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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Spillovers of monetary policy across borders: International lending of Dutch banks, insurers and pension funds [*]

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Abstract

We analyze the relationship between ECB monetary policy and international lending by Dutch financial institutions. Our results suggest that banks hardly change their foreign lending in response to policy changes. We find some evidence in support of the portfolio channel (in response to a contractionary shock, better capitalized banks increase their foreign lending less than banks with lower capital) and the bank lending channel (larger banks lend more after a contractionary shock than small banks). Insurers and pension funds do not respond to ECB monetary policy, but increase lending when banks in the host country are constrained by prudential regulation.

Keywords: Monetary policy, international banking, pension funds, insurers, spillovers

JEL classifications: F42, F44, G15, G21

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1. Introduction

Monetary policy is a powerful instrument. It can have far-reaching effects on asset prices, exchange rates, and other financial variables, and on financial institutions' risk-taking behavior, and through these transmission channels on output and prices. The financial effects at the domestic level are the subject of substantial research (cf. Bernanke and Blinder, 1992; and Kashyap and Stein, 2000), but also the financial effects of monetary policy at the international level are increasingly scrutinized (see, for example, Bruno and Shin, 2012; Cetorelli and Goldberg, 2012; Avdjiev et al., 2016; Gagnon et al., 2017; and Nsafoah and Serletis, 2018). If monetary policy affects foreign lending by domestic financial institutions, then monetary policy may have spillover effects on financial conditions in other countries.

However, recent studies come to conflicting results regarding both the size and even the direction of the effects of monetary policy on foreign bank lending. For example, Temesvary et al. (2018) find evidence that monetary easing (tightening) of the Federal Reserve's policy is associated with greater (reduced) lending by U.S. banks abroad, which they attribute to the bank lending channel (Bernanke and Gertler, 1995), whereby especially liquidity-constrained banks are able to use central bank liquidity to fund new loans. For a larger country sample, Bruno and Shin (2015) use a VAR framework to show that a contractionary U.S. monetary policy shock leads to a decrease of cross-border lending and of leverage of international banks. Bremus and Fratzscher (2015) find that expansionary monetary policy since the crisis has supported cross-border lending, both inside and outside the euro area, while tighter prudential regulation has constrained such lending. Conversely, Correa et al. (2018) find evidence that a rise in interest rates is associated with slower credit growth at home and greater lending abroad. They explain this with an "international portfolio rebalancing channel," by which banks substitute domestic lending for foreign when low rates push up collateral values and encourage lending at home. Similarly, Bräuning and Ivashina (2017) find that banks reduce reserve holdings and increase foreign lending after a tightening of domestic monetary policy. They explain this through a swap channel, by which the costs of hedging foreign currency positions rise with increasing interest rate differentials.

This paper examines the effects of monetary policy changes on foreign lending by the Dutch financial sector, based on confidential institution-specific data for the period 2000:Q1 to 2015:Q4 for banks and 2006:Q1 to 2015:Q4 for insurers and pension funds. Our research is part of the International Banking Research Network (IBRN) project on international spillovers

of monetary policy.[†] Research conducted in this project starts from the channels of monetary transmission stressed in the literature, such as the bank lending channel, the portfolio channel, and the risk-taking channel. As there is no single balance sheet item or financial institution characteristic that determines how financial institutions respond to shocks, research within the project emphasizes the importance of institution-level characteristics and the "frictions" that financial institutions face (Buch et al., 2018). These frictions are, for instance, reflected in the capital and liquidity position of individual institutions, and influence how monetary policy impacts foreign lending (domestic or cross-border).

Monetary policy in the Netherlands has been set by the European Central Bank (ECB) during our sample period.[‡] Our time series also contains the period during which ECB policy rates have reached the effective lower bound (ELB). Since in this situation nominal interest rates only move marginally and the more general role of interest rates may change, it is commonly acknowledged that covariation between rates and other variables, including lending, is almost entirely lost. To deal with this problem we also use changes in the shadow bank rate, defined in Krippner (2015).

Our research focusses on the outward transmission of ECB policies. Inward transmission by foreign banks is less relevant, as the domestic credit market in the Netherlands is very concentrated and the market share of foreign banks is very low (see Frost et al., 2017). We therefore examine how ECB policies affect foreign lending by Dutch financial institutions, i.e. banks, insurance companies and pension funds. Dutch *banks* provide a particularly relevant case study for the outward transmission of monetary policy, as the sector is large (380% of GDP) and active in a broad sample of countries, both through cross-border lending and lending by local affiliates. In addition to banks, the Dutch financial sector features a large presence of *insurers* (80% of GDP) and *pension funds* (120% of GDP), which, like banks, are supervised by the central bank and may also respond to changes in policy rates. Our research question is: how do changes in domestic policy rates impact the international lending of Dutch banks, insurers and pension funds?

[†] The IBRN project focuses on monetary policy spillovers from the euro area, Japan, the United Kingdom (U.K.), and the United States (U.S.). Comparable micro-level datasets and empirical approaches are used across 17 countries, based on confidential supervisory data. Every country team ran an identical set of core regressions. Some country reports study inward transmission, where the focus is on how monetary policy in key foreign partner countries affects lending by domestic resident banks or hosted foreign branches. Other reports, including our study, take an outward perspective, exploring how domestic financial institutions adjust their foreign lending to changes in domestic monetary policy, including via their affiliates located in other countries. See Buch et al. (2018) for an overview of the project. Our study is the only one also examining the spill-over effects of monetary policy via insurance companies and pension funds.

[‡] Exchange rates between the (initially 11 euro) area countries were fixed as of 1 January 1999; from this point forward, euro area countries had a common monetary policy. Common banknotes were introduced on 1 January 2002.

Comparing the international lending of banks to insurers and pension funds is relevant for at least two reasons. First, such a comparison allows us to assess whether banks are "special," i.e. whether their business model, access to central bank liquidity or other characteristics make banks respond differently to monetary policy.[§] This provides a broader frame of reference for analysis of bank behavior. Second, given the shift in credit provisioning in many economies from banks to non-banks, the response of non-bank financial institutions is relevant in its own right. In line with recent analysis by the IMF (2016), we examine whether the growing share of non-banks in financial intermediation changes monetary transmission.[**]

Our results suggest that banks hardly change their foreign lending in response to ECB policy changes. We find some evidence in support of the portfolio channel (in response to a contractionary shock, better capitalized banks increase their foreign lending less than banks with lower capital) and the bank lending channel (larger banks lend more after a contractionary shock than small banks). Insurers and pension funds do not respond to ECB monetary policy, but increase lending when banks in the host country are constrained by prudential regulation.

