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Negative rates, monetary policy transmission and cross-border lending via international financial centres

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Abstract

We study the effects of negative interest rate policies (NIRP) on the transmission of monetary policy through cross-border lending. Using bank-level data from international financial centres – the United Kingdom, Hong Kong and Ireland – we examine how NIRP in the economies where banks have their headquarters influences cross-border lending from financial-centre affiliates. We find that NIRP impairs the bank-lending channel for cross-border lending to non-bank sectors, especially for those banks that have only a weak deposit base in IFCs – and are thus relatively more exposed to NIRP in their headquarters. Using euro-area data, including bank-level data from France, we find that NIRP does not influence *overall* cross-border lending from banks' headquarters' economies, but NIRP does impair lending to financial sectors based in IFCs. This impairment is stronger for banks with a large deposit base in headquarter economies exposed to NIRP.

Key words: Bank lending; Cross-border lending; International financial centres; Monetary policy; Negative interest rates; Risk-taking.

JEL codes: E52, F34, F36, F42, G21.

Non-technical summary

While a growing body of research has concluded that negative interest rate policies (NIRP) have been an effective part of policy toolkits domestically, there has been limited focus on NIRP's cross-border effects to date. We fill this gap by analysing NIRP's effects on banks' global lending, contributing to a broader International Banking Research Network[1] initiative.

Specifically, we ask whether NIRP have altered the global transmission of monetary policy through cross-border bank lending, with a focus on international financial centres (IFCs) – which play a substantive role in worldwide banking and the global spillover effects of monetary policy.

To answer this, we use proprietary bank-level data tracking the size and composition of banks' cross-border lending, and other balance-sheet information, on a quarterly basis. We focus on transmission through three IFCs: the UK, Hong Kong and Ireland. These datasets include bank affiliates whose nationality differs from the IFC in which they are based – e.g. a French bank's outward lending from the UK. We study how NIRP in a bank's headquarter country affect the transmission of its headquarter monetary policy through the IFC-affiliates' cross-border lending, i.e. how changes in policy rates at home feed through to global lending decisions made in IFCs. We complement this with insights from bank-headquarter countries where NIRP has been enacted – France and the euro area more broadly.

For IFCs, we first regress the growth in IFC banks' cross-border lending on changes in home monetary policy, accounting for potential confounding factors. We find that outward monetary-policy transmission to non-bank sectors changes when headquarter policy rates are negative. Negative headquarter policy rates can impair the international bank-lending channel of monetary policy, especially for lending to the corporate sector. In contrast, for cross-border loans to other banks (interbank and intragroup), negative headquarter policy rates do not appear to impair bank-lending.

Second, applying our regression to different 'types' of banks, we investigate heterogeneity in transmission across IFC affiliates. We focus especially on banks' reliance on local deposits and intragroup funding, which comprise a substantial share of affiliates' liabilities in the three IFCs. We find that the funding structure of IFC affiliates (particularly their reliance on local deposit funding) is an important determinant of the extent of impairment when headquarter policy rates turn negative. UK and Hong Kong results suggest that the international bank-

[1] Paper ccontributing to Low interest rates and international banking initiative: https://www.newyorkfed.org/ibrn

lending impairment is smaller for IFC affiliates that are more reliant on IFC deposits, i.e. with funding less exposed to NIRP in home countries.

We complement these results by assessing the response of cross-border lending from headquarter countries to headquarter monetary policies – for euro-area monetary policy and French banks. Disentangling by sectors and recipient countries, estimates for France indicate bank-lending impairment for cross-border financial lending towards IFCs. They also suggest a special role for lending to the financial sector, with larger and more significant reactions to monetary policy for financial lending to IFC destinations, in contrast to non-financial lending. Finally, for French banks with a large deposit base in headquarter economies exposed to NIRP, international bank-lending impairment appears stronger.

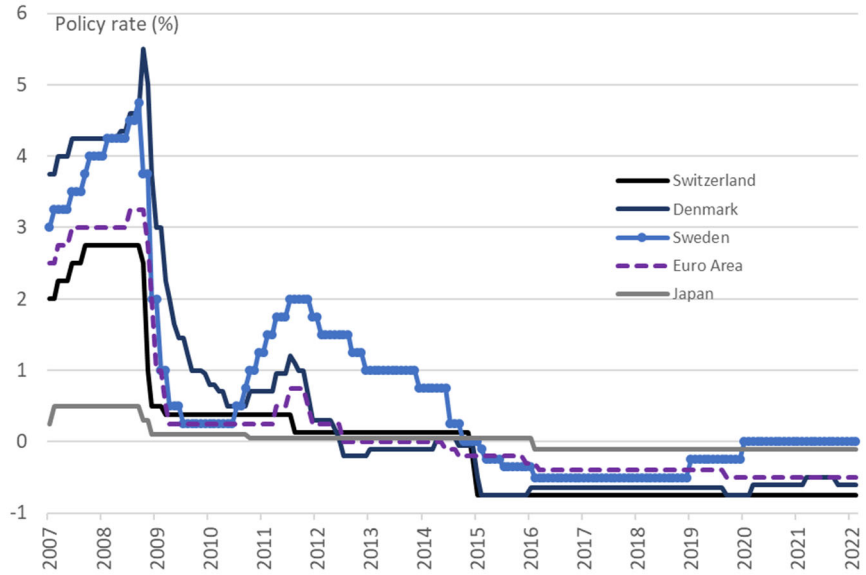
The fact that we find evidence of impairment in the international bank-lending channel through IFCs suggests that the cross-border spillovers – through international lending – of monetary policy can be less pronounced when headquarter countries enact NIRP.

Importantly, impairment is strongest for IFC-intermediated cross-border lending to non-financial corporations, with foreign affiliates' activities in IFCs responding to economic conditions in their headquarters. Hence, to assess the cross-border effects of monetary policy is important to take a global approach. Rather than consider only the first-round effects of (e.g.) euro-area monetary policy to the rest of the world alone, it is important to also consider flows through IFCs and their knock-on effects to other countries.

1. Introduction

In the wake of the 2007-2008 global financial crisis (GFC), several advanced economies have introduced negative interest rate policies (NIRP). Since 2012, central banks in Denmark, the euro area, Japan, Sweden and Switzerland have all enacted NIRP against a backdrop of low natural real rates of interest (Holsten, Laubach and Williams, 2017), as **Figure 1** demonstrates. In order to achieve sufficient macroeconomic stimulus in this environment,[2] these central banks turned to NIRP as part of their unconventional monetary policy (UMP) toolkits, taking their headline monetary policy interest rates below zero.

Figure 1 – Time series plot of headline policy rates in regions with negative rates



Notes: Headline negative interest rates. *Source*: Bank for International Settlements, European Central Bank, Bank of Japan and authors' calculations.

The introduction of NIRP has stimulated a large body of economic research (see Brandão-Marques, Casiraghi, Gelos, Kamber and Meeks, 2021, and Heider, Saidi and Schepens, 2021 for recent surveys). The existing literature has analysed a range of transmission channels, including NIRP's effects on money market interest rates, the yield curve, bank-lending volumes and interest rates, non-bank financial institutions (NBFIs), as well as macroeconomic growth and inflation. An overarching conclusion from this growing body of work has been that, overall, NIRP appears to have been an effective part of central bank toolkits.

[2] For Denmark and Switzerland, policymakers in part turned to NIRP to deal with currency appreciation pressures, in addition to broader macroeconomic stabilisation.

However, as Brandão-Marques et al. (2021) emphasise, there has been limited focus on the cross-border effects of NIRP to date.[3] The vast majority of studies are focused on the domestic effects of NIRP. This paper seeks to fill this gap by analysing the effects of NIRP on banks' global lending activities, contributing to a broader International Banking Research Network (IBRN) project studying the cross-country implications of NIRP for banks. Specifically, we ask whether NIRP has significantly altered the international transmission of monetary policy through cross-border bank lending, with a particular focus on international financial centres (IFCs).[4] Our paper complements a concurrent IBRN project (Cao, Dinger, Gómez, Hodula, Jara, Juelsrud, Liaudinskas, Malovana, Rakovská and Terajima, 2021), which focuses on the transmission of core countries' low and negative interest rates to small-open economies.

To answer our question, we utilise confidential bank-level data for a range of countries that tracks the size and composition of banks' cross-border claims at a quarterly frequency. We first focus on the transmission through IFCs, using data from the United Kingdom (UK), Hong Kong and Ireland. These datasets capture bank affiliates whose nationality differs from the IFC in which they are based – for example, we can track a French bank's cross-border lending activities in the UK. So, we specifically study how NIRP in a bank's headquarter country influences the transmission of its headquarter monetary policy through the IFC-affiliates' cross-border lending. In other words, we assess how changes in policy rates at home feed through to banks' global lending decisions made in IFCs, and how NIRP influences this transmission. We complement this analysis with insights on international lending behaviour from bank-headquarter countries/regions where NIRP has been enacted – specifically France and the euro area more broadly.

Our focus on the effects of NIRP on cross-border monetary policy transmission through IFCs is primarily motivated by the substantive role of IFCs in international banking activities. In past decades, the increasing interconnectedness of the international financial system has placed IFCs – like Hong Kong and London – at the heart of global banking activities. As such, changes in monetary policy rates may have substantive spillover effects through IFCs, as Hills, Ho, Reinhardt, Sowerbutts, Wong and Wu (2019) identify. Moreover, given the economies of scale and scope that bank affiliates in IFCs may benefit from – e.g. the agglomeration of other

[3] The limited number of studies that do analyse the cross-border dimensions of NIRP predominantly focus on its financial market impacts. For instance, Fukuda (2018) demonstrates that NIRP in Japan has positive spillovers to equity markets in other Asian countries. Varghese and Zhang (2018) identify similar positive financial-market spillovers from ECB NIRP. Notwithstanding this, Arteta, Kose, Stocker and Taskin (2016) argue that the cross-border financial market spillovers from advanced-economy NIRP to emerging market and developing economies have not differed significantly from the spillovers of conventional monetary policy expansions.

[4] An 'international financial centre' (IFC) is host to major financial activities, with a significant share performed by foreign international banking groups.

financial services that support cross-border lending nearby – there may be reason to expect decisions about a banking groups' global portfolio to be made from their IFC office. In view of this, we find it informative to study whether the transmission of monetary policy is substantially altered when bank affiliates in IFCs face NIRPs in their headquarter countries. Moreover, while others have *excluded* IFCs from studies of cross-border bank lending that use aggregated data (e.g. Takats and Temesvary 2020, 2021) given lending from IFCs can be driven, at least in part, by different factors compared to traditional banking-based considerations such as carry trade, arbitrage and hedging (Bussière et al, 2021), our study examines the relevance of NIRP for both financial sector and corporate sector cross-border lending from financial centres. Our focus on IFCs is additionally motivated by the fact we have access to bank-specific data for specific IFCs. Although there are some differences across the three IFCs, these data, particularly data on cross-border banking activities, are collected according to common standards (e.g. feeding into data collections by the BIS).[5] By using data from a range of IFCs, we are able to compare and contrast results across countries, exploring how bank and country characteristics interact with NIRP and the international transmission of monetary policy more broadly.

Focusing on IFCs is additionally useful given the comparatively limited scope for exploiting cross-country heterogeneity when studying the global spillover effects of NIRP. As Figure 1 shows, NIRP have only been enacted in a handful of jurisdictions, although these regions comprise a substantial share of cross-border banking activity and are therefore likely to play an important role in global shock transmission. Importantly, the IFCs in our study play host to banks headquartered in a range of countries, spanning both those with NIRP (the "treated") and those without (the "control group"). This heterogeneity in banks' nationality is crucial for our identification.

Our empirical analysis is structured around two potentially competing channels: international bank lending and international risk-taking. According to the first channel, reductions in policy rates in positive territory can reduce banks' funding costs and thus result in an increase in the overall *quantity* of lending. However, NIRP may impair this transmission, for example, by limiting the extent to which funding costs can be reduced. For instance, banks' deposit rates may be bound below at low or negative rates, given incentives for households and businesses to hold cash rather than bank deposits.[6] Thus, reductions in interest rates in negative territory

[5] The bank data in the IFCs are collected by the UK, Hong Kong and Ireland in accordance with the BIS guidelines, definitions and requirements for reporting international banking statistics.
[6] As it is typically thought more costly for companies with large balance sheets to switch into cash, rates on corporate deposits are likely to be less constrained than retail deposit rates. Consistent with this logic, Brandão-Marques et al. (2021) emphasise that rates on corporate deposits have fallen by more than those on retail deposits in regions that have used NIRP.

may pass through to bank lending to a lesser extent. In this sense, NIRP may *impair the bank-lending channel*. According to the second channel, reductions in policy rates in positive territory can reduce banks' profit and net interest margins. Seeking to maximise their overall returns, this could result in search-for-yield-type behaviour that generates increases in riskier lending (Dell'Ariccia, Laeven and Marquez, 2014). When policy rates are low or negative, this effect could be more pronounced, as bank profit margins become more squeezed. For example, if reductions in policy rates pass through to lending rates, but – due to NIRP – do not pass through to bank funding costs, banks' net interest margins will fall. Because of this, NIRP may incentivise *greater risk-taking* by banks (Bittner, Bonfim, Heider, Saidi, Schepens and Soares, 2022).[7]

While these channels may operate at a domestic level, there is reason to believe that they may work globally too. In addition to the overall size and scope of IFCs, bank risk-taking behaviour in particular is likely to have a strong geographical dimension. Within advanced economies, returns on a range of asset classes co-move strongly, reflecting the global financial cycle (Miranda-Agrippino and Rey, 2020). Facing NIRP at home, it is not inconceivable to hypothesise that banks may seek returns by extending more lending to higher return-yielding regions and asset classes in the global economy. And the economies of scale and scope that IFCs offer might mean that such behaviours may only be picked up at this level.

For IFCs, we present three main results. First, we find evidence that the outward transmission of monetary policy via IFC affiliates' cross-border lending to non-bank sectors changes when headquarter policy rates are negative. Our results for the UK, Hong Kong and Ireland suggest that negative headquarter policy rates can impair the international bank-lending channel of monetary policy, especially for lending to the corporate sector.

Second, we investigate potential heterogeneity in this transmission across IFC affiliates, focusing especially on their reliance on local deposits and intragroup funding. We find that the funding structure of IFC affiliates (particularly their reliance on local deposit funding) is an important factor in determining the extent of impairment in the bank-lending channel when their headquarter policy rate turns negative. Results for the UK and Hong Kong suggest that the impairment in the international bank-lending channel is smaller for IFC affiliates that are more reliant on IFC deposits and thus whose funding (denominated largely in local currency and USD) tends to be less exposed to negative rates in their home countries. Although this

[7] Bittner et al. (2022) propose an augmented bank balance-sheet channel, where impairment in the pass-through of monetary policy to funding costs reduces banks' ability to expand lending and the benefit of maintaining tighter lending standards decreases.

heterogeneity is less apparent for banks in Ireland, there is an important differences vs. the UK and Hong Kong: namely, that banks in Ireland were subject to euro-area NIRP.

Third, for cross-border loans to other banks (interbank and intragroup), we do not find evidence to suggest that negative headquarter policy rates impair the bank-lending channel or promote risk-taking by IFC affiliates. However, our results indicate that intragroup *funding* from the headquarter office is less sensitive to changes in home-country monetary policy when headquarter rates turn negative. This is consistent with the hypothesis that, as the pass-through of policy rate reductions into funding costs become more limited under NIRP in headquarters, this can affect banks' affiliates in IFCs via an intragroup funding channel.

