Loan contract characteristics and monetary transmission in the EU

-- Version v25 --

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ABSTRACT

The aim of this paper is to study what is the role of loan contract characteristics, such as maturity of loans and fixation rate period, to explain the evolution of lending rates and its reaction to monetary shocks across EU and Euro area countries. While other factors may also have an influence, the evidence gather in this paper points to a significant role of differences in loan contract characteristics for explaining diverging speed of transmission of monetary policy across Euro area countries. Given the single currency, differences in loan contract characteristics across countries and the consequent divergence in the speed of monetary transmission are particularly relevant within the Euro area.

This paper postulates a transmission channel acting through income effects which can be more or less relevant depending on the underlying loans contract characteristics. Finally, this paper discusses how, following a monetary shock, loan contract characteristics determine, to a large extent, potential distributive effects between borrowers and lenders but also within borrowers and between countries.

KEYWORDS

Euro area, monetary policy, transmission mechanism, pass-through, retail banking, lending rates.

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D33, D47, D90, E43, E44, F36, F42, G21.

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360, 520, 550, 560, 630.

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Disclaimer

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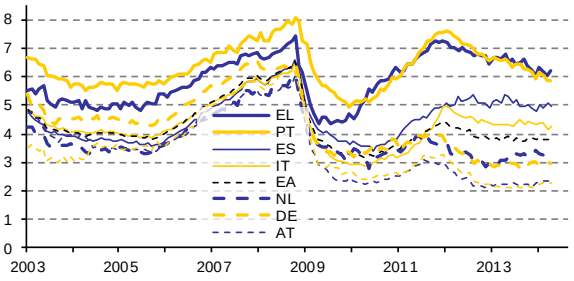
1. INTRODUCTION

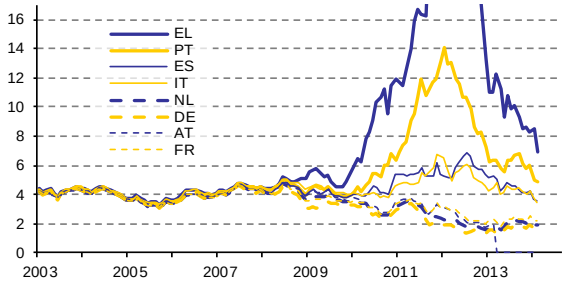
In the years following the onset of the financial crisis, an increased dispersion in lending rates and sovereign bond yields across European countries was observed (Chart 1 and 2). This divergence in rates and yields is often used as evidence of the fragmentation of financial markets (Steen, 2013; ECB, 2013a, p. 32; Gros, 2013), which is jeopardising an appropriate transmission of monetary policy within the Euro area. When monetary policy is unable to steer retail interest rates, a unique monetary policy for the whole Euro are cannot be effective anymore; it might even exacerbate cross-country differences.

Chart 1: **Lending rates charged on small loans to NFCs**
Percentage



Notes: Small loans: up to one million Euro. Data refer to rates charged on new loans.
Source: ECB Statistical Data Warehouse and own presentation.

Chart 2: **Sovereign bonds' yields**
10-year bonds, percentage



Source: Bloomberg.

Financial fragmentation can, not only hamper the capacity of monetary policy to achieve its main goal of steering inflation, but it can also have significant consequences for the real economy. For instance, differences in lending rates can put some SMEs in a better (worse) competitive position than others and therefore impact international trade. Differences in lending rates that depend just on the country of residence of the firms and not on their intrinsic (in)efficiency create an uneven playing field which goes against the goals of the EU internal market as established in the Treaties.

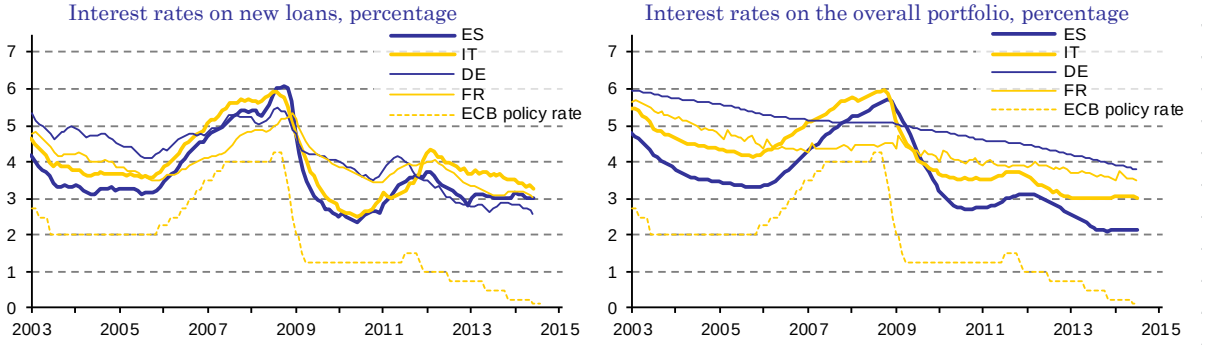
A series of studies have analysed the drivers of the transmission of monetary policy to ultimately impact lending rates and the real economy. Although the transmission mechanism is deemed to be characterised by very long lags (ECB, 2013b), changes in the monetary stance can affect lending rates for new loans very quickly (Chart 3 left-hand panel). On the other hand, monetary policy shocks may, indeed, need more time to impact lending rates for the overall portfolio of loans (Chart 3 right-hand panel). Differences in how monetary shocks impact new loans and outstanding loans imply redistributive effects between economic agents depending on the moment when they have contracted their loans. A disparate response to the monetary policy stance is also observed across countries, e.g., lending rates react much faster in Spain than in Germany.

The aim of this paper is to study what is the role of loan contract characteristics, such as maturity of loans and fixation rate period, to explain the evolution of lending rates and its reaction to monetary shocks across EU and Euro area countries. While other factors may also have an influence, the evidence gather in this paper points to a significant role of differences in loan contract characteristics for explaining diverging speed of transmission of monetary policy across Euro area countries.

In this paper, we distinguish the impact on lending rates for new lending from the impact on lending rates for existing loans. While banks are bound by the contracts already signed for existing loans, they have a broader leeway in steering contract conditions for new loans. Depending on loan contract features, changes in the policy rate may automatically translate to the lending rates applied to existing loans with no or little control from the part of lenders. Banks may seek to compensate potential negative impacts of monetary shocks on their existing loans by charging higher rates on new loans.

Given the small size of new loans with respect to the volume of the loan portfolio, large changes in the conditions of new loans may be required to offset even small changes in the contract conditions of existing loans.

Chart 3: **Interest rates charged on loans for house purchase**



Source: ECB and own elaboration.

This paper proposes a new approach which complements the current understanding of monetary transmission: the potential impact of monetary shocks on bank income and subsequent feedback effects. Traditionally, the transmission mechanism focuses on how monetary policy is transmitted to lending rates by impacting the balance sheet of banks. For instance, in the interest rate channel, monetary policy impacts lending rates by influencing funding costs of banks; the lending channel works through constraining or releasing the amount of deposits and funding available for banks so that a contraction or expansion in the volume of lending is achieved.

The innovative approach of this paper proposes to look at the effects of monetary shocks on the income of banks due to the automatic resetting of the interest rate of existing loans depending on their contract characteristics. This approach complements what is called the capital channel, which focuses on the initial capital position of banks from a balance sheet point of view.

The transmission of monetary policy is usually understood to work in a single direction: changes in the policy rate impact market rates which, in term, impact retail rates. The income effects proposed above may have second round effect feeding back into other segments of the lending activity of the bank. Monetary policy shocks may improve or constraint bank income. To avoid an impact on capital, banks may seek to use other segments of their activities to compensate a negative effect on income stemming from a monetary shock.

Depending on loan contract characteristics, the effects of monetary shocks through this income channel may reinforce or reduce the impact of other transmission channels. In extreme circumstances, the income channel could even totally offset other channels to the point of making ineffective the monetary shock. In other words, loan contract characteristics may influence when the zero lower bound of monetary policy is effectively attained and when the economy may have entered the liquidity trap.

The rest of the paper is organised as follows. Section 2 provides the theoretical background of the paper through a short literature review on monetary transmission mechanism and on interest rate pass-through. The section is completed by a short discussion on how banks set lending rates. Section 3 presents the main features of mortgage contracts across EU countries as available at a unique database compiled by the European Commission. The Commission database, complemented by monetary statistics from the ECB, feeds a model which is used to rank EU countries according to the speed of monetary transmission to the banking system (Section 4). In Section 5, the validity of the model is assessed against actual data and the consequences are discussed, including the existence of a new channel of monetary transmission working through bank income (Section 5.1). The model is also used to project how lending rates may develop in the future (Section 5.2). Some conclusions are gathered in Section 6. Finally, four annexes

provide additional data, complementary simulations and discuss some of the simplifications and assumptions underlying the simulations and models in the paper.

2. THEORETICAL BACKGROUND

This section presents a short overview of the theoretical background of the paper. It includes a summary of the main views on monetary policy transmission (Section 2.1) and on the quantification of interest rate pass-through and the identification of its drivers (Section 2.2). The section is completed with a review of how lending rates are formed (Section 2.3).

2.1. THE MONETARY TRANSMISSION MECHANISM

The monetary transmission mechanism describes how changes in the monetary policy stance are transmitted throughout the economy to ultimately impact inflation, aggregate output or employment.

For a long time, the interest rate channel was considered the main channel of monetary transmission particularly because it responded to Keynes' seminal work and the ISLM model. Among others, Brunner and Meltzer (1988), Hubbard (1995), Cecchetti (1995) or Bernanke and Gertler (1995) participated in a debate in which they argued about the existence of an additional channel, the credit channel, which can be subdivided into the balance sheet channel and the bank lending channel. Having said that, in the view of Bernanke and Gertler (p. 28), the credit channel should not be considered an independent channel but a set of factors that amplify and propagate the interest rate channel by generating a sort of "financial accelerator". Mishkin (1996) focused the debate by providing a comprehensive overview of the various channels of monetary transmission. Besides the interest rate and the credit channels, with their various "sub-channels", Mishkin mentions also the asset price channel. More recently, Ireland (2005) provides an excellent survey on the literature on monetary transmission channels.

From a European perspective, the European Central Bank (2009c) synthetises the channels of monetary transmission involving banks. On top of the usual interest rate and credit channels, an additional channel working through the risk-taking behaviour by banks has recently been proposed. Within the credit channel, the ECB paper reports also a process working through bank capital indicating that banks with low capitalisation are more sensitive to changes in monetary policy than banks which are well capitalised[1].

In general, monetary policy can influence the flow of new credit to ultimately affect output by boosting or restricting investment. This is particularly the case for the interest rate channel and some forms of the credit channel (the bank lending channel, the balance sheet channel operating through equity prices, the balance sheet channel operating through the general price level and the balance sheet channel operating through household balance sheet effects). The evolution of lending rates charged by banks on new loans is crucial for explaining the functioning of these channels.