The paper is organized as follows. Section 2 discusses our data and describes some main trends. Section 3 discusses our estimation method and presents the results, first for banks and then for insurers and pension funds. Section 4 concludes.

2. Data and trends

2.1 Data

As prudential supervisor of banks, insurers, pension funds and investment funds, De Nederlandsche Bank (DNB) collects data from Dutch financial institutions for a variety of functions. For *banks*, the institution-specific reporting for the BIS International Banking Statistics provides a long, quarterly time series on foreign claims, broken down by counterparty sector (private sector, banks and government) and type of lending (cross-border lending and local lending in foreign currency vs. local lending in local currency). While the BIS reporting does not include information on lending flows, a proxy can be computed based on changes in the stock of total foreign claims on the private sector.[††] This definition of lending thus includes

[§] See, for instance, IMF (2016).

[**] The IMF (2016) finds that both banks and non-banks contract their balance sheets when monetary policy tightens, but that non-bank financial intermediaries do so to a greater extent. Looking only at the insurance sector, Pelizzon and Sottocornola (2016) find that recent ECB monetary policy generally has a dampening impact on insurers' returns, although the effect of interventions changes over time. Neither of these studies focuses explicitly on the cross-border dimension.

[††] The data are reported by banks in euro at end-of-quarter exchange rates. While a currency break-down is not available, we assume that cross-border lending and local lending in foreign currency are denominated in euro, and that the euro value of local lending in local currency fluctuates with quarterly changes in the market exchange rate of the local currency against the euro. Because a sectoral breakdown of local lending in local currency is not available before 2014 Q3, we assume that the sectoral breakdown remained constant in the period 2000-2014, and calculate claims on the private sector as a fixed fraction

both loans and securities issued by the private sector (e.g. corporate bonds), and both by the head office and by local affiliates in the host countries. As we are interested in spill-over effects outside the euro area, we use claims on non-euro-area residents. The BIS data are complemented with data on individual bank characteristics, such as total assets, Tier 1 capital, and the share of local lending in local currency, which are available at a quarterly frequency from supervisory reporting sources.[‡‡] Our final sample consists of 64 Dutch banks over the period 2000Q1 to 2015Q4, accounting for more than 99 percent of the Dutch banking sector.[§§] While Dutch banks have a global footprint, they tend to concentrate on EU markets (de Haan et al., 2015).[***]

For *insurance companies and pension funds*, the data on foreign lending by country is obtained from the balance of payment statistics, which contain detailed information on the holdings of assets, split by country of origin and sector, at an institutional level. An advantage of this granular dataset is that it contains information on transactions, i.e. the net purchases and sales of assets corrected for price and exchange rate effects. The data are available at quarterly frequency over the period 2006Q1-2015Q4. For the purpose of this analysis we zoom in on loans and bonds to the private sector. To match the BIS definitions for the bank data, the private sector is defined as other insurance companies and pension funds, other financial institutions (excluding banks), households and non-financial institutions. For the analysis, data on the solvency position and total assets is also obtained, and stems from supervisory reporting. Our sample consists of 21 insurance companies and 28 pension funds. These institutions account (by assets) for over 70 percent of the Dutch insurance sector and nearly 80 percent of the Dutch pension fund sector, respectively. Compared to insurance companies, pension funds are larger, lend more to foreign countries and are also active in a larger number of foreign countries.

2.2 Trends in foreign lending

The international activities of the Dutch banking sector underwent substantial growth in the early part of the sample period, leading up to a peak in 2007. At that time, international activities represented 52% of Dutch banks' total assets. Around half of the system's foreign

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of total local claims in local currency for each bank-country-quarter combination. The implicit assumption is that the quarterly growth rate of claims on the private sector is equal to the growth rate of claims to all sectors. In practice, while the size of such exposures is large, the number of observations is smaller; this affects data for about 140 bank-country combinations per quarter.

[‡‡] The supervisory data have had to be assembled from different reporting standards covering the periods 2000-2004, 2004-2007, 2008-2013 and 2014-present (the latter in accordance with the EU Capital Requirements Directive IV). The resulting structural breaks have been corrected to the greatest extent possible.

[§§] The micro-data for this study are collected under legal powers which provide strict conditions for their use and dissemination. Researchers interested in reviewing or replicating our results may contact Jakob de Haan (j.de.haan@dnb.nl).

[***] Dutch banks are also active across North American, Asian, and Latin American markets.

activities comes from their local offices and the other half from the headquarters (Figure 1). Yet during and since the global financial crisis, Dutch banks have divested foreign assets. This reflects the acquisition and break-up of ABN Amro in 2008 by the Royal Bank of Scotland, Santander and Fortis; the sale of foreign activities of ING as a condition of state support received in 2008; the nationalization of SNS Reaal in 2013; and a broader deleveraging trend brought on by the losses and capital shortfalls exposed by the crisis. Foreign claims now amount to 39% of total bank assets. On the other hand, the composition of foreign claims has remained broadly stable, with cross-border and foreign currency loans making up 52% of overall foreign claims in 2007, and 49% at the end of 2015.

[Insert Figure 1 here]

Figure 2 shows the evolution of the foreign claims of Dutch insurance companies and pension funds on the private sector. For insurance companies, there is a steady increase in foreign claims until 2010, when claims began to decline (panel A). In 2010, the share of foreign lending as a percentage of total lending equaled 36%, while at the end of 2015 this was only 21%. Dutch pension funds exhibit a large decrease in foreign holdings earlier, after 2009:Q1 (panel B). This decline is technical and is attributed to these institutions' shift towards investing in investment funds, which could be domiciled in the Netherlands but hold foreign securities. For the largest pension funds we are able to "look through" the investments via investment funds and as such get insight in foreign securities invested in by pension funds but via investment funds. In our analysis, we have conducted a robustness check with this data including the investments via investment funds.

[Insert Figure 2 here]

Table 1 presents some descriptive statistics for all banks, insurance companies and pension funds in our sample. The relatively large standard deviation of the total assets for all sectors confirm that the banking sector as well as the insurance and pension fund sector are all quite concentrated with a handful of large institutions.

[Insert Table 1 here]

3. Empirical method and results

We proceed to our estimation method and our estimation results. In section 3.1 we present our regressions for outward transmission by financial institutions. We show the results for banks in section 3.2. We then discuss the results for insurers (section 3.3) and pension funds (section 3.4).

