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Jingyang Liu
Clemens Kool

U.S.E. Discussion Paper Series nr: 17-14

Tjalling C. Koopmans Research Institute
Utrecht University School of Economics
Utrecht University

Kriekenpitplein 21-22
3584 EC Utrecht
The Netherlands
telephone +31 30 253 9800
fax +31 30 253 7373
website www.uu.nl/use/research

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How to reach the authors

Please direct all correspondence to the first author.

JingyanLiu~
Clemens Kool~^
~Utrecht University
Utrecht University School of Economics
Kriekenpitplein 21-22
3584 TC Utrecht
The Netherlands.
E-mail: J.Liu@uu.nl
^Maastricht University
School of Business and Economics
P.O. Box 616
6200 MD Maastricht

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Monetary dynamics in the euro area: a disaggregate panel approach

Jingyang Liu[a]
Clemens Kool[ab]

Utrecht School of Economics
Utrecht University

September 2017

Abstract

In this paper, we use panel cointegration estimation to analyze the determinants of heterogeneous monetary dynamics in ten euro area member countries over the period 1999-2013. In particular, we investigate the role of real house prices, real equity prices and cross border bank credit. For the period up till 2008 we find a significantly positive income effect, a significantly negative interest rate effect, a significantly negative effect of net foreign credit and a significantly positive housing price effect. Inclusion of the financial crisis shows evidence of a structural break in money demand and some sign reversals, most significantly so for the interest rate effect. Finally, we find evidence of a divide in the long-term money demand relation between the Northern and Southern parts of the euro area, potentially complicating monetary policy.

Keywords: money demand stability; structural breaks; panel cointegration; DOLS; asset prices; net foreign credit

JEL classification: E41; F45; C33

Acknowledgements

Financial support from the China Scholarship Council (CSC) is gratefully acknowledged. We thank seminar participants at the Utrecht University School of Economics, Maastricht University and the International Conference on Applied Financial Economics for useful comments and suggestions. Special thanks go to Jan Jacobs, Liu Dingming and Lou Chaoming. We thank Milena Dinkova (USE) for proof reading.

1. Introduction

In a recent speech, ECB president Mario Draghi stated that "*the decision to grant central banks price stability objectives, and to give them independence to deliver those objectives, was based on the understanding that inflation is always, ultimately, a monetary phenomenon. It could thus always be controlled in the medium-term by a committed monetary authority*" .[1] From that perspective, the development of monetary aggregates should be a key component of the ECB's monetary policy framework. In practice, the role of monetary aggregates has been considerably reduced over time. Like many other central banks, the ECB increasingly relied on interest rate targeting to maintain price stability up till the start of the 2008 financial crisis.

Over the past years, interest in the dynamics of monetary aggregates has increased again for two reasons. On the one hand, persistently low inflation and economic growth in combination with a policy rate virtually equal to zero has led to the use of unconventional monetary policy in which size and composition of the central bank's balance sheet play an important role. On the other, the search for causes of the financial crisis and subsequent euro debt crisis has brought to light strongly divergent patterns in money and credit growth across euro area countries. This has also raised the question how and to what extent money and credit developments are related to booms in real estate and equity markets.

Monetary aggregates have developed heterogeneously across euro area countries from the introduction of the euro (Bosker, 2004), despite the ECB's common monetary policy. For instance, over the period of 1999 to 2013 M3 increased 35% in Germany in comparison with 60% in Spain. The highest growth rate (170%) over that period was recorded in Ireland. These cumulative growth rates diverge considerably from the 4.5% per year ECB reference rate of money growth. During the same time, housing prices developed in a diverse way across euro area member states as well. Some countries experienced extremely high growth rates in real estate prices. Particularly in Spain and Ireland average annual growth rates were in the double digits till 2008. Stock market returns showed some heterogeneity too over the past decades. Similar patterns show up in cross border capital flows. The data on international bank lending and current account imbalances show that most Northern European countries had an external surplus and were net lenders in the

[1] Marjolin Lecture, February 4, 2016.

international market, whilst Southern European countries mostly ran external deficits and became debtors, particularly prior to the financial crisis.

This paper contributes to the literature through the analysis of the heterogeneity of monetary dynamics across euro area member countries and their possible relation with housing market and equity market developments and cross border credit flows. This is important for three reasons. First, extending monetary analysis by including a broader set of determinants in a money demand framework than standard ones can be helpful to underpin the monetary pillar of the policy framework (Setzer, van den Noord and Wolff., 2011). Second, the analysis helps to understand the divergence across euro area member countries, including housing market and stock market heterogeneity. These divergences may endanger euro area financial stability. Third, the introduction of the euro as a common currency has facilitated large capital flows between countries, with correspondingly larger and more persistent current account imbalances. Strong capital flows to the group of Southern European countries prior to the financial crisis and similarly large outflows after the crisis have contributed to destabilizing effects in financial markets and on government finances.

To shed more light on the relation between money and housing prices, equity prices and cross border financial (credit) flows, we start from a standard money demand framework in which real money demand depends on income and an opportunity costs variable, the nominal interest rate. In turn, we add housing prices, equity prices and net foreign bank lending as an additional variable in the analysis. Since we are interested in the information that a disaggregate perspective may provide, we use a panel set up for 10 original euro area countries using quarterly data for the period 1999-2013. Greece and Luxembourg are excluded for lack of data. In this approach, we impose a homogeneous long-run relation across countries, but allow for heterogeneous short-run dynamics. We acknowledge that the 2008 financial crisis may have had a structural impact on the relation between the variables in our analysis. For this reason, we also investigate two separate sub periods 1999-2008 and 2008-2013.

We find a significantly positive income effect, a significantly negative interest rate effect and a significantly positive housing price effect for the first period, similar to previous research. For equity prices, support is limited. If anything the effect in the first sub period is negative. Complementary to research on the link between net foreign credit and domestic credit, we find a significantly negative link between net foreign credit and domestic money. However, when we

extend our sample to include the financial crisis and its aftermath, structural breaks are observed in the long run money demand function. Especially the interest rate effect changes sign and is positive in the second sub period. There is also some evidence of sign reversals for equity prices and net foreign credit.

Finally, we find evidence of a divide in the long-term money demand relation between the Northern and Southern parts of the euro area. The most pronounced difference regards the interest rate coefficients which have opposite signs for these two groups. It suggests the North-South divide needs to be taken into account when thinking about monetary policy and monetary transmission.

The paper is set up as follows. In section 2, we briefly review the literature on money demand analysis in the euro area. In section 3, we introduce the model and the econometric estimation approach. Data sources and stylized facts of the data are shown in section 4. We present and discuss the empirical results in section 5. Conclusions and suggestions for future research are provided in section 6.

2. Literature review

Money demand theory provides a suitable framework to analyze the relation between money aggregates, the real economy and financial markets. There is a substantial empirical literature using such framework. For the euro area almost all research focuses on euro area wide aggregates and does not pay attention to the information in country-specific developments.

The stability of money demand function plays a dominant role in making appropriate monetary policy. Early demand studies for the euro area as a whole by Coenen and Vega (2001), Calza, Gerdesmeyer and Levy (2001), and Brand and Cassola (2004) employ standard specifications of money demand to provide suggestive evidence of the stability of a long run euro area money demand function[2]. When extended samples are employed, stability of the money demand function receives less support. Later studies typically need to include additional variables such as stock prices, stock price volatility, housing price or cross-country capital flows, to retain money demand stability. Examples are Boone, Mikol and van den Noord (2004), Carstensen (2006), Dreger and

[2] These studies are typically based on the pre-euro period with samples ending in the late nineties. As a consequence, the euro area aggregate is constructed from national series, using specific assumption with respect to the conversion of exchange rates.

Wolters (2009) and De Santis, Favero and Roffia (2013)[3]. Joseph, Larrain and Ottoo (2012) extend the standard money model and provide a theoretical base for the inclusion of domestic and foreign wealth. Friedman (1970, 1988) already suggested that if the demand for money was viewed in a portfolio framework, wealth may be a determinant. Friedman (1988) proposes a wealth effect, a transaction effect and a substitution effect to explain the relationship between money and asset prices.

Adalid and Detken (2007) investigate the relation from another perspective. They identify liquidity shocks using broad monetary aggregates as proxy for 18 OECD countries with historical data, and illustrate that liquidity shocks are a driving factor for real estate prices during boom episodes but not during normal times. More generally, boom and bust cycles in asset markets have historically been strongly associated with large movements in monetary aggregates. Most empirical literature provides evidence on the positive relation between money and house prices. Greiber and Setzer (2007) investigate the relation between money and property prices in the euro area. They show that causality runs in both directions, i.e. a reinforcement mechanism between broad money increases and housing price growth. Other examples are Boone and van den Noord (2008) and Setzer, van den Noord and Wolff (2011). They provide empirical evidence that the housing price is positively related to money growth due to its wealth and transaction effect.

The research on the relation between equity prices and money is relatively scarce compared with that on housing prices. Carstensen (2006) incorporates the equity price spread and volatility in a money demand system using aggregate euro area data. The study explicitly explains the substitution relation between equity and money holdings: the higher return on stocks, the less preference on holding money aggregates. Later studies extend the data sample and provide more consistent evidence on a negative relation between money growth and equity prices. Examples are Boone, van den Noord (2008) and Dreger and Wolters (2009).

