands, mortgage holders also have full recourse against borrowers who have defaulted on mortgage payments. Moreover, there is a Mortgage Code of Conduct that should prevent lenders from granting risky mortgages (see Van Dijkhuizen 2005).
[46] In addition, the Dutch law allows 15% of a mortgage loan to be repaid without charge each year, and prepayment when moving homes is also not charged.
[47] A detailed description of the variable measuring HEW and its usage in this study is given in Appendix 3.C.

equity by moving to a cheaper accommodation or by taking out a higher mortgage than necessary for buying the house.

In contrast to Schwartz et al. (2008), but similar to Benito (2009) and Hurst and Stafford (2004), this study is about gross HEW, since all or part of the proceeds can be reinvested into the housing sector. Given that part of the effect of equity withdrawal on the economy is due to investment in the housing sector, this does not question the relevance of aggregate effects.

The DHS consists of approx. 1800 households per survey year, of which around 900 households state whether they have withdrawn home equity without moving (labelled as *non-transactors* in Table 3.1). On average 24 households have moved during a year and have indicated whether they used the surplus value i.e. selling value minus total sum of the mortgage (referred to as *transactors*).[48] Due to the availability of important explanatory variables, the econometric analysis is restricted to a sample covering the years 2004 to 2007, but the proportions of withdrawers are similar to the full DHS sample.

Table 3.1 Summary statistics DHS and sample

DHS								
	individuals (total)	households	non-transactors	withdrawers (without moving)		transactors	withdrawers (when moving)	
2002	4772	1943	857	53	*6.2%*	16	4	*25.0%*
2003	4627	1912	979	57	*5.8%*	17	9	*52.9%*
2004	4877	1993	1048	68	*6.5%*	27	10	*37.0%*
2005	4726	1936	986	56	*5.7%*	42	10	*23.8%*
2006	4387	1776	913	55	*6.0%*	28	12	*42.9%*
2007	4070	1660	877	63	*7.2%*	13	5	*38.5%*
total	Observations	11220	5660	352	*6.2%*	143	50	*35.0%*
	(Households)	(3615)	(1538)	(246)		(128)	(49)	

Sample								
			non-transactors	withdrawers (without moving)		transactors	withdrawers (when moving)	
2002								
2003								
2004			204	16	*7.8%*	15	6	*40.0%*
2005			218	22	*10.1%*	24	7	*29.2%*
2006			227	14	*6.2%*	11	2	*18.2%*
2007			243	17	*7.0%*	7	2	*28.6%*
total	Observations		892	69	*7.7%*	57	17	*29.8%*
	(Households)		(492)	(61)		(55)	(17)	

Notes: Numbers refer to the year in which HEW is observed, but were assessed in the survey of the following year. E.g. 2007 numbers come from the DHS survey 2008, but examine HEW in 2007.

[48] This labelling follows Schwartz et al. (2008).

The explanatory variables can be broadly classified according to the different motives driving equity withdrawal.[49] These are (i) overcoming negative income shocks, (ii) financial motives including financial cost minimisation and portfolio diversification, (iii) direct wealth effects, (iv) consumption smoothing over the life-cycle, and (v) house price insurance. A dummy variable measuring whether the income of an individual is 'unusually low' compared to a 'regular' year captures a negative income shock. Similarly, a negative health shock and dummies for marriage or divorce try to assess the importance of equity withdrawal as a financial buffer. In this regard, liquidity constraints might play a role (see e.g. Hurst and Stafford 2004), which are proxied by the households self-assessed possibility to 'easily get a loan', the ability to manage on the household income and the availability of liquid assets.

Variables accounting for the financial efficiency motive include an estimate of the income tax rate and the lagged value of the sum of outstanding mortgages. Households paying a higher tax rate and having more mortgage debt should benefit most from the tax deductibility scheme and more favourable financing conditions.[50]

Another reason why households might withdraw equity is to rebalance their portfolio, by shifting housing wealth towards other assets. I try to proxy this effect with a self-assessed measure of the increase in the value of the home since it has been bought and with the increase in the last year. These are however imperfect proxies since they might also capture direct wealth effects from increased house prices, which lead to higher consumption financed by HEW. Life-cycle effects are captured by the age of the household, a dummy variable indicating whether the individual is retired, and expectations about the future financial situation of the household. Finally, the standard deviation of regional house prices over the last five years is used to assess house price uncertainty and the insurance role of home equity. This measure is similar to the one used by Benito (2009) and Banks et al. (2004), but relies on aggregated data from Statistics Netherlands rather than on the survey data.

In addition, control variables for mortgage and demographic characteristics, education, time and geographical effects are included. Expectations about future

[49] Appendix 3.D contains the full list of explanatory variables and their definition.
[50] This holds if households refinance their existing mortgages at a lower interest rate while at the same time increasing the amount borrowed or if part of the equity withdrawn is used to pay off more expensive debt.

mortgage interest rates, house price developments and changes in the tax deductibility scheme complete the set of explanatory variables.

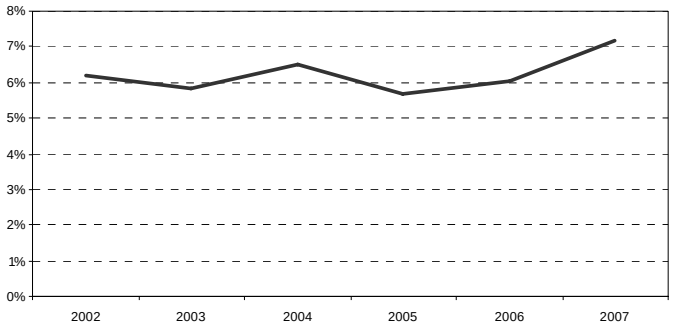
3.4.2 Descriptive statistics

This section presents some descriptive statistics separately for households withdrawing home equity without moving, which in the following are loosely called 'non-transactors', and households withdrawing home equity when moving, which in the following will be referred to as 'transactors'.[51]

Non-transactors

According to the DHS, the share of mortgage holders withdrawing home equity without moving fluctuated around 6 to 7% between 2002 and 2007, as shown by Figure 3.1.[52]

Figure 3.1 Share of mortgage holders withdrawing home equity



Source: DHS.

While this proportion remained rather stable, the annual mean amount withdrawn changed somewhat more over time, with an average value over all withdrawals of 29,422€ over 2002 to 2007 (in 2000 prices).[53] This is a slightly higher value than the

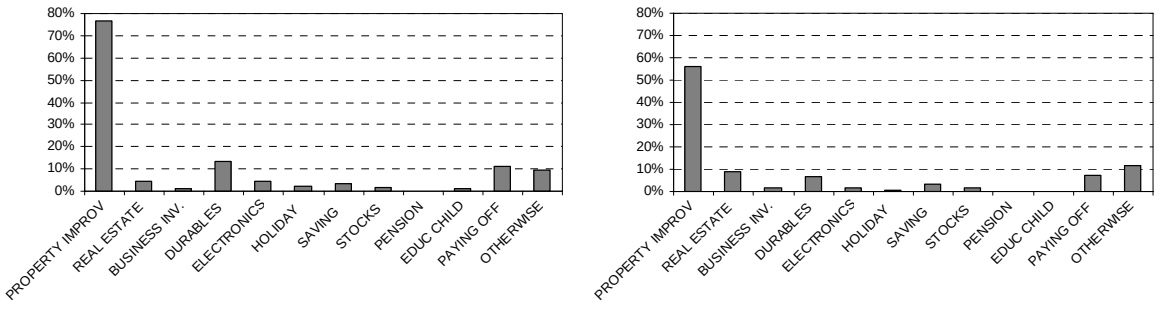
[51] This labelling follows Schwartz et al. (2008).
[52] Benito (2009) found for the UK that around 10% of all homeowners withdrew home equity in 2003 (taking transactors and non-transactors together), whereas according to Schwartz et al. (2008) 7.2% of all Australian households withdrew equity in 2005 without property transactions and 4.4% through transactions (net HEW).
[53] See Figure 3.7 in Appendix 3.B. HEW as a share of GDP is calculated by multiplying the mean amount withdrawn by the share of withdrawers compared to all households in the survey and the number of households in the Netherlands.

25,615€ British households withdrew on average during 1992 to 2003 according to Benito (2009).[54] Translated into aggregate figures, gross HEW by non-transactors represented between 1 and 2% of GDP in the Netherlands and has therefore a potentially significant impact on the economy.