We complement these IFC results by turning to direct cross-border lending from headquarter countries and the transmission of headquarter monetary policies – in particular for euro-area monetary policy using data for euro area as a whole, with a more specific focus on France. For the euro area overall, our results demonstrate an international bank-lending channel towards the rest of the world, but with only limited signs of an impairment in periods of NIRP. However, this might be due to the aggregate nature of the euro-area-wide data – in which extra-euro-area loans cannot be broken down by recipient country or counterparty sector. To shed more light on this, we use more granular data for France. Disentangling by sectors and recipient countries, results for France confirm the impairment of the bank-lending channel for cross-border financial lending towards IFCs. The results also suggest a specific role for IFCs, with larger and more significant reactions to monetary policy for financial lending towards these destinations, in contrast with other types of lending. Finally, our results confirm heterogeneities in the effects of NIRP with respect to banks' balance sheets, notably the role deposit funding. For banks with a large deposit base in headquarter economies exposed to NIRP, the impairment of the international bank-lending channel is stronger.

Together, our results have important implications. First, the fact we find evidence of impairment in the international bank-lending channel through IFCs suggests that the cross-border spillovers – through international lending – of monetary policy can be less severe when headquarter countries enact NIRP. Second, our results indicate that IFCs play an important role in intermediating funds across borders for non-financial firms. Third, and related to that, our findings indicate that foreign affiliates' activities in IFCs are responsive to economic conditions in their headquarters. So, in order to assess the cross-border effects of monetary policy it is important to take a global approach and consider flows through IFCs.

The remainder of this paper is structured as follows. After a brief literature review, Section 2 introduces the main hypotheses underpinning our analysis. Section 3 then describes the bank-

level data for our three IFCs – Hong Kong, Ireland and the UK – outlines our empirical specification and summarises the results. Section 4 complements this analysis using data from the euro area, with a deep dive using more granular data for France. Section 5 concludes.

Related Literature

Our work is part of a broader IBRN initiative analysing the impact of low interest rates and NIRP on bank lending, funding and profitability. A key novelty of this initiative comes from the concurrent analysis of confidential bank-level datasets, enabling rich meta-analyses of results. Alongside Cao et al. (2021), this paper contributes to this initiative by taking a global perspective, analysing the effects of NIRP, specifically, on cross-border banking lending.

More broadly, our paper is related to three strands of the academic literature. First, our work relates to research assessing the effects of negative interest rates on the size and composition of bank lending – surveyed in, for example, Bradão-Marques et al. (2021) and Heider et al. (2021). In theory, NIRP could be contractionary through the bank-lending channel once a 'reversal rate' has been reached (Brunnermeier and Koby 2018, Eggertsson et al 2019). However, Repullo (2020) recently questioned the existence of a 'reversal rate', using a model with endogenous bank capital. The overall empirical evidence suggests that the effects of policy rate cuts below zero on domestic bank lending largely resemble those of cuts in positive territory. However, there are differences across banks. For instance, according to some studies, banks with a larger share of liquid assets (Bottero et al., 2019), greater access to wholesale funding (Basten and Mariathasan, 2019), a lower share of deposit funding (Heider, Saidi and Schepens, 2019; Lopez, Rose and Spiegel, 2020; Demiralp, Eisenschmidt and Vlassopoulos, 2021) are able to increase lending more after NIRP.[8] While there is some evidence that banks take on more risk following the adoption of NIRP (Basten and Mariathasan, 2019; Bottero et al., 2019; Heider et al., 2019; Bubeck, Maddaloni and Peydró, 2020; Grandi and Guille, 2021; Bittner et al., 2022), this additional *ex ante* risk-taking has not yet translated into *ex post* risk crystallisation. However, these studies are all focused on banks' domestic lending activities, so do not capture cross-border spillover channels from NIRP that are a key novelty of our work.

Cross-border spillover channels of monetary policy through cross-border bank lending form the second strand of related literature for our work. Buch, Bussière, Goldberg and Hills (2019) summarise the results of a previous IBRN initiative studying the cross-border spillovers of

[8] Focusing on Japan and Sweden, respectively, Inoue, Nakashima and Takahashi (2019) and Eggertsson et al. (2019) find that banks with a larger share of retail deposits tend to lend less when interest rates are negative. In the euro area, Bittner et al. (2022) find that the initial level of deposit rates is important for the strength of the deposit channel and composition of credit supply, including potentially higher risk-taking if deposit rates are low.

conventional and unconventional monetary policies. Within that, Hills et al. (2019) emphasise an important cross-border dimension of spillovers through IFCs. We build on this literature by assessing how the transmission of monetary policy through banks' cross-border lending differs when policy interest rates are negative.

Third, our research extends a growing literature studying the role of IFCs in the global banking network (see, e.g. Bussière, Cao, de Haan, Hills, Lloyd, Meunier, Pedrono, Reinhardt, Sinha, Sowerbutts and Styrin, 2021 and the references within). The findings of Bussière et al. (2021) suggest that cross-border IFC lending and lending from the headquarter can differ in terms of how they react to cyclical policies in receiving countries. Specifically, in the face of euro-area monetary policy shocks, cross-border lending from French affiliates based in the UK interacts with macroprudential policies in receiving countries, whereas cross-border lending from French headquartered banks does not. In a similar spirit we show how negative interest rates in major jurisdictions influence cross-border lending from major IFCs.

2. Hypotheses

In this paper, we address the following question: for a bank affiliate resident in an IFC (hereafter denoted as 'IFC affiliate'), does the transmission of its headquarter-country monetary policy change when policy rates are in negative territory? We define monetary policy changes to encompass both conventional policies – affecting short-term interest rates – and unconventional policies like quantitative easing and forward guidance – which can affect the longer end of the yield curve. We include both sets of monetary policy indicators in our subsequent empirical framework.

We structure our analysis around two channels for cross-border bank lending: the international bank-lending channel and the international risk-taking channel. In the context of NIRP and the transmission of monetary policy through cross-border lending, these two mechanisms have potentially counteracting effects on the quantity of international lending following changes in monetary policy. We explain each in turn.

2.1. International Bank-Lending Channel

The standard bank-lending channel predicts that expansionary monetary policy is associated with increases in the overall quantity of bank lending. Lower policy rates feed through into reduced funding costs for banks that, in turn, relax constraints (Kashyap and Stein, 1995; Holmström and Tirole, 1997). Cetorelli and Goldberg (2012a) discuss how having global operations influences the transmission of monetary policy through banks' balance sheets.

NIRP may interact with this transmission. In particular, by limiting pass-through of policy rate reductions into funding costs, NIRP may impair the bank-lending channel. At low or negative rates, banks' deposit rates may be bound below and so reductions in monetary policy rates may not feed through into lower funding costs for banks. As a consequence, reductions in policy rates in negative territory may pass-through into bank lending to a lesser extent.[9]

It is important to note that this mechanism is relevant for the overall quantity of a banks' lending. It is not specific to their global operations. However, to the extent banks raise funds in their headquarters and use internal capital markets to transfer funds to affiliates (Cetorelli and Goldberg, 2012b), there is reason to believe there may be a global dimension to this transmission channel.

2.2. International Risk-Taking Channel

Dell'Ariccia et al. (2014) emphasise a risk-taking channel for monetary policy through banks' balance sheets. In particular, reductions in policy rates can reduce banks' profit and net interest margins. Seeking to maximise their overall returns, this could result in search-for-yield-type behaviour that generates increases in riskier lending.

When policy rates are low or negative, this effect could be more pronounced, as margins become increasingly squeezed. For example, when policy rates are reduced into negative territory, they can pass through to lending rates but, due to the mechanical bounds on banks' funding costs, not to deposit rates, therefore squeezing net interest margins. As such, reductions in monetary policy rates in negative territory could incentive more risk-taking by banks than equivalent rate cuts in positive territory.

While this channel is also not specific to a banks' global operations, there are good reasons to expect there to be a global dimension to this risk-taking. Access to global markets offers a potentially broader spectrum of returns for banks, both across asset classes and geographically. Thus, banks' risk-taking may well have a strong global dimension.

[9] Banks might adjust both the price and quantity terms of their lending, with both leading to a more muted response in the volume of bank lending. We would expect that, at least initially, banks could reduce the pass-through to price terms, and lending rates would become less responsive to (expansionary) monetary policy. Through general-equilibrium effects, bank-lending volumes might then in turn expand less as well.

3. Lending from International Financial Centres

We first analyse the transmission of monetary policy through banks in IFCs, focusing on how changes in interest rates and spreads in banks' headquarters influence cross-border lending from affiliates in IFCs. For example, we assess how a change in the monetary policy stance of the European Central Bank (ECB) influences the cross-border lending of French banks based in the UK.

3.1. Data

To assess this dimension of cross-border transmission, we use three bank-level datasets summarising banks' balance sheets from the UK, Hong Kong and Ireland. The datasets are compiled by national central banks and banking supervisors where they are privately held and, as a consequence, we use the three datasets independently to ensure confidentiality is maintained. They cover cross-border lending, disaggregated by recipient country, permitting a rich specification of fixed effects to control for potential confounding factors in our regressions. Banks' nationalities are recorded in the data, allowing us to use this information to identify banks facing NIRP in their headquarters.

The cross-border lending data can also be disaggregated by the type of the claim (for example loan or debt instrument), as well as by the receiving sector (bank and non-bank sectors). In line with international data collection efforts under the umbrella of the BIS, the level of disaggregation of receiving sectors has recently been expanded and we can examine not only claims on all non-banks but – from 2014 at the earliest – also claims on the corporate or NBFI sector.[10] We thus focus on both a sample starting in 2005Q1 (following Claessens, Coleman and Donnelly, 2016) as well as a more recent sample starting in 2014Q1 or 2015Q1 for which we have more disaggregated results due to the BIS enhanced locational banking statistics (Avdjiev, McGuire and Wooldridge, 2015).[11]

The dataset also includes broader information on banks' balance sheets which we use to derive control variables, and to consider bank-level heterogeneity in monetary policy transmission.

The lending data for all three countries is volatile in its raw form. We therefore employ several data-cleaning techniques to focus on quantitatively significant links, which may vary at the extensive margin between IFC-affiliate banks and receiving countries. We apply a similar

[10] For the case of Hong Kong, the disaggregation of non-bank sector into corporates and NBFI has only become available since 2015Q1.
[11] Data runs until 2019Q4 in the case of Hong Kong and Ireland, and 2019Q3 in the case of the UK.

cleaning procedure for all three regions, albeit with some differences to account for specificities of each dataset. Specifically, we only keep links where cross-border lending is at least £100mn in size (UK data).[12] To alleviate the effect of possible data errors and the effect of outliers, we drop growth rates outside the -100/500% range. We then winsorise the dependent variable in a way that growth rates are not greater than 100% in absolute value. Finally, we keep only bank-time-country observations with at least 8 consecutive observations. Control variables in our regressions are winsorised at the 1% level.

Summary statistics for the UK, Ireland and Hong Kong data are reported in Tables 1, 2 and 3, respectively. We discuss features of the data for each region in turn.

United Kingdom

The UK is a major IFC with sizable external liabilities (over 250% of GDP) (see, e.g., Beck, Lloyd, Reinhardt and Sowerbutts, 2022). It hosts a number of foreign-affiliate branches and subsidiaries (107 branches and 47 subsidiaries as of 2019Q3). Almost 50% of assets are due to foreign-owned banks. These foreign affiliates undertake a range of different activities, in particular investment banking, trading and foreign lending. Importantly for this study, a significant number of affiliates are from countries which have implemented negative rates (with EA, Japanese, Swiss, Swedish and Danish affiliates all playing a significant role).

The UK data is collated from the Bank of England's statistical reporting forms. The nationality of each bank is determined by the location of its ultimate parent – e.g. holding company – and not by the nationality of its largest shareholder. For example, a 'UK-owned' bank simply means that its ultimate parent is incorporated in the UK. The UK data also includes information on the reliance of affiliates on intragroup funding.

Ireland

The Irish banking system comprises three primary sub-sectors: international investment banks, retail banks and cooperative local banks, known locally as credit unions. International investment banks reside in Ireland's International Financial Services Centre (IFSC) and intermediate finance internationally. They account for nearly 70% of the international activities of Irish resident banks and are the focus on this contribution.

There are 58 banks in the sample, with headquarters in both euro-area and non-euro-area countries – for example the US, the UK, and Switzerland. The external liabilities of these banks amount to 71% of GDP. The Central Bank of Ireland requires banks with offices resident in

[12] Due to the risk of outliers when small positions change, we also only consider observations of bank-lending pairs if the stock of lending exceeds £1mn in the current or preceding quarter's total stock of external lending (UK data).

Ireland to report their balance sheets at a monthly frequency to compile monetary aggregates and financial statistics on the residency principle. Unlike consolidated data, which net out intragroup activity, a primary advantage of these data is that they allow for the observation of intragroup bank activities. Attributes collected from this data source include cross-border claims, internal capital market positions and total assets.

For the purposes of our study, there is a notable difference between the Irish IFSC and the global banking activities in the UK and Hong Kong. Specifically, as a euro-area member, Ireland itself faced NIRP. This factor helps to explain differences across the three IFCs when assessing heterogeneity in monetary-policy transmission across banks.

Hong Kong

Hong Kong, similar to other IFCs, also hosts a large number of foreign banks – including many global systemically important banks (GSIBs). But, contrary to the UK and Ireland banking system, a large number of them operate in the form of foreign bank branches in Hong Kong, as opposed to foreign subsidiaries. In particular, at the end of 2019, out of 148 foreign banks operating in Hong Kong, 131 were established in foreign bank branches. Importantly, foreign banks whose home countries have implemented NIRP (e.g. euro area and Japanese banks) have only established foreign bank branches in Hong Kong. Meanwhile, it is noteworthy that the liability structure of foreign banks in Hong Kong differs significantly between subsidiaries and branches. As documented in Hills et al. (2019), the liability structure for the group of foreign subsidiaries is very similar to that of other domestic banks in Hong Kong, which largely fund their business by local deposits (which accounted for over 70% of their liabilities). In contrast, the funding structure of foreign bank branches are relatively more diversified, with intragroup and deposit funding accounting for a similar share on average (see Table 3). Given the material difference in the liability structure between subsidiaries and branches and also due to fact that none of the foreign banks from countries that implemented have established foreign subsidiaries in Hong Kong, we therefore focus on a sample of foreign bank branches in Hong Kong's case for a clearer identification on the effect of NIRP. Indeed, the large presence of foreign bank branches and their high reliance of intragroup funding provide a suitable empirical setting to test the hypothesis of home-country monetary policy transmission to the IFC via the internal capital market channel.

On the asset side, these foreign bank branches play a key intermediation role for borrowers outside of Hong Kong. For instance, at the end of 2019, their cross-border lending to bank and non-bank sectors abroad accounted for more than 65% and 50% of the total cross-border volumes by all banks in Hong Kong respectively. In terms of geographical span of their cross-

border exposures, while they generally lend to borrowers in Asian economies, they also have significant exposures to the US and Europe.

3.2. Regression Specification

Our question of interest is how a change in monetary policy in a bank's headquarters influences cross-border lending from the bank's IFC affiliate and, in turn, how this transmission might differ when headquarter policy rates are negative.