On the other hand, there are two channels that operate through the impact on cash flows of corporates and consumers (one form of the balance sheet channel and the transmission operating through household balance sheet effects). The difference between these two channels and the previous ones relies on the "type" of interest rate impacting spending. The real interest rate is the main factor influencing lending and investment for the first group of channels, while nominal interest rate is more relevant for the second group of channels that act through cash flows.

Mishkin (1996, p. 12) and Bernanke and Gertler (1995, p. 28) implicitly assume that debt payments are contractually fixed for the duration of the loans. Therefore, they focus on the potential ways of boosting

[1] The ECB further discusses monetary transmission in several other papers. See, for instance, ECB (2000, 2002, 2008, 2009d, 2010, 2011a or 2011b), Draghi (2012) or the studies conducted by the *Eurosystem Monetary Transmission Network* (Angeloni et al., 2002).

or deterring new lending and they argue that monetary policy is expected to have a relatively weak impact on long-term rates. However, depending on the loan contract characteristics, changes in the monetary stance may impact not only new loans but also the overall portfolio of loans to the extent that lending rates can be revised. Although loans can have very long maturities, lending rates may depend on a much shorter term than the maturity of the loan. Loan conditions can be renegotiated sometime after the initial contract was signed; for instance, if the broad economic and financial conditions have substantially changed and the borrower asks for a revision. The initial contract may also include an automatic revision of the interest rate on regular intervals. These circumstances would lead to long-term loans to be influenced by shorter-term rates.

In this context, the goal of this paper is to assess if differences in loan contract characteristics may affect the transmission of monetary policy with respect to both new loans and existing loans. Given the little room of manoeuvre for banks to change existing contracts, we postulate that the impact of monetary transmission on existing loans occurs mainly through effects on earnings. The traditional account of how the transmission occurs (e.g. Mishkin, 1996, Bernanke and Gertler, 1995, or Ireland, 2005) focuses either on the quality of borrowers' balance sheet and the behaviour of borrowers (as in the balance sheet channel) or on how monetary policy can affect the balance sheet of banks and, consequently, the supply of credit (as in the bank lending channel). Our thinking about the effects on earnings and income could represent a new channel of transmission mechanism which would work in combination with the capital channel.

2.2. EMPIRICAL ANALYSIS: QUANTIFYING THE PASS-THROUGH

Given the importance of retail bank rates in most of the transmission channels, an abundant literature focuses on measuring how much of the changes in the policy rates does actually impact retail bank rates[2]. Structural features of the financial system such as barriers to competition, the degree of development of financial markets or the ownership structure of the banking system make retail interest rates sticky and, therefore, monetary policy rate pass-through incomplete.

A series of papers (e.g. ECB, 2009d; Belke, Beckmann and Verheyen, 2013; or Kleimeier and Sander, 2006) have tried to quantify the size of the pass-through of monetary policy for different deposit and loan categories. These papers put a strong emphasis in assessing the efficiency of the monetary policy, the heterogeneity of the Euro area financial system (particularly relevant in the context of the single currency) or the competitive situation in different types of bank loans and deposits.

The strong emphasis of these papers on quantifying the pass-through with little analysis of the potential driving factors behind it led Bernanke and Gertler (1995) to dub the transmission mechanism as a "black box". However, other papers have attempted to identify the determinants of the interest rate pass-through and the drivers of the differences across countries and products. For instance, the ECB (2010) lists a series of factors that may have influenced the properties of monetary policy since the creation of the Euro: reforms in the labour market, the introduction of the Euro itself and financial innovation. Nevertheless, this study does not go as far as to integrate these drivers on the pass-through model nor to quantify their exact impact.

A recent study from the IMF (Al-Eyd and Berkmen, 2013) includes additional drivers in the formation of lending rates besides the policy rate. The authors find that funding costs, credit risk and leverage have become important determinants of lending rates since the onset of the crisis. Following a decrease in interbank activity, they also find that the transmission of monetary policy through the Euribor has declined.

[2] Besides the selection presented here, Van Ewijk (2013) or Kleimeier and Sander (2006) provide an excellent survey on the abundant literature on interest rate pass-through.

Jevcak and Briciu (2013) argue that the main drivers of the recent diverging financing conditions across Euro area countries are variations in the quality of loan portfolios, in the profitability of banks or in the availability of capital buffers. On top of that, variations in financial positions of non-financial private sector and in sovereign funding cost would also play a role.

Drudi et al. (2009, p. 10) argue that the level of mortgage indebtedness, the contractual characteristics of credit contracts and the way banks finance mortgage lending determines the impact of monetary policy on the credit supply, the disposable income of indebted households and the speed of this impact.

Besides reporting the different sensitivity to monetary policy depending on the capitalisation of banks, the European Central Bank (2009c) provides other interesting insights. It indicates that a supply-induced reduction of lending may have contributed to amplifying the downturn in the wider economy (p. 63) and that the features of the banking sector may have sheltered banks from the effects of monetary policy on their funding, and thus on their ability to lend in some countries (p. 70). It also mentions a study that had examined how monetary policy can impact bank profitability. That study argues that it is highly relevant whether banks lend predominantly at floating rates or at fixed rates and that there are considerable differences across Euro area countries as regards the typical initial rate fixation period of bank loans (p. 73). Unfortunately, it seems that the aforementioned study was not finalised or, at least, not published.

Building on the findings by Jecvak and Briciu (2013), Drudi et al. (2009) and ECB (2009c), this paper discusses the specific role of loan contract characteristics as a potential driver of the pass-through of monetary policy and, the speed of the transmission of monetary policy. Before introducing the database used for performing some simulations, the next section explains how bank set lending rates.

2.3. LENDING RATE SETTING

Among all the factors that influence the formation of lending rates (see Section 2.2 and ECB, 2009d, for further details), there are two elements that are crucial for the discussion of this paper: the index used as a references and the frequency of revision (or period or rate fixation). They are briefly discussed hereafter.

2.3.1. Reference index

The viability of the retail business of a bank depends on obtaining higher earnings in the loans it grants than its funding cost. As a consequence, lending rates are usually determined by applying a mark-up over a measure of bank funding. Reference indexes can be grouped in three categories. First, official rates: the central bank central policy rate or another rate established by national law (Drudi et al., 2009, p. 28). Second, interbank market rates with different maturities: EONIA, Euribor, Libor, Sofibor, Wibor… Finally, indexes calculated internally by the banks and other references.

The transmission of monetary policy through the lending channel depends on the capacity of the central bank to influences those indices that are used for setting lending rates.

2.3.2. Period of interest rate fixation

The interest rate of a loan can be fixed for the whole life of the loan or it can be revised at regular intervals. The frequency of rate revision, or the fixation period, is one of the main factors behind the lagged transmission of monetary policy through mortgages. According to Drudi et al. (2009, pp. 7 and 29) demand, supply and institutional factors influence the frequency of rate revision. Demand factors include culture, risk aversion or consumers' planning horizon; supply factors include refinancing practices of banks or the degree of a financial market's development. Institutional factors include the regulatory framework such as capital requirements (variable rate loans require less capital as they shift the interest rate risk to households), the degree of consumer protection (reflected, for instance, in foreclosure and bankruptcy procedures), the degree of fiscal subsidisation of owner-occupied housing and mortgage loans, or supervisory rules for covered bonds and securitised loans.

Besides the impact on monetary transmission, the frequency of rate revision can have strong distributive effects as it determines who bears the interest rate risk (either the consumer or the financial institution)[3]. In this regards, the fixation period provides an indication about the expectations of banks and borrowers with respect to the evolution of rates and their respective negotiating power[4]. Banks prefer a fixed rate when they expect reference rates to decline in the future and prefer a variable rate when interest rates are expected to increase. Borrowers have opposite preferences. The negotiation power of banks and borrowers depends on factors such as banks' funding conditions, the level of competition in the market and on borrowers' solvency.

Loan contracts may include clauses to protect banks (and borrowers) against large variations in reference rates. A common protection practice is limiting the variation of interest rates through a cap and/or a floor clause. Practices vary widely across countries: from floor and ceiling rates being compulsory by law (e.g. Belgium) to be a popular practice but without legal requirements like in France (Drudi et al., 2009, p. 28) to have been declared abusive and void by the Supreme Court as in Spain[5]. Another way banks protect themselves against the risk of increasing rates is through the spread applied over the reference rate. In general, loans with long fixation period include a larger spread than loans with frequent rate revisions. Freixas (2009, pp. 644-645) argues that banks reacted to the decrease in the policy rate by increasing the spreads applied to the reference indexes when setting lending rates for new loans (see also Annex A.3.2).

3. DATABASE DESCRIPTION

During the three quarters from 2008 Q3 to 2009 Q1, the European Commission gathered information about banking credit to households across EU Member States. This unique dataset provides data on specific loan contract characteristics which can be very relevant for understanding monetary transmission through the lending channel but that are usually not available in other sources[6]. They include the period of rate fixation (Section 3.1), the index used as a reference (Section 3.2) and loan maturity (Section 3.3).

The Commission database provides information for three types of loans: mortgage credit[7], consumer credit and corporate loans. According to ECB data[8], the total volume of loans provided by Euro area banks to the real economy (households and non-financial corporations) amounted to €9,500 billion in July 2014. The bulk of it was either corporate loans (45 per cent of total loans) or loans for house purchase (40 per cent), with consumer credit representing less than 10 per cent. Between 2000 and 2014, total volume of mortgages provided by Euro area banks more than doubled while corporate loans expanded more moderately (an increase of 75 per cent during the same period).

The aim of this paper is to study the role of loan contract characteristics in explaining the speed of transmission of monetary policy. Due to the importance of mortgages in banks' loan portfolio in terms

[3] Hellwig (2014, p. 5) argues that this can give rise to worries about governance and moral hazard: *"from the perspective of constitutional law in a democracy, governance of decisions that have such distributive effects is a fundamental issue"*. Krugman (2013) argues that loans with floating rates and with innovative redemption schemes (see Annex A.2.1) were an important driver behind the build-up of excessive debt by US households and in the subsequent collapse in household income and consumption when instalments were revised upwards.

[4] Economic literature on banks' price-setting behaviour typically uses models of oligopolistic bank competition where banks act as price-setters in the retail loan and deposit markets due to their market power. However, banks are usually assumed to be price takers in the interbank market and the capital markets. See ECB (2009d, pp. 94-95).

[5] See Buck (2013). The ruling affects about 460,000 home-loan contracts granted by the BBVA, but the ruling is extensive to all other banks in Spain, so that the total number of affected contracts can be expected to be on the millions.