Panel A in Figure 3.2 shows that most of the households use all or part of the equity withdrawn for property improvements (77%) and only a small fraction also or exclusively for spending on durable goods (13%), electronics (5%) or for paying off other debt (11%). The usage in monetary terms reflects this pattern as displayed in panel B. The bulk of the money is reinvested into the housing sector (56%) and only a small part used to purchase durables (6.5%), electronics (1.7%) or to pay off existing debt (7.3%). These figures show that net home equity withdrawal masks a substantial amount of withdrawals reinvested into housing, which is also confirmed by evidence from the USA (Canner et al. 2002) and the UK (Benito 2009) and suggests that only a small part of the growth in consumption in recent years may be attributed to HEW.

Figure 3.2 Use of home equity withdrawn over 2002 to 2007 (non-transactors)

Panel A Shares (multiple answers possible) *Panel B* Shares in monetary terms



Notes: Figure shows the percentage of households that used (part) of the money withdrawn for a certain purpose (panel A) and the percentage of the monetary value going to it (panel B). *Property Improv.* stands for *Property Improvement* and *Business Inv.* for *Business Investment*. Source: DHS.

From Table 3.2 we get some first descriptive information on the characteristics of withdrawers vis-à-vis non-withdrawers. On average, both groups are affected equally by

[54] 25,615€ are the 15,612£ (in 2000 prices) mentioned by Benito (2009) using the average exchange rate during 2000. This is even more remarkable when taking into account that the British figure includes transactors and non-transactors, the former usually being regarded as withdrawing more equity. Schwartz et al. (2008) found that non-transactors withdrew on average 20,000 AU$ in 2005, compared to an average of 80,000 AU$ withdrawn by transactors (approximately 6,643€ and 26,573€ respectively, using the average exchange rate during 2000 and in 2000 prices; numbers refer to net HEW).

income shocks or other shocks with potential financial impacts, as revealed by t-tests of the means. However, withdrawers seem to be significantly more likely to be constraint by loans and to have debts, as well as having on average more outstanding mortgage debt on the home they are living in and a lower household income than non-withdrawers. Furthermore, the proportion of endowment mortgages among the mortgages with the highest outstanding value is higher for withdrawers, making it easier to access home equity.[55]

Table 3.2 Summary statistics (non-transactors)

		total	withdrawers	non-withdrawers	t-test
buffer motive					
	shock income $^{-}$	0.02	0.04	0.02	0.15
	shock health $^{-}$	0.13	0.17	0.13	0.25
	Δmaritial status	0.00	0.01	0.00	0.20
financial motive					
	mortgage outstanding (t-1)	101.12	**122.31**	**99.34**	**0.01**
	Δ^{k} house price	111.38	125.33	110.21	0.23
	Δ^{1} house price	8.77	13.91	8.34	0.15
life-cycle motive					
	age	52.52	53.68	52.42	0.43
	retired	0.25	0.32	0.25	0.19
	future economic situation $^{-}$	0.21	0.17	0.21	0.49
	future economic situation $^{+}$	0.22	0.29	0.22	0.17
other controls					
	household income	30.74	**26.17**	**31.12**	**0.02**
	net worth	72.59	63.05	73.39	0.61
	debt	0.13	**0.30**	**0.12**	**0.00**
	loan constraint	0.03	**0.10**	**0.03**	**0.00**
	assets	0.89	0.87	0.89	0.53
	female	0.19	0.12	0.19	0.12
mortgage characteristics					
	endowment mortg. (t-1)	0.02	**0.06**	**0.02**	**0.01**
	nrm (t-1)	0.88	0.91	0.88	0.41
	mortg. guarantee (t-1)	0.30	0.36	0.30	0.28
	fixed interest (t-1)	0.87	0.81	0.87	0.17
	her	0.18	0.19	0.18	0.34
	her >0.35	0.08	0.07	0.08	0.82
	Observations/(households)	892/(429)	69/(61)	823/(408)	

Notes: Table shows sample means (proportions for dummy variables) and p-values for t-tests; mean values significantly different at the 10% level between the two groups are in boldface. Source: DHS 2004-2007.

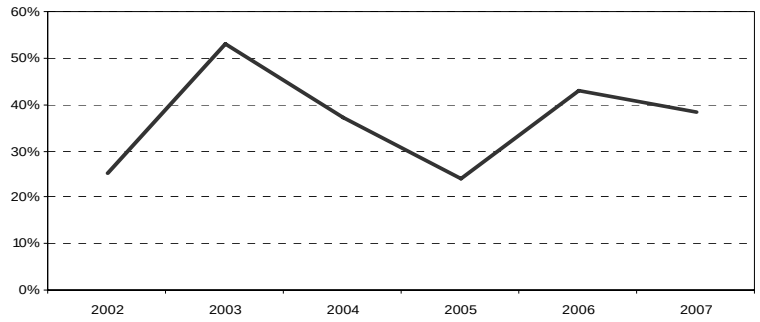
[55] Since it cannot be exactly assessed by the DHS which mortgage has been refinanced with a higher value or whether a new mortgage has been taken out, the following approach has been adopted: mortgage variables refer to the mortgage with the highest value outstanding in *t-1*, except for the amount outstanding, which is the sum over all mortgages held by a household in *t-1*. Although any approach trying to tackle this problem has its drawbacks, this one has the advantage of being consistent with the financial motive, which predicts that the financial gain is bigger if a higher value is refinanced.

Transactors

HEW is much more frequent among transactors than among non-transactors as shown by Figure 3.3. On average, 37% of all transactors withdrew home equity over 2002 to 2007, although there are significant differences from year to year. With 42,397€ (in 2000 prices) the mean value withdrawn is significantly higher than the one for non-transactors (29,422€), which is in line with previous studies of Schwartz et al. (2008), Benito and Power (2004), and Holmans (2001). By number, however, most of the withdrawals are accounted for by non-transactors, which is also reflected in the aggregate. Home equity withdrawn by transactors was between 0.1 and 0.5% of GDP in the period analysed and is thus a smaller amount than HEW by non-transactors.[56]

The spending pattern is similar to non-transactors (see Figure 3.4). The majority of households uses the equity withdrawn for property improvements (68%) and only few households also or exclusively for the purchase of durables (6%), electronics (8%) or the redemption of other debt (16%). A substantial share of withdrawers (38%) also uses the proceeds to cover additional moving costs such as taxes and broker fees.[57]

Figure 3.3 Share of HEW through transaction as a fraction of total transactions

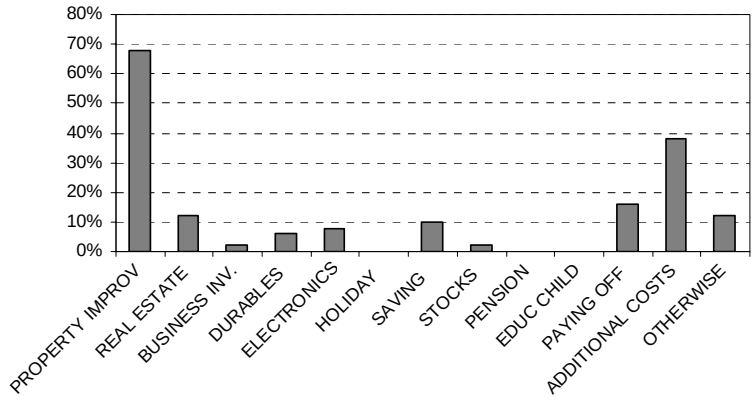


Source: DHS.

[56] See Figure 3.8 in Appendix 3.B. This finding is in contrast to Schwartz et al. 2008 who found that transactors accounted for 72% of the overall value of (net) withdrawals. Besides the different concepts of gross and net HEW, DHS data does not cover the sale of properties resulting from the death of an owner, a potentially significant component. Differences between Australia and the Netherlands both in the mean amounts withdrawn and the number of property transactions might also account for the disparity of the data.

[57] For transactors, the DHS only provides information about the usage of the equity withdrawn, but not on the monetary value going to each category.

Figure 3.4 HEW through transaction: use of surplus value (multiple answers possible) during 2002 to 2007



Notes: Figure shows the percentage of households that used (part) of the money withdrawn for a certain purpose. *Property Improv.* stands for *Property Improvement* and *Business Inv.* for *Business Investment*. Source: DHS.

A mean comparison of some key variables between withdrawers and non-withdrawers gives preliminary insight into the motivation behind HEW. Although one should read the results with caution due to the small sample size, a few patterns emerge. Table 3.3 shows that withdrawers are more likely to have experienced a negative income shock, to have children and to have not attended university. The proportion of retirees is lower among withdrawers and the net worth of withdrawers compared to non-withdrawers is on average lower (not statistically significant).