Recently, the relation between money and foreign credit has attracted attention. Research provides increasing evidence that persistent current account deficits – and more precisely cross-border bank credit funding these imbalances – in some euro area countries correspond to

[3] Boone et al. (2004), Carstensen (2006) and Dreger and Wolters (2010) identified a structural break at the beginning period of the establishment of the euro area. De Santis et al. (2013) discuss the impact of sovereign debt crisis on the money demand function, but did not find break pressure. Note that most of the literature uses sample periods before 2008 or 2009 and neglect the potential impact of the 2008 Financial Crisis on the money demand function.

excessive asset and real estate booms, see van Ewijk (2013). Kool, de Regt and van Veen (2013) perform panel analysis on individual euro area member countries. They provide empirical evidence that net foreign debts do play a significant role in money growth since the early 2000s. Joseph et al. (2012) theoretically discuss money demand model and extends it by including foreign wealth components. In line with this perspective, De Santis et al. (2013) empirically show that purchases of assets from euro area residents by foreigners result in an increase of broad monetary aggregates.

Only a few studies analyze euro area money demand using the information on country-specific developments of euro area members. Dedola Gaiotti and Silipo (2001) compare aggregate and national money demand estimations in the pre-euro area. Carstensen, Hagen, Hossfeld and Neaves (2009) compare money demand dynamics for the euro area (EMU) as a whole with that of its four largest member countries, Germany, France, Italy and Spain. Nautz and Rondorf (2011), Setzer et al. (2011) and Setzer and Wolff (2013) perform a panel analysis where variables are defined in deviation of the euro area mean, similar to our approach.[4] This latter approach provides more scope for finding a stable money demand function than for the euro area as a whole because possibly disturbing effects of common omitted variables are eliminated from the analysis. In theory, the approach allows for an analysis of heterogeneous monetary developments in euro area member countries. In practice, none of these three studies pay much attention to the consequences of the estimated money demand function for national monetary developments in comparison to the euro area as a whole.

3. Hypothesis and Model

The aim of this paper is to analyze monetary dynamics in the euro area in the period 1999-2013, using a disaggregate panel approach. The heterogeneity of monetary dynamics across euro area member countries may shed light on the relation between money, cross border credit flows and financial asset markets. This is important for three reasons. First, extending the monetary analysis by including a broad set of determinants in a money demand framework can be helpful to underpin the monetary pillar of the policy framework. Second, the analysis helps to understand the divergence across euro area member countries, including housing market and stock market

[4] Note that this is virtually the same as doing a panel analysis with time fixed effects. With time fixed effects the unweighted average across countries is used, where individual countries are included with a different weight in the euro area average.

heterogeneity, which are a potential threat to euro area financial stability. Third, it considers the link between increasing cross-border credit flows, which correspond to the emergence of larger and more persistent current account imbalances since the start of the common currency, and domestic monetary developments.

3.1 Hypotheses

The first issue we want to investigate is the role of asset prices in money creation. In our specification, we only consider a direct link between domestic money and domestic asset markets.[5] The development of monetary aggregates – measured by national contributions to euro area wide M3 – shows considerable heterogeneity across euro area member states since the introduction of the euro (Setzer et al. 2011; Bosker, 2004).[6] House price developments display diversity across euro area countries too. Several countries, like Ireland and Spain, experienced strong growth in house prices. In other countries more moderate increases are observed. Equity prices also show a certain degree of variation in terms of annual growth across member states. The first hypothesis is that the differences in asset price development correspond to the heterogeneity in monetary dynamics.

Asset prices could affect money growth through three channels, i.e. the wealth effect, substitution effect and transaction effect (Friedman, 1988; Stein, 1995; Setzer et al. 2011; Goodhart and Hofmann, 2008). Rises in house and stock prices imply an increase in nominal wealth, which may result in differences between the actual and desired portfolio composition. In turn, the desired portfolio adjustment could lead to a growing demand for money. This is called the wealth effect, through which asset prices have a positive effect on money growth. The substitution effect, also called risk-spreading effect, suggests a negative relation between asset prices and money creation. Lower asset risk or higher expected future revenue makes asset more attractive. It implies a reduced demand for money, a shift from money to assets and rising asset prices (Friedman, 1988). In addition, a rise in asset prices implies an increase in the demand for financial transactions, which may increase the demand for money. This is called the transaction effect which indicates a positive relation between asset prices and money creation. The overall effect of asset prices on

[5] In contrast, Joseph et al. (2012) provides a theoretical discussion about the connection between domestic money demand and foreign asset prices. De Santis et al. (2013) document a stable domestic money demand function by including foreign asset prices for the euro area.
[6] Fig. 1 also shows the heterogeneity in monetary aggregates.

monetary aggregates depends on the relative strength of the three effects.[7] Previous empirical evidence overall suggests a positive sign for housing prices and a negative effect for equity prices.

The second issue we investigate in the paper is the role of net foreign credit in money creation. During the past decades, cross border capital flows display substantial differences across member countries.[8] Borio and Disyatat (2015) and Lane and McQuade (2014) among others link these heterogeneous cross-border capital flows to divergent credit growth across countries. Here, we hypothesize that net foreign credit may be related to money growth as well. More precisely, when domestic commercial banks fund part of their money and credit creation though borrowing from abroad, a negative relation arises between net foreign credit and money growth.

The third issue we address is the potential (in-) stability of the money demand function. This is of great importance in the implementation of monetary policy and the role of monetary aggregates in this policy. Already before 2008, there were indications of instability of the money demand function as documented earlier. In empirical studies that contain data beyond 2001, frequently additional explanatory variables like real estate prices, equity prices or equity volatility are required to find a stable money demand function. On the policy side, the ECB over time lowered the weight of monetary aggregates in its decision-making process due to the perceived unreliability of the standard relation between money growth and inflation. Most of these studies do not use data covering the 2008 financial crisis. Including this disruptive period would be another argument for a structural break in money demand. For this reason, we will analyze monetary dynamics both for the whole period 1999-2013 and the sub periods 1999-2008 and 2008-2013. Note that most empirical studies documenting breaks use aggregate euro area data. For disaggregate data, money demand instability appears to be less of a problem, see Nautz and Rondorf (2011), Setzer, van den Noord and Wolff (2011) and Setzer and Wolff (2013).

3.2 Model

In this paragraph, we provide a brief basis for the empirical specification of the money equation to be estimated. Most theoretical and empirical money demand research (See Ericsson, 1999; Coenen and Vega, 2001, Dreger and Wolters, 2010) starts from a long-run money demand function of the form:

[7] Since we focus on a disaggregate analysis of money demand, we do not explicitly take into account the possible link from money to asset prices. See Blot et al.(2017) for a discussion of this link.
[8] See figure 4.

(1) $M^d/P = f(Y, R, Z)$

Where M^d is some nominal money aggregate, P represents the price level, Y is a scale variable and R is the nominal opportunity cost of holding money. Z is a vector of additional determinants; see Ericsson(1999). Real GDP is the most common scale variable and is expected to exert a positive effect on money demand. In the literature, opportunity cost measures vary from the 3-month money market rate to the 10-year government bond yield and are assumed to have a negative effect on money. Some studies also include a proxy for the "own" rate on money, for which inflation may be used (Dreger and Wolters 2010, 2014; Coenen and Vega, 2001). Additional variables used in the literature comprise proxies for uncertainty or wealth effects, particularly real estate and equity prices.

In our analysis, we start from a standard specification and then include the housing price and the equity price to capture wealth factors, and net foreign credit to account for cross-border dynamics in money market as additional variables.[9] Net foreign credit is defined as the net level of foreign assets (loans) of the domestic banking sector. Intuitively, lending to foreign banks may decrease the scope for domestic money expansion. For asset prices, the sign is ambiguous. Overall, it leads to the following equation (2):

(2) $m_{it} - p_{it} = a_{it} + \beta_{it} y_{it} + \gamma_{it} R_{it} + \theta_{it} Z_{it} + \varepsilon_{it}$

Where *m* equals the log of M3, *p* is the log of the GDP deflator, *y* is the log of real income (GDP), *R* the nominal interest rate. *Z* represents the real housing price, the real equity price, and net foreign credit as a percentage of GDP, respectively. We choose the nominal 10-year government bond rate as the appropriate opportunity costs of money in our analysis. The subscript *i* refers to individual euro area countries, while *t* is the time index. The parameters $\beta_{it} > 0$, $\gamma_{it} < 0$ denote the hypothesized income elasticity, and semi-elasticities with respect to the opportunity cost.

We expect θ_{it} to be positive when Z represents the real house price, as the empirical literature provides evidence that the wealth effect together with transaction effect dominate the substitution effect. We expect θ_{it} to be negative when Z denotes the real equity price. Here, the literature suggests that the substitution effect dominates. Finally, we hypothesize θ_{it} to be negative when Z

[9] Joseph et al. (2012) extends Ericsson (1999) and provides a theoretical background and empirical evidence for foreign credit in a monetary function. They interpret net foreign credit as a component of wealth.

is net foreign credit: the more cross-border capital inflow – borrowing from abroad –the more money in the domestic market.