[6] The European Central Bank (2006, pp. 5 and 18) argues that the differences in fixation period and maturity could be among the most relevant factors determining lending rates. However, it explains that an exact assessment is not possible due to deficiencies in availability of data and reporting requirements. The ECB undertook an exercise to estimate the fixation periods and maturities prevailing across Euro area countries (see Drudi et al., 2009, p. 27). That study is used to complement the European Commission dataset.

[7] Strictly speaking, mortgages are the loans for house purchase secured against the property. As most loans for house purchase are indeed secured against collateral, the terms mortgage and loans for house purchase are used indistinctly throughout this paper.

[8] See the ECB Statistical Data Warehouse (www.sdw.ecb.europa.eu).

of total size and their expansion over time, the rest of this paper focuses exclusively on mortgage credit.

3.1. PERIOD OF INTEREST RATE FIXATION

As a consequence of the various factors influencing the frequency of rate revision (see Section 2.2), data show a wide variation across countries ranging from countries with a predominance (more than 70 per cent) of fixation periods beyond one year (Belgium, France, the Netherlands, Slovakia and Germany[9]) to countries with a predominance (more than 70 per cent) of fixation periods of up to one year (Hungary, Ireland, Cyprus, Slovenia, Estonia, Finland, Malta, Austria, Bulgaria, Portugal, Spain, Romania, Luxembourg, Poland, Lithuania and Czech Republic); with a few countries in an intermediate position (the United Kingdom, Italy, Latvia, Sweden, Denmark and Greece); see Table 1.

The average fixation period for "variable-rate" loans was between 4 and 6 months for most of the countries, while the average fixation period for "fixed-rate" loans was between 10 and 15 years for most countries[10]. Data on the type of fixation period and on the actual duration should be jointly considered. For instance, in Malta, the fixation period for "fixed-rate" mortgages is above 25 years, but this kind of loans represents less than 10 per cent of the mortgage portfolio.

Table 1: **Mortgage characteristics per country**

Country	Fixation period type (%)		Frequency of revision		Average maturity (y)
	Short term	Long term	Short term (m)	Long term (y)	
AT	94.5	5.5	2.3	5.2	21.4
BE	26.8	73.2	12.0	18.2	19.4
CY	81.0	19.1	1.0	5.0	24.2
DE	2.1	97.9	3.3	12.5	12.0
ES	98.4	1.6	10.1	10.0	22.2
FI	91.7	8.3	9.2	9.6	17.5
FR	11.6	88.4	12.0	15.5	17.1
EL	37.0	63.0	1.5	6.3	22.6
IE	77.0	23.0	2.8	5.0	21.6
IT	56.3	43.7	2.3	14.4	20.2
LU	98.9	1.1	1.0	15.0	15.7
MT	93.6	6.4	1.0	25.5	29.3
NL	8.8	91.2	6.2	14.0	28.3
PT	97.2	2.8	4.2	5.0	33.3
SI	90.0	10.0	5.6	15.0	16.1
SK	3.3	96.7	1.0	14.7	23.9
BG	96.5	3.5	5.6	14.6	22.8
CZ	100.0	0.0	5.6	14.4	23.0
EE	91.4	8.6	5.1	13.6	18.9
HU	74.7	25.3	6.0	14.0	18.7
LT	99.8	0.2	4.5	14.6	24.0
LV	53.3	46.7	4.5	14.2	23.7
PL	99.8	0.2	2.8	14.8	22.8
RO	98.8	1.2	6.0	14.9	23.1
DK	63.6	36.4	1.0	13.7	26.2
SE	47.8	52.2	3.0	14.0	33.2
UK	60.9	39.1	1.0	13.8	21.5*

Notes: Data for the average of the three quarters 2008 Q3, 2008 Q4 and 2009 Q1. The fixation period type and frequency of revision refers to outstanding loans; average maturity refers to new loans. The sample representativeness in Cyprus, Luxembourg, Netherlands, Slovenia, Czech Republic, Lithuania and Latvia may be limited and estimates for these countries should be taken with caution. Average maturity was not available for the UK; the value shown in the table corresponds to the average of the overall sample. Short term: loans with a fixation period of up to one year. Long term: loans with a fixation period of over one year. "m": months; "y": years.
Source: European Commission and own calculations.

3.2. INDEX USED AS A REFERENCE

Data show significant differences across countries with respect to the choice of the reference index. Some countries use mainly or exclusively official rates (Belgium, Ireland, Luxembourg and Malta), while others

[9] According to Drudi et al. (2009, p. 26), the most predominant fixation periods was between 5 and 12 years for the Netherlands, 10 years for Germany, more than 10 years for France and for the entire period of the loan for Belgium.
[10] The category "variable-rate loans" refers to loans with a period of rate fixation equal or shorter than one year and the category "fixed-rate loans" refers to loans with a period of rate fixation longer than one year.

mainly or exclusively interbank rates (Cyprus, Germany, Spain, France, Italy, Netherlands, Portugal, Slovenia, Bulgaria, Estonia, Hungary, Lithuania, Poland, Romania and Sweden). Slovak banks use internal indexes. Finally, there are a few countries where various types of reference indexes are used (Austria, Finland, Greece, Latvia, Denmark and United Kingdom). Within the countries using interbank rates, there are also some differences in terms of the specific maturity used as reference. For instance, in Bulgaria it is mainly 1-month Sofibor/Euribor/Libor; in Germany, 3-months Euribor and; in Spain, 1-year Euribor.

As most of those indexes are highly correlated, the specific choice of the reference index is less relevant for the purpose of this paper. For instance, while 1-year Euribor would, in general, be higher than 3-month Euribor, this will be taken into account when establishing the size of the mark-up over the reference index. Nevertheless, relations among rates are complex and their evolution can diverge during certain periods.

3.3. MATURITY

The average duration of loans is key for assessing the time needed for rolling over the loan portfolio of banks. This feature is particularly relevant for the countries with long fixation periods. European Member States show a wide variation in the maturity of new mortgages, ranging from about 15 years in Germany to more than 30 years in Portugal or Sweden (Table 1).

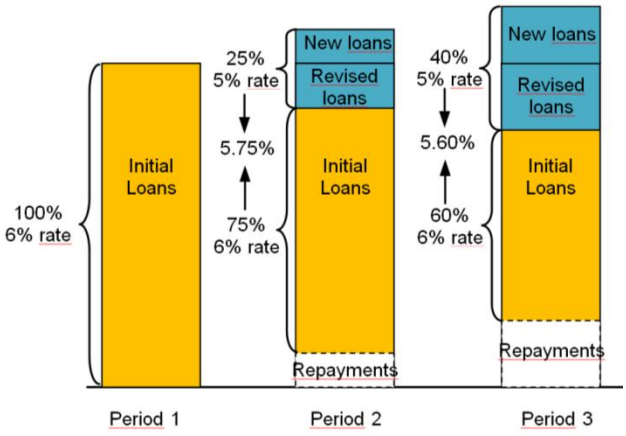
4. LOAN CONTRACT CHARACTERISTICS AND SPEED OF MONETARY TRANSMISSION

This section presents a simulation which aims at identifying the role of mortgage micro-structure in determining the speed of monetary policy transmission. The simulation measures how much time is needed for a change in the policy rate to be fully transmitted to the overall loan portfolio of a bank. Section 4.1 presents how the simulation was constructed; the results are discussed in Section 4.2.

4.1. METHODOLOGY AND ASSUMPTIONS

The basic idea of the simulation is to replicate the gradual rollover of the loan portfolio of banks. Initially, all loans pay a lending rate of 6 per cent. A drop in the policy rate implies a new lending rate of 5 per cent, which applies to all new loans and to the existing loans to the extent that their rate is revised. Data on average maturity, volumes of new and outstanding loans and the frequency of revision of interest rates are used (see Chart 4 for an illustration of the simulation. For further illustration, see also Annex A.3.2).

Chart 4: **Adjustment of the loan portfolio**



Source: Own elaboration.

The outcome of the simulation is the percentage of the loan portfolio affected by the new lending rate (in Chart 2, it would be 0 per cent in period 1, 25 per cent in period 2 and 40 per cent in period 3) or,

what is equivalent, the average lending rate (in Chart 4, it would be 6 per cent in period 1, 5.75 per cent in period 2 and 5.60 per cent in period 3).

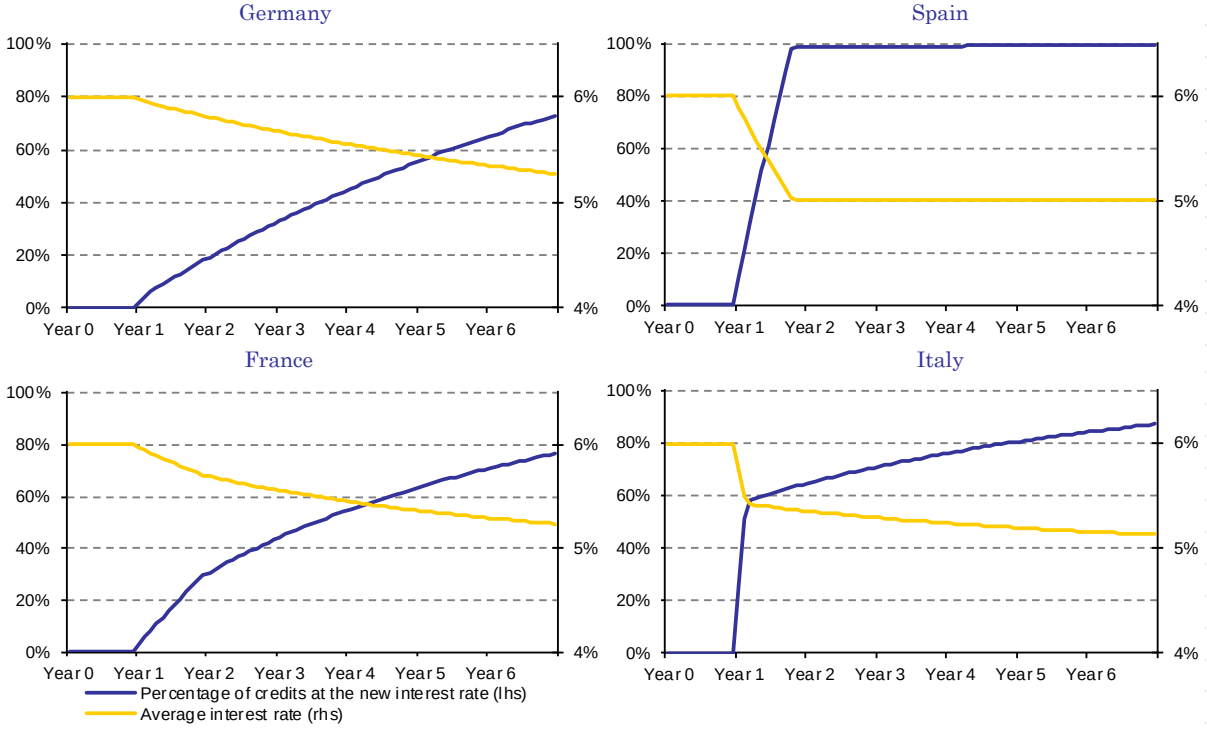
To make the model comparable across countries and to isolate the micro-structure of mortgages from other factors, the simulation is based on the following assumptions: a stationary economy, homogeneity of credits and uniform distribution.