To answer the first half of this question, we setup the following regression, where the dependent variable of interest $\Delta y_{b,j,t}$ captures the exchange rate-adjusted log-change in the stock of cross-border lending of each bank b, with a nationality hq, to different recipient countries j at a quarterly time frequency t:

$$\Delta y_{b,j,t} = \alpha + \sum_{k=1}^{K} \left[\beta_{1,k} \Delta r_{b,t-k}^{hq} + \beta_{2,k} \Delta Spr_{b,t-k}^{hq}\right] + \boldsymbol{\gamma} \boldsymbol{X}_{b,t-1} + f_b + f_{j,t} + \varepsilon_{b,j,t} \quad (1)$$

where $\Delta r_{b,t-k}^{hq}$ denotes the quarterly percentage point change in the short-term interest rate in bank b's headquarter (hq) country at $t-k$ and $\Delta Spr_{b,t-k}^{hq}$ is the quarterly percentage point change in the headquarter yield curve spread. We include both the short-term interest rate and the yield curve spread to capture both conventional and unconventional types of monetary policy, which typically operate through different segments of the yield curve. Throughout we define the short-term interest rate using market (interbank) interest rates to reflect the prevailing borrowing rate for banks. The yield curve spread is defined as the difference between 10-year and 3-month government bond yields.

In equation (1), the coefficients $\beta_{1,k}$ and $\beta_{2,k}$ reflect the average association between changes in banks' headquarter short-term interest rates and the yield curve spread, respectively, and the cross-border lending of their IFC-affiliate. Throughout, we report the cumulated sum of these coefficients, using $K = 4$ as our baseline to capture the lagged effect of changes in interest rates on cross-border lending over a 1-year period. Consistent with both the international bank-lending and risk-taking channels outlined in Section 2, we hypothesise that these cumulated coefficients – i.e. $\sum_{k=1}^{K} \hat{\beta}_{1,k}$ and $\sum_{k=1}^{K} \hat{\beta}_{2,k}$ – are significantly negative. In other words, a looser headquarter monetary policy – either through a reduction in short-term interest rates or a reduction in the yield curve spread – will, on average, be associated with an increase in bank-affiliates' cross-border lending from an IFC.

A selection of lagged bank-time controls are collected in $\boldsymbol{X}_{b,t-1}$. These include bank balance sheet characteristics and macroeconomic controls for the state of headquarter

macroeconomy. In particular, we include controls for banks' capital ratio, their liquid asset share, their core deposit ratio,[13] and their securities share, alongside year-on-year inflation and real GDP growth in the headquarter macroeconomy. The capital ratio reflects the percentage of banks' capital to asset ratio. It helps to control for the fact that the adjustment of loans in response to changes in deposits – potentially induced by changes in monetary policy – could be impaired by capital constraints.[14] The liquid asset ratio is defined as the percentage of a bank's asset portfolio that is liquid. It controls for banks' ability to adjust their assets in response to changes in monetary policy. The core deposits ratio reflects the percentage of a banks' balance sheet financed with core deposits from local sources. It captures the *ex ante* extent to which banks can access alternative sources of funding. The securities share is the share of bills, commercial paper and other short-term paper as well as longer-term investments and securities in total assets.

In addition, we include bank fixed effects f_b in equation (1) to account for all observed and unobserved bank-specific factors that do not vary over time or recipient country. The joint recipient country and time fixed effects $f_{j,t}$ control for observed and unobserved variation in recipient countries that can vary over time, including changes in the demand for credit.

We then study the potential differences in transmission when headquarter policy rates are negative by extending equation (1). This negative rates-interaction regression is given by:

$$\begin{aligned}\Delta y_{b,j,t} = \alpha &+ \sum_{k=1}^{K}\left[\beta_{1,k}\Delta r^{hq}_{b,t-k} + \beta_{2,k}\Delta Spr^{hq}_{b,t-k} + \beta_{3,k}\mathbf{1}^{hq}_{b,t-k}\right] \\ &+ \sum_{k=1}^{K}\left[\delta_{1,k}\left(\Delta r^{hq}_{b,t-k} \times \mathbf{1}^{hq}_{b,t-k}\right) + \delta_{2,k}\left(\Delta Spr^{hq}_{b,t-k} \times \mathbf{1}^{hq}_{b,t-k}\right)\right] \\ &+ \boldsymbol{\gamma}\boldsymbol{X}_{b,t-1} + f_b + f_{j,t} + \varepsilon_{b,j,t}\end{aligned} \tag{2}$$

where $\mathbf{1}^{hq}_{b,t-k}$ denotes an indicator variable that takes the value 1 in periods where the policy interest rate in bank b's headquarters (hq) is negative, and 0 otherwise. Unlike the short-term

[13] Core deposits are from local sources. We also use the term "local deposit share" for the same variable later in the paper when discussing the role of local deposit funding in our examination of bank heterogeneities. The terms "core deposit ratio" and "local deposit share" are thus used interchangeably throughout the paper.

[14] For the case of Hong Kong, the inclusion of capital ratio is not permitted as only foreign bank branches are considered in the empirical analysis and these entities do not have capital financing of their own. To account for banks' lending capacity constraint, bank's non-performing loan ratio, cost-to-income ratio and log real assets are added as additional bank controls.

interest rate change variable $\Delta r_{b,t-k}^{hq}$, which we define using the market interest rate to reflect overall funding conditions, we define the indicator variable using headline policy rates to reflect when policy frameworks were adapted to allow for negative interest rates.

Equation (2) includes interaction terms, $\left(\Delta r_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$ and $\left(\Delta Spr_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$, to assess how NIRP influences the transmission of short-term interest rate and yield curve spread changes, respectively. The associated coefficients, $\delta_{1,k}$ and $\delta_{2,k}$, thus reflect how the transmission differs when banks' headquarter policy rates turn negative. When these coefficients are significantly different from zero, we conclude that NIRP is associated with a significant change in monetary policy transmission through cross-border lending by IFC affiliates.

The channels we outline in Section 2 do not have a direct one-for-one mapping with the short-term interest rate and yield-curve spread interactions, respectively. To the extent that NIRP impairs the bank-lending channel, we hypothesise that the cumulated interaction coefficients can be positive $\sum_{k=1}^{K} \hat{\delta}_{1,k} > 0$ and/or $\sum_{k=1}^{K} \hat{\delta}_{2,k} > 0$. Combined with the hypotheses that $\sum_{k=1}^{K} \hat{\beta}_{1,k} < 0$ and $\sum_{k=1}^{K} \hat{\beta}_{2,k} < 0$, this implies that a reduction in headquarter short-term interest rates or yield curve spreads can be associated with a smaller increase in a bank's cross-border lending when headquarter policy rates are negative than otherwise, i.e. impaired bank-lending channel. In contrast, to the extent NIRP can engender a risk-taking channel through banks' profitability, then we hypothesise that the interaction coefficients can be negative, i.e. $\sum_{k=1}^{K} \hat{\delta}_{1,k} < 0$ and/or $\sum_{k=1}^{K} \hat{\delta}_{2,k} < 0$. Combined with the hypothesis that $\sum_{k=1}^{K} \hat{\beta}_{1,k} < 0$ and $\sum_{k=1}^{K} \hat{\beta}_{2,k} < 0$, this implies that a reduction in headquarter short-term interest rates or yield curve spreads can be associated with a larger increase in a bank's cross-border lending when headquarter policy rates are negative than otherwise.

3.3. International Financial Centre Results

This section presents results for the cross-border lending of foreign affiliates located in IFCs (namely the UK, Hong Kong and Ireland). As cross-border lending can be disaggregated into non-bank and bank sectors, we study them separately in order to gain a more comprehensive view on the effects of NIRP on the outward transmission of monetary policy. In what follows, we first discuss the results for loans to the non-bank sector, and then consider bank-level heterogeneity in this transmission. Finally, we examine the effects on cross-border flows vis-à-vis banks, both interbank and intragroup.

3.3.1. Cross-border lending to the non-bank sector

(i) Baseline results

Table 4 presents our baseline results for IFC affiliates' cross-border lending to the non-bank sector from 2005Q1 to 2019Q4. Since our focus is on the outward transmission of headquarter-country monetary policy via IFC affiliates' cross-border lending, we thus exclude banks' bilateral lending to their respective home country in the sample to allow clearer identification, as any changes in headquarter monetary policy may directly affect banks' lending to the borrowers at home.[15,16]

Columns (1) to (3) show the results for equation (1) without adding the negative rates-interaction terms for UK, Ireland and Hong Kong, respectively. The cumulated coefficients – that is $\sum_{k=1}^{K} \hat{\beta}_{1,k}$ and $\sum_{k=1}^{K} \hat{\beta}_{2,k}$ for $K = 4$ –capture the cumulative lagged effect of a 1pp decline in short-term rate or yield curve spread in the home country over a 1-year horizon on the average growth of IFC affiliates' cross-border lending in the current period ($t = 0$).

Over the whole period – i.e. including both times of positive and negative rates – we find somewhat weak international transmission of headquarter monetary policy in columns (1) to (3). While coefficients are generally negative for changes in short-term interest rates and yield curve spreads across the three IFCs' results, in line with our hypotheses outlined in Section 2, they are only statistically significant for Hong Kong (column (3)). The seemingly weak average transmission effects may be due to the fact that equation (1) has not explicitly accounted for potential differences in the monetary policy transmission between positive and negative rates periods, which in turn may mask the average effect on a net basis.

To address this, we run the negative rates-interaction regression (i.e. equation (2)) to assess how NIRP influences the cross-border transmission of short-term rates and yield curve spread changes. The results are presented in columns 4 to 6. Overall, when the interaction terms are included, we find stronger evidence of international monetary policy transmission via IFC affiliates' lending to the non-bank sector. For the UK, the negative coefficients on the standalone changes in short-term interest rates (i.e. $\sum_{k=1}^{K} \hat{\beta}_{1,k}$) turn statistically significant and peak at a three-quarter horizon (i.e. -0.0445 in column (4)), providing evidence for the existence of the international bank-lending channel under a positive interest rate environment. More importantly, this channel is found to be offset and weakened when headquarter policy

[15] Results are qualitatively similar when lending to the home country is included. For details, see appendix tables A1-a to A1-c, respectively.
[16] For euro-area banks, we treated lending to the euro area as lending to home country (e.g. lending by a German bank to borrowers in France would be treated as lending to the home country) as both are subject to ECB monetary policy.

rates turn negative, as indicated by the positive and significant coefficient on the associated interaction term between short-term interest rate changes and the negative rate dummy (i.e. $\sum_{k=1}^{K} \hat{\delta}_{1,k}$ = 0.264 when $K = 3$). Evidence of impaired monetary policy transmission during negative rate periods is also found for the case of Hong Kong (column (6)), though the impairment effect appears to work through changes in yield curve spreads (i.e. $\sum_{k=1}^{K} \hat{\delta}_{2,k} = 0.13$ when $K = 4$) instead. For Ireland, interaction terms with changes in short rates are predominantly positive, consistent with the impairment hypothesis, although the effects are not statistically significant.

Taking these findings together, there is some evidence to suggest the outward transmission of monetary policy via IFC affiliates' cross-border lending to non-bank sectors changes when headquarter policy rates are negative, and that the impaired bank lending channel appears to be a dominant driver.

(ii) Sectoral breakdown by lending to corporates and NBFIs

Given the above findings, we further examine whether the effect of NIRP could vary across different types of non-bank borrowers (i.e. corporates vs. NBFIs). We focus on 'real' lending to abstract from other activities (e.g. hedging and derivatives trade) which IFC affiliates may engage in. As data for this sectoral breakdown has only become available from 2014Q1 onwards, we re-run our analysis by regressing on the growth rate of cross-border lending to corporates and NBFIs over the same period separately, and report the results in Table 5. For the ease of presentation, here we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy, and we also report the associated non-interacted terms in Table 5. We note that there are circumstances where the cumulative effects for the interaction term and the non-interaction term peak at a different horizon. If this occurs, we report the peak cumulative effect for the non-interaction terms (i.e. changes in short-term rates and yield curve spreads) in squared brackets and coloured in blue.[17] The corresponding interaction terms are also reported in square brackets. The complete results are presented in the Appendix.

Overall, the results for loans to corporates sharpen the earlier findings for impairment of monetary policy transmission during negative rate periods for the aggregate non-bank sector. The evidence is more mixed for lending to the NBFI sector.

[17] Unless otherwise indicated, the peak cumulative effects for UK are at a three-quarter horizon (i.e. summing $t-1$ to $t-3$), while the peak cumulative effects for Ireland and Hong Kong are at a four-quarter horizon (i.e. $t-1$ to $t-4$).

For the UK, the impairment effect on lending to non-bank sector under the NIRP is largely driven by lending to corporates (columns (1) and (4)). By contrast, there is no evidence for a significant change in the monetary policy transmission for lending to NBFIs when headquarter policy rates turn negative (column (7)). These results jointly suggest that while there is a weaker lending response on the aggregate amount of cross-border lending to non-bank sector during negative interest rate periods, there appears to be a compositional change in banks' cross-border non-bank loan portfolio from corporates towards NBFIs concurrently. Such compositional changes may be interpreted as a suggestive evidence of a simultaneous risk-taking channel; however further information on the relative riskiness of corporate vs. NBFI lending is required to arrive at firmer conclusions.

Similarly, for the case of Hong Kong, we find evidence of impaired transmission channel (working through the yield curve spread changes) for lending to corporates only (column (6)), but not for loans to NBFIs during negative rate periods (column (9)).[18] For Ireland, we find evidence of impaired bank-lending channel working through changes in short-term interest rates for both lending to corporates and NBFIs during negative rate periods (columns (5) and (8)).

One implication arising from these results is that, while we generally find support on the existence of impaired bank-lending channel for lending to the non-bank sector as a whole under a negative interest rate environment, the distributional effect within different non-bank sectors may vary across jurisdictions.

3.3.2. Exploring heterogeneities across banks

In this section, we explore the extent to which the transmission channels discussed so far vary with respect to observable bank characteristics. In particular, we focus on whether the funding structure of IFC affiliates could increase or decrease their exposure to negative rates in their headquarters. This is especially relevant in light of the results presented in Section 3.3.1, which generally suggest that NIRP is associated with an impairment of the international bank-lending channel.

As discussed earlier, the impairment in the bank-lending channel can stem from the limited pass-through of policy rate reductions to the funding costs of banks under the negative rate environment. As banks' intragroup funding tends to be a major funding source for IFC affiliates,

[18] The insignificant results for Hong Kong could be due to a small sample issue. Cross-border lending to NBFI by foreign banks in Hong Kong constitutes only a relatively small fraction in their overall cross-border lending to non-bank sector. Based on 2019Q4 positions, on aggregate cross-border lending to NBFIs accounted for less than 20% of all cross-border lending to non-bank sector of foreign banks in Hong Kong.

the limited pass-through to funding costs of parent groups under the NIRP can, in turn, affect the lending sensitivity of the IFC affiliates. In this regard, we conjecture that IFC affiliates that have higher a reliance of intragroup funding (measured by the ratio of intragroup funding to total liabilities) will be more exposed to the negative rates in their headquarters, and therefore tend to amplify the impairment in the bank-lending channel. Conversely, IFC affiliates that are more reliant on local deposit funding (measured by the share of local deposit to total liabilities) should be less exposed to negative interest rates in their headquarter countries, and therefore less subject to the impaired bank-lending channel. This is because these local deposits are in most cases denominated in local currencies of the IFCs or in other major non-NIRP currencies (i.e. US dollar),[19] so that the funding costs of these local deposits are not affected by the negative policy rate in the headquarters of the IFC affiliates.