3.1 Model[†††]

We use the following regression to explain how changes in ECB monetary policy affect changes in foreign lending by Dutch financial institutions:

$$\Delta Y_{b,j,t} = \alpha_0 + \sum_{k=0}^{K}(\alpha_{1,k}\,\Delta MP_{t-k}^{domestic} + \alpha_{2,k}\Delta MP_{t-k}^{domestic} Friction_{b,t-K-1}) + \alpha_3 Friction_{b,t-K-1} + \alpha_4 X_{b,t-1} + \alpha_5 Z_{t-1}^{domestic} + \alpha_6 VIX_{t-1} + f_j + f_b + \varepsilon_{b,j,t}$$

where ΔY is the log change of foreign claims of institution *b* on country *j* at time *t;* we use total claims on foreign non-bank private borrowers, but also distinguish between cross-border claims and claims booked at the foreign affiliates of these institutions (henceforth named "local claims"). We include a vector of bank controls ($X_{b,t-1}$). To control for supply conditions at the home country ($Z_{t-1}^{domestic}$), we use proxies for the business cycle, i.e. the GDP gap (BIS, 2014), and the financial cycle, captured by the credit-to-GDP gap (Drehmann et al., 2011). To control for host country demand conditions ($Z_{j,t-1}$), we use the business and the financial cycle proxies for the host country. Lastly, we use the VIX to control for international market conditions (VIX_{t-1}). $\Delta MP_{t-k}^{domestic}$ is either the first difference of the nominal policy rate or the shadow rate for the domicile country (from Krippner, 2015).[‡‡‡] We use K=3, i.e. monetary policy over the current and last three quarters (one year in total).

The coefficients α_{1k}s and their annual cumulative effect captured by $\Sigma\ \alpha_{1k}$ allow us to test the overall relationship between the change in foreign claims and monetary policy. However, it does not provide information on the specific frictions through which monetary policy affects the international activities of global financial institutions. For banks, this direct

[†††] This part of the paper heavily draws on the description of the IBRN approach provided in Argimón et al. (2018).

[‡‡‡] As pointed out by Claus et al. (2016), the shadow short rate is a synthetic summary measure that is derived from yield curve data and essentially reflects the degree to which intermediate and longer maturity interest rates are lower than would be expected if a zero policy rate prevailed in the absence of unconventional policy measures. This measure is better at capturing the effect of monetary policy on financial institutions' assets, especially in the effective lower bound (ELB) period. As policy rates reached the ELB, the value of longer dates assets may have changed, as several central banks started their quantitative easing programs. The shadow rate incorporates this information. Although during most of the period under consideration monetary policy was loosened, there were also periods when policy became more restrictive. For instance, there is a monetary tightening cycle just prior to the Global Financial Crisis (GFC).

relation may also be weakly identified, as credit demand factors are difficult to control for. We expect that the direct effect of a monetary policy tightening—captured by $\Sigma\ \alpha_{1k}$—is negative for both cross-border and local office claims. Moreover, cross-border claims should react more to home-country monetary policy changes compared to local claims. While the former claims are funded with the parent's balance sheet, which is more affected by home-country monetary policy, the latter is likely to be funded with host-country deposits, which are more dependent on the host-country's monetary policy.

To better identify the channels of monetary policy transmission, we use the technique introduced by Kashyap and Stein (2000) and later applied by Cetorelli and Goldberg (2012) by introducing a set of regressors labeled *Friction*. These variables allow us to identify the effect of monetary policy in the cross-section of financial institutions, which mitigates some of the concerns related to the potentially endogenous determination of monetary policy. In the specification, the coefficients of interest are the α_2s, which capture the differential effect of monetary policy on foreign claims, conditional on these frictions.

We include a vector of institution-specific controls (X) in model (1) and a set of domestic financial and macroeconomic controls ($Z^{domestic}$), which allows us to take changes in domestic credit demand into account. In addition, we include controls for destination-country credit demand (Z) and global factors (VIX), which may affect changes in the pace of growth of foreign claims. All regressions include destination-country fixed effects and institution fixed effects. Standard errors are clustered at the bank level.

We first identify the portfolio channel by focusing on frictions that may affect the asset side of banks' balance sheets (Den Haan et al., 2007; Dell'Ariccia et al., 2017; and Jimenez et al., 2014). As policy rates increase, banks, insurers and pension funds may seek to rebalance their portfolios to safer assets, with the opposite happening as policy rates decrease. In particular, their capital position may determine the amounts and types of assets that the institutions can purchase. More capital may allow investments in potentially riskier assets such as loans to the non-bank private sector. The effect of monetary policy conditional on the capital position is ambiguous. For example, theory suggests that banks with lower levels of capital should decrease their overall lending as a result of monetary policy tightening, the so called "bank capital channel" (Van den Heuvel, 2002). However, tighter monetary policy could also lead banks to rebalance their asset portfolios toward safer assets (Jimenez et al., 2014). If foreign claims are considered safer in a tightening environment, we should observe a positive relation between increasing policy rates and changes in foreign claims. Given these two counterbalancing effects, we do not have an ex ante expectation for the sign of the coefficients

α_2s. As for the total effect of monetary policy, we expect that the effect of monetary policy on well-capitalized institutions is ambiguous. In the portfolio channel regressions, we use the shadow rate as our measure for monetary policy. The shadow rate is not as important for banks' funding conditions, but it may affect the pricing of securities held in financial institutions' balance sheets, as well as the returns on potential investment opportunities. As the shadow rates vary even in the ELB period, the tests on the portfolio channel will be identified with information throughout the entire sample period. Moreover, for insurers and pension funds the shadow rate is used across all specifications since these institutions are expected to mainly react to changes in the yield curve, and not to the short-term policy rate.

Next, for banks we use their size, measured by the log of total assets, to identify funding frictions across banks to test the bank lending channel. The bank lending channel (Bernanke and Gertler, 1995) emphasizes the role of bank liabilities in the transmission of monetary policy. That is, as policy rates increase the cost of banks' external financing also rises, which may lead to a decrease in lending. Larger banks may be able to fund themselves at cheaper rates and withstand changes in monetary policy (Kashyap and Stein, 2000). We expect that the effect of monetary policy conditional on bank size is positive for both cross-border and local office claims: foreign activities of larger banks are more insulated from monetary policy. Kashyap and Stein (2000) and Cetorelli and Goldberg (2012) have shown that large banks should not be affected by monetary policy changes, as they have better access to external sources of finance or can use their internal liquidity management to mitigate the effect of policy rate changes. We expect that the total effect —the sum of the direct and conditional effects of monetary policy—for median-sized banks should be a wash. In these bank lending channel regressions, we use the nominal policy rate as our measure of monetary policy. For insurers and pension funds the bank lending channel is irrelevant.