A stationary economy. There is only one step change in the policy rate and all other macroeconomic conditions remain constant over time. Any other factors affecting the transmission of monetary policy -such as financing conditions of banks, credit risk, leverage, quality of loan portfolios, profitability of banks or availability of capital buffers- are also considered constant over time and across countries. The change in the policy rate has an immediate and full effect (100 per cent pass-through) on the lending rate of new credits and on the lending rate of outstanding credits when they are revised. As a consequence, the specific index used as a reference for setting the rate is not relevant for this simulation.

Homogeneity of credits within banks' portfolio. The loan portfolio is split into two sub-portfolios: a) loans with a short fixation period (up to one year), and b) loans with a longer fixation period (more than one year). Within each sub-portfolio, all loans are homogeneous in terms of size, maturity, and other contract conditions so that the average loan is representative of the overall sub-portfolio.

Uniform distribution of credits over time. The redemption scheme is supposed to be annuity mortgages: constant monthly instalments comprising interest payments and capital redemptions. The percentage of reimbursement of credits is constant every month as well as the proportion of credits with interest rates being revised. On the other hand, there are no early repayments nor mortgage equity withdrawals.

Chart 5: **Simulation on the speed of adjustment of loans portfolio**, Interest rates dropping from 6% to 5%
Share of outstanding credits affected by the new rate and average interest rate of the loan portfolio



Source: European Commission, ECB and own calculations.

4.2. RESULTS

The outcome of the simulation for the four biggest Euro area economies (Germany, Spain, France and Italy) is shown in Chart 5. The blue (dark) line indicates the percentage of credits being affected by the new interest rate. The yellow (light) line is the average interest rate in the country.

As observed in the chart, the speed of transmission is much faster in Spain and Italy than in Germany or France, mainly due to a larger share of loans with a short fixation period within the loan portfolio of the former two countries than in the latter two (see Table 1). One year after the change in the policy rate, the average interest rate of the loan portfolio was 5.0 per cent in Spain, 5.4 per cent in Italy, 5.7 per cent in France and 5.8 per cent in Germany. Alternatively, the share of loans affected by the new rate was 99.1 per cent in Spain, 58.5 per cent in Italy and only 27.0 per cent in France and 18.5 per cent in Germany.

The number of months to reach a certain threshold of "revised" loans allows for a cross-country comparison of the speed of adjustment. For instance, in Germany, over 100 months are needed for the new rate to affect at least 90 per cent of the loan portfolio while in Spain this is already achieved within one year (Table 2). Within the Euro area, the countries with the quickest adjustment of interest rates include Austria, Luxembourg, Malta, Portugal, Slovenia, Estonia, Finland or Spain; countries with slow adjustment include Belgium, Germany, France, the Netherlands or Slovakia. Countries in an intermediate position, with a quick adjustment in a first moment but with a rather long period for the adjustment to affect the overall portfolio, include Cyprus, Ireland, Greece, Italy or Latvia[11].

Table 2: **Speed of adjustment to new interest rates**
Time needed for 50 and 90 per cent of loans to be affected by the new rate, number of months

Country	50 per cent	90 per cent	Category
NL	40	123	Slow Transmission
BE	22	116	
FR	32	111	
DE	43	104	
SK	24	97	
LV	5	102	Mixed features
IT	2	85	
SE	3	84	
DK	1	67	
UK	1	64	
EL	10	56	
HU	4	48	
IE	2	28	
CY	1	25	
ES	5	10	Fast transmission
FI	5	9	
SI	3	6	
BG	3	6	
RO	3	6	
CZ	3	5	
EE	3	5	
LT	3	5	
PT	3	4	
AT	2	3	
PL	2	3	
LU	1	1	
MT	1	1	

Source: European Commission, ECB and own calculations.

Besides the wide range of speed of adjustment, one important feature of the simulation is that the size of the change in the interest rate does not affect the speed of adjustment; i.e., it does not matter whether the interest rates is going, let's say, from 6 to 5 per cent or from 6 to 4 per cent; within a given time lag after the change in the policy rate, 90 per cent of the portfolio of loans will be adjusted to the new rate.

[11] See Annex A.1 for an overview of the actual evolution of lending rates for Euro area countries classified according to Table 1.

A short survey with various explanations about the formation of retail rates is presented in Section 2.2. While it is important to understand the underlying drivers, this paper focuses on the consequences and potential impacts of the extreme divergence in the transmission of monetary policy through retail rates across European countries as shown in Table 2. If those impacts are found to be relevant, a deeper analysis of the drivers would indeed be very pertinent. However, such an enterprise is left for further research.

As a consequence next section focuses on the implications of loan contract characteristics for monetary policy but also in terms of income distribution. The largest Euro area countries in each of the three categories in Table 2 (Germany, France, Italy and Spain) has be retain as representative cases. The conclusions of the analysis can be generalised to all the other countries in each category.

5. CHANGES IN THE MONETARY POLICY STANCE AND EVOLUTION OF LENDING RATES: THE ROLE OF LOAN CONTRACT CHARACTERISTICS

The simulation presented in Section 4 is useful for classifying the countries depending on the time needed for changes in the policy rate to pass through lending rates according to the underlying loan contract characteristics. In this section, the model is further developed to assess how actual monetary shocks have impacted lending rates across Euro area countries in the last years (Section 5.1). With the policy rate having hit the zero lower bound, the model is also used to simulate how interest rates will react to future changes in the policy rate depending (Section 5.2).

5.1. CONSEQUENCES OF DISPARITIES IN THE SPEED OF MONETARY TRANSMISSION

This paper postulates that loan contract characteristics play a major role in shaping how lending rates react to monetary shocks. Under normal circumstances, lending rates on new loans react rather promptly to changes in the monetary stance, as far as income is not significantly affected. However, large movements in reference rates could have a major impact on a bank through the effects on the overall portfolio of loans. Confronted with a significant deterioration of income the bank may be forced to cross-subsidise loss-making activities with other business lines. For instance, a bank may seek to compensate losses in its portfolio of loans by increasing the rate charged on new loans despite potential improvements in its access to funding or independently of the creditworthiness of the borrower. Loan contract characteristics play a crucial role in these dynamics.

The reasoning proceeds in three steps. First, the mechanics presented in Section 4 are confronted with actual data to assess the capacity of loan contract characteristics to determine lending rates both at "normal" times and during the recent financial crisis (Section 5.1.1). Secondly, the role of lending rates for shaping bank income is discussed in Section 5.1.2. Finally, potential feedback effects of income into the transmission mechanism as well as the consequences in terms of distributional effects and on the zero lower bound of monetary policy are examined in Section 5.1.3.

5.1.1. The model vs. actual data

The methodology presented in Section 4 can be used for reconstructing the average interest rate charged over the portfolio of mortgages. This can be computed using data on the volume of loans (outstanding volumes and new loans) available at official monetary statistics, on contract characteristics (period of rate fixation and maturity) available at the European Commission dataset and on interest rates charged on new loans available at the ECB.

A distinction should be made from "normal" times to extraordinary circumstances that may have arisen due to the severity of the recent crisis. Up to late 2011, model predictions accurately the actual data on rates charged on outstanding loans (Chart 6). According to contract characteristics (see Table

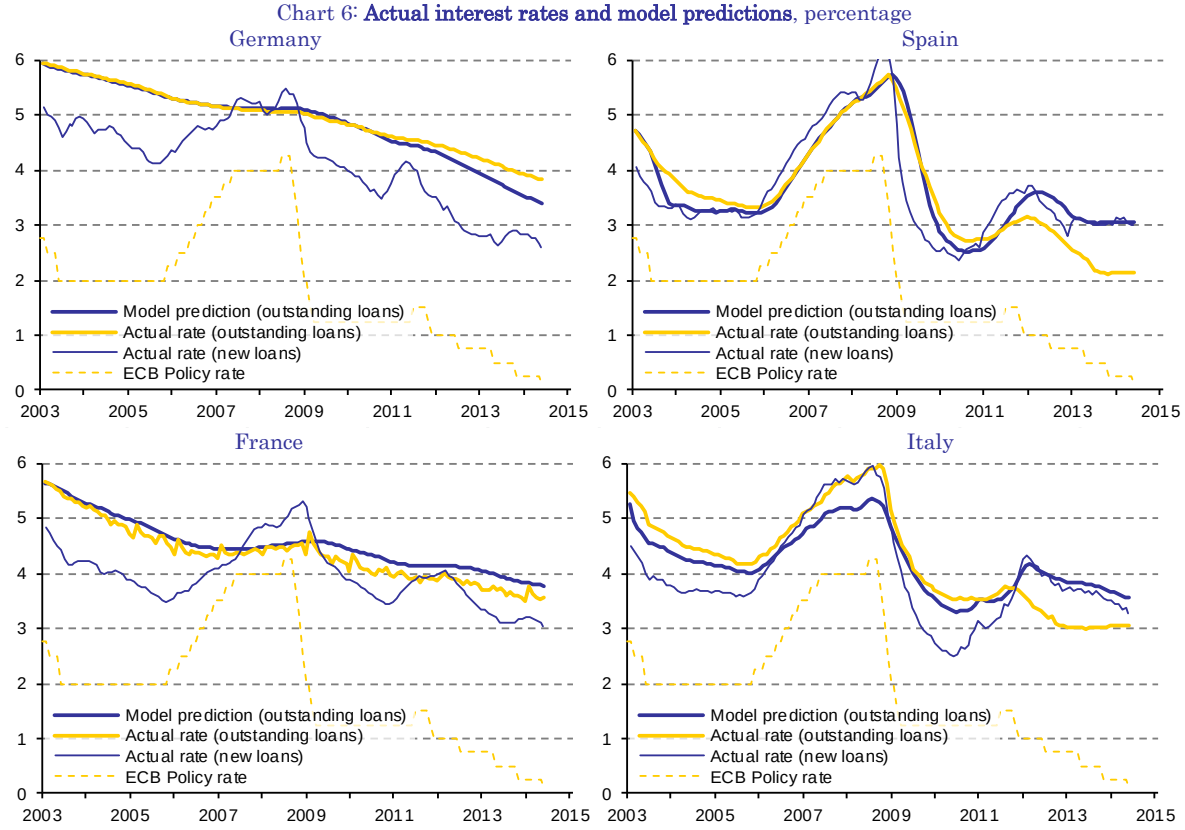
1) and to the analysis presented in Section 4, lending rates in Germany and France adjust much slower than in Spain and Italy.