To test the above, we employ three empirical specifications for cross-border lending to non-banks of IFC affiliates. First, we employ the same interaction regression model as before (i.e. equation (2)), but on a split sample of IFC affiliates based on a specific balance sheet factor. Specifically, to analyse heterogeneity with respect to banks' intragroup funding share, banks are classified into those that heavily rely on intragroup funding if their average share of intragroup funding to total liabilities across the sample period is higher than the upper quartile (i.e. above the 75th percentile). Otherwise, banks are classed as having a low reliance on intragroup funding. Likewise, to investigate heterogeneity with respect to banks' deposit reliance, we split IFC affiliates into high and low reliance in a similar fashion (i.e. above and below the 75th percentile).

Second, we study explicitly how the funding structure of IFC affiliates may amplify or mitigate the impaired bank lending channel when headquarter policy rates are negative by extending equation (2) with triple interaction terms. Specifically, we consider the following triple interaction specification:

$$\Delta y_{b,j,t} = \alpha + \sum_{k=1}^{K}\left[\beta_{1,k}\Delta r^{hq}_{b,t-k} + \beta_{2,k}\Delta Spr^{hq}_{b,t-k} + \beta_{3,k}\mathbf{1}^{hq}_{b,t-k}\right] + \sum_{k=1}^{K}\left[\mu_{1,k}\Delta r^{hq}_{b,t-k} + \mu_{2,k}\Delta Spr^{hq}_{b,t-k}\right] * High\_BSF_b \quad (3)$$

[19] Summary statistics in tables 1 and 3 show that around 80% of deposits in IFC affiliates in UK and HK are denominated in local currency and other non-NIRP currency (e.g. US dollar). In the UK, Sterling deposit accounts for around 50% of affiliates' deposit funding on average and 36% are in other currencies (mostly US dollar), while only 16% of deposits are in euros. In Hong Kong, Hong Kong dollar and US dollar deposits together account for more than 80% of affiliates' deposit funding on average.

$$+\sum_{k=1}^{K}\left[\delta_{1,k}\left(\Delta r_{b,t-k}^{hq}\times \mathbf{1}_{b,t-k}^{hq}\right)+\delta_{2,k}\left(\Delta Spr_{b,t-k}^{hq}\times \mathbf{1}_{b,t-k}^{hq}\right)\right]$$

$$+\sum_{k=1}^{K}\left[\theta_{1,k}\left(\Delta r_{b,t-k}^{hq}\times \mathbf{1}_{b,t-k}^{hq}\right)+\theta_{2,k}\left(\Delta Spr_{b,t-k}^{hq}\times \mathbf{1}_{b,t-k}^{hq}\right)\right]\times High\_BSF_b$$

$$+\boldsymbol{\gamma X}_{b,t-1}+f_b+f_{j,t}+\varepsilon_{b,j,t}$$

where $High\_BSF_b$ denotes a dummy variable that takes the value unity if the average value of each aforementioned balance-sheet factor of IFC affiliates (i.e. intragroup funding share or local deposit share) is higher than the upper quartile, and zero otherwise.

Equation (3) includes triple interaction terms, $\left(\Delta r_{b,t-k}^{hq}\times \mathbf{1}_{b,t-k}^{hq}\times High_BSF_b\right)$and $\left(\Delta Spr_{b,t-k}^{hq}\times \mathbf{1}_{b,t-k}^{hq}\times High\_BSF_b\right)$, which statistically assess the extent to which the impaired bank-lending channel may be amplified or mitigated by the funding structure of IFC affiliates. As discussed, we expect IFC affiliates with higher reliance on intragroup funding to be more exposed to NIRP than their peers with lower intragroup funding reliance. We therefore expect to see the impaired bank-lending channel to be larger (i.e. $\sum_{k=1}^{K}\theta_{1,k}>0$ and $\sum_{k=1}^{K}\theta_{2,k}>0$). Conversely, the corresponding coefficients on the triple interaction term are expected to be negative (i.e. $\sum_{k=1}^{K}\theta_{1,k}<0$ and $\sum_{k=1}^{K}\theta_{2,k}<0$) when the local deposit share of IFC affiliates is considered, because higher deposit share affiliates are conjectured to be less exposed to negative interest rates in their headquarters.

In addition to the dummy variable interaction regression, we also consider a third approach by replacing the dummy variables with the time-varying continuous variables of IFC affiliates' intragroup funding share and local deposit share respectively (i.e. $BSF_{b,t-K-1}$) for the triple interaction specification as a robustness check. Specifically, both balance sheet factors will be lagged by $t-K-1$(i.e. 5 quarters when $K=4$) to alleviate potential endogeneity issues. As before, we expect $\sum_{k=1}^{K}\theta_{1,k}>0$ and $\sum_{k=1}^{K}\theta_{2,k}>0$ when intragroup funding share is considered, while $\sum_{k=1}^{K}\theta_{1,k}<0$ and $\sum_{k=1}^{K}\theta_{2,k}<0$ are expected when local deposit share is examined.

Table 6 presents the results that focus on how the heterogeneity of IFC-affiliates' local deposit share may affect the extent of home-country monetary policy transmission to IFC affiliates' cross-border lending to non-banks. Similarly, Table 7 shows regressions that consider

heterogeneity with respect to IFC-affiliates' intragroup funding share.[20] Specifically, columns (1) to (6) present the split regression results for the three IFCs, while columns (7) to (12) show the two triple interaction regression results, respectively, for the three IFCs. For brevity, only the estimated coefficients on the interaction term between monetary policy and IFC affiliates' balance sheet factors are shown in the tables, while the full regression results are available on request.

On the whole, we find robust evidence suggesting that the extent of impairment in the international bank-lending channel under NIRP will vary depending on the local deposit share of IFC affiliates. For the split regressions, both the UK and Hong Kong results suggest that the impairment in the bank-lending channel is less (more) apparent for high (low) deposit IFC affiliates (columns (1)-(2) and (5)-(6) of Table 6). This is consistent with our conjecture that high deposit IFC affiliates, whose funding tend to be less exposed to negative rates in their home countries as compared with low deposit IFC affiliates. By contrast, we find the opposing result for Ireland. In particular, the evidence suggests the impaired bank-lending channel is present for the group of high deposit IFC affiliates under the NIRP, while the impairment is not significant for the group of low deposit affiliates (see columns (4) and (5)). The differences in the Irish results vs. the UK and Hong Kong, are likely attributed to the fact that Ireland, as a euro-area member where banks' local deposit funding is largely denominated in euros, is subject to negative interest rates, so that the pass-through of policy rate reduction to banks' local deposit rates in Ireland is hindered by a zero-lower bound (Heider et al., 2020). Therefore, high deposit IFC affiliates in Ireland would indeed be more exposed to NIRP and thus more subject to the impaired bank-lending channel than their low deposit counterparts. For the triple interaction regressions, while we do not find significant results for the UK, Ireland and Hong Kong, results are consistent with that seen in the split regressions.[21]

The results are somewhat mixed in Table 7 when we examine the extent to which banks' intragroup funding share may play a role in determining the extent of monetary policy transmission under the NIRP. For the UK and Hong Kong, there is some tentative evidence suggesting that IFC affiliates with higher reliance on intragroup funding tend to be more subject to the impaired international bank-lending channel as compared to their counterparts under the NIRP. This is evidenced by the positive and statistically significant coefficients on

[20] The corresponding regression results for IFC-affiliates' cross-border lending to corporates are qualitatively similar to those for lending to non-bank. The results are available upon request.
[21] A plausible reason for finding stronger evidence in the case of Hong Kong relative to the UK results could be due to the fact that local deposit funding generally accounted for a larger share in IFC affiliates' liabilities in Hong Kong (22% on average) than those in the UK (10% on average) (see Tables 1 and 3), thus making them relatively more shielded from the impact of NIRP.

$\left(\Delta Spr_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq} \times High\_BSF_b\right)$ in the triple interaction regression for the UK (i.e. column (8)), and also in the split regression results for the case of Hong Kong (i.e. columns (5) and (6)). However, this finding is less robust under other specifications. In addition, we find evidence of the impairment effects for IFC affiliates located in the UK and Ireland for IFC affiliates with lower intragroup funding reliance as indicated in the split regressions (columns (1) and (3)). [22]

Taking these findings together, there is evidence to suggest the extent of outward transmission of monetary policy under the NIRP via IFC affiliates' cross-border lending to non-bank sectors does vary across banks. Largely in line with the hypothesis of impaired international bank-lending channel, we find that the funding structure of IFC affiliates (particularly their reliance on local deposit funding) is an important factor in determining the extent of impairment in the bank-lending channel when their headquarter policy rate turns negative.

3.3.3. Extensions to other aspects of banks' balance sheets

In this sub-section, we assess the extent to which the results presented for our base case (section 3.3.1) are specific to IFC affiliates' cross-border lending to non-banks. We do so by investigating the implications of NIRP on IFC banks' cross-border lending to banks, domestic lending and external funding in turn.

(i) Cross-border lending to banks

Apart from lending to non-bank borrowers, foreign banks in the three IFCs also play an active role in the interbank market both domestically and internationally. It is thus important to assess how NIRP may affect the international transmission of headquarter monetary policy via IFC affiliates' cross-border lending to banks. In this subsection, we investigate the effect of NIRP on IFC banks' cross-border interbank loans as well as intragroup banking flows.

Table 8 presents the results for IFC affiliates' cross-border lending to the bank sector. Cross-border lending towards the home country is excluded, as before, for a clearer identification. Columns (1) to (3) first show the results for IFC affiliates' lending to all banks abroad (i.e. lending to both unaffiliated banks and related intragroup banking affiliates), while columns (4) to (6) present the results for IFC affiliates' cross-border intragroup lending only.[23]

Except for Ireland, a looser monetary policy in the headquarter country is associated with an increase in IFC banks' cross-border interbank loans under a positive interest rate environment

[22] For Ireland, the sign reverses in column (10) when the continuous dummy is included.
[23] Due to data limitation, Ireland does not have geographical breakdown for intragroup-lending or intragroup-funding, which preclude us from separating out intragroup-lending to or -funding from the headquarters.

(columns (1) and (3)). However, contrary to the results for cross-border lending to the non-bank sector, we do not find strong evidence for the case of the UK and Hong Kong for a significant change in the transmission when headquarter policy rates become negative.[24] For Ireland, while we find a marginally significant negative coefficient on the interaction term $\left(\Delta r_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$, we have some reservation interpreting this as evidence for risk-taking behaviour under NIRP as the coefficient on short-term rate changes has a counterintuitive sign (i.e. $\sum_{k=1}^{K} \hat{\beta}_{1,k} > 0$) during the positive-rate period. As such, there is still a contractionary effect of a reduction in short-term interest rate on banks' cross-border interbank loans under negative rate period (i.e. $\sum_{k=1}^{K} (\hat{\beta}_{1,k} + \hat{\delta}_{1,k}) > 0$), inconsistent with the risk-taking channel hypothesis.

For intragroup lending, we do not find significant spillover effects from home-country monetary policy on IFC affiliates' intragroup lending for the case of UK and Hong Kong, irrespective of whether the headquarter policy rate is positive or not (columns (4) and (6)). In fact, cross-border intragroup lending by IFC affiliates in these countries seems somewhat isolated from monetary policy changes in their home countries suggesting that other considerations drive such lending decisions (Cetorelli and Goldberg, 2012a). The results also indicate that the results in columns (1) and (3) (i.e. lending to all bank sector) seem to be driven largely by lending to unaffiliated banks abroad. For Ireland, there is some evidence for significant international spillover effects on intragroup lending (columns (5)). However, as the intragroup lending towards headquarter offices cannot be separated out from the dependent variable due to data limitation, Ireland's result may not be directly comparable with the UK's and Hong Kong's results.

On balance, our results in Table 8 suggest that the outward spillover effect of headquarter monetary policy via IFC affiliates' cross-border lending tends to be transmitted to unaffiliated banks abroad, but to a lesser extent for their intragroup affiliates during positive rate periods. In addition, there seems to be no strong and clear evidence to support the presence of impaired bank-lending or risk-taking channel for IFC affiliates' cross-border interbank loans when headquarter policy rate turns negative.

(ii) Inward transmission to IFCs via IFC affiliates' domestic lending

While there is evidence to support an outward transmission of NIRP at the home country to the rest of the world via IFC affiliates' cross-border lending, an important related question is whether there is also an inward transmission of the negative rates to these IFCs via IFC

[24] While we find a positive coefficient on the interaction term on changes in yield curve spread in Hong Kong's result, it is only statistically significant at the first-quarter horizon and become insignificant over a longer horizon. This indicates that the impairment effect is rather short-lived.

affiliates' domestic lending.[25] This question is important for policymakers in the host country (particularly for IFCs) as IFC-based foreign-owned banks are not only important funding providers for multinational corporates and overseas banks, but some of them also play a key role in providing liquidity for domestic corporates as well as the local interbank and financial markets. Importantly, in view of the large presence of foreign banks operating in these IFCs, the potential inward spillover effect of NIRP, if any, may raise significant financial stability implications for these IFCs and their host economies. Furthermore, this subsection complements above cross-border lending results by offering a more comprehensive picture on how foreign bank branches in IFCs manage their lending business in different segments.

To examine the potential inward transmission of NIRP, we repeat our regressions (equation 2) by replacing the dependent variable with IFC affiliates' domestic lending. We consider lending to domestic non-banks – split further into non-financial corporates and NBFIs – and domestic banks. Again, given that there is only one country-bank pair remaining, we therefore exclude the recipient country-time fixed effects from the regression, and the standard errors are now clustered at the bank-level. The results for UK, Ireland and Hong Kong are shown in columns (1) to (12) of Table 9 respectively.[26]

Overall, there is clear evidence for an inward transmission of home-country monetary policy to the three IFCs via IFC-affiliates' domestic lending to non-bank borrowers. In line with the bank-lending channel, IFC affiliates tend to increase lending to non-banks in response to the loosening in home-country monetary policy under a positive interest rate environment, as indicated by the negative and significant coefficients on $\Delta r_{b,t-k}^{hq}$ in columns (1) to (3). Similar to the results found in cross-border lending, for all three IFCs the bank lending channel is found to be impaired during NIRP periods, as indicated by the positive coefficients on the interaction term $\left(\Delta r_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$. We also find evidence of an impaired international bank-lending channel during NIRP periods for loans to domestic corporates from the three IFCs (see columns (4) to (6)).

The results are less conclusive for lending to domestic NBFIs in the IFCs. For the UK, loans to domestic NBFIs appear to be unresponsive to changes in the home-country monetary policy stance both during positive and negative interest rate environments (column (7)). For Ireland, while we do find evidence for a significant inward transmission of home-country monetary policy (column (8)), both the estimated coefficients on $\Delta r_{b,t-k}^{hq}$ and $\left(\Delta r_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$ are of

[25] Specifically, IFC-affiliates' domestic lending refers to the lending of a foreign-owned bank-affiliate resident in the IFC to local borrowers in the country hosting the IFC.
[26] As there is no breakdown of domestic lending to NBFIs in Hong Kong, the corresponding result for the case of HK is not available.

opposing sign relative to those for lending to domestic corporates (column (2)). The differences in the estimated effects of changes in home-country monetary policy stance between loans to domestic corporates and NBFIs for the Ireland's results may jointly suggest that there may be a compositional change in banks' domestic non-bank loan portfolio from corporates towards NBFIs when the headquarter policy rate turns negative.[27]

For IFC-affiliates' local interbank lending, there appears no strong evidence to indicate a significant inward spillover from changes in home-country monetary policy stance during positive interest rate periods (see columns (10) to (12)). That said, there is tentative evidence of an impaired international bank-lending channel during negative interest rate periods in the case of UK, as indicated by the positive and statistically significant coefficient on $\left(\Delta \mathrm{Spr}_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$. However, these results are statistically insignificant in the case of Ireland and Hong Kong, respectively (columns (11) and (12)).