There is a lively debate about whether higher capital requirements cause domestic bank lending to decrease (see, e.g. Bridges et al., 2015 and De Marco and Wieladek, 2016 for discussion of the evidence). Likewise, there is some evidence about the effect of higher capital requirements on foreign bank lending. Using a different sample of Dutch banks and a different time period, Frost et al. (2017) find that increased capital requirements tend to precede higher bank lending activity in the host country. Ohls et al. (2017) and Damar and Mordel (2017) find similar results for German and Canadian banks, respectively. Therefore, as the final step in our analysis, we check whether capital requirements in the host country affect foreign lending of Dutch financial institutions. Our proxy for capital requirements in destination countries (*cap_req*) draws on the IBRN prudential instrument database as described in Cerutti et al.

(2017). This measure captures tightening or loosening of capital requirements in destination country *j* at time *t*. It has a value of +1 when prudential measures are tightened, and -1 when measures are loosened.

3.2 Regressions for bank lending

Tables 2-4 show the regression results for banks. In Table 2 the dependent variable is total foreign lending, while in Tables 3 and 4 we split this into local foreign lending and cross-border lending, respectively. The baseline specification as presented in column 1 of Tables 2-4, in which monetary policy is measured by changes in the ECB policy rate, aims to examine whether tighter monetary policy increases the cost of financial institutions' liabilities leading to an adjustment of their lending. If so, their foreign lending would decrease. However, the effect on local foreign lending would depend on whether the local office is funded by the parent or by financing from the host country; in the latter case local lending would be less affected by monetary policy in the home country. Our findings suggest a statistically insignificant coefficient on monetary policy changes for total claims (Table 2) and cross-border claims (Table 4). However, the coefficient on monetary policy changes is significant and positive for local lending (column 1 in Table 3), suggesting that Dutch banks increase their local foreign lending if the ECB tightens its policy.

Column (2) of Tables 2-4 show the same baseline specification, but using the change in the shadow rate as proxy for ECB policy changes. As explained in section 3.1., this specification focuses on frictions that may affect banks' portfolio of assets as monetary policy changes. For example, in periods with low rates, as a result of loose monetary policy, financial institutions may search for yield by lending to riskier firms or investing in high-yielding assets. For total claims, cross-border claims, and local lending, monetary policy shocks as measured by the shadow rate are insignificant.

In column (3) of Tables 2-4, we interact monetary policy (proxied by the change in the shadow rate) with the Tier 1 leverage ratio to identify the portfolio channel. As domestic monetary policy tightens, banks may invest in safer assets (den Haan et al., 2007), which may be located abroad. As it is not clear ex ante which claims are riskier, the total impact of a monetary policy tightening on foreign claims is ambiguous. The results for the interaction between monetary policy and the capital ratio suggest that an increase in the shadow rate is not associated with an increase in the growth of local claims for banks with a higher Tier 1 leverage ratio. However, the relation between the shadow rate and the log change of cross-border and total claims for Dutch banks is different from the result for local claims. In these cases, the

coefficient on the interaction term between the change in the shadow rate and the Tier 1 leverage ratio is negative and significant. Banks with stronger capital positions lend less across borders as monetary policy tightens. As noted before, this result can be explained by stronger-capitalized banks' desire to lend less abroad and more domestically, while the weaker-capitalized banks prefer to diversify their portfolio internationally.

In column (4) of Tables 2-4, we interact ECB monetary policy (proxied by the change in the policy rate) with bank size to identify the bank lending channel. As pointed out before, it is likely that large banks would be less sensitive to monetary policy as their external funding costs may be less affected when monetary policy tightens. So we expect that the interaction between monetary policy and bank size would be positive. The results for the interaction between monetary policy and bank size differ across different types of claims. For total and cross-border claims, we find that larger banks are indeed better able to mitigate the negative effects of contractionary monetary policies than smaller banks. In contrast, for local claims, we do not find a significant interaction term between monetary policy and bank size. However, the total effect of monetary policy for the median bank in the Netherlands does not significantly react as monetary policy tightens.

In column (5) of Tables 2-4, we add capital requirements in the host country to the model shown in column (1) in order to examine whether foreign lending by Dutch banks is affected by regulation. Our results do not provide evidence for this. The coefficient on our proxy for capital requirements is not significantly different from zero in the regressions. This deviates from earlier findings of Frost et al. (2017), which were based on total claims instead of private sector claims.

3.3 Regressions for lending by insurers

Table 5 shows the regression results for insurance companies. The baseline results in column (1) with the shadow rate as proxy for monetary policy, show that foreign lending by insurance companies does not respond to changes in monetary policy. Likewise, the coefficients on the interaction between monetary policy changes and the solvency rate (column (2)) and the size of insurers (column (3)) turn out to be insignificant. The overall impact, i.e. the cumulative effect of all coefficients, is similarly insignificant. However, as shown in column (4), insurers tend to increase their foreign lending to countries that increase their bank capital requirements. Hence, the increased activities of insurance companies in these countries can probably be seen as a substitution for bank lending that may be refrained by higher capital requirements. In economic terms, insurers lend about 3.8% more a quarter after bank capital requirements were

tightened, relative to quarters where no action was taken. Moreover, insurance companies lend more to countries with a higher credit-to-GDP gap, again representing an upturn in the financial cycle and potentially more profitable (short-term) investment opportunities.

3.4 Regressions for lending by pension funds

Table 6 shows the regression results for pension funds for the full period 2006Q1-2015Q4. The results in table 6 show that, like insurers, pension funds do not increase their foreign lending in response to monetary policy changes. Likewise, we do not find evidence for a significant interaction between monetary policy and pension funds' solvency and between monetary policy and pension funds' size. The overall impact, i.e. the cumulative effect of all coefficients, is similarly insignificant.

As mentioned previously, around 2009 pension funds started to invest more via investment funds. For the largest pension funds we are able to "look through" the investments via investment funds. However, this is only possible from 2009Q2 onwards. For robustness, Table 7 therefore shows the regression results over the period 2009Q2-2015Q4, both including (columns 1-4) and excluding (columns 5-8) the investments via investment funds. The results are quite similar to the ones in table 6. However, in the specification including the investments via investment funds and in line with our findings for insurers we find some (weak) evidence that pension funds tend to increase their foreign lending to countries that increase their bank capital requirements.