However, after 2011 the model predictions deviate significantly from the actual evolution of rates charged on outstanding loans. This is particularly the case for the countries where variable rates prevail (Spain and Italy) and much less in the countries with a predominance of fixed rate loans (Germany and France; although a certain deviation is also observed for Germany).

One could think that these developments could be signalling a change in the practice with respect to loan contract characteristics, but two factors tend to invalidate such a hypothesis. Firstly, one should keep in mind the long maturity of mortgages (up to 30 years or even longer) so that a change in the type of loans contracted will only have a gradual impact on the overall portfolio.

And secondly, while the evolution of rates charged on new loans in Spain and Italy clearly follows the evolution of the policy rate, such interconnection seems to be lost from late 2011 onwards. Furthermore, data from the Spanish National Institute of Statistics (Instituto Nacional de Estadística, 2014) indicate that, in June 2014, still more than 90 per cent of new mortgages in Spain were agreed under variable rates[12]. An analysis of bank income can provide some insights of potential forces driving the disparities which are observed between the model predictions and actual rates after 2011.

Chart 6: **Actual interest rates and model predictions**, percentage



Notes: The model uses inputs from monthly data on interest rate on new loans, outstanding volumes and flows and one off data on loan characteristics (period of rate fixation and maturity). When loan rates are revised, it is assumed that the rate on new loans prevalent in the period of rate revision applies to those "old" loans.
Source: European Commission, ECB and own calculations.

5.1.2. Lending rates and bank income

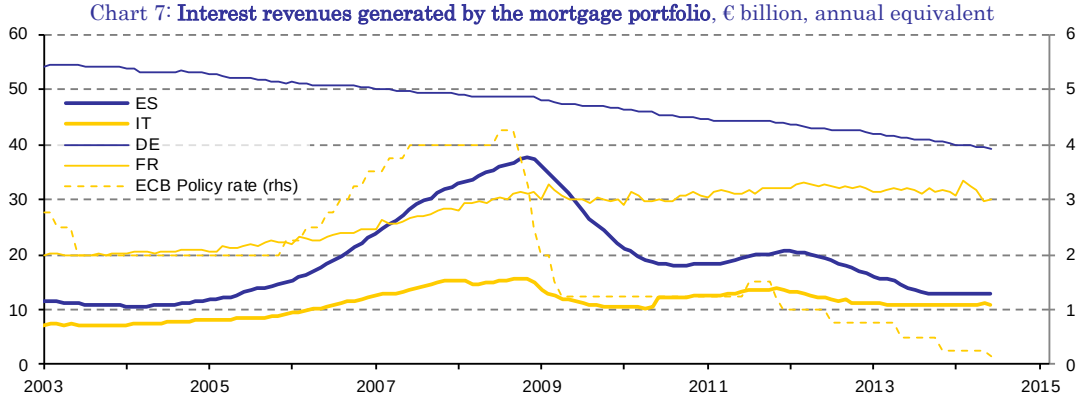
In broad terms, net income can be calculated as revenues minus costs. Neglecting commission and fees, the revenues obtained by a bank in its loan portfolio can be easily calculated by multiplying

[12] A newspaper article of August 2014 explains the reasons for such a high share of variable rate loans despite the extremely low market rates (see Montserrat, 2014).

interest rates by the volume of loans. Chart 7 plots the interest revenue generated by the mortgage portfolio for the four largest countries in the Euro area. Data show that the drop in the policy rate from 4.25 in late 2008 per cent to 0.05 per cent in September 2014 had a differentiated impact on bank interest earnings across countries depending on the prevailing features of the loan portfolios in each country. Indeed, interest revenues generated by mortgages in Spanish banks plummeted from a peak of almost €40 billion a year to less than €13 billion a year (a decline of 66 per cent). On the other hand, in Germany, interest revenue generated by mortgages declined only from €48 billion to €40 billion in the same period (a decline of 17 per cent). Interest revenue in France was almost unaffected.

Bank income depends not only on revenues but also on funding costs. With highly integrated wholesale markets, changes in the policy rate impact banks' funding conditions rather quickly and homogeneously across countries. Although the decrease in the policy rate also eased funding costs, the improvement in cost was much smaller and insufficient to compensate for the deterioration in revenues. As mentioned in Section 2.3, banks are usually assumed to be price-setters in the retail loan market but price-takers in the interbank market and capital markets (see also ECB, 2009d, pp. 94-95). The "war on deposits" in Spain provides a clear indication that any potential improvement in the availability and cost of funding for banks as a consequence of the decline in the policy rate was noticeably insufficient to compensate for the deterioration in interest earnings induced but that same cut in the policy rate[13].

Chart 7: **Interest revenues generated by the mortgage portfolio**, € billion, annual equivalent



Source: ECB and own calculations.

Under the above circumstances, it can be assumed that the interest income (or interest margins) obtained by the mortgage portfolio after discounting its funding cost followed a similar profile to the evolution of interest revenues as observed in Chart 7. In other words, given the loan contract characteristics prevailing in each country, the monetary shocks occurring from 2008 onwards induced a rapid and substantial erosion in incomer for Spanish banks but a much milder one for German and French banks. Next section discusses how banks have reacted to this deterioration in their income generated by the loan portfolio.

5.1.3. Feedback effects of bank income into monetary policy

The erosion in bank income due to the decline in lending rates charged on outstanding loans may explained the developments observed in lending rates after 2011 (see Chart 6), in particular, the divergence between model predictions and actual rates (for outstanding loans) and the disconnection of rates charged on new loans from the policy rate.

Analysing US data, Freixas (2009, p. 644) maintains that a decline in the policy rate can affect existing contracts with variable rates, but not necessarily new loans. In fact, the author notes that the policy rate decreases during the crisis were compensated by increases in spreads. Analogous

[13] The significant drain that the deposit war was having in bank income required the intervention of the Bank of Spain by (unofficially) capping deposit remuneration (see Barrón, 2010). However, in early 2011, some Spanish banks were still offering a remuneration on deposits up to 4 per cent (see De Dios Portillo, 2011; see also Johnson, 2011; Penty, 2012; or Dowsett, 2012).

dynamics are also observed in Europe, particularly in the countries with a predominance of loans with variable rates (see Chart 6 and Annex A.3.1). Freixas points three reasons why the reductions in the policy rate may not be passed through to the final borrowers and, therefore, it may not affect the supply of credit: a) the spreads and conditions on loans depend upon the business cycle, b) liquidity shortages may lead banks to constitute a liquidity buffer by investing in liquid assets, and c) losses may have eroded banks' capital and they may prefer to invest in low-risk assets to comply with capital requirements.

Lending rates developments are also consistent with the fact that banks may engage in cross-selling and cross-subsidising of activities as argued by the European Central Bank (2009d, p. 95). Indeed, banks may charge higher lending rates on new loans to compensate for a loss incurred on existing loans due to the decline in rates. It cannot be discarded that banks apply also higher rates for new loans in other portfolios, such as consumer lending or corporate lending.

Three interlinked effects emerge as a consequence of the divergent evolution of rates charged on new and on outstanding loans: a) income redistribution between borrowers and lenders, b) income redistribution within borrowers and, c) effects on the zero lower bound of monetary policy.

Implications for income distribution between borrowers and lenders. The type of rate determines who bears interest risk (either the borrower or the lender). A change in (market) rates implies a redistribution of funds between borrowers and lenders in the case of fixed-rate loans, but not in the case of variable-rate loans. When a change in the policy rate effectively occurs, the income redistribution will impact bank earnings positively or negatively. This extraordinary impact on bank earnings can potentially trigger the cross-subsidisation of activities pointed out by the ECB (2009d, p. 95).

In countries with long fixation periods (Germany and France), banks can profit of the environment of declining interest rates and offer advantageous rates to new customers as they keep receiving a high remuneration from the "old" loans. On the other hand, banks in countries where rates are revised frequently (Spain and Italy), the overall return in their loan portfolio deteriorates very rapidly and banks tend to compensate it by charging substantially higher rates to new customers.

Bernanke and Gertler (1995, p. 36) argue that redistributions between borrowers and lenders may not be macroeconomically neutral. This may be due to feedback effects from rates charged on existing loans to rates charged on new loans as a consequence of the impact of monetary policy on bank income.

The deterioration in bank earnings could be compensated if cheaper funding sources were to be available. These dynamics may explain the large recourse to the ECB extraordinary liquidity facilities by Spanish and Italian banks (see European Commission, 2014, Chart 2.A.3)[14]. Our model and the loan contract characteristics indicate that other "non-core" countries like Greece, Portugal and Ireland would be in a situation similar to Spain[15]. Banks from those three countries were also among the largest users of ECB liquidity facilities. On the other hand, the model indicates that banks from other "core" countries like Belgium and the Netherlands would be in situation similar to German and French banks. It remains to be further analysed which was the role played by loan contract

[14] When comparing the cost of funding obtained from the ECB and the yields obtained from Spanish sovereign bonds it seems that Spanish banks may have obtained a significant advantage from carry trade. However, the very limited amount of sovereign bonds purchased by Spanish banks in comparison with the funds obtained from the ECB does not support the hypothesis that central bank cheap liquidity was used for carry trade. For further details, see European Commission (2014), Section 1.4.4. See the discussion above with the arguments put forward by Freixas (2009) on why the banks did not channelled the new funds received into new lending. Furthermore, the coexistence of the "war on deposits" in Spain with the massive funds obtained from the ECB with very cheap conditions are difficult to reconcile with a use of funding for carry trade instead of using it for lending.

[15] In line with the arguments put forward in this paper, various reports highlight that variable rate loans in a context of very low policy rate have significantly eroded interest revenues in Ireland (see, for instance, European Commission, 2013, p. 12; Kennedy and McIndoe-Caler, 2012, p. 90 or Goggin, Holton et al. 2012).

characteristics in explaining the divide between core and non-core Euro area countries during the recent financial crisis.

Implications for income distribution within borrowers. Besides the redistribution of funds between borrowers and lenders, the divergence between the rates charged on existing and new loans also implies a redistributive effect within borrowers. These distributive effects depend, to a great extent, on the market conditions prevailing in the moment the loan was agreed with little role for borrowers' intrinsic characteristics (e.g. creditworthiness). The mechanism operates once again through income feedback effects stemming from the underlying loan contract characteristics.

Under the single monetary policy of the Euro area, these two redistributive effects between lenders and borrowers and within borrowers may also imply some redistributive effects between countries as reflected in the "financial fragmentation" of the single market.