Table 3.3 Summary statistics (transactors)

	Variables	total	withdrawers	non-withdrawars	t-test
buffer motive					
	shock income -	0.11	**0.24**	**0.05**	**0.04**
	shock health -	0.11	0.12	0.10	0.85
life-cycle motive					
	age	48.14	49.12	47.73	0.75
	retired	0.23	0.12	0.28	0.20
	future economic situation -	0.14	0.18	0.13	0.62
other controls					
	household income	27.46	27.35	27.50	0.97
	net worth	72.47	32.71	89.37	0.35
	debt	0.28	0.35	0.25	0.44
	assets	0.84	0.82	0.85	0.81
	female	0.21	0.24	0.20	0.77
	children	0.35	**0.53**	**0.28**	**0.07**
	higher education	0.25	**0.06**	**0.33**	**0.03**
	Observations/households)	57/(55)	17/(17)	40/(40)	

Notes: Table shows sample means (proportions for dummy variables) and p-values for t-tests; mean values significantly different at the 10% level between the two groups are in boldface. Source: DHS 2004-2007.

For a more thorough understanding of the variables driving HEW, an econometric analysis is carried out in the following. Due to data availability it is restricted to the period 2004 to 2007.

3.4.3 Econometric approach

A probit model for the decision to withdraw home equity is estimated separately for households who have recently moved and might have used the surplus value from selling the house (transactors) and for households who have not moved and might have withdrawn equity by taking out a second mortgage or refinancing with a higher principal (non-transactors).

The probability that a household has withdrawn is given by

$$P(y = 1 | x, z, d) = \Phi(\alpha + x\beta + z\delta + d\gamma) \tag{3.1}$$

and the estimated equation can be formalised by

$$y_{it} = 1[\alpha + X_{it}^{'}\beta + Z_{it-1}^{'}\delta + D_t\gamma + \varepsilon_{it} > 0] \tag{3.2}$$

with X being a vector of contemporaneous covariates, Z a vector of lagged covariates, D a vector of year dummies controlling for time effects, i = 1, 2, ... , N an index for households and t = 2004, ... , 2007 for years. The random error ε is assumed to be normally distributed with $\mu = 0$ and $\sigma = 1$. Equation (3.2) is estimated by maximum likelihood with standard errors clustered at the individual level.[58] This pooled probit approach implicitly assumes that unobserved effects are absent and all individual heterogeneity is accounted for by the covariates.[59]

[58] Since the DHS is a panel, households appear more than one time in the sample. Clustered standard errors allow for serial correlation at the individual level and are robust to some forms of misspecification of the likelihood function, where the maximum is still at the same point as for the true likelihood function.

[59] Unobserved time constant random effects turn out to be insignificant when estimating a random effects (RE) probit model (results are available from the author). Note, however, that the signs of the coefficients obtained by pooled probit estimation are correct even in the presence of RE, since average partial effects are estimated consistently (see Wooldridge 2002).

3.5 Estimation results

This section first presents the results for non-transactors, followed by a discussion of the findings regarding transactors. For the former, separate estimations are carried out for the year 2007 and the pooled sample of 2004 to 2007 to test the stability of the estimates. This approach also takes into account that the DHS asks explicitly for information about HEW in 2007, whereas for the pooled sample an indicator variable has to be constructed (see Appendix 3.C). Estimates for transactors are only based on the pooled sample.

Non-transactors

The decision to withdraw equity in 2007 is modelled by a basic specification capturing the different motives that might drive HEW (column 1 in Table 3.4) and a more general model additionally controlling for expectations and personal characteristics (column 2).

It is first investigated whether withdrawing home equity acts as financial buffer. While this is supported by data for the USA (Hurst and Stafford 2004) and the UK (Benito 2009), there is little evidence for the Netherlands. A negative income shock increases the propensity to withdraw in the basic model, but this effect becomes insignificant when controlling for additional variables. For 2007 it seems rather to be the case that households use their home equity when expecting a deterioration of their future economic situation. At first sight this it at odds with the idea of precautionary saving, but can be reconciled with it if the amount withdrawn is saved, used for measures that buffer expected negative events in the future or reinvested into housing so that net HEW is non-negative.

Households also seem not be driven by financial efficiency considerations in 2007. Both the tax rate and the outstanding mortgage amount in *t-1* do not enter the model significantly. In contrast, the house price appreciation in the last year is associated with a positive and significant coefficient, meaning that households take advantage of recent capital gains. Part of this might be related to portfolio rebalancing in a broader sense, where households try to avoid an excessive accumulation of wealth in one asset class.

As a further result, the data support life-cycle effects.[60] The probability of withdrawing equity increases until around the age of 55 and decreases afterwards. This confirms findings by Schwartz et al. (2008) and is consistent with the view that households first have to build up housing equity in early years that can be used later on.

An aspect that has received little attention by previous studies is the characteristics of mortgages taken out prior to HEW. This analysis looks at the mortgage with the highest outstanding value in *t-1*, making it a plausible candidate for refinancing. One would expect insignificant coefficients pertaining to this mortgage should the approach not reflect reality. However, results show that holding an endowment mortgage is an important driver of withdrawing home equity, as it facilitates borrowing, and being guaranteed by the National Mortgage Guarantee works in the same direction.[61] As mentioned earlier, the latter not only reduces credit risk, but also offers advantages in form of lower capital requirements to the lending institution.

In addition, expectations and personal attitudes play a role, as shown by the extended model in column (2). Individuals that already planned to withdraw home equity in *t-1* are more likely to do so in *t*, as well as individuals expecting a rise in mortgage interest rates. In contrast, HEW occurs less frequently if one thinks in a longer time dimension when deciding about what part of the income to spend or to save, or if one plans to move in the foreseeable future. These factors do not only deliver additional insight into the determinants of HEW, but by controlling for them there is less risk of an omitted variable bias that would arise if one of the explanatory variables like mortgage characteristics were correlated with the error term in equation (3.2).

To see whether these results hold for a larger sample and a longer time period, the model is re-estimated for a pooled sample covering the period 2004 to 2007. Again, a baseline specification (column 3) is compared to extended models (column 4 and 5).[62] While the analysis confirms most of the previous findings, there are some important differences.

First, the effects of a negative income shock or of an expected worsening of economic conditions are no longer significant, questioning the hypothesis that HEW acts

[60] As Schwartz et al. (2008) point-out, it is difficult to disentangle age from cohort effects if T is small and impossible in cross-sections. However, in contrast to life-cycle effects there is no obvious reason why there could be cohort effects, and even if there were some, it seems plausible that the former would prevail.
[61] The concept of an endowment mortgage is related to an open end home equity loan or home equity line of credit, where the borrower can choose when and how often to borrow against the equity in the property.
[62] Table 3.7 in Appendix 3.E shows average partial effects (APE) for all five model specifications.

as a financial buffer for Dutch households. There is also little evidence that an improved economic situation expected in the future triggers HEW today. The coefficient carries a positive sign as predicted by theories of consumption smoothing, but it is no different from zero at common confidence levels.

Second, withdrawing home equity is tied to financial efficiency considerations over the four year period: the higher the outstanding mortgage value is, the more important the potential financial gain from refinancing and the higher the propensity to withdraw equity.

Third, changes in the house price are on average over the four years less important, being only significant at the 20% level (column 4 and 5). In contrast, there is strong evidence that loan constrained or indebted households are more prone to withdraw. This supports the idea that it is mainly the collateral channel through which HEW affects the economy (see Buiter 2008; Iacoviello 2005), but does not imply that it is households at financial risk who make use of their home equity. Although withdrawers are on average less risk averse in financial matters, as they do not regard investments in shares as too risky (see variable *financial risk aversion*), neither household income nor net worth seem an important driving factor. In addition, individuals liking to spend all their income immediately (*spending*) are significantly less likely to withdraw (column 4 and 5), and a higher proportion of withdrawers state that they have a good knowledge of financial matters (*financial knowledge*). Withdrawers are also less likely to have a home expenditure ratio (*her*) above 0.35 which is an important risk criterion used by lending institutions.[63]

In concurrence with the analysis of the survey of the year 2007, the pooled sample confirms the importance of mortgage characteristics, interest expectations, and life-cycle effects for the decision to withdraw home equity. The propensity to withdraw equity increases until the mid-50s and decreases afterwards, but there is some evidence that this effect is offset for retirees, although only at the 20% level (column 4 and 5). This would in principle be in line with life-cycle models predicting elderly people to decumulate wealth, and with the finding by Chiuri and Jappelli (2008) that the degree of mortgage

[63] This suggests that the reality in the Netherlands is different from the US, where Mian and Sufi (2009) find that homeowners with high credit card utilisation rates and low credit scores had the strongest tendency to borrow against increases in home equity during the house price boom, but experienced also the highest default rates after 2006. In the Netherlands there is no subprime segment comparable to the US mortgage market and stress tests indicate that the risks arising from a substantial correction in the housing market remain limited (DNB 2008).