4. Conclusions

Our results suggest that banks hardly change their foreign lending in response to ECB policy changes. We find some evidence in support of the portfolio channel (in response to a contractionary shock, better capitalized banks increase their foreign lending less than banks with lower capital) and the bank lending channel (larger banks lend more after a contractionary shock than small banks). For insurers and pension funds, the effect of monetary policy changes on their foreign lending is generally not significant. However, for insurers and pension funds we do find a positive coefficient for host country bank capital requirements (i.e. these institutions increase lending when domestic banks (in the host country) are constrained by prudential regulation), which may indicate substitution effects between banks and non-banks.

The difference in the role of monetary policy may be indicative of a number of distinct characteristics in the nature and business model of the different institutions. First of all, the institutional setting for institutions is different, as banks have access to central bank liquidity

while insurers and pension funds typically do not. Moreover, banks have long-term assets and short-term liabilities, while this maturity mismatch is generally reversed for insurers and pension funds. A second explanation is that the type of lending is different: banks have a large share of retail lending (e.g. mortgages, SME loans, etc.) while insurers and pension funds are more likely to buy more bonds.

While it is too early to draw policy implications, we can imagine that further development of these insights is relevant for understanding how market structure influences international spillovers of monetary policy from different countries, as well as the case for or against international monetary and regulatory cooperation.

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Figure 1. International claims of Dutch banks (bln EUR)

This figure shows the geographical distribution of claims of Dutch banks on all sectors.

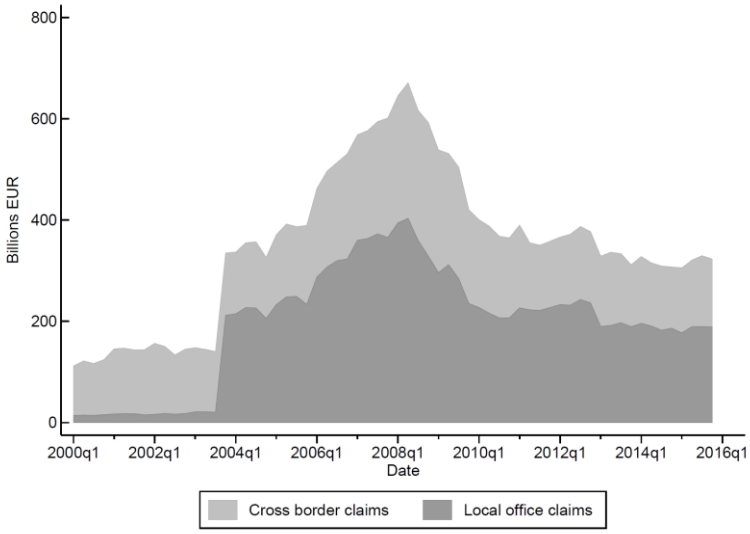
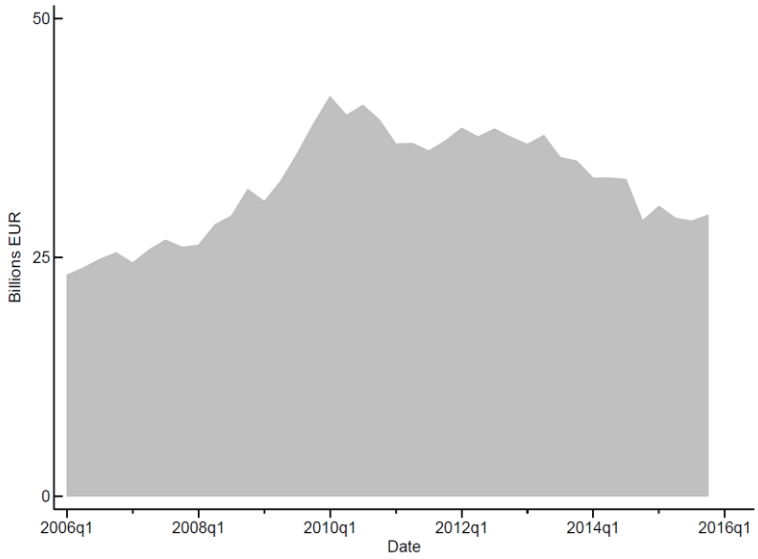


Figure 2. Foreign claims of Dutch insurance companies and pension funds (bln EUR)
Panel A – Insurance companies



Panel B – Pension funds

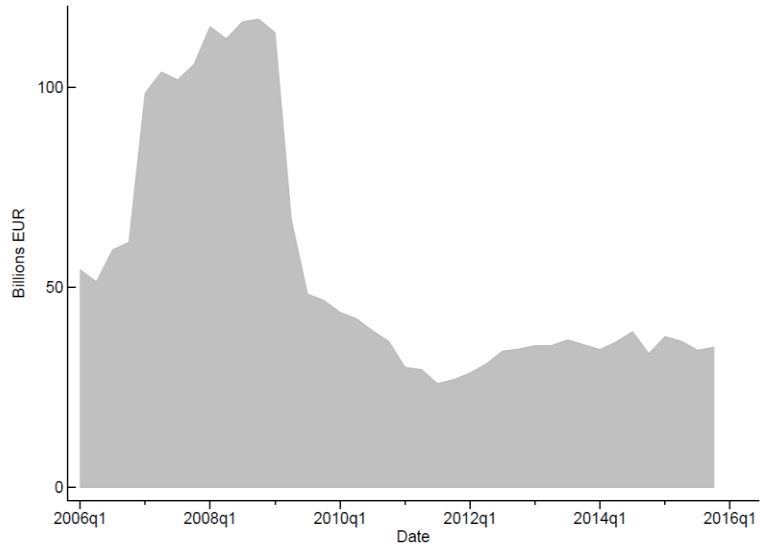


Table 1. Summary statistics

		Banks	Insurers	Pension funds
Local foreign claims/assets:[1]	Mean	1.17	9.81	6.92
	Stand. Dev.	2.42	10.04	6.57
	Min	0.00	0.04	0.00
	Max	19.76	74.9	57.77
Cross border claims/assets:	Mean	0.35	-	-
	Stand. Dev.	1.31	-	-
	Min	0.00	-	-
	Max	26.25	-	-
Log change total claims:	Mean	0.00	-0.03	-0.05
	Stand. Dev.	0.24	0.27	0.34
	Min	-1.00	-1.00	-1.00
	Max	0.99	1.00	1.00
Log change local claims:	Mean	0.02	-	-
	Stand. Dev.	0.22	-	-
	Min	-1.00	-	-
	Max	0.98	-	-
Log change cross-border claims:	Mean	0.00	-	-
	Stand. Dev.	0.26	-	-
	Min	-1.00	-	-
	Max	0.99	-	-
Log total assets:	Mean	10.99	15.77	16.38
	Stand. Dev.	2.28	1.53	1.25
	Min	3.18	12.75	13.67
	Max	13.90	18.36	19.74
Tier-1 ratio:[2]	Mean	7.00	349.69	115.83
	Stand. Dev.	6.46	939.48	22.39
	Min	0.76	100.92	0.00
	Max	36.47	245.88	252.70

[1] Claims on private non-banks for banks and claims on total private sector for insurance firms and pension funds.
[2] Solvency ratios for insurance firms and pension funds.