Overall, these results together suggest that changes in home-country monetary policy do have an inward spillover effect to the IFCs' host countries via IFC-affiliates' local lending. Under the positive interest rate environment, the inward spillover effect is more apparent for lending to local non-financial corporates, but less so to the local interbank markets, which is in line with the international bank-lending channel hypothesis. Importantly, largely similar to the results found in the cross-border lending, the bank-lending channel is also found to be impaired during NIRP.

(iii) Cross-border intragroup funding

So far, our analysis has focused on the international transmission of home-country monetary policy via IFC affiliates' cross-border lending. Another important aspect that deserves further investigation is whether there is a direct transmission of home-country monetary policy from the banks' headquarter offices to their IFC affiliates via the intragroup funding channel. Previous studies (Cetorelli and Goldberg, 2012a; Buch et al., 2019) show that the internal capital market of global banks plays a key role in determining how shocks could trigger international spillover effects.

To examine this, we repeat our regressions by replacing the dependent variable with IFC affiliates' intragroup funding from banks' headquarter office. Given that there is only one country-bank pair remaining, we therefore exclude the recipient country time-fixed effect from the regression. The results are shown in columns (1) to (3) of Table 10. As noted earlier, the results for Ireland may not be directly comparable to the UK's and Hong Kong's results as we

[27] In addition, during the period coinciding with NIRP the NBFI sector in Ireland tripled in size and it was the fifth largest host globally at end-2020.

cannot distinguish the intragroup funding solely from headquarter country due to limited data availability.

The Hong Kong and UK, albeit less significantly, results both indicate that there is evidence of direct transmission of home-country monetary policy from banks' headquarter office to their IFC affiliates via the intragroup funding channel. Specifically, under the positive interest rate environment, IFC affiliates tend to experience a rise in intragroup funding from headquarter (Hong Kong: -0.191** at the third-quarter horizon for $\beta_{1,k}$; UK: a negative, but insignificant coefficient) in response to a loosening in the home-country monetary policy stance. However, this channel is found to be impaired during the negative interest rate periods, as indicated by the positive and significant coefficient on the interaction term for both the UK and Hong Kong $\left(\Delta r_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$.

In summary, the results point to a weaker sensitivity of intragroup funding provided by headquarter office to changes in home-country monetary policy stance under the NIRP. This is consistent with the hypothesis that, as pass-through of policy rate reductions into funding costs of a bank becomes limited under NIRP, this constraining factor is not confined to the bank's domestic business but can also affect its affiliates in the IFCs via the intragroup funding channel. Combined with the results in Table 4 and 5, these findings together provide novel evidence that the intragroup funding from the headquarters is one important channel for determining the international spillover effects of NIRP.

4. Cross-Border Lending from Banks' Headquarters

We now complement the analysis in Section 3, by assessing the transmission of headquarter-country monetary policy through banks' cross-border lending from their headquarters. As such, we consider the transmission of euro-area monetary policy through euro-area banks' cross-border lending, before using more granular data focusing on French banks.

4.1. Data

We use two distinct bank-level datasets: euro-area-wide data from the ECB and for France from the French supervisory authority (*Autorité de Controle et de Régulation*, ACPR). The datasets are compiled by central banks and banking supervisors where they are privately held.

4.1.1. Euro area

The euro-area banking data used in the analysis is taken from Individual Balance Sheet Items (IBSI) database and consists of end of month outstanding amounts (stocks) data for selected balance sheet indicators. The sample consists of 288 bank entities from 14 euro area countries

from 2007Q4 to 2020Q2,[28] though the time length varies from country to country. IBSI data allows us to differentiate cross-border lending by broad geography –domestic lending, lending to euro area (other than domestic) and rest of the world (other than euro area and domestic), though for the purpose of our analysis we only focus our results on lending to rest of the world.. Interest-rate and yield-curve spread data are the same as in Section 3, as is the definition of the NIRP dummy. For the euro area, the dummy takes the value 1 from 2014Q2 and 0 otherwise, consistent with the definition shown in Figure 1.

We use a series of bank specific and macroeconomic controls. As bank variables we use the leverage ratio, the share of stable deposits – (from households and non-financial companies) in total liabilities, and a proxy for the liquidity ratio, all calculated based on IBSI data. As macroeconomic controls we use the lagged domestic real GDP growth rate for each euro area country.[29] The macroeconomic control variables for the recipient region are all based on weighted averages, using domestic banks' exposure to the rest of the world as weights. To control for loan demand in the destination region, as well as the state of the financial cycle, we include exposure-weighted measures of the business and financial cycle (based on the BIS statistics). Table 11 summarises the descriptive statistics of the main variables.

4.1.2. France

French banking data captures the stock of cross-border lending as well as bank balance sheet characteristics, at a quarterly frequency from 2000Q2 to 2017Q4 (measured at the end of period). Cross-border lending is disaggregated by recipient country and by counterpart sector (financial *vs.* non-financial sectors), allowing to exploit different degrees of cross-sectional heterogeneity. As per the focus of this paper, the sample is restricted to the 83 banks headquartered in France. To be consistent with the treatment of data in Section 3, three further data cleaning steps are considered. First, we keep only lending destinations that account for at least 0.1% of the total cross-border lending (on average over 2000-2017) to focus on quantitatively significant links. This restricts the number of recipient countries from 253 initially to 53. Similar to Section 3, we also winsorise the dependent variable to ensure that quarterly growth rates of cross-border lending do not exceed 100% in absolute value. Third, we keep data points only if they belong to a continuous series of observations spanning at least 8 quarters (i.e. 2 years). The dataset also includes information on banks' balance sheets, which we use as control variables. As in section 3, control variables are winsorised at the 1% level.

[28] Given the other variables used for the analysis are quarterly, we take end-of-quarter data of IBSI data for each individual bank.
[29] Based on national account statistics (MNA) from the ECB Statistical Data Warehouse (SDW).

Table 12 provides descriptive statistics, showing notably signs of the more volatile nature of lending towards the financial sector.

Other variables are taken from external providers. Controls for the destination country are the financial and the business cycles obtained from the BIS. More specifically, business cycle indicators are built following the methodology of BIS (2014); financial cycle indicators follow Drehmann et al. (2011). We also control for macroeconomic conditions in France using the growth rate of GDP and CPI inflation rates for France. Both taken from the IMF WEO database. Regressions for France also include global control on the monetary policy in the core economies (the US and the UK) that can influence cross-border lending.[30] To avoid potential simultaneity bias in monetary policies across advanced economies, controls for the US and UK monetary policies are introduced prior to monetary policy changes in EA (i.e. at $t-5$).

4.2. Regression specification

A first question of interest relates to whether results for the cross-border lending of IFC affiliates are confirmed when taking the perspective of the banks' headquarter country. The specifications for Section 4 are therefore very close to Section 3. The dependent variable is also $\Delta y_{b,j,t}$ the exchange rate-adjusted quarterly log-change in the stock of cross-border lending of each bank b to recipient country j at a quarterly time frequency t. $\Delta r^{EA}_{b,t-k}$ denotes the change in the short-term interest rate at $t-k$ and $\Delta Spr^{EA}_{b,t-k}$ is the change in the yield curve spread. $\mathbf{1}^{EA}_{b,t-k}$ denotes an indicator that takes value 1 when the ECB policy interest rate is negative. The main difference with the specifications in Section 3 are that rates, spreads, and NIRP dummies are now the same for all banks and recipient-country – as the headquarter country / area is unique.

Similarly to Section 3, lagged bank-time controls are collected in $\boldsymbol{X}_{b,t-1}$ while time-invariant bank fixed effects f_b are also included. We also include controls for the lagged economic conditions. The main difference with the specification in Section 3 arises from the fact we can no longer include destination-country-time fixed effects. Instead, we include specific destination-country controls $\boldsymbol{Z}_{j,t-1}$, namely the BIS-based indicators for the business and financial cycles. Finally, we include global variables that can affect the extent of cross-border lending in $\boldsymbol{Q}_{t-5}$ by introducing measures of monetary stances in key centre economies (United States and United Kingdom). To avoid endogeneity or simultaneity issues, these are

[30] For the US, we use monetary policy surprises constructed following the methodology of Kuttner (2001). For the UK, we use the quarterly change in the shadow rates constructed by Krippner (2020).

introduced with 5 lags, i.e. prior to changes in EA monetary policy. The resulting specification is the following:

$$\begin{aligned}\Delta y_{b,j,t} = \alpha &+ \sum_{k=1}^{K}\left[\beta_{1,k}\Delta r_{b,t-k}^{home} + \beta_{2,k}\Delta Spr_{b,t-k}^{home} + \beta_{3,k}\mathbf{1}_{b,t-k}^{EA}\right] \\ &+ \sum_{k=1}^{K}\left[\delta_{1,k}\left(\Delta r_{t-k}^{home} \times \mathbf{1}_{t-k}^{EA}\right) + \delta_{2,k}\left(\Delta Spr_{t-k}^{home} \times \mathbf{1}_{t-k}^{EA}\right)\right] \\ &+ \boldsymbol{\gamma X}_{b,t-1} + \boldsymbol{\varphi Z}_{\boldsymbol{j,t-1}} + \phi Q_{t-5} + f_b + \varepsilon_{b,j,t}\end{aligned} \tag{4}$$

The interpretation of the coefficients for the variables of interest also follows Section 3. In particular, our interest lies in the coefficients associated to interactions, $\delta_{1,k}$ and $\delta_{2,k}$. They allow assessing how the NIRP influences the transmission of respectively the short-term interest rate and the yield curve spread changes. When positive and significantly different from zero, they suggest that NIRP impairs the bank-lending channel.

4.2.1. Results for the euro area as a whole

We establish stylised facts related to cross-border lending by euro-area banks by analysing the results of the regressions using data on the 288 bank entities from the euro area as described in Section 4.1.1. Table 13 depicts the results. Column (1) shows results for total loans from euro-area banks to the rest of the world (i.e. non-euro-area countries). Column (2) shows a similar scope as column (1) – taking all categories of loans towards all non-euro-area countries – but using the French sample with only French banks.

We find no strong evidence of an international bank-lending channel towards the rest of the world before the introduction of NIRP.[31] This is indicative that cross-border lending was not driven by euro-area monetary policy. Interestingly, the coefficient on changes in the short-term interest rates interacted with the NIRP dummy is significant and negative for total lending to the rest of world (column 1), suggesting that during the post-2014 period, cross-border loans to extra-euro-area countries increases when monetary policy loosens. By contrast, the specification in column (2) based on French sample which starts in 2000, does not find a similar pattern.

[31] In both columns (1) and (2), the coefficients for changes in the short-term policy rates are positive and insignificant, while those for changes in the spread not stable when considering the full four lags.

Overall, we conclude that evidence for impairment of the international bank-lending channel is mixed at such an aggregate level. As euro-area-wide data on cross-border lending towards non-euro-area countries cannot be further disaggregated, we turn to the more granular French sample that would allow to explore heterogeneities across recipient countries, counterpart sectors, and currencies.

4.2.2. Recipient countries, sectors, and bank heterogeneity: Results for France

Using French data, we extend the analysis to the position of headquarters located in a NIRP economy with more granular data. Results of regression (3) for cross-border lending for French banks from France are shown in Table 14. Column (1) and (2) focus on cross-border lending to the financial sector (i.e. including affiliates) while columns (3) and (4) concern the non-financial sector. For each sector, we distinguish between cross-border lending to IFCs (columns (1) and (3)) and cross-border lending to the rest of the world (columns (2) and (4)). Therefore, column (1) focuses on cross-border lending to the financial sector in IFCs (i.e. including affiliates in IFCs). Due to Ireland belonging to the euro area, this country is excluded from our sample of international financial centres – which therefore is limited to the UK and Hong Kong to maximise consistency with Section 3.[32]

Results focusing on the cross-border lending from French banks confirms the evidence found in Section 3 for IFCs. It indicates that monetary policy in the headquarters' economy implies an international bank-lending channel when interest rates are positive and that impairment occurs for financial lending towards the international financial centres. Results in column (1), for financial lending towards the international financial centres, confirm the impairment of the international bank lending channel under the NIRP through the financial sector. While coefficients for rate and spreads are negative and significant – supporting the existence of an international bank lending channel – the coefficients for rate and spreads interacted with the NIRP dummy are positive and significant.[33] These results from France towards IFC affiliates also appear to indicate that the impairment of the international bank-lending channel occurs

[32] Results are however robust when adding other extra-euro area countries that can be identified as international financial centres, such as the United States and Switzerland. This is shown in Table A6 in Appendix. Results towards individual IFC are not reported due to the limited number of observations available when singling out specific country.

[33] The magnitude of the coefficients interacted with NIRP for rate and spreads can be traced back to some extent to the coefficient on the NIRP dummy being itself large and positive, requiring in turn sizeable coefficients for the interacted terms. When summing the contributions from all coefficients during the NIRP period, the sum of the average effect on cross-border bank lending is close to 0 (0.012). This resumes to monetary policy changes in the euro area leading to non-significant changes in cross-border lending towards IFC under the NIRP policy – in line with the results obtained in section 3.

sooner – peaking at around Q2 – than for lending from IFC affiliates to the rest of the world in Section 3 – which peaks at around Q3. As reported in columns (2) and (4), the coefficients of interest are not significant for cross-border lending to the rest of the world. These results are in line with the literature documenting the specific role of the former in global banking. Table 14 shows that only financial lending towards IFC experiences a significant reaction to changes in monetary policy at home and a subsequent impairment during the NIRP period. This suggests a specific role of IFC for French-headquartered banks which, when facing monetary policy changes in EA, seem to adjust more largely their lending portfolio in IFC than in the rest of the world. This is in line with the literature on IFC describing their specific role as "bridges to international business" (Sassen, 1999; IMF, 2000). Most notably, Bussière et al. (2021) have suggested that French banks use their affiliates in the UK to engage in shorter-term and cyclical lending with the rest of the world. This mechanism would be consistent with Table 14 showing a more significant reaction for cross-border financial lending towards IFC, while other lending types – possibly more relationship-based and with longer maturities – adjust much less to monetary policy shocks. Our results not only tend to confirm this literature, but also to extend results to more IFC, and suggest an impairment of this mechanism under the NIRP.

A further question of interest relates to whether banks characteristics affect the monetary policy transmission towards international financial centres. Table 15 details the results from regression (3) when banks characteristics are considered, reporting for banks with low (column 1) and large (column 2) deposit ratio, respectively.