3.3 Econometric method

In line with Setzer et al.(2011), Boone and van den Noord (2008) and Nautz and Rondorf (2011), we estimate equation (2) by panel co-integration –DOLS— as developed by Kao and Chiang (2001) and Kao (1999). The method assumes common long-run vectors across countries and cross-sectional independence, allows for heterogeneity in the short run dynamics. Alternatively, we could use FMOLS. However, we prefer DOLS as it has a relatively small bias for samples with modest N. We perform the estimation using one lag and one lead, i.e. DOLS(-1,1). In eq.(2), $\varepsilon_{it} = u_i + \epsilon_{it}$ with u_i being the country fixed effects, ϵ_{it} is an error term. Since ϵ_{it} is auto-correlated according to Kao and Chiang(2001), we use the Newey and West(1994) correction. The inclusion of lags and leads improves the efficiency in estimating the panel co-integration vector. All variables are defined in deviations from the cross-sectional mean. The demeaning deletes the common shocks which are the main sources of dependence across the member countries and minimizes the impact of omitted variables. The approach is similar to a specification including time fixed effects. Pesaran and Smith (1995) show that a pooled panel estimation provides unbiased estimates of coefficient means when the coefficients differ randomly. The estimated coefficients in our paper then should be interpreted as the average reaction to the variables.

We use panel estimation for a number of reasons. First, it allows the use of short-run heterogeneity across member countries to bring out the underlying long term determinants of money demand. Second, at the level of the euro area, it is hard to identify a money demand function since monetary aggregates in the euro area may be partly supply driven (Bosker, 2004). However, this is less of an issue at a disaggregating level. Setzer et al. (2011) illustrate that in a common currency union with perfect capital mobility, money can flow wherever it is needed. Therefore, at sub-union levels of aggregation, we do not expect large money supply effects and variations in money aggregates (relative to the monetary union as a whole) should reflect variations in money demand rather than money supply (again relative to the euro area as a whole). Also, in this approach there is less risk of reverse causality from money aggregates onto its determinants in money demand function such as real GDP and financial market prices.

4. **Data**

Our sample contains 10 original member countries in the euro area with a time span from 1999Q1 to 2013Q3. Regarding monetary aggregates, we use the national contribution to overall M3. End of month M3 data are obtained from Datastream and ultimately from national bank statistics. Quarterly data is constructed by taking averages of monthly data. Real and nominal GDP are provided by Eurostat, where the former is defined as chain-linked volumes with 2005 as bench year. We construct the GDP deflator (2005=100) as the ratio of nominal to real GDP multiplied by 100. Real money balances are obtained through dividing nominal M3 by the GDP deflator. In our analysis, real money aggregates and real GDP are expressed in logarithms. The data of opportunity cost, i.e. 10-year government bond yield are from ECB. Quarterly interest rates are period averages and expressed in annual percentages.

With regard to the housing price, quarterly nominal house price data (base year 2010) are obtained from the OECD. The data starts from 2000Q1 to keep panel balance because the data of Austria are not accessible before that. Euro area countries do not provide a consistently defined equity price index. Thus to keep consistency, we employ a Datastream index (base year 1985). We deflate nominal house prices and equity prices by the GDP deflator and express the resulting series in logarithms in the subsequent analysis. Finally, net foreign credit is used. The net foreign credit variable is constructed as the difference of a country's gross cross border asset position and gross cross border liability position. The data are collected from BIS locational banking statistics by residence and denoted in US dollars. For instance, gross foreign asset position of the Netherlands represents the amount of claims that a country's banking sector holds to its counterparties outside the region. Thus the gross liability position is defined as the amount the Netherlands borrow from the rest of the world, including other EA members. Therefore, the net foreign credit is a narrower measure than country's net foreign asset position while includes all cross border items like FDI. Note that the data are converted to be expressed in euros by the contemporaneous dollar/euro exchange rate which is accessible in ECB statistics. In the following analysis the net foreign credit is expressed as a percentage of nominal GDP.

We first illustrate the statistical stylized facts of all variables which are displayed in table 1. All variables are summarized in levels and first differences over the full period 1999-2013 (see Panel A) and two sub-periods, i.e. 1999Q1-2008Q2 (in panel B) and 2008Q3-2013Q3 (in panel C). The stylized facts are a mix of cross sectional variation and time variation. We first focus on the overall

period in panel A. Both money and GDP levels show large and persistent differences across member countries mainly due to differences in size. For net foreign credit cross country variation is also large, though country size is not an obvious determinant of cross-country variation. However, some countries tend to be persistent debtors(borrowers), while others are persistent creditors (savers) due to underlying characteristics, which leads to substantial cross-sectional variation. The two (indexed) asset price variables show relatively low variation. The relatively high variation of the nominal interest rate is mainly caused by the cross-sectional divergence in the second half of the sample. The first difference statistics in panel A show that over the whole period, real GDP growth was about 1.4 percent per year, while real money growth equaled 3.4 percent. On average interest rates remained stable, house prices rose with about 1.5 percent annually and equity prices declined with slightly more than 2 percent per year. Net foreign credit increased slightly too. Variation in equity prices changes was quite large as could be expected. Variation in house price changes is much more subdued and comparable to money growth variation.

Looking at the stylized statistics across the two sub periods in panels B and C, we note quite stable patterns in terms of means and standard deviations for most level variables. The most noteworthy exception is the nominal interest rate which shows a tripling of the standard deviation from the first to the second sub period. Due to the crisis, there is substantial variation across time and countries in interest rate levels after 2008 with overall declines in the Northern European countries and strong rises in the Southern ones. For the first differenced variables, we note average money, real GDP, housing prices and equity prices experienced a substantial decrease from 1999-2008 to 2008-2013. Average annual real money growth dropped from 5 percent to approximately zero. Meantime, real GDP growth fell from an average annual growth of 2.5 percent per year before 2008 to -0.6 percent thereafter. Housing prices on average increased by almost 4 percent per year before the crisis and declined by 2.5 percent after. For equity prices the corresponding percentages are +1.2 and -8 percent. For the nominal long term interest rate and net foreign, the mean change is comparable across the two periods, but variation increases substantially.

To shed more light on the relative contribution of cross-section and time variation, we provide some graphic evidence in figures 1 to 5.[10] Figure 1 shows M3 growth across euro area countries as well as the euro area average growth rate. The band width is quite small at the early stage of the

[10] For presentational purposes, the real house price and the real equity price are rescaled to base year 2005.

establishment of the euro area and then widens to a difference about 30 percent over the time 2007-2008. In the second sub-period it declines somewhat to around 15 percent. The euro area average growth ranges between zero and fifteen percent over the full sample period, and reached to a peak of 12 percent in 2007Q4. The minimum money growth is relatively stable in the first sub-period. While the maximum growth rate across countries changes quite a lot and reaches 27 percent in 2007Q2. In the second sub-period, both the minimum and maximum growth rate decline. Note that average real money growth rate moves roughly with real GDP growth.

In figure 2, we observed the strong homogeneity of long-term nominal interest rates prior to the financial crisis. Virtually all variation until 2008 comes from trend changes over time. After 2008, time variation persists but cross-country variation becomes a dominant factor. Weak countries are perceived to be very risky, leading to strongly rising rates until mid-2012. At the same time, other countries become more attractive as they are seen as a safe haven, leading to lower nominal interest rates. In 2012-13, spreads narrow again though they remain substantially higher than in the early years.

Figure 3 illustrates developments of house prices over the period 2000-2013, with considerable variation across euro area states and time. Due to the index character of this variable with base year 2005, cross country variation in that year is minimal. From 1999 till about 2008, there is an upward house price trend on average, which is predominantly driven by the countries who initially have relatively low prices. In this period, house prices are quite stable in Austria, Belgium and Germany over the sample period. Booms occur in Spain, France, Italy and Ireland before 2006 and in the Netherlands already before 2002. From 2008 housing prices fall on average due to the hit from financial crisis, though there is substantial variation across countries as seen by the fanning out.

Figure 4 shows the movement of equity price across country and time. The picture looks somewhat similar to figure 3 for housing prices. Naturally, there is little cross country variation in the base year 2005. Interestingly, this lack of cross country variation is observed for the whole boom period 2003-2008. All countries experience roughly the same upward trend in equity prices, reflecting strong financial integration. Cross-country variation in the bear markets before 2003 and after 2008 is much greater. The impact of the financial crisis in 2008-09 is clearly visible, as is the stabilization from 2010 onward.

Finally, figure 5 provides evidence on the net foreign credit position across countries and time. The average remains relatively stable, but variation around that is larger than for money growth. In the early years, it is especially Ireland that has a large and increasing positive net foreign credit position, while Portugal has a substantial negative position. Italy and Spain have more moderate negative positions in this period. Between 2004 and 2009, the Irish positive position deteriorates quickly and becomes substantially negative – most likely partly due to its banking crisis – bringing it in the same class as Portugal. After 2009, both Portugal and Ireland are forced to adjust. Finland then becomes the country with the most negative net foreign credit position.

In the next step, we apply unit root tests to check the stationary of the variables which are going to be used in the analysis. This is also a preparation for the panel co-integration analysis. We employ three approaches to test for unit roots. In particular, IPS(Im, Pesaran and Shin, 2003) and Fisher type (Choi,2006) assume different unit root process across panel sections, while LLC(Levin, Lin and Chu, 2002) propose an identical unit root process. All three methods have the null hypothesis of a unit root. A time trend is included in the real GDP and M3 test, while for others it is not. Table 2 illustrates the test results for each variable both in levels and first differences. We used the demeaned variables, which are indicated by an upper bar. In general, it can be concluded that real money, real income, nominal interest rates and net foreign credit are non-stationary and integrated at one order, i.e. I(1). According to the IPS and Fisher tests, house prices and equity prices are I(1), while the LLC results marginally lead to the conclusion that the two are I(0). For the first differences, I(1) is rejected in all cases. In the subsequent co-integration analysis, we assume all level variables to be I(1).