market regulation is negatively correlated with the homeownership ratio among the elderly.[64] In countries with strongly regulated markets, ownership ratios start falling after the age of 70, possibly reflecting the desire or need to access home equity, while this effect is much weaker where mortgage markets are highly developed as in the Netherlands. The possibility of over-mortgaging, re-mortgaging, taking out a second mortgage, or trading down allows homeowners to access home equity without moving into rental accommodation. [65]

The pooled sample also enables to assess the relative importance of home equity as insurance against rising house prices. While Banks et al. (2004) find supporting evidence in data for the USA and the UK, and Benito (2009) gets mixed results from the British BHPS, results from the specifications in column (4) and (5) show no significant effect. Regional house price volatility, measured as the standard deviation over the five years preceding the survey year, does not seem to influence the decision to withdraw home equity when controlling for other regional effects. This might partly explain the contradicting results in Benito (2009), where regional house price volatility seems to matter, but it becomes insignificant when measured at the district level.[66]

Finally, the analysis tries to give an intuition of how the supply side affects HEW. Previous empirical analyses concentrated on the demand side, abstracting from any changes on the supply side that might affect the decision to withdraw equity. Column (5) includes three variables capturing supply effects: a measure for the change in credit standards for loans for house purchase, for the change in credit standards for consumer credit and other loans, as well as an interaction term between the latter and the dummy variable for a negative income shock.[67] Aggregate data show that demand for loans and credit standards are negatively correlated and therefore we would also expect to find a negative effect of tightening credit standards on the individual propensity to withdraw in the DHS data.[68] For interpreting the results it is important to note that these credit

[64] This analysis does not, however, tell us what the withdrawn equity is used for. Should all the proceeds be reinvested into housing or saved, there would be no reduction in wealth.
[65] 'Trading down' means that one moves to a cheaper property, but reduces the mortgage by less, so that the difference between selling price of the old home and purchase price of the new home on the one side, and the reduction in the amount borrowed on the other side, is positive.
[66] House price volatility gets negatively significant at the 20% level in column (4) and (5) when there a no controls for constant regional effects.
[67] Data on changes in credit standards come from the Dutch part of ECB's Bank Lending Survey for the Euro area. The yearly figure used in the analysis is an average of the monthly values referring to the past quarter.
[68] See Figure 3.9 and Figure 3.10 in Appendix 3.B.

standards refer to the purpose of the loan, i.e. mortgages used for consumption or education expenditure are affected by 'credit standards for consumer credit and other loans' and only mortgages used for investing in housing, including building and home improvements, are affected by 'credit standards for house purchases'.[69] Consistent with the expectation, all three coefficients carry a negative sign, but only the interaction term is significant at the 5% level. This means that credit standards do not seem to influence home equity withdrawal on average, but they become important for households facing a negative income shock. Since it is plausible that these households would spend the equity withdrawn on consumer goods or for other purposes rather than reinvesting it into housing, the relevant credit standards are the ones for 'consumer credit and other loans'. When they are tightened, it becomes more difficult to re-mortgage or to take out a second mortgage if the income stream is adversely affected. This indicates the importance of also taking into account supply side conditions when trying to understand the factors driving equity withdrawal. Results have, however, to be interpreted with caution, since the yearly changes in credit standards could also pick up other time effects, although year dummies in column (3) and (4) are not significant (not shown).

As robustness check specification (4) is re-estimated after removing potential outliers from the sample (see Appendix 3.F). This analysis confirms the main results from the full sample.

[69] See ECB (2001) p. 27 for details.

Table 3.4 Probit models for the probability of withdrawing home equity (non-transactors)

		2007		2004 - 2007		
		(1)	(2)	(3)	(4)	(5)
buffer motive						
	shock income $^{-}$	1.633*	0.299	0.261	-0.438	1.038
		(0.052)	(0.828)	(0.595)	(0.388)	(0.170)
	shock health $^{-}$	-1.464**	-3.163*	0.095	0.033	0.045
		(0.013)	(0.092)	(0.574)	(0.886)	(0.845)
	Δmarital status			0.608	0.589	0.698
				(0.286)	(0.248)	(0.178)
financial motive						
	mortgage outstanding (t-1)	0.001	0.003	0.004***	0.004***	0.004***
		(0.652)	(0.611)	(0.001)	(0.004)	(0.006)
	Δk house price	0.000	-0.008***	0.000	-0.000	-0.000
		(0.984)	(0.008)	(0.552)	(0.742)	(0.741)
	Δ1 house price	0.013**	0.039***	0.002	0.003	0.003
		(0.042)	(0.001)	(0.293)	(0.129)	(0.138)
	surplus (t-1)		0.006		0.001	0.000
			(0.157)		(0.602)	(0.664)
life-cycle motive						
	age	0.221*	0.842**	0.051	0.108**	0.117**
		(0.068)	(0.022)	(0.249)	(0.040)	(0.024)
	age²	-0.002*	-0.008**	-0.000	-0.001**	-0.001**
		(0.066)	(0.028)	(0.360)	(0.050)	(0.029)
	retired		1.227		0.458	0.457
			(0.236)		(0.148)	(0.145)
	future economic situation $^{-}$	0.663*	2.098**	-0.032	-0.041	-0.050
		(0.067)	(0.040)	(0.860)	(0.835)	(0.804)
	future economic situation $^{+}$	-0.976**		0.205	0.177	0.190
		(0.020)		(0.203)	(0.371)	(0.336)
insurance						
	regional house price volatility				19.385	22.880
					(0.463)	(0.354)
other controls						
	household income	0.000	-0.122	-0.003	-0.029	-0.020
		(0.991)	(0.112)	(0.905)	(0.185)	(0.369)
	household income²	-0.000	0.001*	-0.000	0.000	-0.000
		(0.402)	(0.059)	(0.384)	(0.975)	(0.800)
	net worth	0.001	0.003***	0.000	0.000	0.000
		(0.119)	(0.005)	(0.548)	(0.263)	(0.418)
	debt	0.776	0.531	0.588***	0.861***	0.894***
		(0.138)	(0.428)	(0.001)	(0.000)	(0.000)
	loan constraint		1.213		0.865**	0.838**
			(0.176)		(0.023)	(0.023)
	income problem		0.049		-0.165	-0.135
			(0.952)		(0.673)	(0.725)
	rate exp increase		1.981*		0.388**	0.324**
			(0.079)		(0.018)	(0.049)
	hew planned (t-1)		2.225***		0.978***	0.939***
			(0.000)		(0.000)	(0.000)
	mover		-1.807**		-1.167***	-1.207***
			(0.016)		(0.000)	(0.000)
	financial risk aversion		-0.154		-0.339**	-0.340**
			(0.776)		(0.044)	(0.040)
	time horizon		-3.117***		-0.249	-0.270
			(0.006)		(0.138)	(0.103)
	spending				-0.918**	-0.866**
					(0.016)	(0.020)
	financial knowledge		-0.727		0.345**	0.351**
			(0.187)		(0.040)	(0.035)
mortgage characteristics						
	endowment mortg. (t-1)	2.895***	5.493**	0.741*	0.643	0.553
		(0.000)	(0.012)	(0.075)	(0.146)	(0.217)
	mortg. guarantee (t-1)	0.745*	3.130**	0.331**	0.343*	0.352**
		(0.066)	(0.012)	(0.039)	(0.057)	(0.050)
	her >0.35	-1.484*	0.041	-0.538*	-0.875**	-0.865**
		(0.058)	(0.984)	(0.089)	(0.024)	(0.025)
supply side conditions						
	credit stand. (house purchase)					-0.002
						(0.929)
	credit stand. (other)					-0.018
						(0.657)
	shock income $^{-}$ x credit stand. (other)					-0.137**
						(0.040)
	Observations/(households)	249/(249)	242/(242)	892/(429)	796/(393)	796/(393)
	Pseudo-R²	0.420	0.665	0.144	0.275	0.269
	LR chi²	86.988	101.296	88.600	182.140	187.054
	Chi² p-value	0.000	0.000	0.000	0.000	0.000

Notes: Probit coefficient estimates (p-values in parenthesis). Standard errors are clustered at the individual level. Coefficients significantly different from zero at the 10%, 5% and 1% level are indicated with *, ** and *** respectively. *Pseudo R²* refers to McFadden's R², which is defined as $1\text{-}L_1/L_0$ with L_1 being the log-likelihood of the full model and L_0 being the likelihood of the "constant only" model. *LR chi²* is the test that at least one of the predictors' regression coefficients is not equal to zero. Dummies for regional and year effects (the latter are not included in model (5)) as well as further control variables are not shown. Appendix 3.D contains the full list of explanatory variables.