Table 2. Banks – total private sector claims

This table shows the regression results for all banks over the period 2000Q1-2015Q4. The dependent variable is the log change in total non-bank private claims to host country j over period t divided by total non-bank private claims in period t-1. All regressions are estimated by Ordinary Least Squares (OLS) accounting for bank, quarter and host country fixed effects. Standard errors are clustered by institution, and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Basis	Shadow	Capital	Size	Cap_req
ΣΔ Domestic	0.0296	0.0002	0.0315*	-0.184**	-0.0105
$MP_{t\ to\ t-3}$	(0.176)	(0.987)	(0.0837)	(0.0264)	(0.440)
ΣΔ Domestic			-0.004***	0.0195***	
$MP_{t\ to\ t-3}$* $Channel_{t-4}$			(0.004)	(0.006)	
Total effect of ΣΔ			0.007	-0.008	
MP for median bank			0.611	0.757	
Log total $assets_{t-1}$	-0.026	-0.019	-0.005		-0.022
	(0.162)	(0.303)	(0.772)		(0.260)
Capital $ratio_{t-1}$	-0.001	0.000		-0.001	0.000
	(0.771)	(0.991)		(0.648)	(0.923)
Liquid asset $ratio_{t-1}$	0.000	-0.000	-0.001	-0.001	0.000
	(0.429)	(0.384)	(0.309)	(0.199)	(0.384)
$Channel_{t-4}$			-0.002	-0.003	
			(0.313)	(0.855)	
Core deposits $ratio_{t-1}$	0.000	0.000	0.000	0.001	0.000
	(0.717)	(0.599)	(0.473)	(0.385)	(0.533)
Cap_req_{t-1}					-0.007
					(0.582)
Business cycle	-0.001	0.000	-0.001	-0.002	0.004
$domestic_{t-1}$	(0.728)	(0.959)	(0.789)	(0.566)	(0.243)
Business $cycle_{j,\ t-1}$	0.001	-0.000	0.000	0.001	-0.001
	(0.668)	(0.804)	(0.994)	(0.452)	(0.589)
Financial cycle	0.000	0.001*	0.000	0.000	0.001*
$domestic_{t-1}$	(0.351)	(0.082)	(0.244)	(0.300)	(0.097)
Financial $cycle_{j,t-1}$	0.000	0.000	0.000	0.000	0.000
	(0.351)	(0.283)	(0.244)	(0.300)	(0.497)
$\Delta MP_{j,t-1}$	-0.001	-0.000	0.000	-0.001	0.001
	(0.787)	(0.980)	(0.999)	(0.837)	(0.791)
VIX_{t-1}	0.000	-0.001**	-0.001**	0.000	-0.002***
	(0.835)	(0.010)	(0.019)	(0.703)	(0.001)
Observations	9,872	9,872	9,775	9,775	9,270
R^2	0.018	0.018	0.020	0.019	0.029
R^2_{adj}	0.010	0.010	0.011	0.011	0.012
Mon. policy measure	Short	Shadow	Shadow	Short	Shadow

Table 3. Banks – local private sector claims

This table shows the regression results for all banks over the period 2000Q1-2015Q4. The dependent variable is the log change in local non-bank private claims in host country j over period t divided by local non-bank private claims in period t-1. All regressions are estimated by Ordinary Least Squares (OLS) accounting for bank, quarter and host country fixed effects. Standard errors are clustered by institution, and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Basis	Shadow	Capital	Size	Cap_req
ΣΔ Domestic	0.0989***	0.0299	0.0607	-0.0117	0.0212
$MP_{t\ to\ t-3}$	(0.006)	(0.132)	(0.190)	(0.912)	(0.303)
ΣΔ Domestic			-0.006	0.008	
$MP_{t\ to\ t-3}$* $Channel_{t-4}$			(0.247)	(0.357)	
Total effect of ΣΔ			0.0257	0.0609	
MP for median			(0.221)	(0.128)	
bank					
Log total $assets_{t-1}$	0.006	0.021	0.025		0.013
	(0.869)	(0.612)	(0.503)		(0.752)
Capital $ratio_{t-1}$	-0.003	0.000		-0.003	0.001
	(0.399)	(0.983)		(0.420)	(0.804)
Liquid asset $ratio_{t-1}$	0.000	-0.000	0.000	0.000	-0.001
	(0.997)	(0.844)	(0.906)	(0.898)	(0.506)
Core deposits $ratio_{t-1}$	0.002	0.001	0.000	0.001	0.001
	(0.242)	(0.329)	(0.774)	(0.341)	(0.274)
$Channel_{t-4}$			0.001	0.058	
			(0.883)	(0.218)	
Cap_req_{t-1}					-0.001
					(0.944)
Business cycle	-0.010*	-0.005	-0.005	-0.010*	-0.001
$domestic_{t-1}$	(0.053)	(0.312)	(0.340)	(0.057)	(0.947)
Business $cycle_{j,\ t-1}$	-0.004	-0.004	-0.004	-0.004	-0.003
	(0.439)	(0.455)	(0.424)	(0.425)	(0.491)
Financial cycle	0.001	0.002*	0.002	0.002	0.002**
$domestic_{t-1}$	(0.256)	(0.056)	(0.129)	(0.175)	(0.030)
Financial $cycle_{j,t-1}$	0.000	-0.000	0.000	0.000	0.000
	(0.557)	(0.576)	(0.693)	(0.669)	(0.837)
$\Delta MP_{j,t-1}$	0.003	0.007	0.008	0.004	0.009
	(0.657)	(0.287)	(0.242)	(0.567)	(0.191)
VIX_{t-1}	0.001	-0.000	-0.001	0.000	-0.001
	(0.295)	(0.661)	(0.454)	(0.674)	(0.407)
Observations	2,609	2,609	2,596	2,596	2,435
R^2	0.023	0.022	0.025	0.025	0.022
R^2_{adj}	0.006	0.005	0.006	0.006	0.004
Mon. policy measure	Short	Shadow	Shadow	Short	Shadow