5. Empirical analysis

In section 5.1, we investigate the existence of a long run relation for monetary aggregates. We start with the standard money demand equation and then add the housing price, the equity price and net foreign credit in turn, as formulated in equation (2). We estimate the equation with quarterly data for the whole period 1999-2013 and two sub periods 1999-2008 and 2008-2013, using the default time of Lehmann Brothers at October 2008 as break point in section 5.1.

5.1 Co-integration test

This section first applies a panel co-integration test using the approach proposed by Pedroni (1999). Table 3 provides the statistics of the Phillips Perron group test and ADF test for estimations over the full period and two sub-periods for four sets of specifications. The equation

always includes real GDP and the nominal interest rate. In addition, the housing price, the equity price and net foreign credit will be included in turn. The null hypothesis on no co-integration is rejected for the full period, regardless of the inclusion of one of the three additional variables. In the first sub period, the null hypothesis is strongly rejected when equity prices and net foreign credit are included, but not when housing prices are incorporated. This is consistent with the results of Nautz and Rondorf (2011). In the second sub period, the null hypothesis can be rejected in the ADF test, but it cannot be rejected in the PP test. This may be resulting from the limited observations in this sub period. Given the support for co-integration in the full period and the first sub period, we continue with the estimation of the long run money relationship.

In the following, we apply DOLS to estimate the long run monetary relation using panel co-integration, see Kao and Chiang (2001). We specify a DOLS (-1,1) model, which leads to the equation:

(3) $\overline{y_{it}} = \alpha_i + \beta \overline{x_{it}} + \sum_{j=-1}^{1} \gamma_{it} \Delta \overline{x_{it+j}} + v_{it}$

Where y is real money and x is the vector of explanatory variables (real GDP and nominal interest rate, while housing price, equity price and net foreign credit enter one by one).The upper bar indicates that we are using demeaned variables.

5.2 Panel estimation results

Table 4 contains the results for the standard specification of the money demand equation including real GDP and the nominal interest rate. We only report the long-run coefficient vector β. Standard errors are reported in brackets. The income elasticity is slightly below one and very significant. It is quite stable across sub periods. The estimation result is consistent with monetary theory that the demand for real transactions balances roughly moves proportionally to real income. The interest rate coefficient is significantly positive over the full period. However, the sub period results show that this overall effect is an average of a significantly negative interest effect in the first sub period and a larger positive effect in the second period. We hypothesize that this sign change is primarily due to the financial crisis. Increased sovereign risk in the Southern European countries caused a flight to safety – including an increased demand for money – as well as strongly rising long-term nominal interest rates. To capture this effect, we introduce a time dummy that is zero from 2008Q4 onward and zero before and include both the dummy and the interaction effect of

the dummy with the interest rate in the specification. The last column of table 4 shows the results. It confirms the sign change, though the individual coefficients fail to become significant.

In Table 5, we add real house prices to the specification. The results for income and interest rate are qualitatively similar to the standard specification in table 4. The estimate of the income elasticity appears very robust to the change in specification and remains close to one and significant. The pattern of interest rate coefficients also is the same as before, though with reduced significance. Consistent with the literature, we find a significantly positive house price elasticity both for the full period and the first sub period. In the second sub period, no significant effect is found, most likely due to the heterogeneous housing market developments with only some countries experiencing a severe bust. Including the dummy and interaction terms for the interest rate and the house price only yields significant coefficients for income and the house price.

In Table 6, we report the results when the equity price is included in the specification. We again obtain roughly the same results for the income and interest rate effects. The equity coefficients are insignificant both for the full period and the two sub periods. However, using the dummy and interaction terms for the interest rate and the equity price shows a significantly negative equity price effect before 2008 and a slightly larger positive effect thereafter. Similar to the interest rate effect, there appears to be a structural break in the relation between money and equity prices that is related to the financial crisis period. Our pre-2008 result is consistent with Nautz and Rondorf (2011).

Finally, we turn to the case of net foreign credit as a determinant of money demand. Results are summarized in Table 7. The evidence on income and interest rate effects is similar to previous specifications. With respect to net foreign credit, we find a small significantly negative coefficient both for the whole sample and the first sub period and a small significantly positive effect for the second one. Using the dummy and interaction effects yields the same result. This evidence complements earlier evidence by Lane and McQuade (2014) and Unger (2017), who report a negative relation between cross border credit flows and domestic credit growth. The null hypothesis that debtor countries have more room for domestic money and credit creation while creditor countries have less is confirmed. Our result also supports Joseph et al. (2012), who hypothesize that net foreign credit is a proxy for foreign wealth and as such is a determinant of money demand.

Earlier research on euro area money demand using panel estimation –Nautz and Rondorf (2011), Setzer et al. (2011) and Setzer and Wolff (2013)—typically employs data up till mid-2008. All of these three studies report strongly significant income elasticities in a range from 1 to 1.5. Our income elasticities are on the bottom of this range. With respect to interest rate coefficients, both Nautz and Rondorf (2011), and Setzer and Wolff (2013) use long term rates and report significantly negative interest rate coefficients, similar to ours. Setzer et al. (2011) use the short term interest rate and only find insignificant effects. Overall, our first period results are in line with other research using a disaggregate panel approach. None of these studies uses housing prices, equity prices and net foreign credit as explanatory variables. However, our finding for the first sub period that housing prices are positively related to real money, while for equity prices the link is negative is consistent with the empirical time series literature.

Obviously, the second period results show sign changes in the nominal interest rate, housing prices, equity prices and net foreign credit. This suggests a change in the relation around the time of global financial crisis. Given the impact of the crisis on the operation of the monetary and financial system, such change is not implausible. A full analysis of the underlying determinants of this changes is beyond the scope of this paper. However, both the divergence in sovereign bond yields due to default risk premiums, new rules for micro-prudential and macro-prudential regulations and the start of unconventional monetary policies by the ECB may have play a role.

5.3 The North vs the South

The North-South divide in the euro area is well-known, with the South having relatively low productivity and per capita income, and being net debtors in international markets, see for instance Holinski et al. (2012). Due to the different welfare systems, the housing market has different characteristics as well in South and North (Allen et al. 2008). In our sample, we define the group of Northern countries as Austria, Belgium, Finland, France, Germany and the Netherlands and the group of Southern countries as Ireland, Italy, Portugal and Spain. Given the heterogeneity across the two groups and the homogeneity within each group, we re-run our panel estimation for the two groups separately. Some points stand out.

Panel A of Table 8 contains results for Northern countries, while panel B contains those for the Southern countries. For ease of exposition, we only report the results for the full sample period

including the dummy and interaction effects.[11] Overall, we still observe income elasticities close to unity. For the North they tend to be slightly above one and for the South somewhat below. However, judged by the standard error of the coefficients, the difference is insignificant. The interest rate pattern in North appears opposite to that in South, where the results for South are relatively close to the previous full sample results. For the South, we find a significantly negative coefficient for the first sub period and a positive interaction effect for the second period of almost the same size. This implies an overall interest rate effect close to zero for the second period. Unreported sub period results show a small but significantly negative effect in the second sub period. For the North, the first period effect is significantly positive which is almost offset by the negative interaction effect in the second period. It leads to a small but significant positive effect in the second sub period. The opposite interest rate effects form a puzzle that goes beyond the scope of this paper and is left for future research.

Housing price effects are positive and significant in the North – as was the case for the full sample – and insignificant in the South. Equity price effects are significant and positive in both North and South, where the effect is twice as large in North. For the full sample, we observed negative effects in the first sub period and positive ones in the second. For net foreign credit, the results for North and South are qualitatively similar though the size of the effect is somewhat larger in the South. Moreover, the observed pattern is the same as for the full sample, with a negative coefficient in the first sub period and a somewhat larger positive one in the second.

Overall, we conclude that income and net foreign credit effects are relatively insensitive to the North-South divide. Also, we see the importance of accounting for a structural break in both North and South. However, the distinction between North and South appears important because of the difference in the impact of housing prices and equity prices, and even more so because of the opposite interest rate effects. It suggests the North-South divide needs to be taken into account when thinking about monetary policy and monetary transmission.

5.4 Robustness checks

To check the sensitivity of our results, we perform three more robustness checks. First, we exclude the biggest economy—Germany—in the euro area which may be seen as an anchor country in monetary policy. Second, we reduce the number of countries in our sample by excluding the two

[11] The broader set of results is available upon request. It leaves the conclusions qualitatively unchanged.

countries with the highest real money growth rate during the whole period—Ireland and France—and the two countries —Belgium and Portugal – with the lowest average money growth to check whether these extremes have a dominant influence on the results. Third, we apply GLS instead of DOLS to check for the importance of cross-sectional dependence. The corresponding results are displayed in tables A1-A3 in the Appendix. In general, it gives us consistent results with our main estimation. That is, we still find i) a robust income elasticity close to unity; ii) an interest rate effect that tends to be negative in the first sub period and positive in the second one; iii) a positive relation between housing prices and money growth; iv) a weakly negative link between equity prices and money growth; v) a negative relation between the net foreign asset position and real money growth; and vi) a structural break in the long run money relation around 2008 which shows up not only in the interest rate coefficient, but also in the sign of the housing price, equity price, and net foreign credit coefficients. None of these additional robustness checks shows the sort of sensitivity as was displayed by the North-South division. It reinforces the view that particularly the North-South heterogeneity deserves further attention.

6. Conclusion

In the wake of the recent financial crisis, the development of money and credit aggregates has received increasing attention academically and in monetary policy. For the euro area, interest in monetary dynamics has an extra dimension as strong cross country heterogeneity in money and credit growth as well as real estate markets has been observed since the start of the euro, regardless of the common monetary policy implemented by the ECB.