The results indicate that banks' balance sheets seem to matter, in particular the reliance on deposit funding. It suggests that the international bank lending channel is impaired during the NIRP period for banks with higher deposit funding. The results in column (1) do not show evidence of either international banking channel or impairment for banks with low deposit funding. The results are quite different when we consider banks with large deposit funding as in column (2). The coefficients for interest rate and spreads are negative and significant – supporting the existence of an international bank lending channel – while the coefficients of the interaction between interest rate or spreads with the NIRP dummy are positive and significant. This echoes the literature which has shown that banks with a higher share of deposit funding tend to lend less when policy rates are negative (Eggertsson et al., 2019; Inoue, Nakashima and Takahashi, 2019; Heider, Saidi and Schepens, 2019; Lopez, Rose and Spiegel, 2020) even though this literature focused mainly on domestic lending. The French results are then consistent with the results in section 3.3.2 concerning the Irish IFC. Our results are also symmetric with those of Section 3 where the result was that IFC affiliate relying more on *local* deposit (i.e. deposits in the IFC country, therefore not affected by the NIRP at home)

were less impaired. Symmetrically, we find that French banks relying more on deposit *at home* (in France, the headquarter country, therefore affected by the NIRP) are more impaired.

5. Conclusions

We study the effects of NIRP on the transmission of monetary policy through cross-border lending. Using confidential bank-level data from international financial centres – Hong Kong, Ireland and the United Kingdom – we examine how NIRP in banks' headquarters' economies influence cross-border lending from financial-centre affiliates. We find some evidence that NIRP can impair the bank-lending channel for cross-border lending to non-bank sectors, especially for those banks that have only a weak deposit base in IFCs – and are thus relatively more exposed to NIRP in their headquarters. Using data from Europe, including bank-level data from France, we complement these findings by assessing how NIRP influences cross-border lending from banks' headquarters' economies, including lending to key international financial centres. We find that NIRP influence lending to financial centres, but there is no evidence of impairment for lending to non-bank borrowers.

Together, our results have important implications. First, the fact we find evidence of impairment in the international bank-lending channel through IFCs suggests that the cross-border spillovers – through international lending – of monetary policy can be less severe when headquarter countries enact NIRP. Second, our results indicate that IFCs play an important role in intermediating funds across borders for non-financial firms. Third, and related to that, our findings indicate that foreign affiliates' activities in IFCs are responsive to economic conditions in their headquarters. So, in order to assess the cross-border effects of monetary policy it is important to take a global approach and consider flows through IFCs.

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Tables

Table 1: Summary statistics for UK sample

Variable	Mean	SD	P25	P75	Obs.
Dependent variables					
Cross-border lending growth					
to non-banks	0.0360	0.3670	-0.1440	0.1440	39731.000
to NBFI	0.0480	0.4620	-0.1920	0.1850	9183.000
to Corporates	0.0250	0.3070	-0.1080	0.1010	12196.000
Monetary Policy					
Short Rates 3 Month (pp, Change)	-0.0190	0.3590	-0.0450	0.0930	39731
Spreads 10yr - 3 month (pp, Change)	-0.0270	0.3930	-0.2210	0.0900	39731
Bank balance sheet characteristics					
Capital ratio	0.0540	0.0900	0.0020	0.0940	39731
Liquid assets share	0.3970	0.2250	0.2230	0.5720	39731
Core Deposits share	0.1040	0.1210	0.0370	0.1300	39731
Sterling share of core deposits	0.4870	0.2590	0.3230	0.6580	39378
Euro share of core deposits	0.1580	0.1440	0.0480	0.2250	39378
Other (mostly USD) share of core deposits	0.3550	0.2400	0.1820	0.4850	39378
Securities share	0.1280	0.1180	0.0360	0.1890	39731
Intragroup funding share	0.2740	0.1950	0.1230	0.3940	32995
Home Controls					
Inflation (%, yoy)	1.5700	1.5900	0.4380	2.3090	39731
GDP Growth (%, yoy)	1.7960	2.1830	1.0580	2.8940	39731

Table 2: Summary statistics for Ireland sample

Variable	Mean	SD	P25	P75	Obs.
Dependent variables					
Cross-border lending growth					
to non-banks	0.5653	0.5909	0.4235	0.7838	11,305
to NBFI	0.9049	0.3620	0.5642	0.8343	11,305
to Corporates	0.8659	0.3749	0.3278	0.7693	11,305
Monetary Policy					
Short Rates 3 Month (pp, Change) -	0.0403	0.9309 -	0.1594	0.4310	11,305
Spreads 10yr - 3 month (pp, Chang -	0.1686	0.9077 -	0.7667	0.1600	11,305
Bank balance sheet characteristics					
Capital ratio	0.2330	0.2391	0.0388	0.3552	11,305
Liquid assets share	0.0355	0.1013	0.0012	0.0134	11,305
Core Deposits share	0.5938	0.3040	0.3328	0.8488	11,305
Euro share of core deposits	0.9222	0.0142	0.9117	0.9247	11,305
USD share of core deposits	0.0512	0.0122	0.0397	0.0610	11,305
Sterling share of core deposits	0.0214	0.0036	0.0191	0.0247	11,305
Securities share	0.1947	0.2913	0.1256	0.3289	11,305
Intragroup funding share	0.4411	0.3324	0.1088	0.8307	11,305
Home Controls					
Inflation (%, yoy)	1.6917	1.2697	0.8358	2.4189	11,305
GDP Growth (%, yoy)	3.5648	2.7950	2.3969	4.9538	11,305

Table 3: Summary statistics for Hong Kong sample

Variable	Mean	SD	P25	P75	Obs.
Dependent variable					
Cross-border lending growth					
to non-banks	-0.035	0.308	-0.089	0.044	28653
to NBFIs	-0.118	0.402	-0.214	0.022	1851
to Corporates	-0.057	0.303	-0.101	0.024	10197
Monetary policy					
Short rates 3 Month (pp, change)	-0.028	0.446	-0.063	0.054	28321
Spreads 10yr - 3month (pp, change)	-0.017	0.429	-0.202	0.128	28321
Bank balance sheet characteristics					
log (real assets)	24.652	1.362	23.619	25.822	28653
Liquid asset ratio	0.050	0.056	0.006	0.072	28653
Core deposit ratio	0.226	0.176	0.077	0.355	28653
HKD share of core deposits	0.217	0.197	0.048	0.333	28349
USD share of core deposits	0.590	0.232	0.439	0.762	28349
HKD & USD share of core deposits	0.807	0.173	0.716	0.945	28349
Securities share	0.172	0.130	0.074	0.240	28653
Cost-to-income ratio	0.520	0.317	0.223	0.748	28646
Non-performing loan ratio	0.014	0.034	0.000	0.014	28651
Intragroup funding share	0.312	0.245	0.112	0.469	28653
Home Controls					
Inflation (%, yoy)	1.620	2.432	0.202	2.453	28406
GDP growth (%, yoy)	2.939	3.255	1.180	4.458	28406

Table 4: Outward transmission of home-country monetary policy on cross-border lending to non-bank via IFCs under negative rate periods

Exclude lending to home countries	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:						
Loans to non-bank sectors	UK	IE	HK	UK	IE	HK
ΣΔr (home)_t-1	0.00527	0.00114	-0.00892	-0.00221	-0.00236	-0.0103
	0.665	0.631	0.222	0.861	0.646	0.166
ΣΔr (home)_t-1 to t-2	-6.31e-05	0.000396	-0.0199*	-0.00802	-0.0071	-0.0244**
	0.997	0.896	0.0572	0.591	0.362	0.0192
ΣΔr (home)_t-1 to t-3	-0.0301	-0.00192	-0.0193	-0.0445**	-0.0121	-0.0248*
	0.113	0.606	0.145	0.0239	0.231	0.0673
ΣΔr (home)_t-1 to t-4	-0.0208	-0.00375	-0.0274*	-0.0330	-0.0193	-0.0364**
	0.298	0.413	0.0902	0.113	0.123	0.0284
ΣΔSpr (home)_t-1	-0.00498	-0.000613	-0.0125	-0.0126	-0.000646	-0.0177*
	0.656	0.504	0.185	0.286	0.479	0.0715
ΣΔSpr (home)_t-1 to t-2	0.00329	-0.000931	-0.018	-0.00162	-0.000998	-0.0273**
	0.816	0.535	0.141	0.914	0.505	0.0301
ΣΔSpr (home)_t-1 to t-3	-0.0146	0.000546	-0.0234	-0.0240	0.000463	-0.0344**
	0.412	0.826	0.116	0.206	0.852	0.0282
ΣΔSpr (home)_t-1 to t-4	-0.00308	-0.000143	-0.0274	-0.0122	-0.000235	-0.0424**
	0.870	0.964	0.139	0.547	0.94	0.0307
ΣΔr (home)_t-1 * Negative				0.105	0.00371	-0.0712
				0.132	0.463	0.278
ΣΔr (home)_t-1 to t-2 * Negative				0.143	0.00811	-0.0175
				0.135	0.276	0.856
ΣΔr (home)_t-1 to t-3 * Negative				0.264**	0.0111	-0.0919
				0.0221	0.242	0.475
ΣΔr (home)_t-1 to t-4 * Negative				0.191	0.0167	0.00823
				0.128	0.163	0.954
ΣΔSpr (home)_t-1 * Negative				0.0493	0.000198	0.0504*
				0.0424	0.995	0.0615
ΣΔSpr (home)_t-1 to t-2 * Negative				0.0255	0.0141	0.11***
				0.422	0.727	0.00625
ΣΔSpr (home)_t-1 to t-3 * Negative				0.0745	0.00395	0.088*
				0.0557	0.929	0.0547
ΣΔSpr (home)_t-1 to t-4 * Negative				0.0402	-0.00363	0.13**
				0.367	0.943	0.0192
Recipient country time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Home country controls	Yes	Yes	Yes	Yes	Yes	Yes
Negative dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,253	8,272	22,925	39,731	8,272	22,925
R-squared	0.1049	0.3444	0.1204	0.1177	0.3446	0.1211
Adjusted R-squared	0.0223	0.214	0.0269	0.0214	0.213	0.0271
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: This table reports the estimation results for equations (1) and (2). The dependent variable is log changes in cross-border lending to non-bank sector of affiliates in the UK, IE and HK respectively. The dependent variable excludes lending to non-bank in the home country of foreign bank. Columns 1 to 3 presents the regression results for equation 1 without the interaction terms, while columns 4 to 6 presents the results for equation 2 with the interaction terms for the UK, IE and HK respectively. The data are quarterly from 2005Q1 to 2019Q4 for a panel of foreign banks resident in the UK. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table 5: Outward transmission of home-country monetary policy on cross-border lending to non-bank via IFCs under negative rate periods, with disaggregated breakdown between corporates and NBFIs

Exclude lending to home countries	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable. Loans to:	Non-bank sectors			Corporates			NBFI		
from 2014 -2019	UK	IE	HK	UK	IE	HK	UK	IE	HK
ΣΔr (home)_t-k	-0.0744*	-0.00525	-0.0421*	-0.122***	-0.0198*	-0.0733**	-0.110	-0.0609***	0.0457
	0.0603	0.629	0.0786	0.00403	0.0685	0.0403	0.223	0	0.705
ΣΔr (home)_t-k * Negative	0.255**	0.0054	0.0277	0.470***	0.0182*	0.165	0.0122	0.0541***	0.407
	0.0267	0.595	0.481	1.98e-05	0.0816	0.289	0.954	0	0.333
ΣΔSpr (home)_t-k	-0.0784**	0.0631	-0.0308	-0.0607*** [Q1]	-0.0102	-0.0846*	-0.155	0.236***	0.15
	0.0334	0.298	0.367	0.00745	0.854	0.0644	0.110	0	0.188
ΣΔSpr (home)_t-k * Negative	0.0929**	-0.0696	0.148**	0.0673** [Q1]	0.0558	0.11*	0.0769	-0.0288	0.294
	0.0380	0.21	0.014	0.0215	0.297	0.0978	0.428	0.561	0.331
Recipient country time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Home country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Negative dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,828	4,070	11,452	12,196	4,070	8,374	9,183	4,070	1,336
R-squared	0.1134	0.3550	0.1239	0.1371	0.5021	0.1406	0.1379	0.3457	0.3972
Adjusted R-squared	0.0186	0.219	0.0290	0.0256	0.397	0.0390	0.0147	0.208	0.189
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: This table reports the results for IFC banks' cross-border lending to non-bank (columns 1 to 3) along with disaggregated breakdown into loans to corporates (columns 4 to 6) and NBFIs (columns 7 to 9) respectively. In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy, as well as the associated non-interacted terms are reported in this table. Unless otherwise indicated, the peak cumulative effects for the UK results are at three-quarter horizon, whereas four-quarter cumulative effects are reported for the case of IE and HK. For the case where the cumulative effects for the interaction terms and the non-interaction terms peak at a different horizon, we would report the peak cumulative effect for the non-interaction terms (i.e. changes in short-term rates and yield curve spreads) in squared brackets and coloured in blue. The corresponding interaction terms are also reported in the squared brackets. The data are quarterly from 2014Q1 to 2019Q4 for the case of UK and IE while the estimation period starts from 2015Q1 for the case of HK. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance. The full sets of results are presented in Appendix Tables A2 a-c.

Table 6: Exploring how bank heterogeneity in local deposit share affect the extent of international transmission of home-country on the cross-border lending to non-banks of IFC affiliates

Exclude lending to home countries	(1)	(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable.	UK		IE		HK			UK		IE		HK	
Loans to non-bank sectors from 2005	Low Deposits	High Deposits	Low Deposits	High Deposits	Low Deposits	High Deposits	*Interact with balance sheet factor:*	Interactions (Dummy)	Interactions (Continuous)	Interactions (Dummy)	Interactions (Continuous)	Interactions (Dummy)	Interactions (Continuous)
ΣΔr (home)_t-k	-0.0360	-0.128***	-0.0551	0.0163	-0.0407**	0.0654	* Deposit Share	-0.0153	0.0127	0.0305	0.0266	0.00159	-0.0491
	0.0983	0.00242	0.222	0.624	0.0187	0.455		0.649	0.875	0.2	0.268	0.972	0.613
ΣΔr (home)_t-k * Negative	0.312**	0.0133	0.0658	0.0194*	-0.13	-0.056	* Deposit Share	0.0535	-0.803	-0.0217	-0.0175	0.333	1.592
	0.0152	0.976	0.15	0.0659	0.55	0.854		0.881	0.387	0.386	0.49	0.211	0.143
ΣΔSpr (home)_t-k	-0.0256	-0.0623*	0.0226***	-0.0034	-0.0431**	0.0292	* Deposit Share	0.00475	0.0620	-0.0062	-0.00741	0.0226	-0.0336
	0.267	0.0871	0.00472	0.569	0.037	0.748		0.864	0.389	0.326	0.228	0.67	0.776
ΣΔSpr (home)_t-k * Negative	0.0838*	0.132	-0.581***	-0.177	0.187***	-0.0884	* Deposit Share	0.00581	0.197	0.136** [Q3]	0.11* [Q3]	-0.202*	-0.188
	0.0762	0.146	0.000048	0.379	0.00458	0.57		0.911	0.416	0.0398	0.0981	0.0991	0.503
Recipient country time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Low dummies	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Home Country Controls	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,298	4,657	2,546	1,036	16,924	5,587		39,731	36,186	8,272	8,272	22,925	22,925
R-squared	0.1292	0.3067	0.5456	0.6490	0.1426	0.2500		0.1180	0.1169	0.3458	0.3457	0.1217	0.1218
Adjusted R-squared	0.0224	0.00917	0.194	0.342	0.0253	0.0404		0.0213	0.0187	0.212	0.212	0.0269	0.0270
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time		Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: This table reports the estimation results for exploring how far bank heterogeneity in local deposit share affect the extent of international transmission of home-country monetary policy via IFC affiliates' cross-border lending to non-bank sectors. The dependent variable is log changes in cross-border lending to non-bank sector of affiliates in the UK, IE and HK respectively. The dependent variable excludes lending to non-bank in the home country of foreign bank. Columns 1 to 6 presents the regression results for the split regressions for the three IFCs respectively, while columns 7 to 12 presents the results for the two triple interaction regressions (i.e. equation 3) for the UK, IE and HK respectively. The data are quarterly from 2005Q1 to 2019Q4. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table 7: Exploring how bank heterogeneity in intragroup funding reliance affect the extent of international transmission of home-country on the cross-border lending to non-banks of IFC affiliates