Transactors

A separate analysis for transactors is justified by the fact that the decision to withdraw home equity when moving is more involved and likely to differ from HEW without moving. Findings by Schwartz et al. (2008) and the descriptive data analysis in subsection 3.4.2 point in this direction. Due to the restricted sample size only preliminary evidence can be given, and it is not possible to control for effects pertaining to the decision to move.[70] Bearing these caveats in mind, two probit models are estimated as shown by columns (1) and (2) in Table 3.5.[71]

Similar to the analysis of non-transactors, there is no clear evidence that equity withdrawal is used to buffer negative income shocks, but results indicate that it is a means of borrowing against higher future income to smooth consumption in the medium run. The coefficient of the variable indicating an improved economic situation expected in five years' time is significantly positive in both specifications, supporting predictions from the life-cycle theory.

While age effects are absent, retirees seem to have a lower propensity to withdraw when moving. This puzzling result might reflect the impact of being retiree on the decision to move, which would be more in line with the previous finding that among non-transactors they are more likely to withdraw and with results from Chiuri and Jappelli (2008).

Estimates also show that households with children, debt, and lower net worth are more likely to withdraw when moving, suggesting that HEW represents a convenient financing source. However, it is not mainly households in financial need who withdraw home equity during property transactions. High income households turn out to be more prone to withdraw than households with low or middle income.

Finally, column (2) controls for the financial risk aversion and planning horizon of individuals. In contrast to results for non-transactors, estimates indicate no significant link to home equity withdrawal.

[70] This could potentially bias the estimates, if they also pick up the impact on the decision to move. The small sample size does not allow to estimate a selection equation in this case.
[71] Table 3.8 in Appendix 3.E shows average partial effects (APE) for both model specifications.

Table 3.5 Probit models for the probability of withdrawing home equity (transactors)

		2003 - 2007	
		(1)	(2)
buffer motive			
	shock income $^{-}$	1.666	2.553*
		(0.338)	(0.091)
	shock health $^{-}$	-5.620**	-6.880**
		(0.026)	(0.026)
life-cycle motive			
	age	-0.236	-0.420
		(0.410)	(0.170)
	age²	0.006	0.009*
		(0.123)	(0.051)
	retired	-5.942**	-8.121**
		(0.020)	(0.027)
	future economic situation $^{-}$	-1.612	-2.024*
		(0.162)	(0.094)
	future economic situation $^{+}$	2.900**	3.678**
		(0.019)	(0.015)
other controls			
	household income	0.353***	0.338***
		(0.004)	(0.009)
	household income²	-0.003*	-0.003
		(0.085)	(0.208)
	net worth	-0.007***	-0.009**
		(0.009)	(0.045)
	debt	1.646*	2.043**
		(0.059)	(0.027)
	female	4.147***	4.877***
		(0.000)	(0.003)
	children	4.826***	5.395***
		(0.000)	(0.000)
	couple	0.533	0.536
		(0.386)	(0.616)
	financial risk aversion		-0.850
			(0.373)
	time horizon		-0.409
			(0.669)
	Observations/(households)	57/(55)	56/(54)
	Pseudo-R²	0.640	0.639
	LR chi²	62.495	199.582
	Chi² p-value	0.000	0.000

Notes: Probit coefficient estimates (p-values in parenthesis). Standard errors are clustered at the individual level. Coefficients significantly different from zero at the 10%, 5% and 1% level are indicated with *, ** and *** respectively. *Pseudo R²* refers to McFadden's R², which is defined as $1\text{-}L_1/L_0$ with L_1 being the log-likelihood of the full model and L_0 being the likelihood of the "constant only" model. *LR chi²* is the test that at least one of the predictors' regression coefficients is not equal to zero. Dummies for year and regional effects as well as further control variables are not shown. Appendix 3.D contains the full list of explanatory variables.

3.5 Conclusion

This study assesses the factors driving gross home equity withdrawal in the Netherlands and investigates the relative importance of different motives postulated by theory. While

there has been much interest in home equity withdrawal and its relationship to consumption from central banks and macroeconomists, empirical evidence on the household level is still scarce and has so far been limited to the USA, the UK, and Australia. Using a pooled sample of Dutch households over the years 2004 to 2007, this analysis provides the first evidence for continental Europe. The main results are as follows:

First, in contrast to previous studies the analysis finds little support that home equity withdrawal is used as a buffer for negative income shocks. Financial motives seem to be more important, as households with higher outstanding mortgage value have a higher probability to withdraw.

Second, life-cycle effects turn out to be influential. The propensity to withdraw increases until around the age of 50 and decreases afterwards, reflecting that young households first have to build up home equity before they can withdraw it at a later stage. There is also some indication that elderly homeowners use their housing wealth, although mainly by re-mortgaging or taking out a second mortgage, rather than by moving to cheaper accommodation.

Third, the data do not show that home equity acts as insurance against rising house prices. House price volatility has no significant effect on the propensity to withdraw in the sample of Dutch households. In contrast, the decision to withdraw home equity is driven by expectations about future mortgage interest rates, the financial knowledge an individual has and their behaviour in financial matters.

Finally, an attempt is made to incorporate changes in supply side conditions into the analysis, an aspect that has been neglected by the literature so far. In general, tightening credit standards have no impact on equity withdrawal over the sample period, but they seem to represent a significant impediment for households facing a negative income shock. It remains for future research to assess the impact of changing supply conditions using longer time periods or regional variation.

How home equity withdrawal on the household level translates into aggregate effects, depends largely on what the equity is spent on. Consistent with international evidence, the Dutch survey indicates that the bulk is reinvested into the housing sector and only a fraction spent on consumption goods. This suggests that equity withdrawal feeds back to the economy mainly through the housing sector.

Appendix 3.A Home equity withdrawal and injection

Box 3.1 Definition of home equity withdrawal and injection

Gross home equity withdrawal (HEW) occurs when households borrow against the equity owned in their homes. This can be done via transactions and/or additional borrowing (see Klyuev and Mills 2007). Households withdraw home equity e.g. when they

- remortgage or refinance their existing mortgage with a higher principal;
- take out a second mortgage;
- move to a new house thereby taking out a higher mortgage than necessary for buying the house itself;
- trade down to a lower value house while decreasing their level of secured debt by less; or
- sell a house to move into rental accommodation.

Households inject (gross) equity into their homes when they

- make a down payment on a house purchase;
- make amortization on a mortgage;
- purchase homes and investment properties with cash or proceeds from (gross) HEW; or
- finance home improvements with cash or through (gross) HEW.

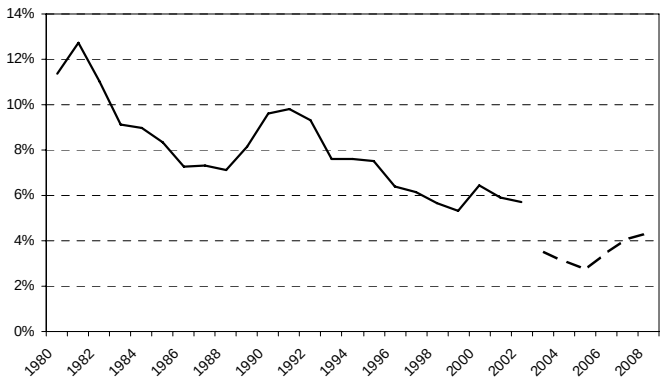
The difference between *gross HEW* and *gross injection* of equity into homes is *net HEW*. Home improvements entirely financed through mortgages have no impact on net HEW, thus net HEW masks a substantial amount of withdrawals reinvested into housing. This chapter makes use of data about gross HEW provided by the DHS.

Appendix 3.B: Descriptive statistics

Figure 3.5 Growth in house prices and outstanding mortgage value of Dutch households (yearly percentage change)

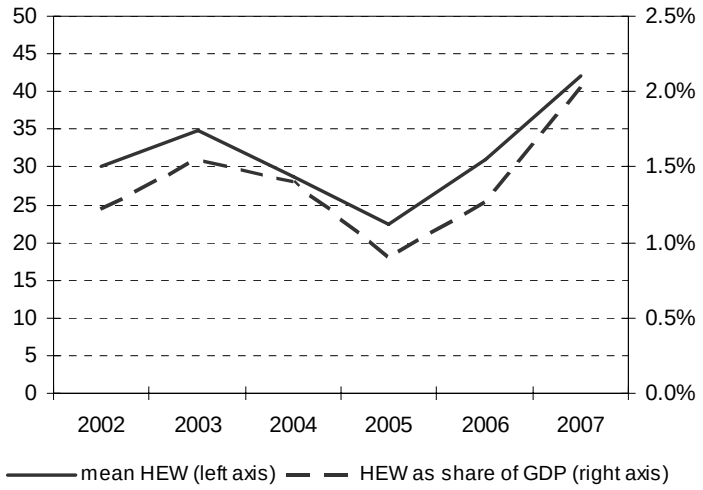
Source: CBS (Central Bureau of Statistics Netherlands) (house prices) and ECB (mortgages).