In this paper we intend to contribute to the understanding of the relation between real economic developments and monetary aggregates. We employ panel data of 10 member countries of the euro area over the period 1999-2013 to exploit the heterogeneity across the member countries. More in particular, we investigate to what extent wealth effects, proxied by real house prices and real equity prices, play a role in money demand, whether cross border bank credit flows play a role in the development of domestic money and whether the financial crisis has affected the stability of money demand reported in the literature prior to the crisis. For the analysis, we start with a standard framework where money demand depends on income and the nominal interest rate. In turn, we add three extra determinants, housing prices, equity prices and net foreign credit respectively.

We employ a panel co-integration methodology which is proposed by Kao and Chiang (2001) to analyze the determinants of monetary dynamics in the euro area member countries. It allows us to exploit a homogenous long run money relation while considering the heterogeneity across countries as well. During the empirical analysis, all variables are measured in deviation from their euro area average to reduce cross-sectional dependence and omitted variable bias. We estimate for the whole period from 1999-2013 as well as two sub periods, namely 1999-2008 and 2008-2013. As an alternative to the sub period estimation, we introduce a crisis dummy and interaction effects for a full sample analysis.

For the period up till 2008 our evidence is similar to earlier research. That is, we find a significantly positive income effect, a significantly negative interest rate effect and a significantly positive housing price effect. For equity prices, support is limited. If anything the effect in the first sub period is negative. Complementary to research on the link between net foreign credit and domestic credit, we find a significantly negative link between net foreign credit and domestic money.

However, when we extend our sample to include the financial crisis and its aftermath, structural breaks are observed in the long run money demand function. Especially the interest rate effect changes sign and is positive in the second sub period. There is also some evidence of sign reversals for equity prices and net foreign credit. The estimated income elasticity is stable and robust and remains close to one – consistent with transactions theories of money demand – independent of the inclusion of wealth variables, the choice of sample period or the set of countries in the sample.

Finally, we find evidence of a divide in the long-term money demand relation between the Northern and Southern parts of the euro area. The most pronounced difference regards the interest rate coefficients which have opposite signs for these two groups. This puzzling result suggests the North-South divide needs to be taken into account when thinking about monetary policy and monetary transmission. Clearly, this is beyond the scope of this paper. It is therefore left for future research.

7. References

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Table 1 Stylized statistics

Panel A 1999Q1-2013Q3

Var.	Level						First differenced					
	unit	Obs.	Mean	Std.	Min	Max	unit	Obs.	Mean	Std.	Min	Max
m	Real money aggregates, logarithm	590	8.32	1.01	6.53	9.94	% per quarter	580	0.88	2.04	-7.30	15.37
y	Real GDP, logarithm	590	11.71	1.00	10.29	13.35	% per quarter	580	0.35	1.11	-5.46	6.00
i^l	Nominal long term interest rate, %	590	4.32	1.29	1.37	13.22	Percentage points	580	-0.01	0.40	-1.84	2.53
hpi	Real house price index, logarithm	586	-0.14	0.20	-0.71	0.43	% per quarter	576	0.37	1.89	-8.89	6.83
eqi	Real equity price, logarithm	590	2.11	0.82	0.03	3.76	% per quarter	580	-0.55	11.20	-42.00	49.27
nfc	Net foreign credit, % GDP	590	7.45	22.84	-59.49	62.55	Percentage points	580	0.16	5.61	-57.22	49.74

Panel B 1999Q1-2008Q2

Var.	Level						First differenced					
	unit	Obs.	Mean	Std.	Min	Max	unit	Obs.	Mean	Std.	Min	Max
m	Real money aggregates, logarithm	380	8.21	1.01	6.53	9.85	% per quarter	370	1.38	1.80	-5.81	9.18
y	Real GDP, logarithm	380	11.68	1.01	10.29	13.32	% per quarter	370	0.63	0.92	-5.10	6.00
i^l	Nominal long term interest rate, %	380	4.44	0.65	3.15	5.73	Percentage points	370	0.01	0.28	-0.51	0.91
hpi	Real house price index, logarithm	376	-0.17	0.23	-0.71	0.43	% per quarter	366	0.95	1.63	-8.89	6.83
eqi	Real equity price, logarithm	380	2.22	0.84	0.18	3.76	% per quarter	370	0.29	9.90	-10.19	49.27
nfc	Net foreign credit, % GDP	380	5.40	20.88	-52.36	57.14	Percentage points	370	0.10	4.46	-57.22	23.93

Panel C 2008Q2-2013Q3

Var.	Level						First differenced					
	unit	Obs.	Mean	Std.	Min	Max	unit	Obs.	Mean	Std.	Min	Max
m	Real money aggregates, logarithm	210	8.52	0.98	7.06	9.94	% per quarter	210	0.00	2.15	-7.30	15.37
y	Real GDP, logarithm	210	11.76	1.00	10.51	13.35	% per quarter	210	-0.15	1.23	-5.46	3.89
i^l	Nominal long term interest rate,%	210	4.11	1.97	1.37	13.22	Percentage points	210	-0.06	0.55	-1.84	2.53
hpi	Real house price index, logarithm	210	-0.09	0.10	-0.45	0.33	% per quarter	576	-0.63	1.89	-7.98	3.88
eqi	Real stock price, logarithm	210	1.90	0.74	0.03	3.15	% per quarter	580	-2.02	13.08	-42.22	24.39
nfc	Net foreign credit, % GDP	210	11.15	26.65	-59.49	62.55	Percentage points	210	0.26	7.21	-41.45	49.74

Table 2 Unit root test

level						
	$\bar{m}$	$\bar{y}$	$\bar{\imath}$	$\overline{\text{hpı}}$	$\overline{\text{eqı}}$	$\overline{\text{nfc}}$
IPS	3.86(0.99)	2.10(0.98)	1.95(0.97)	1.79(0.96)	-0.84(0.20)	-1.31(0.10)
ADF	-2.45(0.99)	-1.84(0.97)	-0.83(0.80)	-0.07(0.53)	-0.57(0.72)	0.61(0.27)
PP	-2.86(0.99)	-1.69(0.95)	-1.64(0.95)	-2.18(0.99)	1.28(0.10)	0.52(0.30)
LLC	1.85(0.97)	-0.41(0.34)	2.03(0.98)	-1.62(0.05)	-1.34(0.09)	-1.30(0.10)
First differenced						
IPS	-11.00(0.00)	-4.82(0.00)	-9.90(0.00)	-4.38(0.00)	-18.84(0.00)	-18.26(0.00)
ADF	2.96(0.01)	8.03(0.00)	9.30(0.00)	2.42(0.01)	19.12(0.00)	9.77(0.00)
PP	38.30(0.00)	31.42(0.00)	31.44(0.00)	34.97(0.00)	68.65(0.00)	74.96(0.00)
LLC	-6.90(0.00)	-14.75(0.00)	-6.47(0.00)	-5.01(0.00)	-15.59(0.00)	-19.17(0.00)

NOTE:

a. For the unit root test on M3 and GDP, a time trend is included.

b. The null hypothesis of IPS, FISHER and LLC is that all panels contain a unit root, the alternative hypothesis is that some panels are stationary. p-values are in parentheses.

Table 3 Panel co-integration test

Time span	1999-2013		1999-2008		2008-2013	
	Group PP	Group ADF	Group PP	Group ADF	Group PP	Group ADF
$\bar{y}$, $\bar{\imath}^l$	-2.91(0.00)	-2.57(0.01)	-3.28(0.00)	-2.29(0.01)	0.79(0.79)	-2.70(0.00)
$\bar{y}$, $\bar{\imath}^l$,$\overline{HPI}$	-1.10(0.13)	-1.66(0.05)	-0.75(0.23)	-1.03(0.15)	0.85(0.80)	-3.29(0.00)
$\bar{y}$, $\bar{\imath}^l$,$\overline{EQI}$	-1.94(0.03)	-1.54(0.06)	-2.54(0.00)	-2.11(0.03)	1.13(0.87)	-3.26(0.00)
$\bar{y}$, $\bar{\imath}^l$,$\overline{NFC}$	-2.55(0.01)	-2.00(0.02)	-3.95(0.00)	-2.48(0.01)	0.42(0.66)	-1.92(0.03)

Note: p-values are in parentheses.

Table 4 Long-run money demand: standard specification

Model	$\bar{y}$, $\bar{\imath}^l$			
Period	1999-2013	1999-2008	2008-2013	1999-2013
$\bar{y}$	0.985***	0.984***	0.981***	0.985***
	[0.273]	[0.361]	[0.321]	[0.273]
$\bar{\imath}^l$	0.018***	-0.042	0.019***	-0.013
	[0.006]	[0.038]	[0.004]	[0.035]
$\bar{\imath}^l$ *DUM				0.031
				[0.035]

Note: standard errors are in brackets. ***, **, * indicate significance at 1, 5, 10% level, respectively.

Table 5 Long-run money demand: including house prices

Model	$\bar{y}$, $\bar{\imath}^l$, $\overline{hpi}$			
Period	2000-2013	2000-2008	2008-2013	2000-2013
$\bar{y}$	0.988***	0.984**	0.971***	0.987***
	[0.278]	[0.385]	[0.305]	[0.278]
$\bar{\imath}^l$	0.017***	-0.045	-0.008**	-0.010
	[0.005]	[0.049]	[0.004]	[0.043]
$\bar{\imath}^l$ *DUM				0.025
				[0.043]
$\overline{hpi}$	0.153**	0.226*	-0.007	0.170**
	[0.078]	[0.120]	[0.076]	[0.085]
$\overline{hpi}$ *DUM				-0.025
				[-0.090]

Note: standard errors are in brackets. ***, **, * indicate significance at 1, 5, 10% level, respectively.