Exclude lending to home countries	(1)	(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable.	UK		IE		HK		*Interact with balance sheet factor:*	UK		IE		HK	
Loans to non-bank sectors from 2005	Low Intragroup Share	High Intragroup Share	Low Intragroup Share	High Intragroup Share	Low Intragroup Share	High Intragroup Share		Interactions (Dummy)	Interactions (Continuous)	Interactions (Dummy)	Interactions (Continuous)	Interactions (Dummy)	Interactions (Continuous)
ΣΔr (home)_t-k	-0.0487**	-0.0841	-0.125***	-0.000822	-0.0592***	-0.0168	* Intragroup Share	0.00879	-0.153	0.0443*	0.0856***	0.0163	0.0874
	0.0398	0.503	0.00645	0.965	0.00696	0.608		0.800	0.0313	0.063	0.00148	0.588	0.112
ΣΔr (home)_t-k * Negative	0.282**	0.127	0.122**	-0.0211	-0.229	-0.323	* Intragroup Share	0.0451	-0.0712	-0.0377	-0.0809***	0.22	0.26
	0.0281	0.873	0.0106	0.146	0.209	0.547		0.896	0.842	0.133	0.00428	0.528	0.719
ΣΔSpr (home)_t-k	-0.0303	-0.0126	-0.00339	-0.0174***	-0.0729***	-0.0317	* Intragroup Share	0.0401	-0.0921	-0.0111***	-0.00903	0.0183	0.113*
	0.227	0.741	0.766	0	0.00877	0.367		0.217	0.0995	0.00115	0.172	0.594	0.0751
ΣΔSpr (home)_t-k * Negative	0.0321	0.233***	-0.284**	0.282*	0.0844	0.219**	* Intragroup Share	0.0270	0.281**	0.0546	0.0899	-0.0102	-0.111
	0.563	0.00319	0.0106	0.0769	0.33	0.0167		0.720	0.0238	0.411	0.266	0.923	0.549
Recipient country time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Low dummies	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Home Country Controls	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,614	4,047	3,306	1,625	16,315	5,965		39,501	29,177	8,272	8,272	22,925	22,925
R-squared	0.1246	0.3296	0.4555	0.7606	0.1455	0.2522		0.1187	0.1159	0.3469	0.3479	0.1219	0.1217
Adjusted R-squared	0.0207	0.0418	0.198	0.393	0.0307	0.0513		0.0217	0.0172	0.214	0.215	0.0270	0.0268
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time		Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: This table reports the estimation results for exploring how far bank heterogeneity in intragroup funding reliance affect the extent of international transmission of home-country monetary policy via IFC affiliates' cross-border lending to non-bank sectors. The dependent variable is log changes in cross-border lending to non-bank sector of affiliates in the UK, IE and HK respectively. The dependent variable excludes lending to non-bank in the home country of foreign bank. Columns 1 to 6 presents the regression results for the split regressions for the three IFCs respectively, while columns 7 to 12 presents the results for the two triple interaction regressions (i.e. equation 3) for the UK, IE and HK respectively. The data are quarterly from 2005Q1 to 2019Q4. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table 8: Outward transmission of home-country monetary policy on cross-border lending to banks via IFCs under negative rate periods

Exclude lending to home countries *Dependent variable*	(1)	(2) All interbank loans	(3)	(4)	(5) of which: intragroup loans	(6)
	UK	IE	HK	UK	IE	HK
ΣΔr (home)_t-k	-0.0601*	0.0412**	-0.0835***	0.0662	-0.0271*	-0.0163
	0.0702	0.0223	0.00185	0.558	0.0763	0.812
ΣΔr (home)_t-k * Negative	0.0902	-0.0287*	0.146	-0.0908	0.0273*	0.351
	0.644	0.0992	0.659	0.754	0.0739	0.357
ΣΔSpr (home)_t-k	-0.0558	0.00393	-0.0216 [Q1] [-0.0919*** [Q4]]	0.0653	0.00481*	0.0238
	0.114	0.2	0.147 [0.00178]	0.505	0.0728	0.778
ΣΔSpr (home)_t-k * Negative	-0.0633	-0.0693	0.132*** [Q1] [0.13 [Q4]]	-0.127	0.0758	-0.0377
	0.434	0.241	0.00915 [0.172]	0.331	0.288	0.785
Recipient country time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Home country controls	Yes	Yes	Yes	Yes	Yes	Yes
Negative dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,720	8,272	22,288	5,349	8,272	4,490
R-squared	0.1169	0.2725	0.1104	0.1731	0.5824	0.1977
Adjusted R-squared	0.00873	0.127	0.0356	0.00103	0.499	0.0728
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: This table reports the results for IFC banks' cross-border lending to bank sector (columns 1 to 3) and intragroup lending to affiliates (columns 4 to 6) respectively. The dependent variables exclude lending to home country. In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy, as well as the associated non-interacted terms. Unless otherwise indicated, the peak cumulative effects for the UK results are at three-quarter horizon, whereas four-quarter cumulative effects are reported for the case of IE and HK. For the case where the cumulative effects for the interaction terms and the non-interaction terms peak at a different horizon, we would report the peak cumulative effect for the non-interaction terms (i.e. changes in short-term rates and yield curve spreads) in squared brackets and coloured in blue. The corresponding interaction terms are also reported in the squared brackets. The data are quarterly from 2014Q1 to 2019Q4 for the case of UK and IE while the estimation period starts from 2015Q1 for the case of HK. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance. The full sets of results are presented in Appendix Table A3 a-c.
^ Due to data limitation, it is not possible to exclude intragroup lending to the home country in the dependent variable for the case of IE (i.e. column 5).

Table 9: Inward transmission of home-country monetary policy on IFC affiliates domestic lending to bank and non-bank customers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Non-bank sectors			Corporates			NBFI			Market loans to banks		
	UK	IE	HK	UK	IE	HK	UK	IE	HK	UK	IE	HK
ΣΔr (home)_t-k	-0.0227*	-4.996*	-0.0747**	-0.0349**	-1.766*	-0.0814**	0.00341	25.09***		0.0210	1.114	-0.0525
	0.0793	0.0832	0.0279	0.0138	0.0937	0.0207	0.882	5.84E-09		0.301	0.21	0.438
ΣΔr (home)_t-k * Negative	0.277**	3.125***	0.433**	0.652***	1.832***	0.462**	-0.258	-23.62***		0.614	-0.819	0.496
	0.0217	0.00911	0.0248	0.00346	0.000324	0.0452	0.266	1.24E-08		0.108	0.338	0.32
ΣΔSpr (home)_t-k	-0.0178	-0.951	-0.0784**	-0.0331***	-0.782	-0.0677*	0.0187	0.189		0.0135 Q4	-0.109	-0.0561
	0.135	0.378	0.0231	0.00969	0.415	0.0539	0.403	0.305		0.584	0.899	0.467
ΣΔSpr (home)_t-k * Negative	0.0222	10.36	0.0368	0.0810	9.262	-0.083	-0.0468	11.69***		0.228** Q4	11.27	-0.0993
	0.603	0.357	0.715	0.217	0.318	0.467	0.584	0.00532		0.0134	0.208	0.645
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Home country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Negative dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Observations	8,673	767	5,595	7,712	702	5,253	7,291	793		10,937	1,625	4,364
R-squared	0.0644	0.2026	0.0885	0.0799	0.2167	0.0869	0.0500	0.6314		0.0304	0.1197	0.0825
Adjusted R-squared	0.0283	0.0675	0.0500	0.0423	0.0725	0.0465	0.00963	0.573		-0.000958	0.0411	0.0402
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank		Bank	Bank	Bank

Note: This table reports the results for IFC banks' domestic lending to non-bank (columns 1 to 3) along with disaggregated breakdown into loans to domestic corporates (columns 4 to 6) and domestic NBFIs (columns 7 to 9) respectively. Meanwhile the results for IFC banks' lending to local banks are show in columns 10 to 12 respectively. In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy, as well as the associated non-interacted terms are reported in this table. Unless otherwise indicated, the peak cumulative effects for the UK results are at three-quarter horizon, whereas four-quarter cumulative effects are reported for the case of IE and HK. For the case where the cumulative effects for the interaction terms and the non-interaction terms peak at a different horizon, we would report the peak cumulative effect for the non-interaction terms (i.e. changes in short-term rates and yield curve spreads) in squared brackets and coloured in blue. The corresponding interaction terms are also reported in the squared brackets. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank. P-values below coefficient estimates indicate the level of significance.

Table 10: Direct transmission of home-country monetary policy to banks resident in the IFCs via intragroup funding channel

Dependent variable:	(1)	(2)	(3)
	Intragroup funding from home country		
	UK	IE^	HK
ΣΔr (home)_t-k	-0.0566 [Q1] [-0.100 [Q3]]	-0.00115	-0.191** [Q3]
	0.293 [Q1] [0.235 [Q3]]	0.928	0.0309
ΣΔr (home)_t-k * Negative	0.283* [Q1] [0.146 [Q3]]	0.000158	0.465* [Q3]
	0.0772 [Q1] [0.574 [Q3]]	0.99	0.0888
ΣΔSpr (home)_t-k	-0.0962	0.00347	0.203
	0.212	0.278	0.153
ΣΔSpr (home)_t-k * Negative	0.0681	0.075	-0.266
	0.423	0.212	0.102
Recipient country time fixed effects	No	Yes	No
Bank fixed effects	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes
Home country controls	Yes	Yes	Yes
Negative dummies	Yes	Yes	Yes
Observations	1,838	8,272	1,846
R-squared	0.0673	0.4542	0.1584
Adjusted R-squared	-0.00015	0.345	0.0806
Cluster	Bank-time	Bank-time	Bank-time

Note: This table reports the results for IFC banks' intragroup funding from headquarter office only (columns 1 to 3).In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy, as well as the associated non-interacted terms. Unless otherwise indicated, the peak cumulative effects for the UK results are at three-quarter horizon, whereas four-quarter cumulative effects are reported for the case of IE and HK. For the case where the cumulative effects for the interaction terms and the non-interaction terms peak at a different horizon, we would report the peak cumulative effect for the non-interaction terms (i.e. changes in short-term rates and yield curve spreads) in squared brackets and coloured in blue. The corresponding interaction terms are also reported in the squared brackets. The data are quarterly from 2014Q1 to 2019Q4 for the case of UK and IE while the estimation period starts from 2015Q1 for the case of HK. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance. The full sets of results are presented in Appendix Tables A3 a-c.
^ Due to data limitation, it is not possible to focus on intragroup funding solely from headquarter country in the dependent variable for the case of IE (i.e. column 2). Intragroup funding here is from all countries instead.

Table 11: Summary statistics for euro area banks

Variable	Definition	Mean	**SD**	P25	P75	Obs,
Dependent variables						
Total loans - RoW	*(log)* Total lending to rest of the world *(q-o-q)*	0.003	0.40	-0.07	0.07	10,728
Monetary policy						
Euribor 3-month	*p.p, change*	-0.074	0.31	-0.07	0.006	11,326
Spread 10y – 3m	*p.p change*	-0.011	0.52	-0.24	0.17	11,172
Bank characteristics						
Leverage ratio	Equity / Total assets *(%)*	0.005	0.01	0.00	0.003	11,352
Deposit liabilities	Private EA Deposits in M3 (HH+NFC) + Private EA Deposits outside M3 (HH+NFC) / Total liabilities *(%)*	0.30	0.26	0.02	0.51	11,352
Liquidity ratio	Liquidity ratio (total cash + total loans to domestic NCB+ private sector debt securities + euro area government debt securities)/total assets *(%)*	0.13	0.12	0.03	0.18	11,352
Controls						
Domestic GDP	Real GDP *(%,y-o-y)*	0.96	4.06	0.25	2.45	11,426
Exposures (FC weighted) – EA	Sum((exposure to country i /total exposure to EA) * financial cycle country i)	-4.20	5.64	-8.65	-0.52	6,580
Exposures (FC weighted) – RoW	Sum((exposure to country i /total exposure to RoW) * financial cycle country i)	1.95	3.64	-0.35	3.19	6,444
Exposures (BC weighted) – EA	Sum((exposure to country i /total exposure to EA) * business cycle country i)	3.31	1.13	3.08	4.01	6,580
Exposures (BC) – RoW	Sum((exposure to country i /total exposure to RoW) * business cycle country i)	0.79	0.74	0.37	1.25	6,444

Table 12: Summary statistics for French sample

Variable	Mean	SD	P25	P75	Obs.
Dependent variable					
Cross-border lending growth *(q-o-q)*					
To financial sector	0.0175	0.4827	-0.3180	0.3308	29,644
To non-financial entities	0.0166	0.3411	-0.0842	0.1078	95,848
Total	0.0164	0.3807	-0.1141	0.1450	232,664
Monetary policy					
Euribor 3-month *(p.p., change)*	-0.0677	0.4416	-0.1489	0.1873	433,938
Spread 10y – 1y *(p.p., change)*	0.0184	0.3575	-0.1700	0.1270	433,938
Home controls					
Inflation *(%, y-o-y)*	1.6844	0.9294	1.2680	2.2182	384,188
GDP growth *(%, y-o-y)*	1.0854	1.5947	0.1950	2.0790	377,233
Destination-country controls					
Business cycle *(index)*	0.0095	0.0273	-0.0098	0.0285	242,543
Financial cycle *(index)*	0.0337	0.1143	-0.0315	0.0980	242,543

Table 13: Outward transmission of EA monetary policy for Euro area banks' cross-border lending, disaggregated between counterpart sectors and recipient areas

Exclude lending to EA	(1)	(2)
Emitting countries	Euro area	France
Counterpart sector:	Total	Total
Recipient countries:	Non-EA countries	Non-EA countries
ΣΔr (home)_t-k	0.007	0.059
	0.680	0.139
ΣΔr (home)_t-k * Negative	-0.267** ^{Q2} [-0.168 ^{Q4}]	13.548
	0.036 [0.168]	0.555
ΣΔSpr (home)_t-k	-0.011* ^{Q1} [-0.013 ^{Q4}]	-0.099** ^{Q3} [-0.021 ^{Q4}]
	0.068 [0.285]	0.016 [0.649]
ΣΔSpr (home)_t-k * Negative	0.013	0.226
	0.554	0.586
Σ Negative t-k	-0.017**	0.786
	0.050	0.568
Bank fixed effects	Yes	Yes
Bank controls	Yes	Yes
Recipient-country fixed effects	No	Yes
Recipient-country controls	Yes^	Yes
Home country controls	Yes	Yes
Observations	4,430	26,409
R-squared	0.014	0.02
Adjusted R-squared		0.01
Cluster	Bank	Bank-time