Implications for the zero lower bound of monetary policy. Finally, loan contract characteristics seem to influence when the zero lower bound of monetary policy has been attained. Indeed, the decision of June 2014 to decrease the policy rate to 0.15 per cent (and to 0.05 per cent in September)[16] will still need some time to be fully absorbed by the banks in countries with contract characteristics leading to a slow transmission (probably only by 2015 or later). On the other hand, data seem to indicate that the zero lower bound of monetary policy had already been attained by 2012 or 2013 in the countries where loan characteristics lead to a quick monetary transmission (see Chart 6).

As a summary, loan contract characteristics may influence how changes in the monetary stance affect incentives. In countries with long fixation periods, banks can translate the declines in the monetary stance to new loans because their earnings are only marginally affected. Therefore, higher rates charged on old borrowers can act as a sort of financial accelerator to positively amplify the effects of easing monetary policy on the flow of fresh credit.

On the other hand, in countries with frequent revisions of the rates, declines in the monetary stance are quickly translated to the overall portfolio of loans so that existing borrowers benefit from better conditions. This releases disposable income which could be available for fostering aggregate spending. However, this is achieved at the expenses of banks' earnings, solvency and viability. Whenever cheaper funding conditions are not available, banks will react by searching higher returns in other business lines including raising rates charged on new loans. These two forces (increases in disposable income and increases in the rates charged on new loans) act in opposite directions. As a consequence, the final effect of an easing monetary policy on the flow of fresh credit becomes ambiguous.

5.2. PROJECTING HOW LENDING RATES WILL EVOLVE IN THE FUTURE

The simulation used in the previous section can also be used to predict how the rates charged on outstanding loans will react to future increases in the policy rate. Such an increase in the policy rate will be taken whenever the central bank considers that the economy is overheating and there is a risk of increasing inflation. However, the decisions announced by the ECB in June 2014 (see ECB, 2014a) included a clear forward guidance and imply that extremely low policy rates will be maintained at least until late 2015.

The model for projecting future developments in lending rates is constructed by assuming that the increase in the policy rate is quickly transmitted to rates charged on new loans in all countries and that it is of a size leading interest rates on new loans to be 5 per cent across countries. Two scenarios are tested: a first scenario with an immediate increase in the policy rate (as of September 2014) and a second scenario where the current environment of low interest rates is prolonged until the end of 2015

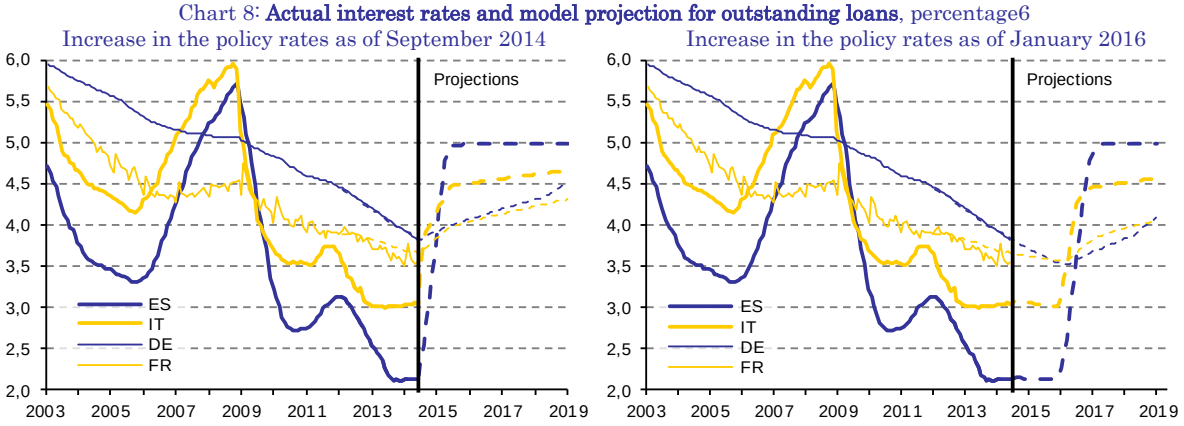
[16] See ECB (2014a and 2014b) for further details.

and the increase in the policy rate occurs only from January 2016 onwards. This second scenario is more in line with the forward guidance implicitly expressed by the ECB (2014a).

The outcome of the simulation shows, in any of the two scenarios, a divergent reaction to the increase in the policy rate depending on loan contract characteristics (Chart 8). Indeed, two or three years after the policy decision has been taken, the spread between the interest rate charged by banks in Spain (5 per cent) and banks in Germany or France (about 4 per cent) amounts to still almost one percentage point. While these spreads tend to narrow over time, a rather long period of time is expected to elapse before lending rates converge across countries. The convergence can be expected to last even longer if the overall increase in the policy rate is taken gradually over a period of time rather than through a one-off decision.

The discussion about the impact on income and potential redistributive effects between borrowers and lenders, within borrowers and between countries is also valid here. A future increase in the policy rate will permit the banks to recover their revenue levels in Spain and Italy rather quickly. The overall impact on banks' net income will depend on the evolution of funding cost, but it can be expected to be positive. In Germany and France, banks' earnings will only increase gradually, so that some erosion in banks' net income (depending on the evolution of funding conditions) can be expected. This would reverse the situation with respect to the time of low interest rates.

Chart 8: **Actual interest rates and model projection for outstanding loans**, percentage6



Notes: Continuous lines correspond with actual data and dotted lines with model projections. The model uses input data starting from 2012 onwards. The increase in the policy rate is assumed to be such as to make the rates charged on new loans to be 5 per cent.
Source: European Commission, ECB and own calculations.

The impact on the real economy would be the opposite of the impact on banks. An increase in the policy rate will probably achieve rather quickly its goal of cooling down the real economy in countries like Spain and Italy, but only gradually in countries like Germany and France. This may have some implications for the capacity of monetary policy to steer the business cycle across countries.

6. CONCLUSIONS

Loan contract characteristics can have a substantial influence in the speed of transmission of monetary policy, particularly, the frequency of revision of rates for existing loans and its maturity. This paper shows how the transmission of changes in the policy rate to lending rates can range from a few months to several years depending on loan contract characteristics. Differences across Euro area countries are particularly relevant as a single monetary policy may have very different effects across Member States depending on the prevailing loan contract characteristics in each individual country.

In its traditional formulation, the lending channel focuses on the effects of changes in the policy rate in the supply of new credit through price effects. The simulations presented in this paper, point to an

additional channel working through banks' earnings and the overall portfolio of loans. The relevance of this channel depends on loan contract characteristics.

This paper also discusses the role of loan contract characteristics in influencing how monetary shocks can trigger redistributive effects not only between the banking system and its borrowers, but also between different borrowers, depending on the moment they have signed their loan contract. Moreover, loan contract characteristics can influence when the zero lower bound of monetary policy is attained in each individual country.

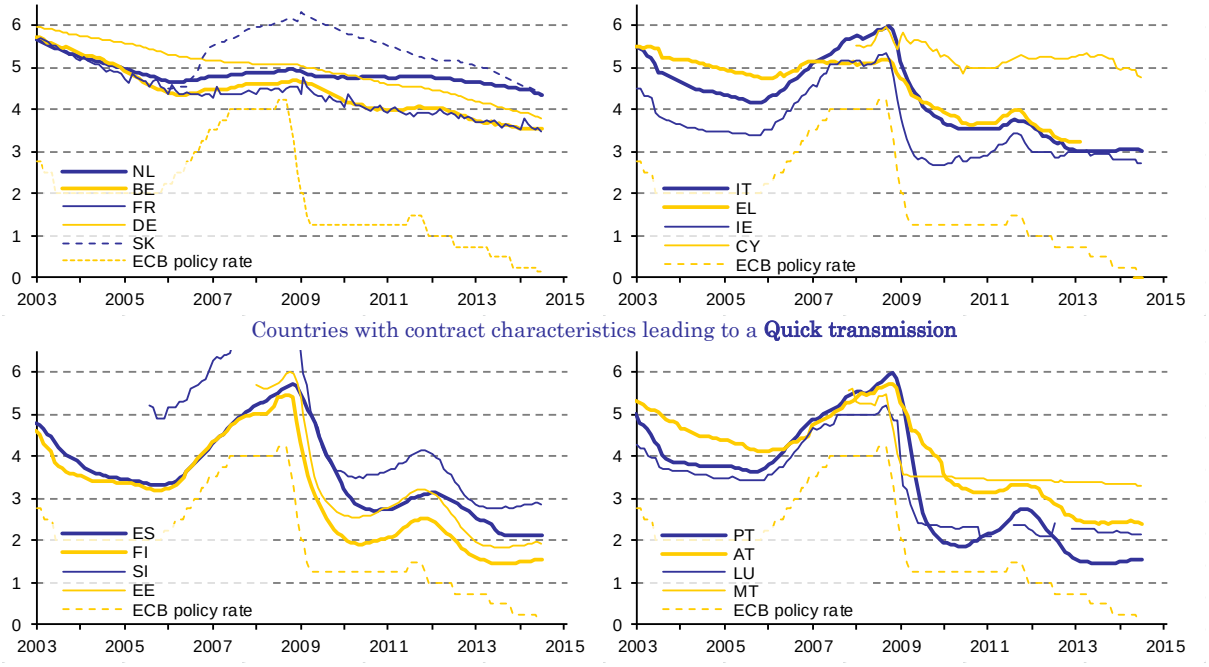
A. ANNEXES

Four annexes complement this paper. Annex A.1 provides some data about other Euro area countries beyond the four large Euro area countries. Annex A.2 explains the assumptions and simplifications that were taken for constructing the models in Sections 4 and 5. Annex A.3 presents additional charts on spreads and the portfolio roll-over of loans. Besides the speed of monetary transmission, the actual effectiveness of monetary policy depends on its final impact in terms of size. In this context, Annex A.4 presents a simulation that replicates the repayment of loans to assess how loan contract characteristics can play a role with respect to the impact of monetary policy shocks in terms of disposable income.

A.1. EVOLUTION OF ACTUAL INTEREST RATES ACROSS THE EURO AREA

According to the simulation presented in Section 4, European countries can be classified in several groups depending on the speed of monetary transmission. As a reinforced evidence for the validity of the discussion in this paper, the evolution of actual lending rates charged on outstanding loans seems to be consistent with what would be predicted from loan contract characteristics (Chart A1).

Chart A1: **Interest rates charged on** outstanding credits **for house purchase**



Source: ECB and own elaboration.

For instance, the increase in the policy rate in the mid-2000s from 2 to 4 per cent clearly impacted the countries with a quick transmission. However, it did not impact the countries with a slow transmission because they were still in the process of absorbing a previous decline in the policy rate (from a value

of 4.75 per cent prevailing in 2000-2001 to a value of 2 per cent in 2003-2005). Similar dynamics are observed with respect to the drop in the policy rate in 2008-2009 (from 4.25 to 1.25 per cent). The countries with mix features appear in an intermediate position: they follow a profile similar to the countries with a quick transmission, but with narrower ranges of variation.