Table 6 Long-run money demand: including equity prices

Model	$\bar{y},\ \bar{\imath}^{l}, \overline{eqi}$			
Period	1999-2013	1999-2008	2008-2013	1999-2013
$\bar{y}$	0.991***	0.998**	0.972***	0.990***
	[0.266]	[0.361]	[0.351]	[0.243]
$\bar{\imath}^{l}$	0.017***	-0.032	0.023***	-0.018
	[0.006]	[0.039]	[0.004]	[0.030]
$\bar{\imath}^{l}$ *DUM				0.042
				[0.031]
$\overline{eqi}$	-0.027	-0.057	0.049	-0.057*
	[0.035]	[0.045]	[0.063]	[0.032]
$\overline{eqi}$ *DUM				0.097***
				[0.020]

Note: standard errors are in brackets. ***, **, * indicate significance at 1, 5, 10% level, respectively.

Table 7 Long-run money demand: including net foreign credit

Model	$\bar{y},\ \bar{\imath}^{l}, \overline{nfc}$			
Period	1999-2013	1999-2008	2008-2013	1999-2013
$\bar{y}$	0.989***	0.997***	0.972***	0.991***
	[0.265]	[0.340]	[0.314]	[0.263]
$\bar{\imath}^{l}$	0.018***	-0.167***	0.014***	-0.172***
	[0.006]	[0.036]	[0.004]	[0.033]
$\bar{\imath}^{l}$ *DUM				0.191***
				[0.033]
$\overline{nfc}$	-0.001**	-0.003***	0.002***	-0.003***
	[0.000]	[0.000]	[0.000]	[0.000]
$\overline{nfc}$ *DUM				0.004***
				[0.000]

Note: Standard errors are in brackets. ***, **, * indicate significance at 1, 5, 10% level, respectively.

Table 8 Panel co-integration for Northern European countries

Panel A: Northern European countries				
Model	$\bar{y}, \bar{\imath}^l$	$\bar{y}, \bar{\imath}^l, \overline{hp\imath}$	$\bar{y}, \bar{\imath}^l, \overline{eq\imath}$	$\bar{y}, \bar{\imath}^l, \overline{nfc}$
Period	99-13	00-13	99-13	99-13
$\bar{y}$	1.027***	1.043***	1.020***	1.027***
	[0.280]	[0.294]	[0.287]	[0.285]
$\bar{\imath}^l$	0.303***	0.091***	0.232***	0.221***
	[0.031]	[0.031]	[0.022]	[0.021]
$\bar{\imath}^l$ *DUM	-0.283***	-0.064**	-0.178***	-0.193***
	[0.032]	[0.031]	[0.023]	[0.023]
$\bar{Z}^b$		0.471***	0.292***	-0.001***
		[0.071]	[0.049]	[0.000]
$\bar{Z}^b$ *dum				0.002***
				[0.000]
Panel B: Southern European countries				
Model	$\bar{y}, \bar{\imath}^l$	$\bar{y}, \bar{\imath}^l, \overline{hp\imath}$	$\bar{y}, \bar{\imath}^l, \overline{eq\imath}$	$\bar{y}, \bar{\imath}^l, \overline{nfc}$
Period	99-13	00-13	99-13	99-13
$\bar{y}$	0.930**	0.932**	0.931***	0.962**
	[0.432]	[0.464]	[0.315]	[0.401]
$\bar{\imath}^l$	-0.476***	-0.449***	-0.483***	-0.770***
	[0.141]	[0.142]	[0.099]	[0.133]
$\bar{\imath}^l$ *DUM	0.472***	0.442***	0.485***	0.791***
	[0.141]	[0.142]	[0.098]	[0.133]
$\bar{Z}^b$		0.083	0.147**	-0.004***
		[0.145]	[0.068]	[0.000]
$\bar{Z}^b$ *dum				0.005***
				[0.000]

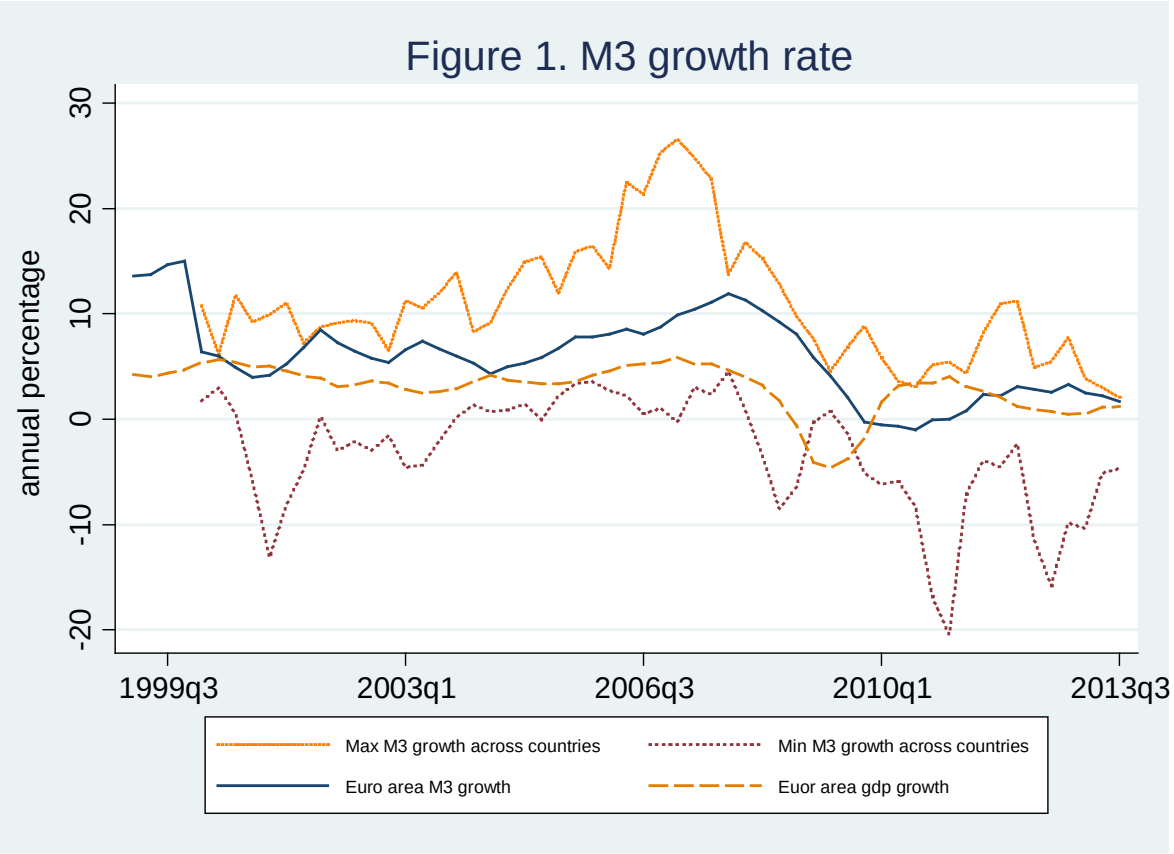

Figure 1. Monetary annual growth rate.
Data source: ECB statistics, growth rates are own calculation
Sample period: 1999q1-2013q3