Table 4. Banks – cross-border private sector claims

This table shows the regression results for all banks over the period 2000Q1-2015Q4. The dependent variable is the log change in cross-border non-bank private claims to host country j over period t divided by cross-border non-bank private claims in period t-1. All regressions are estimated by Ordinary Least Squares (OLS) accounting for bank, quarter and host country fixed effects. Standard errors are clustered by institution, and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Basis	Shadow	Capital	Size	Cap_req
ΣΔ Domestic	0.023	-0.006	0.024	-0.216**	-0.018
$MP_{t\ to\ t-3}$	(0.325)	(0.702)	(0.212)	(0.014)	(0.240)
ΣΔ Domestic			-0.004***	0.022***	
$MP_{t\ to\ t-3}$* $Channel_{t-4}$			(0.005)	(0.004)	
Total effect of ΣΔ MP for			0.000	-0.021	
median bank			(0.999)	0.478	
Log total $assets_{t-1}$	-0.029	-0.022	-0.008		-0.024
	(0.152)	(0.276)	(0.694)		(0.251)
Capital $ratio_{t-1}$	-0.002	-0.001		-0.002	0.000
	(0.655)	(0.832)		(0.605)	(0.985)
Liquid asset $ratio_{t-1}$	0.000	0.000	0.000	0.000	0.000
	(0.674)	(0.629)	(0.552)	(0.361)	(0.658)
Core deposits $ratio_{t-1}$	0.000	0.000	0.000	0.001	0.000
	(0.755)	(0.588)	(0.494)	(0.387)	(0.513)
$Channel_{t-4}$			-0.002	-0.005	
			(0.254)	(0.754)	
Cap_req_{t-1}					-0.007
					(0.615)
Business cycle $domestic_{t-1}$	0.000	0.001	0.000	-0.001	0.005
	(0.980)	(0.674)	(0.895)	(0.845)	(0.156)
Business $cycle_{j,\ t-1}$	0.001	0.000	0.001	0.001	-0.001
	(0.571)	(0.908)	(0.136)	(0.231)	(0.709)
Financial cycle $domestic_{t-1}$	0.001	0.001	0.001	0.001	0.001
	(0.383)	(0.102)	(0.136)	(0.231)	(0.117)
Financial $cycle_{j,t-1}$	0.000	0.000	0.000	0.000	0.000
	(0.327)	(0.270)	(0.250)	(0.303)	(0.556)
$\Delta MP_{j,t-1}$	0.000	0.000	0.000	0.000	-0.001
	(0.910)	(0.939)	(0.936)	(0.931)	(0.792)
VIX_{t-1}	0.000	-0.002***	-0.002***	-0.001	-0.001
	(0.471)	(0.002)	(0.004)	(0.355)	(0.313)
Observations	9,227	9,227	9,133	9,133	8,667
R^2	0.016	0.016	0.018	0.017	0.018
R^2_{adj}	0.008	0.008	0.009	0.009	0.010
Mon. policy measure	Short	Shadow	Shadow	Short	Short

Table 5. Insurance companies

This table shows the regression results for all insurance companies over the period 2006Q1-2015Q4. The dependent variable is the log change in total non-bank private claims to host country j over period t divided by total non-bank private claims in period t-1. Domestic exposures are excluded. All regressions are estimated by Ordinary Least Squares (OLS) accounting for insurer, quarter and host country fixed effects. Standard errors are clustered by institution, and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)
	Basis	Solvency	Size	Cap_req
ΣΔ Domestic	0.000	-0.017	0.126	0.005
$MP_{t\ to\ t-3}$	(0.969)	(0.448)	(0.391)	(0.655)
ΣΔ Domestic		0.006	-0.008	
$MP_{t\ to\ t-3}$* $Channel_{t-4}$		(0.309)	(0.361)	
Total effect of ΣΔ		-0.010	0.118	
MP terms for the		(0.560)	(0.394)	
median institution				
Log total $assets_{t-1}$	0.003	-0.020		0.002
	(0.886)	(0.445)		(0.947)
Solvency $ratio_{t-1}$	0.000		-0.003	0.001
	(0.815)		(0.314)	(0.565)
Liquid asset $ratio_{t-1}$	0.384*	0.214	0.250	0.208
	(0.093)	(0.272)	(0.257)	(0.410)
International	0.070	-0.073	-0.119	-0.908
activities $ratio_{t-1}$	(0.743)	(0.714)	(0.570)	(0.179)
$Channel_{t-4}$		-0.004**	-0.030	
		(0.030)	(0.168)	
Cap_req_{t-1}				0.038***
				(0.005)
Business cycle	0.003	0.002	0.002	0.010**
$domestic_{t-1}$	(0.493)	(0.541)	(0.611)	(0.015)
Business cycle $_{j,\ t-1}$	0.531	0.669**	0.648*	0.259
	(0.111)	(0.044)	(0.052)	(0.460)
Financial cycle	-0.003***	-0.003***	-0.003***	-0.004***
$domestic_{t-1}$	(0.001)	(0.003)	(0.005)	(0.000)
Financial $cycle_{j,t-1}$	0.067	0.094**	0.093**	0.084*
	(0.110)	(0.019)	(0.020)	(0.067)
$\Delta MP_{j,t-1}$	-0.011	-0.007	-0.007	-0.012*
	(0.121)	(0.229)	(0.215)	(0.091)
VIX_{t-1}	0.000	0.000	0.000	0.000
	(0.682)	(0.824)	(0.932)	(0.486)
Observations	5,200	5,029	5,029	4,727
R^2	0.084	0.084	0.082	0.093
R^2_{adj}	0.073	0.071	0.070	0.080
Mon. policy measure	Shadow	Shadow	Shadow	Shadow