A.2. CAVEATS AND SIMPLIFICATIONS

A series of assumptions and simplifications had to be taken not to over complicate the simulations performed in Sections 4 and 5. While these assumptions seem not to have jeopardised the accuracy of the models, the discussion presented in this paper should be interpreted against the following caveats.

A.2.1. Redemption schemes

Monetary policy can only affect the part of the instalments linked to the payment of interest and not to the redemption of capital. The size and distribution of interest over time can affect both the speed of the transmission of monetary policy and its final impact and this depends on the redemption scheme.

The simulations assume that all mortgages are annuity mortgages: they are reimbursed through fixed monthly instalments that include interest payment and capital redemption. Although, in most European countries, mortgages follow an annuity redemption scheme; in a few of them, some alternative formulas are also popular. They include, among others, interest only mortgages (with a majority of loans in Sweden and Netherlands and around a 25 per cent in Denmark, Hungary or Ireland following this redemption scheme) or endowment mortgages (which are significant in Austria, Hungary or the Netherlands)[17]. Accordion mortgages[18] and other innovative redemption schemes are still marginal (Drudi et al. 2009, p. 7).

The existence of redemption schemes other than annuity mortgages may slightly influence the results of the simulations[19].

A.2.2. Early repayments and equity withdrawals

Being agreed for a very long period of time, the parties may will to change loan conditions in a later stage (although usually assuming some kind of penalties). Early repayments, renegotiation of terms and equity withdrawals are three typical cases of changes in the initial contract. All these three events lead, in general, to a slight acceleration in the transmission of monetary policy because they either apply the newest rate (renegotiation and withdrawals) or they decrease the size of the old loan (early repayment) and therefore, the share of the portfolio affected by the old rate. Nevertheless, the impact is rather limited because all of those remain, in general, rare events.

The renegotiation of loans with long term fixation period could significantly accelerate the transmission of changes in the policy rate. However, renegotiations are only triggered after market rates have been low for a certain period of time and therefore, they would just mean an acceleration within the range of slow transmission. On the other hand, one has to take into account that renegotiations are usually initiated from the side of the customer and, therefore, they are asymmetric: they will be triggered for decreases in interest rates, but not for increases.

A.2.3. Time issues: distribution of loans, pass-through and seasonality

An underlying assumption on the simulations was that the initial maturity and the initial size was the same for all loans in the bank's portfolio. However, it is well known that the size of mortgages and their

[17] Information extracted from the European Commission database. In endowment mortgages, a significant amount of capital is left to be paid at maturity.
[18] In traditional loans, changes in interest rates entail a revision of the monthly instalment. In accordion loans, the monthly instalments remain constant and the maturity is extended or reduced in the event of a rate change.
[19] For further details about redemption schemes in Europe, see Drudi et al (2009), pp. 30-31.

maturities have been lengthened in the recent years. The assumption of a homogeneous distribution implies a slight bias towards longer adjustment periods.

The simulations neglect the specific index used as a reference and assume an immediate effect of the change in the policy rate on lending rates. It is true that the use of market or official rates as a reference implies a longer adjustment period than a direct use of the ECB policy rate (e.g. in Ireland). However, the simulation in Section 4 yields a range from a few months to over 100 months for the change in the policy rate to be transmitted to lending rates. The inclusion of the specific reference rate would increase complexity without a substantial change in the essence of a wide dispersion in the speed of transmission across countries.

The European Commission dataset includes three quarters around the collapse of Lehman Brothers. This could be problematic because of the potential seasonality of quarterly data and because the failure of Lehman Brothers meant a major disruption in financial markets. However, data refer mostly to the overall portfolio of loans, which are broadly unaffected by these factors.

A.2.4. Missing values and low representativeness

Financial markets in Europe are very concentrated with a few big banks counting for a large market share in most countries. While the European Commission dataset was gathered from large banks in all countries, in a few Member States, the survey was responded by a limited number of banks, which may not necessarily represent the overall national market. This is particularly the case for Luxembourg and Latvia, followed by Cyprus, Slovenia, Czech Republic and Lithuania and, to a lesser extent, by the Netherlands. The results for those countries must be interpreted with caution.

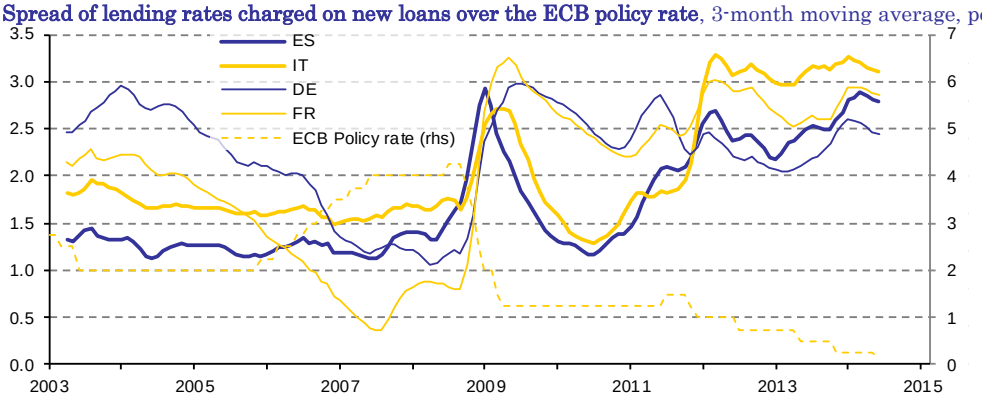
Given that not all the respondents provided full information in their replies, some missing values were replaced by the averages of the full sample. This was done for the maturity of loans in the UK, for the size of loans in Slovenia, Czech Republic and the Netherland and for the frequency of revision for Slovenia, Bulgaria and Czech Republic.

Finally, the questionnaire was drafted in a way that the value for maturities was only available for new loans and not for the overall portfolio of loans as it might have been more desirable.

A.3. ADDITIONAL CHARTS: INTEREST RATE SPREADS AND PORTFOLIO ROLL-OVER

A.3.1. Interest rates spreads

Chart A2: **Spread of lending rates charged on new loans over the ECB policy rate**, 3-month moving average, percentage



Source: ECB and own calculations.

Data show two distinctive patterns in how banks reacted to the decline in the policy rate of 2008-2009 (Chart A2). In Germany and France, banks increased the mark-up they used to calculate lending rates

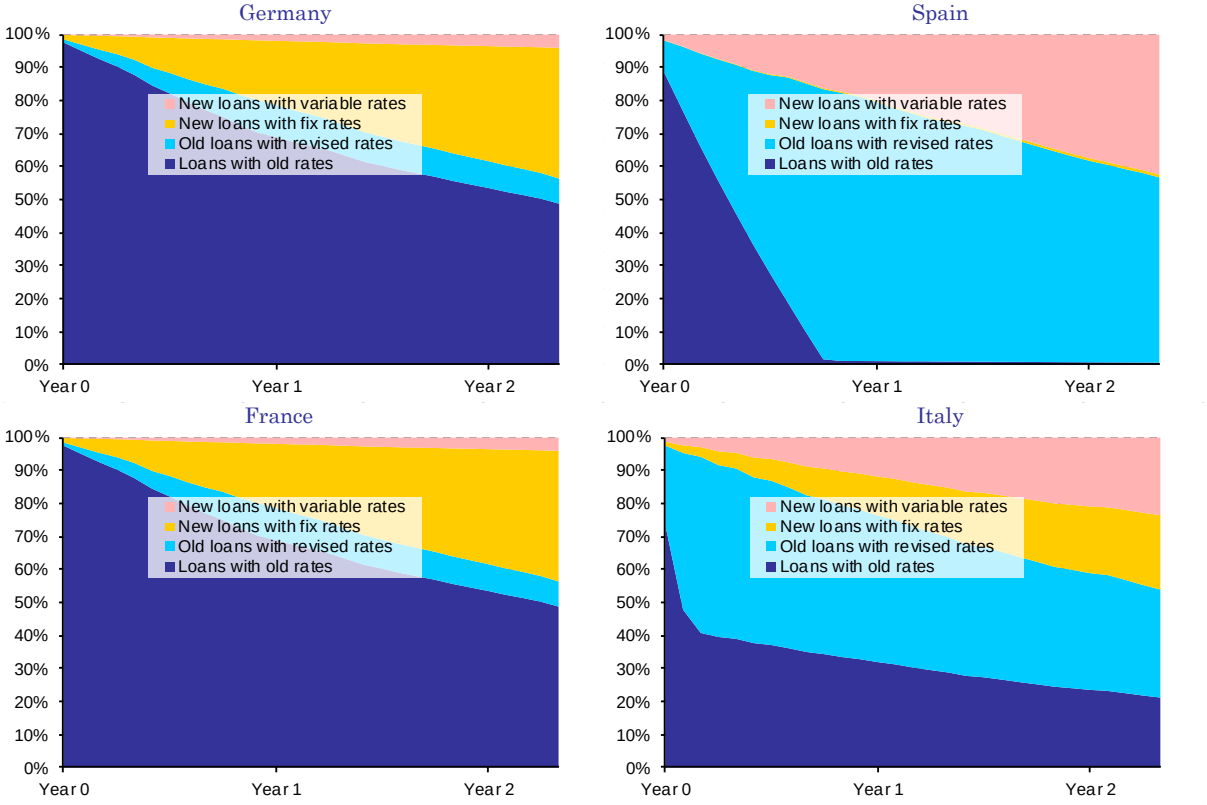
on new loans and they have maintained at those high levels thereafter[20]. On the other hand, banks in Spain and Italy have maintained the mark-up at similar levels to the ones prevalent before the crisis until 2011. The short spike in late 2008 and early 2009 can be explained, to a large extent, by technical issues such as how monthly averages are calculated, the specific index used as a reference and the information available in the moment of deciding about the loan rate (e.g. a loan agreed in March may be set against the latest known value of Euribor, which could be the one of February or even January).

However, banks in all four countries reacted to the decreases in the policy rate of late 2011 and late 2013 by increasing the mark-ups.

A.3.2. Portfolio roll-over

The results of the simulations are presented in the main paper as average evolution of interest rates. As a complement, Chart A3 presents, for the four larges Euro area economies, an overview of how the loan portfolio is being rolled-over with new loans and how the rates of the old loans are being revised over time. It represents a summary of the computations used in the simulation presented in Section 5[21].

Chart A3: **Roll-over of the loan portfolio and revision of rates**, percentage of loans out of the loan portfolio



Notes: The chart represents the evolution of volumes for the four loan categories. The computation is based on data for outstanding volumes of loans and new loans for the period 2012-2014 (June). Using data for the period 2003-2005 does not substantially change the results.
Source: European Commission, ECB and own calculations.