Figure 3.6 Average mortgage interest rates in the Netherlands



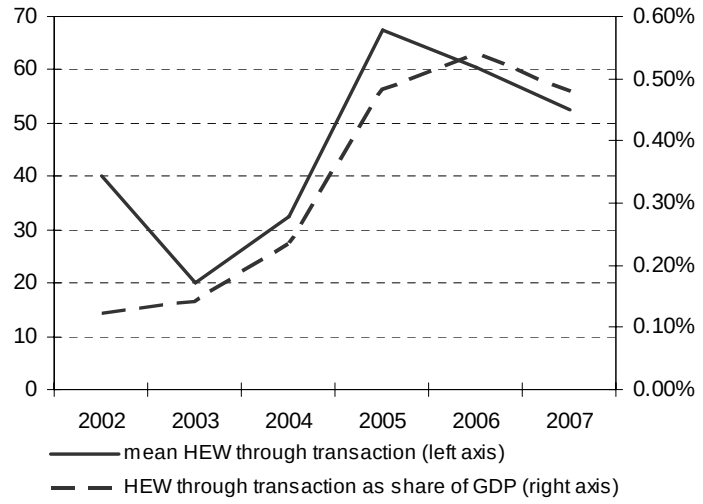
Source: Eurostat (1980-2002), DNB (2003-2008) weighted by new business volumes. Break in 2003.

Figure 3.7 HEW (non-transactors): average amount withdrawn in 1000€ and as share of GDP



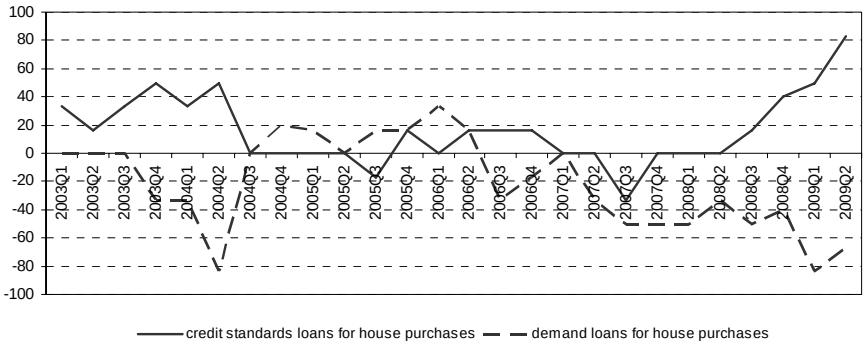
Source: DHS and own calculation.

Figure 3.8 HEW (transactors): average amount withdrawn in 1000€ and as share of GDP



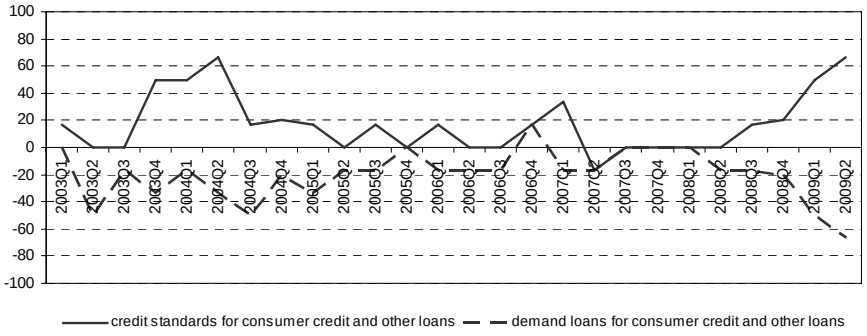
Source: DHS and own calculation.

Figure 3.9 Change in credit standards and loan demand for house purchases (past quarter)



Source: DNB.

Figure 3.10 Change in credit standards and demand for consumer credit and other loans (past quarter)



Source: DNB.

Table 3.6 Ratio of outstanding residential mortgage to GDP (%)

	1994	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*
Belgium	21	21	21	23	25	27	27	28	29	27
Czech Rep.								1	2	3
Denmark	65	63	63	71	76	77	76	80	83	88
Finland	36	31	30	30	30	31	31	32	34	36
France	21	20	20	21	20	21	22	22	23	25
Germany	44	45	48	51	53	57	54	54	54	54
Greece	4	4	5	5	6	7	9	12	15	17
Hungary								2	5	8
Ireland	23	24	24	24	27	29	32	33	37	45
Italy	6	8	7	7	8	9	10	10	11	13
Latvia				0	1	1	2	3	5	8
Luxembourg	24	25	24	23	24	24	26	28	30	33
Netherlands	46	48	52	58	63	69	74	79	88	100
Poland			16	2	2	2	2	3	4	5
Portugal	16	18	22	25	32	39	44	47	50	51
Spain	16	17	18	21	24	27	31	34	38	42
Sweden	55	56	51	49	45	47	46	47	48	50
UK	55	53	59	55	51	55	56	60	65	70
Average	31	31	31	29	30	33	34	32	34	38

Source: Housing Statistics in the European Union 2004.

Appendix 3.C: HEW measured by the DNB Household Survey

The DNB Household Survey (DHS) consists of different questionnaires, where the fourth one addresses accommodation and mortgages. Since 2003 additional questions for the DNB have been added to the survey also enriching the information concerning mortgages and home equity withdrawal. At this point one has to distinguish between HEW without moving and HEW through transactions.

For the former, only the last wave of 2008 asks explicitly about HEW in the previous year, i.e. 2007. All other waves from 2003 to 2007 gather information about HEW in the past five to six years preceding the time of the interview. The following excerpts from the survey of 2007 show which questions have been asked and what information has been obtained.

*WOD44C

This question is about the surplus value on your house. Surplus value is the difference between the selling value or the market value of a house and the remaining debt on the mortgage. Have you once or several times used the surplus value in the past 3 years (i.e. since January 2002)? For example by taking out an additional mortgage or by taking out the existing mortgage anew (and at the same time increasing it) (without moving).

1 yes WOD44D
2 no WOD52A
3 don't know..... WOD52A
4 not applicable..... WOD52A

*WOD44D

What is the total amount? If you do not know exactly, please give an estimate. Please give the amount in thousands of euros, so 180,000 is 180.

amount WOD44E1
999999 don't know.....WOD44F1

*WOD44E1 thru *WOD44E5 (amounts for 5 years)

Can you indicate which amount you used in which year? If you don't know exactly, you can give an estimate. If you really don't know, you can leave the answer empty. If you haven't used (part of) the money in a particular year, please type 0 (zero). Please give the amount in thousands of euros, so 180,000 is 180.

1 2002 : amount WOD44F1
2 2003 : amount WOD44F1
3 2004 : amount WOD44F1
4 2005 : amount WOD44F1
5 2006 : amount WOD44F1
6 2007 : amount WOD44F1

Note: the year 2000 is used by mistake in this question (WOD44E1).

Soft check: "If added in total this is [total2 (x 1000 euro)]. This amount is higher than the total amount [total] given earlier (x 1000 euro). You may go back to change the answers.

*WOD44F01 thru *WOD44F13

Where did you use the surplus value for? (More than 1 answer possible.)

1 property improvement (renovating house, kitchen etc.) WOD44H01
2 purchase of real estate (land, holiday house etc.)..... WOD44H01
3 business investment WOD44H01
4 purchase of durable goods (car, boat etc.)..... WOD44H01
5 purchase of electronic equipment, furniture..... WOD44H01
6 holiday, world trip, party etc. WOD44H01
7 savings account WOD44H01
8 purchase of stocks/ investments..... WOD44H01
9 pension arrangements/ old-age/ early retirement/ life insurance..... WOD44H01
10 education of the children..... WOD44H01
11 paying off other loans WOD44H01
12 otherwise..... WOD44G
13 don't know WOD52A

To use the information for the econometric analysis employed in this study, an indicator variable has to be constructed, which tells us whether an individual has withdrawn home equity in a certain year. If a positive value has been withdrawn during a year as assessed by WOD44E1 through WOD44E5, the indicator variable gets the value of 1 and if no money has been withdrawn it gets the value of 0. This information is then cross-checked with question WOD44C. If the individual states that they have not withdrawn home equity in any of the previous years, the values of the indicator variable for these years are replaced by 0.