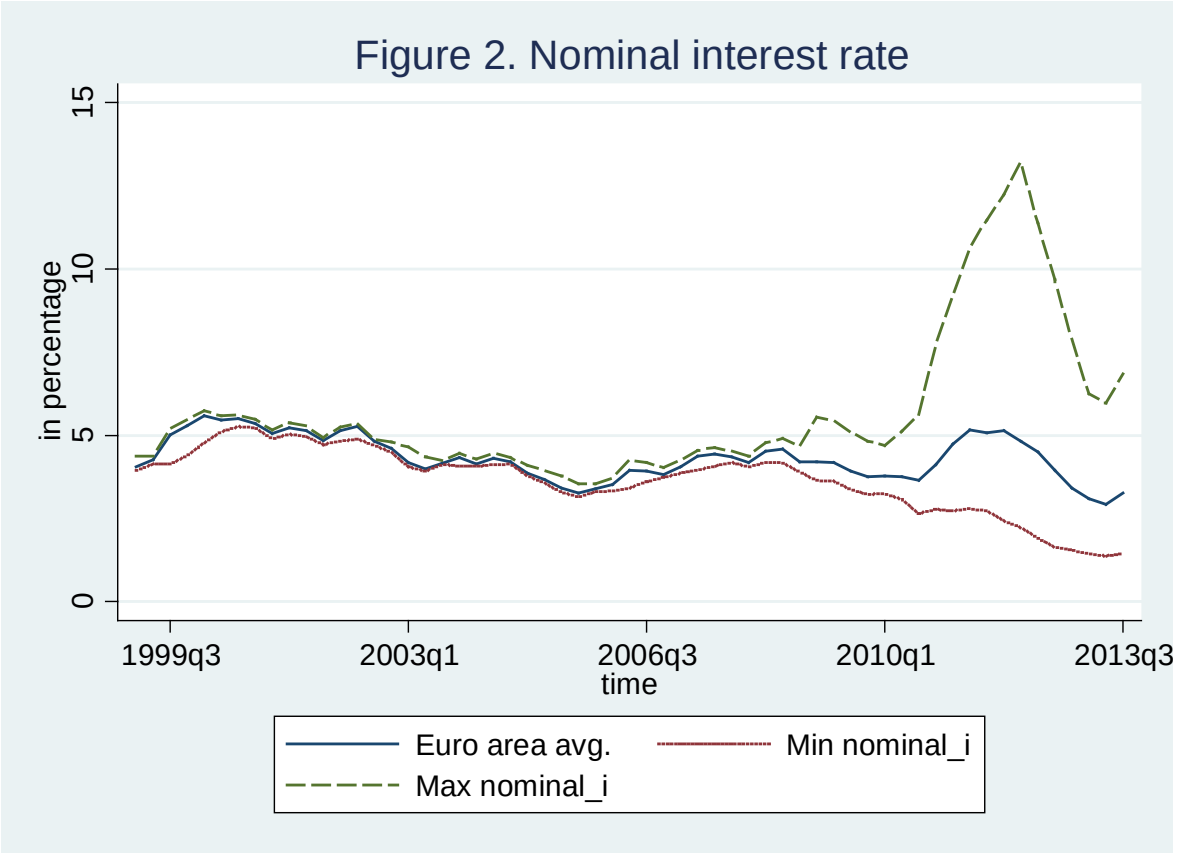

Figure 2. Nominal interest rate

Date source: ECB statistics, max, min and average rate are own calculation

Sample period: 1999q1-2013q3

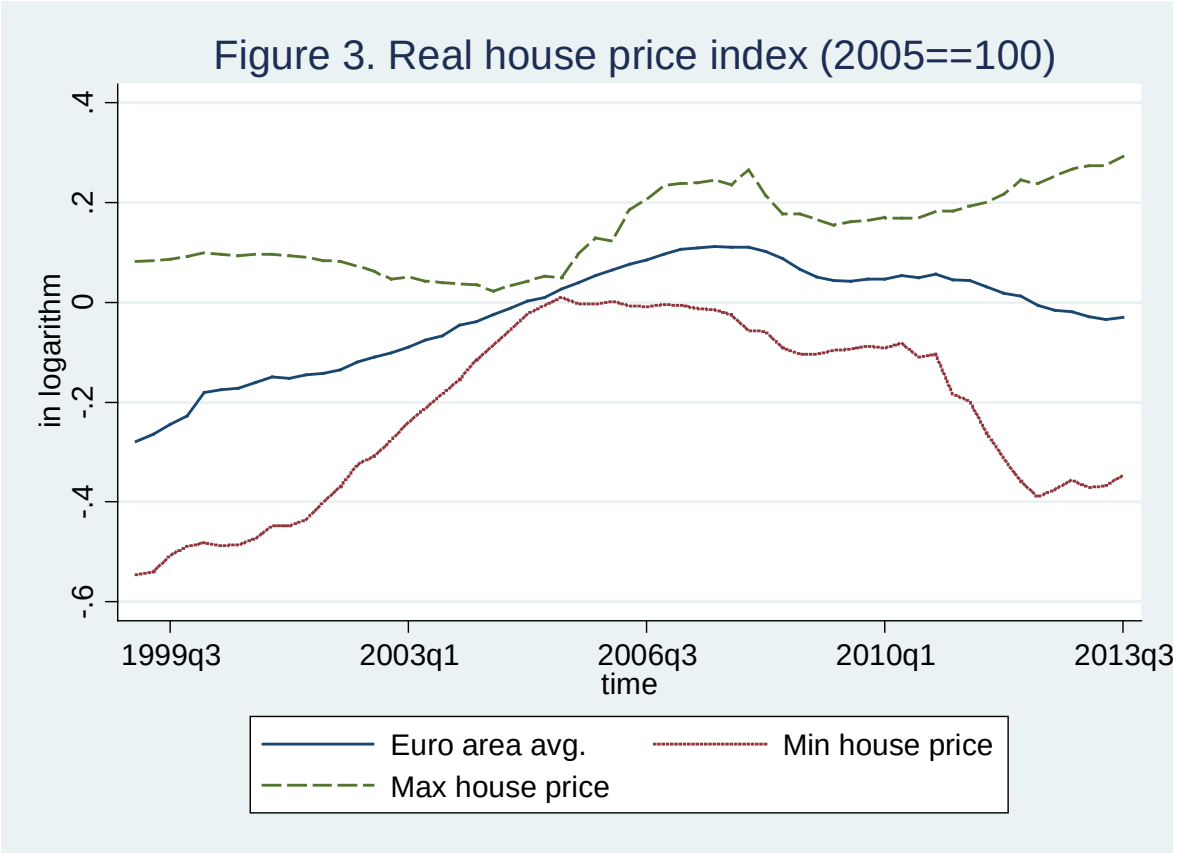

Figure 3. Real house price index (base year 2005)
Data source: OECD statistics
Sample period: 2000q1-2013q3

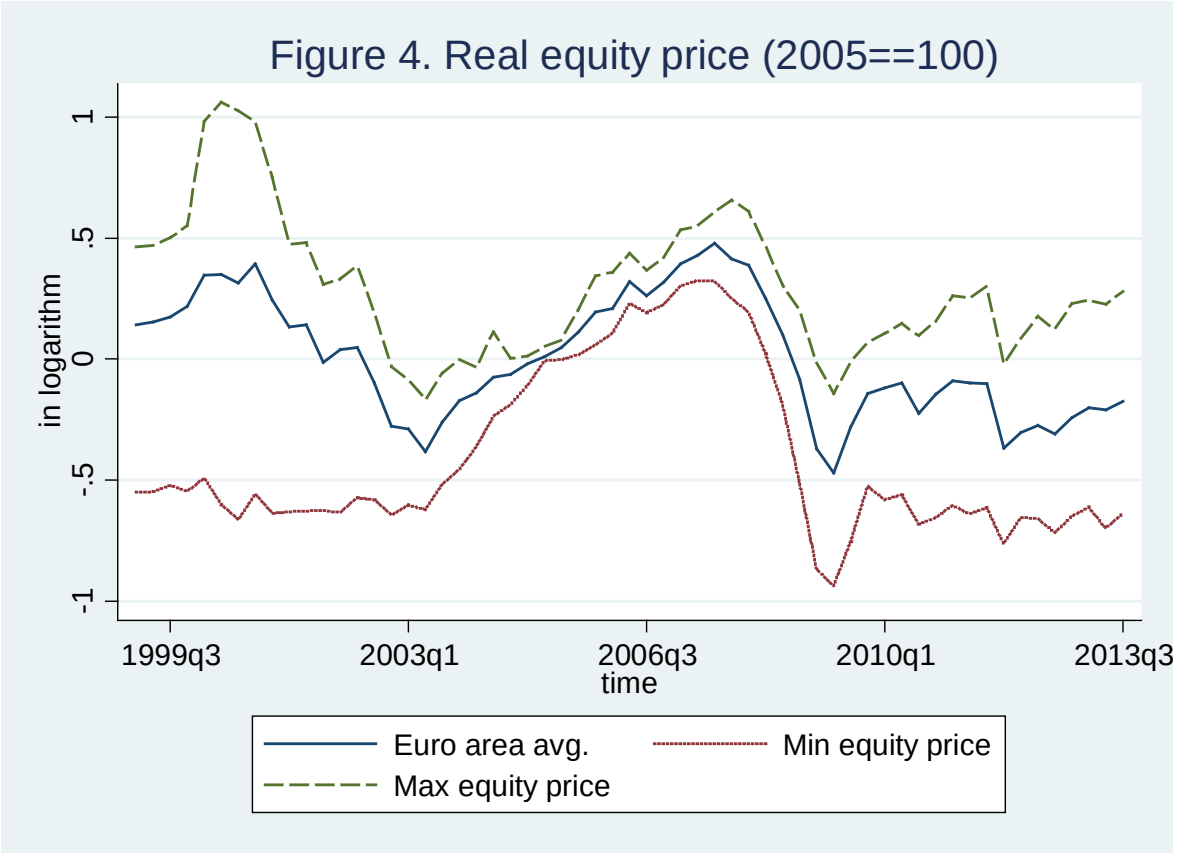

Figure4. Real equity price (base year 2005)
Data source: Datastream
Sample period: 1999q1-2013q3