Table 6. Pension funds

This table shows the regression results for all pension funds over the period 2006Q1-2015Q4. The dependent variable is the log change in total non-bank private claims to host country j over period t divided by total non-bank private claims in period t-1. Domestic exposures are excluded. All regressions are estimated by Ordinary Least Squares (OLS) accounting for pension fund, quarter and host country fixed effects. Standard errors are clustered by institution, and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)
	Basis	Solvency	Size	Cap_req
ΣΔ Domestic	-0.011	0.040	-0.176	-0.013
$MP_{t\ to\ t-3}$	(0.531)	(0.618)	(0.345)	(0.481)
ΣΔ Domestic		-0.043	0.010	
$MP_{t\ to\ t-3}$* $Channel_{t-4}$		(0.518)	(0.394)	
Total effect of ΣΔ		-0.003	-0.167	
MP terms for the		(0.901)	(0.342)	
median institution				
Log total $assets_{t-1}$	0.142***	0.147***		0.201***
	(0.003)	(0.004)		(0.000)
Solvency $ratio_{t-1}$	0.050		0.046	0.033
	(0.123)		(0.186)	(0.293)
Liquid asset $ratio_{t-1}$	1.441***	1.420***	1.370***	1.379***
	(0.000)	(0.001)	(0.001)	(0.001)
International	0.204**	0.200**	0.211**	0.357
activities $ratio_{t-1}$	(0.015)	(0.020)	(0.013)	(0.419)
$Channel_{t-4}$		0.094**	0.163***	
		(0.011)	(0.001)	
Cap_req_{t-1}				0.016
				(0.184)
Business cycle	-0.006	-0.011	-0.008	0.001
$domestic_{t-1}$	(0.290)	(0.036)	(0.157)	(0.816)
Business $cycle_{j,\ t-1}$	0.167	0.247	0.232	-0.010
	(0.699)	(0.579)	(0.614)	(0.983)
Financial cycle	0.003**	0.003**	0.004***	0.003**
$domestic_{t-1}$	(0.047)	(0.015)	(0.008)	(0.012)
Financial $cycle_{j,t-1}$	0.026	0.027	0.027	0.073
	(0.613)	(0.623)	(0.620)	(0.130)
$\Delta MP_{j,t-1}$	0.000	0.004	0.003	-0.001
	(0.966)	(0.371)	(0.360)	(0.867)
VIX_{t-1}	-0.002**	-0.002***	-0.002***	-0.002*
	(0.013)	(0.004)	(0.001)	(0.060)
Observations	8,828	8,662	8,662	7,934
R^2	0.100	0.102	0.100	0.103
R^2_{adj}	0.092	0.094	0.092	0.095
Mon. policy measure	Shadow	Shadow	Shadow	Shadow

Table 7. Pension funds – direct and indirect exposures

This table shows the regression results for all pension funds over the period 2009Q2-2015Q4. The dependent variable is the log change in total non-bank private claims to host country j over period t divided by total non-bank private claims in period t-1. Domestic exposures are excluded. All regressions are estimated by Ordinary Least Squares (OLS) accounting for pension fund, quarter and host country fixed effects. Standard errors are clustered by institution, and ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

	Excluding investments via investment funds				**Including investments via investment funds**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Basis	Solvency	Size	Cap_req	Basis	Solvency	Size	Cap_req
ΣΔ Domestic	-0.032	-0.167	0.026	-0.005	-0.041	-0.225	0.115	-0.007
$MP_{t\ to\ t-3}$	(0.324)	(0.326)	(0.914)	(0.872)	(0.222)	(0.112)	(0.567)	(0.843)
ΣΔ Domestic		-0.051	0.022			-0.065*	0.105	
$MP_{t\ to\ t-3}$* $Channel_{t-4}$		(0.170)	(0.923)			(0.075)	(0.576)	
Total effect of ΣΔ		-0.044	-0.044			-0.055	-0.043	
MP terms for the median institution		(0.205)	(0.109)			(0.131)	(0.128)	
Log total $assets_{t-1}$	0.079	0.026		0.218**	0.035	-0.024		0.194*
	(0.355)	(0.783)		(0.011)	(0.688)	(0.801)		(0.051)
Solvency $ratio_{t-1}$	0.042		0.027	-0.017	0.048		0.026	-0.009
	(0.665)		(0.797)	(0.885)	(0.621)		(0.801)	(0.939)
Liquid asset $ratio_{t-1}$	1.457***	1.484***	1.381***	1.469***	1.413***	1.455***	1.330**	1.392**
	(0.002)	(0.003)	(0.007)	(0.007)	(0.005)	(0.006)	(0.011)	(0.016)
International activities $ratio_{t-1}$	0.136**	0.148**	0.139*	0.632*	0.177**	0.186**	0.177**	0.193*
	(0.029)	(0.020)	(0.054)	(0.082)	(0.038)	(0.035)	(0.048)	(0.055)
$Channel_{t-4}$		0.157	0.071			0.167	0.029	
		(0.216)	(0.390)			(0.174)	(0.748)	
Cap_req_{t-1}				0.012				0.023*
				(0.270)				(0.063)
Business cycle $domestic_{t-1}$	-0.012*	-0.014**	-0.011	-0.008	-0.007	-0.009	-0.006	-0.003
	(0.087)	(0.039)	(0.116)	(0.260)	(0.249)	(0.130)	(0.329)	(0.685)
Business $cycle_{j,\ t-1}$	0.251	0.572	0.497	0.078	-0.058	0.107	0.073	0.078
	(0.679)	(0.353)	(0.607)	(0.908)	(0.441)	(0.822)	(0.878)	(0.300)
Financial cycle $domestic_{t-1}$	0.003	0.002	0.003	0.005**	0.002	0.001	0.002	0.005*
	(0.209)	(0.511)	(0.234)	(0.031)	(0.410)	(0.854)	(0.492)	(0.089)
Financial $cycle_{j,t-1}$	0.007	0.046	0.045	0.099	-0.001	0.024	0.021	-0.271
	(0.928)	(0.618)	(0.617)	(0.249)	(0.983)	(0.757)	(0.783)	(0.612)
$\Delta MP_{j,t-1}$	0.009*	0.009	0.009	0.008	0.004	0.005	0.005	0.001
	(0.095)	(0.141)	(0.118)	(0.164)	(0.574)	(0.500)	(0.489)	(0.935)
VIX_{t-1}	-0.002*	-0.002***	-0.002*	-0.002**	-0.002**	-0.003***	-0.002**	-0.002**
	(0.055)	(0.002)	(0.057)	(0.033)	(0.032)	(0.000)	(0.037)	(0.035)
Observations	6,531	6,306	6,306	5,637	6,934	6,6697	6,697	5,974
R^2	0.108	0.117	0.115	0.111	0.104	0.111	0.111	0.106
R^2_{adj}	0.097	0.106	0.104	0.098	0.094	0.101	0.099	0.094
Mon. policy measure	Shadow	Shadow	Shadow	Shadow	Shadow	Shadow	Shadow	Shadow

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