Given that we have overlapping information about HEW in a certain year prior to 2007, different approaches could be followed. First, one could just rely on information assessed in wave 2007, secondly one could use the latest wave in which an individual is

observed as source of information, and thirdly one could try to combine the information from several waves to improve the quality of the data. The last approach is the one followed in this study. Starting from 2002, I use for each year the information available in the survey of the following year, i.e. in *t+1*. Should the information be missing, I proceed to *t+2* and update my knowledge about HEW in *t*. This procedure continues until 2007 and cross-checks the information with WOD44C as explained before.

Although all of the three approaches have their advantages and disadvantages, the method employed in the chapter and outlined above has some attractive characteristics. By always using the information from the next wave and only updating it if it is missing, it takes into account that individuals usually have a better memory about recent events. Furthermore, it could alleviate measurement error, if in later waves the individual mistakenly states the wrong year in which the HEW should have taken place.

Regarding HEW through transactions, the DNB household survey asks the following question in each wave:

*WOD72B Have you used the surplus value, e.g. by moving to cheaper accommodation or by taking out a higher mortgage than necessary for buying the house itself?
1 yes.....WOD72B
2 no.....WOD72F

This information is then matched with the information regarding the individual in the year the home was bought, which is assessed in question WOD35B.

*WOD35B In which year did you buy your current house?
year WOD35AA

Appendix 3.D: Explanatory variables[72]

buffer motive

shock income $^{-}$	income is 'unusually low' compared to the income expected in a regular year (INKNORM) [1-5, 1t-2t]
shock health $^{-}$	health is 'somewhat' or 'much worse' compared to one year ago (GEZ4) [1-5, 9-10]
Δ marital status	indicates whether the individual got married or divorced (BURGST) [3-5]

financial motive

mortgage outstanding	total amount mortgages on the house in 1000€ if amount<1.5m € (b26hyb/1000) [1-5]
Δ^1 house price	difference between the self-assessed selling value of the house in *t* and *t-1* [1-5]
Δ^K house price	difference between the self-assessed market value of the house in *t* and the CPI adjusted purchase price in *t-K* in 1000€ (WO41-WO34) [1-5]
surplus	difference between the self-assessed market value and the remaining mortgage debt on the house in 1000€; values between 1st and 99th percentile (b26ogb/1000-b26hyb/1000) [2, 4-5]
tax	tax rate estimated as [gross income-net income]/[gross income-mortgage interest payments] (btot, ntot, htr) [1-5]

life-cycle motive

future economic situation $^{-}$	in five years' time the economic situation of the household will be 'worse' or 'much worse' (ECSIT) [1-5, 1t-2t]
future economic situation $^{+}$	in five years' time the economic situation of the household will be 'better' or 'much better' (ECSIT) [1, 3-5, 1t-2t]
age	age in years defined as the difference between survey year and birth year (GEBJAAR) [1-5, 1t-2t]
retired	indicates whether the individual is retired (BELBEZIG, BEZIGBEL, BEZIGHEI) [2, 4-5, 1t-2t]

[72] Variable labels from DHS are in brackets. Numbers in square brackets refer to the use of the variable in the respective regression specification (see Tables 3.4 and 3.5). Specifications for transactors are indicated with a 't' close to the number. The robustness analysis in Table 3.9 follows specification (4) in Table 3.4, except that (shock income $^{-}$) and (Δ marital status) are dropped in column (3).

insurance

house price volatility	standard deviation of the regional house price index in the five years preceding the interview [4-5]

other controls

household income	sum of the net income of the household members weighted by the OECD equivalence scale in 1000€ if amount<2.3m € (ntot) [1-5, 1t-2t]
net worth	total assets - total debt in 1000€ (excluding house price appreciation and mortgages on own accommodation) [1-5, 1t-2t]
debt	indicates whether an individual has any of different types of debt (credit card -, private -, credit line -, purchase -, family -, other debt) (CRED1, PERS1, DOOR1, FINA1, ANDE1, FAMI1) [1-5, 1t-2t]
loan constraint	indicates whether an individual 'disagrees' or 'totally disagrees' with the statement 'I can easily obtain a loan' (LOAN2) [2, 4-5]
income problem	indicates whether it is 'hard' or 'very hard' to manage on the income of the household (INKROND) [2, 4-5]
rate exp increase	indicates whether one expects the mortgage interest rates to be 'higher than now' in two years time (WOD52A) [2, 4-5]
hew planned	indicates whether one is 'probably' or 'certainly' withdrawing home equity in the next two years [2, 4-5]
mover	indicates whether the individual is looking for another accommodation or has already found one (WO53) [2, 4-5]
financial risk averseness	indicates whether one would never consider investments in shares (value six or seven for SPAAR2) [2, 4-5, 2t]
time horizon	indicates whether the personal time horizon for planning expenditures and savings is the next couple of years, the next 5 to 10 years or more than 10 years (dummy=1) or the next couple of months or the next years (dummy=0) (PERIODE1) [2, 4-5, 2t]
spending	indicates whether an individual likes to spend all her/his money immediately (value < 4 for UITGEVEN) [4-5]
financial knowledge	indicates whether one considers herself as 'knowledgeable' or 'very knowledgeable' in financial matters (KUNDE) [2, 4-5]
higher education	highest level of education attended is university (OPLZON) [1-5, 1t-2t]
female	indicates the sex of the individual (GESLACHT) [1-5, 1t-2t]
assets	indicates whether one owns liquid assets in one of the following forms: current account credit, savings account, deposit book, savings certificate, mutual funds, bonds or shares (bet131, bz03, bz04, bz06, bz12, bz13, bz14) [2, 4-5, 1t-2t]

urban	indicates whether the degree of urbanization of the town/city of residence is 'high' or 'very high' (STED) [1-5, 1t-2t]
house price exp decrease	indicates whether one expects the value of the own house to decrease in the next two years (WO44A) [1-2, 4-5]
tax deductibility	indicates whether one expects limitations in the deductibility of mortgage interest rates in the foreseeable future (WOD52F) [1-2, 4-5]
children	indicates whether there are children in the household (AANTALKI) [2, 4-5, 1t-2t]
couple	indicates whether a partner is present in the household (PARTNER) [2, 4-5, 1t-2t]
year*	year dummies [3-4, 1t-2t]
region*	dummies for the regions 'North', 'East', 'South' and 'other West', with 'three largest cities' being the reference category (REGIO) [1-5, 1t-2t]

mortgage characteristics

endowment mortg.	indicates whether the mortgage with the highest value left is an endowment mortgage (HYP51 through HYP55) [1-5]
mortg. guarantee	indicates whether the mortgage with the highest value left has a national mortgage guarantee (NHG) (HYP11 through 15) [1-5]
her	home expenditure ratio (*her*): ratio between total mortgage expenditure and net household income (HY61 through HY65, ntot) [1-5] if $her>0$ and $her\leq 1$
her >0.35	indicates whether *her* is >0.35 [1-5]
nrm	indicates whether the mortgage with the highest value left is a non repayment mortgage (NRM) (HYP51-55) [1-5]
fixed interest	indicates whether the interest rate on the mortgage with the highest value left is fixed (HY71 through HY75) [1-5]

supply side conditions

credit stand. (house purchase)	refers to loans/mortgages granted for house purchase. Measured as net percentage, the variable shows the proportion of banks tightening their credit terms and conditions to banks easing them. It reflects the opinion of the six Dutch banks taking part in the bank lending survey. [5]
credit stand. (other)	refers to loans/mortgages granted for consumption purpose and other use [5]

Appendix 3.E: Average partial effects

Table 3.7 Average partial effects (APE) (non-transactors)