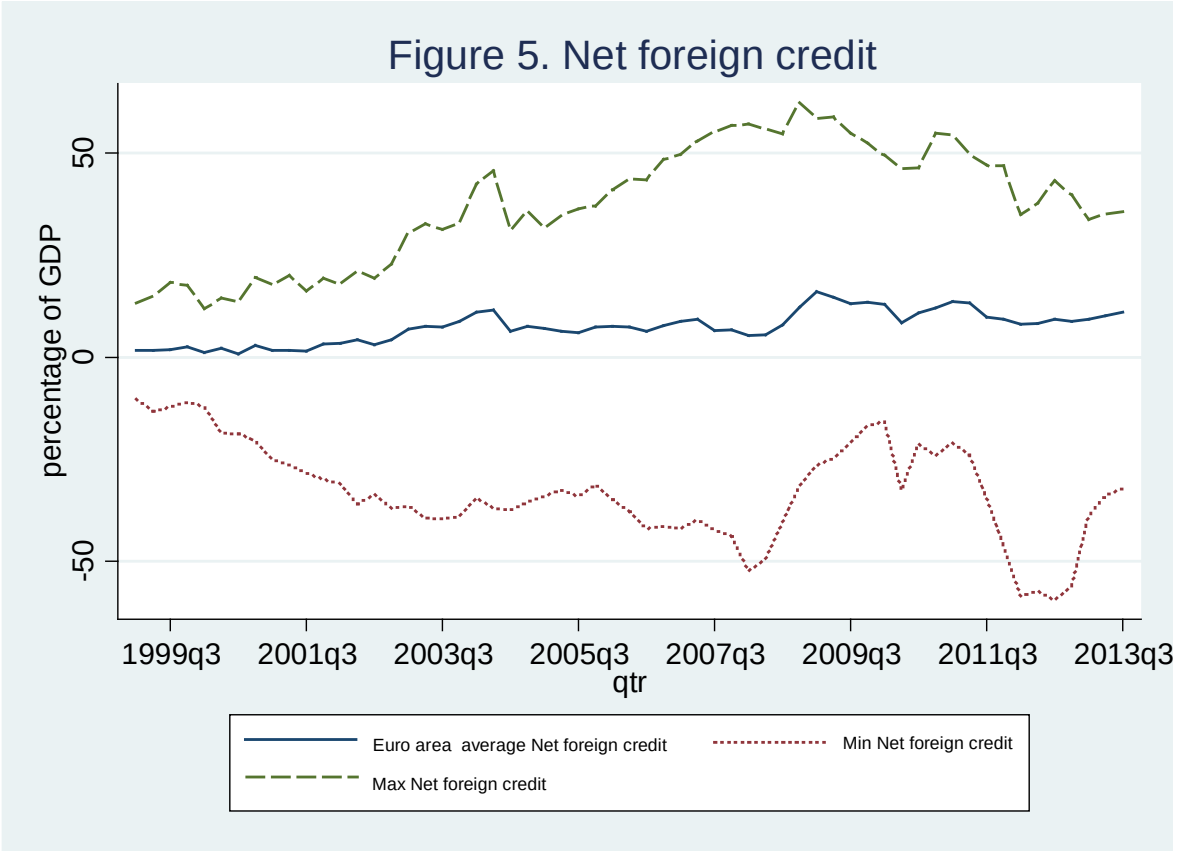

Figure 5. Net foreign credit
Data source: BIS locational bank statistics; net position own calculations
Sample period: 1999q1-2013q3

Appendix

Table A1 Robustness dropping DEU

Panel A													
Model	$\bar{y}, \bar{\imath}^l$			$\bar{y}, \bar{\imath}^l, \overline{hpi}$			$\bar{y}, \bar{\imath}^l, \overline{eqi}$			$\bar{y}, \bar{\imath}^l, \overline{nfc}$		
Period	99-13	99-08	08-13	00-13	00-08	08-13	99-13	99-08	08-13	99-13	99-08	08-13
$\bar{y}$	1.008***	1.006***	1.010***	1.020***	1.027**	0.992***	1.027***	1.041***	1.005***	1.008***	1.012***	1.012***
	[0.299]	[0.376]	[0.351]	[0.326]	[0.426]	[0.330]	[0.292]	[0.371]	[0.383]	[0.290]	[0.348]	[0.341]
$\bar{\imath}^l$	0.015**	-0.342**	0.019***	0.005	-0.470***	-0.005	0.012*	-0.471***	0.020***	0.014**	-0.602***	0.011***
	[0.006]	[0.142]	[0.004]	[0.006]	[0.150]	[0.004]	[0.006]	[0.151]	[0.004]	[0.006]	[0.131]	[0.004]
$\bar{Z}^b$				0.193*	0.225	0.100	-0.051	-0.088*	0.023	-0.000	-0.003***	0.003***
				[0.108]	[0.158]	[0.080]	[0.038]	[0.047]	[0.066]	[0.000]	[0.000]	[0.000]

Panel B				
Model	$\bar{y}, \bar{\imath}^l$	$\bar{y}, \bar{\imath}^l, \overline{hpi}$	$\bar{y}, \bar{\imath}^l, \overline{eqi}$	$\bar{y}, \bar{\imath}^l, \overline{nfc}$
Period	99-13	00-13	99-13	99-13
$\bar{y}$	1.009***	1.022***	1.027***	1.014***
	[0.294]	[0.321]	[0.263]	[0.281]
$\bar{\imath}^l$	-0.265**	-0.414***	-0.346***	-0.563***
	[0.114]	[0.116]	[0.076]	[0.109]
$\bar{\imath}^l$ *DUM	0.281**	0.420***	0.367***	-0.573***
	[0.113]	[0.116]	[0.076]	[0.108]
$\bar{Z}^b$		0.206*	-0.083**	-0.003***
		[0.106]	[0.034]	[0.000]
$\bar{Z}^b$ *dum			0.097***	0.006***
			[0.021]	[0.000]

Table A2 Robustness excluding IE FR BE PT

Panel A													
Model	$\bar{y}, \bar{\imath}^l$			$\bar{y}, \bar{\imath}^l, \overline{hpi}$			$\bar{y}, \bar{\imath}^l, \overline{eqi}$			$\bar{y}, \bar{\imath}^l, \overline{nfc}$		
Period	99-13	99-08	08-13	00-13	00-08	08-13	99-13	99-08	08-13	99-13	99-08	08-13
$\bar{y}$	1.041***	1.054***	1.021***	1.035***	1.036**	1.023***	1.046***	1.056***	1.022***	1.043***	1.044***	1.004***
	[0.229]	[0.376]	[0.298]	[0.242]	[0.411]	[0.314]	[0.231]	[0.371]	[0.240]	[0.223]	[0.336]	[0.306]
$\bar{\imath}^l$	-0.003	-0.179***	-0.006	-0.013*	-0.088***	-0.085***	-0.003	-0.150***	-0.004	-0.011	-0.325***	-0.001
	[0.008]	[0.023]	[0.007]	[0.007]	[0.022]	[0.007]	[0.008]	[0.023]	[0.006]	[0.008]	[0.021]	[0.008]
$\bar{Z}^b$				0.055	0.359***	-0.505***	-0.040*	-0.025	-0.027	-0.002**	-0.003***	0.001**
				[0.061]	[0.102]	[0.070]	[0.023]	[0.030]	[0.048]	[0.000]	[0.000]	[0.000]

Panel B					
Model	$\bar{y}, \bar{\imath}^l$	$\bar{y}, \bar{\imath}^l, \overline{hpi}$	$\bar{y}, \bar{\imath}^l, \overline{eqi}$	$\bar{y}, \bar{\imath}^l, \overline{nfc}$	
Period	99-13	00-13	99-13	99-13	
$\bar{y}$	1.040***	1.042***	1.044***	1.032***	
	[0.229]	[0.274]	[0.243]	[0.223]	
$\bar{\imath}^l$	-0.172***	-0.106***	-0.148***	-0.344***	
	[0.018]	[0.020]	[0.020]	[0.018]	
$\bar{\imath}^l$ *DUM	0.173***	0.068***	0.146***	0.343***	
	[0.020]	[0.021]	[0.021]	[0.000]	
$\bar{Z}^b$		0.242***	-0.032	-0.004***	
		[0.083]	[0.024]	[0.000]	
$\bar{Z}^b$ *dum		-0.870***		0.004***	
		[0.119]		[0.000]	

Table A3 GLS with deviation variables, 10 country sample

Panel A												
Model	$\bar{y}, \bar{\imath}^l$			$\bar{y}, \bar{\imath}^l, \overline{hpi}$			$\bar{y}, \bar{\imath}^l, \overline{eqi}$			$\bar{y}, \bar{\imath}^l, \overline{nfc}$		
Period	99-13	99-08	08-13	00-13	00-08	08-13	99-13	99-08	08-13	99-13	99-08	08-13
$\bar{y}$	0.987***	0.986***	0.983***	0.981***	0.981***	0.982***	1.013***	1.018***	0.943***	1.001***	1.021***	0.966***
	[0.005]	[0.007]	[0.008]	[0.006]	[0.008]	[0.008]	[0.007]	[0.009]	[0.008]	[0.005]	[0.005]	[0.008]
$\bar{\imath}^l$	0.008*	-0.103**	0.010***	0.012**	-0.080	0.009**	0.001	-0.095*	0.013***	0.014***	0.004	0.003
	[0.005]	[0.041]	[0.004]	[0.005]	[0.068]	[0.004]	[0.005]	[0.051]	[0.004]	[0.004]	[0.030]	[0.004]
$\bar{Z}^b$				0.026	0.025	-0.056	-0.062***	-0.087***	0.057***	-0.002***	-0.004***	0.000
				[0.033]	[0.040]	[0.093]	[0.007]	[0.007]	[0.010]	[0.000]	[0.000]	[0.000]

Panel B				
Model	$\bar{y}, \bar{\imath}^l$	$\bar{y}, \bar{\imath}^l, \overline{hpi}$	$\bar{y}, \bar{\imath}^l, \overline{eqi}$	$\bar{y}, \bar{\imath}^l, \overline{nfc}$
Period	99-13	00-13	99-13	99-13
$\bar{y}$	0.986***	0.986***	1.005***	1.008***
	[0.005]	[0.006]	[0.007]	[0.005]
$\bar{\imath}^l$	-0.038	-0.018	-0.027	0.019***
	[0.046]	[0.050]	[0.052]	[0.005]
$\bar{\imath}^l$ *DUM	0.046	0.027	0.038	
	[0.045]	[0.050]	[0.052]	
$\bar{Z}^b$		-0.008	-0.074***	-0.003***
		[0.029]	[0.008]	[0.000]
$\bar{Z}^b$ *dum			0.048***	0.002***
			[0.013]	[0.000]