Due to the long periods of rate fixation, the loan portfolio in Germany and France is still dominated (with more than 50 per cent of the portfolio) by loan with old rates after two years. However, in Spain, over 95 of the portfolio is composed either by new loans or by old loans with revised rates.

[20] In fact, what seems to be happening is that banks continued to charge almost the same rates on new loans with only a gradual adjustment to the decline in the policy rate. For a better understanding of the underlying drivers, a further analysis of the exact process of setting lending rates in Germany and France should be undertaken. Such an exercise goes beyond the scope of this paper.
[21] The actual simulation is actually more complex as it replicates, month after month, the split between the four categories presented on Chart A2 so that the lending rate prevailing in each period (the rate charged on new loans) is duly applied.

Italy is in an intermediate position with about 25 per cent of the loan portfolio still based on old rates after two years.

A.4. IMPACT OF CHANGES IN MONETARY POLICY ON HOUSEHOLD DISPOSABLE INCOME

Besides the time needed for the policy rate to be transmitted to lending rates, the effectiveness of monetary policy depends on its total impact in terms of disposable income, which will ultimately affect spending, investment, aggregate demand and output. This annex presents a short simulation on how loan micro-structure can influence the impact of monetary policy on disposable income.

A.4.1. Background and rationale

The size of a mortgage is, in general, highly influenced by the total price of the property. In turn, real estate prices depend on the intrinsic characteristics of the house itself (size, location, year of construction…), but they may also be affected by the general economic conditions as it is the case during economic booms or in the run up to housing bubbles. In addition, legal and transactional costs (taxation, notary fees, registration fees…) increase the price of the property while loan-to-value (LTV) limitations and other prudential requirements can constrain the size of the mortgage.

At micro level, the capacity of a given household to repay the mortgage depends on its income level. Monthly instalments should be calculated for the financial burden on the household not to be excessive and this can be achieved by prolonging the maturity of the mortgage[22]. This was indeed what happened in the mid-2000s in some countries with real estate prices increasing faster than wages and the duration of mortgages being prolonged. However, the relation between monthly instalments and duration is not linear due to the fact that total interest burden increases with the duration of the mortgage. For instance, total burden for a 10-year mortgage is about €140,000 while for a 20-year mortgage it is about €185,000.

In macroeconomic terms, the overall impact will depend on the overall indebtedness of the household sector. Monetary policy impacts the disposable income of households to the extent that they affect the lending rate of their mortgages and, ultimately, the monthly instalments they have to pay. A decrease (increase) in the monthly instalment will release ("sequester") income that households can (not) use for other purposes (mainly consuming or saving).

A.4.2. Methodology and assumptions

The goal of this simulation is to replicate the instalments of a mortgage and how they are affected by changes in lending rates depending on the specific loan contract characteristics in each country. The assumptions discussed in Section 4.1 also apply, namely, a stationary economy, homogeneity of credits within the loan portfolio and uniform distribution over time.

In this simulation, both the change in the rate and the initial interest rate level play a role in the final impact on disposable income. This was not the case for the simulation on speed (see Section 4). Monthly instalments are computed from the data on average size and on average maturity of loans. Assuming an initial interest rate of 7 per cent, two scenarios are tested: a decline to 6 per cent and a decline to 5 per cent. To allow comparisons across countries, the decline in the instalments is assessed against the GDP of the respective country.

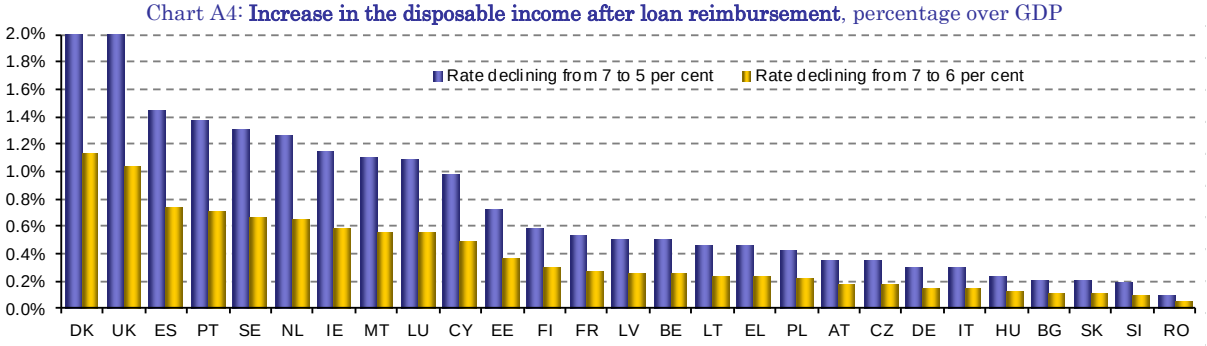
A.4.3. Results

Chart A4 presents the results of the simulation. For a majority of countries, the impact is relatively small: a decrease of 2 percentage points in the interest rate of mortgages releases income representing

[22] The redemption modality (annuity mortgages, interest only mortgages, existence of an initial grace period…) also impacts the duration of the mortgage.

less than 0.5 per cent of GDP. However, in countries like Denmark and the UK, followed by Spain, Portugal, Sweden and the Netherlands the impact can be significant (more than 1.2 per cent of GDP).

Chart A4: **Increase in the disposable income after loan reimbursement**, percentage over GDP



Source: European Commission, ECB and own calculations.

Nevertheless, one should take into account that this corresponds with the first round effects. The final impact will depend on the multiplier, which depends, in turn, on the macroeconomic features of each economy.

A.4.4. Combination of the simulation on speed of monetary transmission and the simulation on final impact

The simulation presented in Section 4 provides an indication of the speed of the loan portfolio to adapt to a change in the policy rate. The simulation presented in this annex provides the size of the final impact in terms of households' disposable income. Chart A5 plots a representation of both simulations combined together.

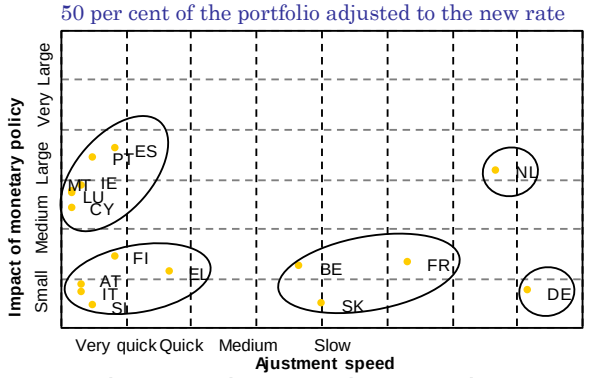
The different patterns in how the policy rate is transmitted to lending rates are particularly relevant for Euro area Member States because all of them are bound by a unique monetary policy. The loan portfolio in a majority of countries adjusts fairly quickly to the change in the policy rate. However, there is a noticeable distinction in the size of the impact: in some of these countries the impact is clearly larger (e.g. Spain and Portugal) than in othernes (e.g. Austria and Italy). On the other hand, in a few countries the policy rate needs a much longer time to be transmitted to lending rates (e.g. Germany and France); the final impact for most of these later countries is rather limited, except for the Netherlands, where the impact is large, but very slow.

As it has been shown in Section 4, in a few countries, the change on policy rate impacts initially an important share of the loan portfolio, but the transmission to the rest of the portfolio is slower. This is particularly the case for Greece, Italy and Slovakia and, to a lesser extent, also for Ireland and Cyprus.

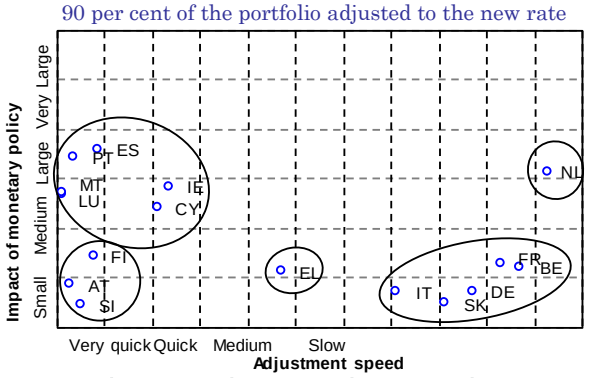
Chart A5: **Adjustment of lending rates to changes in the policy rate: speed and final impact**

Euro area countries

50 per cent of the portfolio adjusted to the new rate



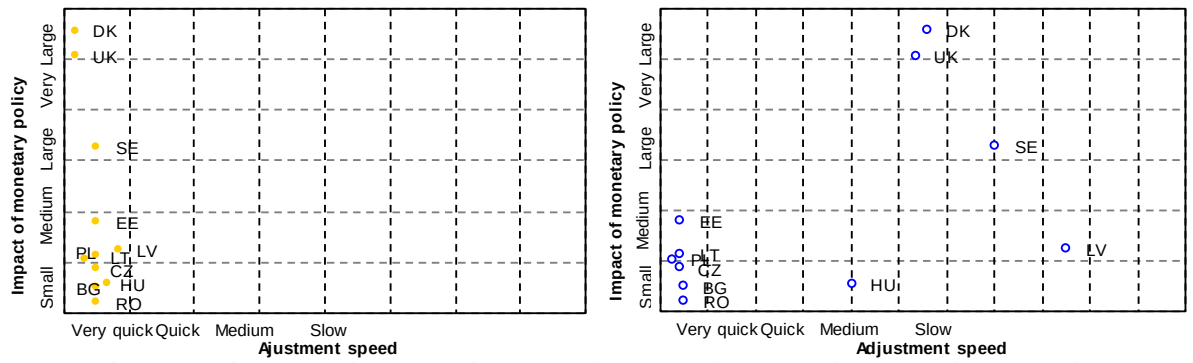
90 per cent of the portfolio adjusted to the new rate



Non-Euro area countries

50 per cent of the portfolio adjusted to the new rate

90 per cent of the portfolio adjusted to the new rate



Note: Data refer to a date before Estonia and Latvia joined the Euro area.
Source: European Commission, ECB and own calculations.

Non-Euro area Member States keep an independent monetary policy, but they are expected to adopt the Euro in the future (except for Denmark and the UK which have an official opt-out and Sweden, who has a *de facto* opt-out). From the time when the data were collected to 2014, Estonia and Latvia had already joined the Euro and Lithuania has been confirmed to do so in 2015. Consequently, although not formally in the Euro, monetary policy in most of these countries is somehow pegged to the one of the European Central Bank (in particular those who participate in the European Exchange Rate Mechanism, ERM II).

In most non-Euro area countries, the monetary policy is quickly transmitted to lending rates (at least to the first half of the loans portfolio) but the overall impact is rather limited. In the three countries with opt-outs (Denmark, Sweden and the UK), the impact is larger. In a few cases, the second half of the loan portfolio is impacted by the new lending rate only after some time has elapsed (Denmark, Hungary, Latvia, Sweden and the UK).

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