		2007		2004-2007		
		(1)	(2)	(3)	(4)	(5)
buffer motive						
	shock inc $^-$	0.239	0.016	0.038	-0.038	0.184
		(0.159)	(0.836)	(0.646)	(0.260)	(0.331)
	shock health $^-$	-0.073***	-0.081***	0.012	0.004	0.005
		(0.000)	(0.000)	(0.595)	(0.888)	(0.849)
	Δmaritial status			0.107	0.086	0.108
				(0.414)	(0.362)	(0.302)
financial motive						
	mortgage outstanding (t-1)	0.000	0.000	0.000***	0.000***	0.000***
		(0.651)	(0.602)	(0.002)	(0.005)	(0.006)
	Δk house price	0.000	-0.000***	0.000	-0.000	-0.000
		(0.984)	(0.005)	(0.553)	(0.742)	(0.741)
	Δ1 house price	0.001*	0.002***	0.000	0.000	0.000
		(0.052)	(0.000)	(0.295)	(0.133)	(0.143)
	surplus (t-1)		0.000		0.000	0.000
			(0.142)		(0.602)	(0.664)
life-cycle motive						
	age	0.019*	0.043***	0.006	0.012**	0.013**
		(0.065)	(0.006)	(0.249)	(0.042)	(0.026)
	age²	-0.000*	-0.000**	-0.000	-0.000*	-0.000**
		(0.064)	(0.012)	(0.359)	(0.051)	(0.030)
	retired		0.070		0.056	0.057
			(0.318)		(0.239)	(0.237)
	future economic situation $^-$	0.067	0.127**	-0.004	-0.004	-0.005
		(0.133)	(0.041)	(0.857)	(0.831)	(0.799)
	future economic situation $^+$	-0.061***		0.027	0.020	0.022
		(0.000)		(0.258)	(0.416)	(0.385)
insurance						
	regional house price volatility				2.098	2.503
					(0.463)	(0.355)
other controls						
	household income	0.000	-0.006*	-0.000	-0.003	-0.002
		(0.991)	(0.085)	(0.905)	(0.187)	(0.370)
	household income²	-0.000	0.000**	-0.000	0.000	-0.000
		(0.391)	(0.044)	(0.381)	(0.975)	(0.800)
	net worth	0.000	0.000***	0.000	0.000	0.000
		(0.130)	(0.002)	(0.549)	(0.265)	(0.420)
	debt	0.085	0.029	0.095**	0.130***	0.139***
		(0.263)	(0.474)	(0.012)	(0.003)	(0.002)
	loan constraint		0.075		0.140	0.137*
			(0.267)		(0.101)	(0.098)
	income problem		0.003		-0.016	-0.014
			(0.952)		(0.642)	(0.703)
	rate exp increase		0.078		0.041*	0.035*
			(0.202)		(0.050)	(0.091)
	hew planned (t-1)		0.154***		0.160***	0.154***
			(0.001)		(0.002)	(0.002)
	mover		-0.067***		-0.074***	-0.075***
			(0.000)		(0.000)	(0.000)
	financial risk aversion		-0.008		-0.034**	-0.035**
			(0.770)		(0.013)	(0.011)
	time horizon		-0.150***		-0.027*	-0.030*
			(0.000)		(0.086)	(0.055)
	spending				-0.065***	-0.064***
					(0.000)	(0.000)
	educ_high					
			(0.132)		(0.075)	(0.067)
mortgage characteristics						
	endowment mortg. (t-1)			0.137	0.095	0.079
				(0.189)	(0.261)	(0.326)
	mortg. guarantee (t-1)			0.045*	0.040	0.042*
				(0.084)	(0.108)	(0.100)
	her >0.35			-0.051***	-0.064***	-0.063***
				(0.010)	(0.000)	(0.000)
supply side conditions						
	credit stand. (house purchase)					-0.000
						(0.929)
	credit stand. (other)					-0.002
						(0.658)
	shock inc $^-$ x credit stand. (other)					-0.015**
						(0.049)
	Observations/(Households)	249/(249)	242/(242)	892/(429)	796/(393)	796/(393)
	Pseudo-R²	0.420	0.665	0.144	0.275	0.269
	LR chi²	86.988	101.296	88.600	182.140	187.054
	Chi² p-value	0.000	0.000	0.000	0.000	0.000

Notes: see Table 3.4.

Table 3.8 Average partial effects (APE) (transactors)

		2003 - 2007	
		(1)	(2)
buffer motive			
	shock income $^{-}$	0.222	0.321**
		(0.259)	(0.016)
	shock health $^{-}$	-0.305***	-0.315***
		(0.000)	(0.000)
life-cycle motive			
	age	-0.029	-0.051
		(0.372)	(0.148)
	age²	0.001*	0.001**
		(0.070)	(0.038)
	retired	-0.414***	-0.436***
		(0.000)	(0.000)
	future economic situation $^{-}$	-0.176	-0.204*
		(0.142)	(0.073)
	future economic situation $^{+}$	0.330***	0.372***
		(0.001)	(0.001)
other controls			
	household income	0.043***	0.042**
		(0.004)	(0.010)
	household income²	-0.000*	-0.000
		(0.097)	(0.215)
	net worth	-0.001***	-0.001**
		(0.003)	(0.043)
	debt	0.214**	0.257***
		(0.026)	(0.005)
	female	0.398***	0.414***
		(0.000)	(0.000)
	children	0.442***	0.434***
		(0.000)	(0.000)
	couple	0.063	0.064
		(0.386)	(0.627)
	financial risk aversion		-0.093
			(0.379)
	time horizon		-0.050
			(0.663)
	Observations/(households)	57/(55)	56/(54)
	Pseudo-R^2	0.640	0.639
	LR chi²	62.495	199.582
	Chi² p-value	0.000	0.000

Notes: see Table 3.5.

Appendix 3.F: Robustness analysis

To check the stability of the results, specification (4) in Table 3.4 is re-estimated after removing potential outliers from the sample. Column (1) in Table 3.9 shows results when leaving out observations with a very high value for Cook's distance, in column (2) observations with large deviance residuals are removed, and in column (3) observations with high leverage according to the hat-value are missing. As cut-off values a Cook's distance >0.4 (2 observations removed), a deviance residual >2.1 (16 observations) and a hat-value >0.2 (33 observations) have been chosen. These are motivated by residual

analysis and common rules of thumb (deviance >0.2, hat-value>3×mean(leverage)) and have taken into account a possible further loss of observations due to missing variation in some of the variables in the reduced sample. The main results from the analysis do not change, showing that estimates are robust to the exclusion of outlying observations.

Table 3.9 Regression analysis adjusted for potential outliers

			2004 - 2007	
		(1)	(2)	(3)
buffer motive				
	shock income $^{-}$	-0.747	-0.258	
		(0.216)	(0.692)	
	shock health $^{-}$	0.060	-0.075	-0.017
		(0.801)	(0.820)	(0.945)
	Δmaritial status	0.749	1.133**	
		(0.139)	(0.033)	
financial motive				
	mortgage outstanding (t-1)	0.004**	0.006***	0.005***
		(0.031)	(0.007)	(0.010)
	Δk house price	0.001	0.000	-0.000
		(0.367)	(0.906)	(0.787)
	Δ1 house price	0.002	0.003	0.006**
		(0.393)	(0.339)	(0.037)
	surplus (t-1)	-0.001	0.000	0.001
		(0.426)	(0.876)	(0.583)
life-cycle motive				
	age	0.115**	0.183**	0.097*
		(0.040)	(0.021)	(0.083)
	age²	-0.001*	-0.002**	-0.001
		(0.056)	(0.024)	(0.117)
	retired	0.433	0.892**	0.292
		(0.178)	(0.010)	(0.399)
	future economic situation $^{-}$	-0.049	0.032	-0.151
		(0.814)	(0.898)	(0.525)
	future economic situation $^{+}$	0.258	0.293	0.345
		(0.215)	(0.267)	(0.117)
insurance				
	regional house price volatility	18.559	64.804**	23.714
		(0.490)	(0.047)	(0.406)
other controls				
	household income	-0.021	-0.022	-0.022
		(0.350)	(0.526)	(0.361)
	household income²	-0.000	-0.000	-0.000
		(0.855)	(0.438)	(0.866)
	net worth	0.001	0.001	0.001
		(0.241)	(0.102)	(0.419)
	debt	0.909***	1.560***	0.983***
		(0.000)	(0.000)	(0.000)
	loan constraint	0.834**	0.879**	1.282**
		(0.041)	(0.033)	(0.013)
	income problem	-0.627	-0.670	0.310
		(0.185)	(0.232)	(0.382)
	rate exp increase	0.429***	0.500**	0.404**
		(0.010)	(0.044)	(0.015)
	hew planned (t-1)	0.983***	1.748***	1.071***
		(0.000)	(0.000)	(0.000)
	mover	-1.509***	-1.207***	-1.622***
		(0.001)	(0.002)	(0.000)
	financial risk aversion	-0.402**	-0.699***	-0.344**
		(0.021)	(0.003)	(0.049)
	time horizon	-0.277	-0.645***	-0.192
		(0.105)	(0.006)	(0.267)
	spending	-1.001**	-1.505***	-0.854**
		(0.012)	(0.008)	(0.020)
	financial knowledge	0.304*	0.499**	0.272
		(0.075)	(0.021)	(0.128)
mortgage characteristics				
	endowment mortg. (t-1)	0.654	1.166**	0.996**
		(0.147)	(0.027)	(0.033)
	mortg. guarantee (t-1)	0.352*	0.181	0.438**
		(0.058)	(0.459)	(0.026)
	her >0.35	-1.130**	-1.828***	-0.971**
		(0.011)	(0.008)	(0.032)
	Observations/(households)	794/(393)	780/(389)	796/(373)
	Pseudo-R^2	0.289	0.482	0.287
	LR chi²	172.330	243.928	143.366
	Chi² p-value	0.000	0.000	0.000

Notes: see Table 3.4. The regression analysis follows specification (4) in Table 3.4.

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