*Notes: In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy. Unless otherwise indicated, the peak cumulative effects are at the four-quarter horizon. For the case where the cumulative effects peak at a different horizon, this is specified in superscript and the cumulative effect at four-quarter horizon is reported in blue brackets. P-values are reported below coefficient estimates. *, **, and *** denote statistical significance at respectively the 10, 5, and 1% levels. ^Recipient country controls in columns 1 to 4 are weighted averages across all countries to which euro area banks located in each individual member state have exposure to, with the exposure amount serving as weights. Detailed coefficients for columns 1 to 4 are provided in the Appendix, Table A4.*

Table 14: Outward transmission of EA monetary policy for French banks' cross-border lending in euros, disaggregated by counterpart sectors and recipient countries

Exclude lending to EA	(1)	(2)	(3)	(4)
Counterpart sector:	Financial sector		Non-financial sector	
Recipient countries:	IFC	Others (non-EA)	IFC	Others (non-EA)
ΣΔr (France)_t-k	-0.212** ^{Q2} [-0.156 ^{Q4}]	0.020	0.051	0.022
	0.043 ^{Q2} [0.319 ^{Q4}]	0.834	0.414	0.545
ΣΔr (France)_t-k * Negative	211.245*	39.920	-3.220	31.923
	0.082	0.591	0.946	0.110
ΣΔSpr (France)_t-k	-0.230* ^{Q3} [-0.124 ^{Q4}]	-0.041	0.044	0.002
	0.099 [0.440]	0.691	0.506	0.904
ΣΔSpr (France)_t-k * Negative	4.496**	0.797	-0.342	0.442
	0.042	0.549	0.703	0.230
Σ Negative t-k	12.680*	2.532	-0.195	1.862
	0.083	0.598	0.945	0.120
Bank fixed effects	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes
Recipient-country fixed effects	Yes	Yes	Yes	Yes
Recipient-country controls	Yes	Yes	Yes	Yes
Home country controls	Yes	Yes	Yes	Yes
Observations	1,404	5,490	3,028	23,620
R-squared	0.03	0.02	0.05	0.02
Adjusted R-squared	0.00	0.01	0.02	0.01
Cluster	Bank-time	Bank-time	Bank-time	Bank-time

*Notes: IFC accounts for United Kingdom and Hong Kong. EA countries are excluded from the sample. In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy. Unless otherwise indicated, the peak cumulative effects are at the four-quarter horizon. For the case where the cumulative effects peak at a different horizon, this is specified in superscript and the cumulative effect at four-quarter horizon is reported in blue brackets. The data are quarterly from 2000Q2 to 2017Q4. P-values are reported below coefficient estimates. *, **, and *** denote statistical significance at respectively the 10, 5, and 1% levels. Detailed coefficients are provided in the Appendix, Table A5.*

Table 15: Bank heterogeneity in outward transmission of EA monetary policy for French banks' cross-border lending to the financial sector in international financial sectors

Exclude lending to EA	(1)	(2)
Heterogeneity:	Deposits funding	
	Low	High
ΣΔr (France)_t-k	-0.214* ^{Q2} [-0.177 ^{Q4}]	-0.027
	0.053 [0.285]	0.962
ΣΔr (France)_t-k * Negative	51.704	1627.403***
	0.660	0.000
ΣΔSpr (France)_t-k	-0.117	-0.602* ^{Q2} [-0.657 ^{Q4}]
	0.487	0.098 [0.212]
ΣΔSpr (France)_t-k * Negative	1.492	31.209***
	0.482	0.000
Σ Negative t-k	3.080	98.035***
	0.662	0.000
Bank fixed effects	Yes	Yes
Bank controls	Yes	Yes
Recipient-country fixed effects	Yes	Yes
Recipient-country controls	Yes	Yes
Home country controls	Yes	Yes
Observations	1,240	164
R-squared	0.03	0.25
Adjusted R-squared	0.00	0.03
Cluster	Bank-time	Bank-time

*Notes: IFC accounts for United Kingdom and Hong Kong. EA countries are excluded from the sample. "Deposits funding" is computed as the ratio of core deposits to total assets. The split low / high is made by allocated the lower three quartiles to the "low" sub-sample while the upper quartile forms the "high" sub-sample. Columns 1 and 2 present the regression results for the split regressions, while columns 3 and 4 presents the results for the two triple interaction regressions (i.e. equation 3) for the UK, IE and HK respectively. In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy. Unless otherwise indicated, the peak cumulative effects are at the four-quarter horizon. For the case where the cumulative effects peak at a different horizon, this is specified in superscript and the cumulative effect at four-quarter horizon is reported in blue brackets. The data are quarterly from 2000Q2 to 2017Q4. P-values are reported below coefficient estimates. *, **, and *** denote statistical significance at respectively the 10, 5, and 1% levels.*

Appendix

Table A1 - a: UK results for cross-border lending to non-bank sector

Loans to non-bank sectors		(1)	(2)	(3) *exclude lending to EA for EA banks*	(4)
ΣΔr (home)_t-1		0.00247	-0.00447	0.00527	-0.00221
	p-value	0.825	0.699	0.665	0.861
ΣΔr (home)_t-1 to t-2		-0.00507	-0.0118	-6.31e-05	-0.00802
	p-value	0.702	0.386	0.997	0.591
ΣΔr (home)_t-1 to t-3		-0.031*	-0.0430**	-0.0301	-0.0445**
	p-value	0.0650	0.0136	0.113	0.0239
ΣΔr (home)_t-1 to t-4		-0.0188	-0.0264	-0.0208	-0.0330
	p-value	0.290	0.152	0.298	0.113
ΣΔSpr (home)_t-1		-0.00864	-0.0155	-0.00498	-0.0126
	p-value	0.361	0.126	0.656	0.286
ΣΔSpr (home)_t-1 to t-2		-0.000674	-0.00507	0.00329	-0.00162
	p-value	0.954	0.685	0.816	0.914
ΣΔSpr (home)_t-1 to t-3		-0.0152	-0.0222	-0.0146	-0.0240
	p-value	0.303	0.158	0.412	0.206
ΣΔSpr (home)_t-1 to t-4		-0.00317	-0.00764	-0.00308	-0.0122
	p-value	0.833	0.639	0.870	0.547
ΣΔr (home)_t-1 * Negative			0.111*		0.105
	p-value		0.0835		0.132
ΣΔr (home)_t-1 to t-2 * Negative			0.149*		0.143
	p-value		0.0956		0.135
ΣΔr (home)_t-1 to t-3 * Negative			0.271**		0.264**
	p-value		0.0129		0.0221
ΣΔr (home)_t-1 to t-4 * Negative			0.200*		0.191
	p-value		0.0946		0.128
ΣΔSpr (home)_t-1 * Negative			0.0387		0.0493
	p-value		0.0679		0.0424
ΣΔSpr (home)_t-1 to t-2 * Negative			0.0227		0.0255
	p-value		0.422		0.422
ΣΔSpr (home)_t-1 to t-3 * Negative			0.0508		0.0745
	p-value		0.131		0.0557
ΣΔSpr (home)_t-1 to t-4 * Negative			0.0145		0.0402
	p-value		0.705		0.367
Negative_t-1			0.0068		-0.0064
			(0.0204)		(0.0243)
Negative_t-2			-0.0362		-0.0348
			(0.0313)		(0.0393)
Negative_t-3			0.0578*		0.0622

		(0.0342)		(0.0401)
Negative_t-4		-0.0442*		-0.0411
		(0.0250)		(0.0273)
Capital Ratio_t-1	-0.0610	-0.0478	-0.0330	-0.0191
	(0.0467)	(0.0469)	(0.0502)	(0.0503)
Liquid Asset Share_t-1	0.0615***	0.0651***	0.0582***	0.0635***
	(0.0204)	(0.0204)	(0.0219)	(0.0219)
Core Deposit Share_t-1	0.0747*	0.0761*	0.0861**	0.0907**
	(0.0402)	(0.0403)	(0.0417)	(0.0417)
Securities Share_t-1	0.0256	0.0303	0.0249	0.0319
	(0.0306)	(0.0305)	(0.0348)	(0.0348)
Inflation Home Ctry_t-1	0.0046*	0.0037	0.0051**	0.0046*
	(0.0024)	(0.0025)	(0.0026)	(0.0026)
GDP Growth Home Ctry_t-1	-0.0013	-0.0011	-0.0006	-0.0007
	(0.0017)	(0.0017)	(0.0018)	(0.0018)
Recipient country time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Low dummies	Yes	Yes	Yes	Yes
Observations	46,253	46,253	39,731	39,731
R-squared	0.1049	0.1054	0.1171	0.1177
Adjusted R-squared	0.0223	0.0225	0.0211	0.0214
Cluster	Bank-time	Bank-time	Bank-time	Bank-time

Note: The dependent variable is log changes in cross-border lending to non-bank sector. Columns 3 and 4 exclude lending to non-bank sector in the home country of the foreign banks. The data are quarterly from 2005Q1 to 2019Q4 for a panel of foreign banks resident in the UK. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A1 - b: IE results for cross-border lending to non-bank sector

		(1)	(2)	(3)	(4)
Loans to non-bank sectors				*exclude lending to EA for EA banks*	
ΣΔr (home)_t-1		0.00267*	0.004	0.001	-0.002
	p-value	0.080	0.220	0.631	0.646
ΣΔr (home)_t-1 to t-2		0.002	0.008	0.000	-0.007
	p-value	0.335	0.101	0.896	0.362
ΣΔr (home)_t-1 to t-3		0.001	0.009	-0.002	-0.012
	p-value	0.651	0.105	0.606	0.231
ΣΔr (home)_t-1 to t-4		0.000	0.005	-0.004	-0.019
	p-value	0.980	0.505	0.413	0.123
ΣΔSpr (home)_t-1		-0.000	-0.000	-0.001	-0.001
	p-value	0.738	0.737	0.504	0.479
ΣΔSpr (home)_t-1 to t-2		0.000	0.000	-0.001	-0.001
	p-value	0.704	0.714	0.535	0.505
ΣΔSpr (home)_t-1 to t-3		0.002	0.002	0.001	0.000
	p-value	0.231	0.234	0.826	0.852
ΣΔSpr (home)_t-1 to t-4		0.002	0.002	-0.000	-0.000
	p-value	0.170	0.172	0.964	0.940
ΣΔr (home)_t-1 * Negative			-0.002		0.004
	p-value		0.630		0.463
ΣΔr (home)_t-1 to t-2 * Negative			-0.006		0.008
	p-value		0.184		0.276
ΣΔr (home)_t-1 to t-3 * Negative			-0.008		0.011
	p-value		0.122		0.242
ΣΔr (home)_t-1 to t-4 * Negative			-0.005		0.017
	p-value		0.473		0.163
ΣΔSpr (home)_t-1 * Negative			-0.008		0.000
	p-value		0.789		0.995
ΣΔSpr (home)_t-1 to t-2 * Negative			0.022		0.014
	p-value		0.508		0.727
ΣΔSpr (home)_t-1 to t-3 * Negative			0.023		0.004
	p-value		0.483		0.929
ΣΔSpr (home)_t-1 to t-4 * Negative			0.019		-0.004
	p-value		0.605		0.943
Recipient country time fixed effects		Yes	Yes	Yes	Yes
Bank Controls		Yes	Yes	Yes	Yes
Home Country Controls		Yes	Yes	Yes	Yes
Bank fixed effects		Yes	Yes	Yes	Yes
Low dummies		Yes	Yes	Yes	Yes
Observations		13,764	13,764	8,272	8,272
R-squared		0.3430	0.3432	0.3444	0.3446
Adjusted R-squared		0.269	0.269	0.214	0.213
Cluster		Bank-time	Bank-time	Bank-time	Bank-time

Note: The dependent variable is log changes in cross-border lending to non-bank sector. Columns 3 and 4 exclude lending to non-bank sector in the home country of the foreign banks. The data are quarterly from 2005Q1 to 2019Q4 for a panel of foreign banks resident in Ireland. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A1 - c: HK results for cross-border lending to non-bank sector

Loans to non-bank sectors		(1)	(2)	(3) *exclude lending to EA for EA banks*	(4)
ΣΔr (home)_t-1		-0.00973	-0.0109	-0.00874	-0.0103
	p-value	0.176	0.136	0.242	0.166
ΣΔr (home)_t-1 to t-2		-0.0171	-0.0217**	-0.0213**	-0.0244**
	p-value	0.104	0.0377	0.0465	0.0192
ΣΔr (home)_t-1 to t-3		-0.0155	-0.0208	-0.0209	-0.0248*
	p-value	0.222	0.104	0.121	0.0673
ΣΔr (home)_t-1 to t-4		-0.0248	-0.034**	-0.0291*	-0.0364**
	p-value	0.107	0.0314	0.0758	0.0284
ΣΔSpr (home)_t-1		-0.0113	-0.0161*	-0.0131	-0.0177*
	p-value	0.2	0.0779	0.169	0.0715
ΣΔSpr (home)_t-1 to t-2		-0.0176	-0.0268**	-0.0198	-0.0273**
	p-value	0.127	0.0237	0.108	0.0301
ΣΔSpr (home)_t-1 to t-3		-0.0208	-0.0319**	-0.0251*	-0.0344**
	p-value	0.139	0.03	0.095	0.0282
ΣΔSpr (home)_t-1 to t-4		-0.0294*	-0.045**	-0.03	-0.0424**
	p-value	0.0952	0.0157	0.109	0.0307
ΣΔr (home)_t-1 * Negative			-0.0673		-0.0712
	p-value		0.285		0.278
ΣΔr (home)_t-1 to t-2 * Negative			-0.015		-0.0175
	p-value		0.87		0.856
ΣΔr (home)_t-1 to t-3 * Negative			-0.0427		-0.0919
	p-value		0.729		0.475
ΣΔr (home)_t-1 to t-4 * Negative			0.0535		0.00823
	p-value		0.697		0.954
ΣΔSpr (home)_t-1 * Negative			0.0453*		0.0504*
	p-value		0.067		0.0615
ΣΔSpr (home)_t-1 to t-2 * Negative			0.106***		0.11***
	p-value		0.00404		0.00625
ΣΔSpr (home)_t-1 to t-3 * Negative			0.106**		0.088*
	p-value		0.012		0.0547
ΣΔSpr (home)_t-1 to t-4 * Negative			0.146***		0.13**
	p-value		0.00557		0.0192
Negative_t-1			0.0023	0.0099	0.0035
			(0.0246)	(0.0236)	(0.0257)
Negative_t-2			-0.0158	-0.0375	-0.0092
			(0.0341)	(0.0323)	(0.0362)
Negative_t-3			0.0315	0.0181	-0.0020
			(0.0375)	(0.0356)	(0.0415)
Negative_t-4			-0.0031	0.0146	0.0200
			(0.0294)	(0.0281)	(0.0323)

log (real assets)_t-1	-0.0100	-0.0091	-0.0068	-0.0064
	(0.0065)	(0.0065)	(0.0069)	(0.0070)
Liquid asset ratio_t-1	-0.0008	-0.0009	-0.0009	-0.0010
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Core deposit ratio_t-1	-0.0004	-0.0005*	-0.0004	-0.0004
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Securities share_t-1	0.0008***	0.0009***	0.0011***	0.0011***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Cost-to-income ratio_t-1	0.0000	0.0000	0.0000	0.0000
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
NPL ratio_t-1	-0.0021**	-0.0020**	-0.0017*	-0.0017*
	(0.0009)	(0.0009)	(0.0010)	(0.0010)
GDP growth (Home)_t-1	0.0026*	0.0024	0.0030*	0.0029*
	(0.0016)	(0.0016)	(0.0017)	(0.0017)
Inflation (Home)_t-1	0.0003	0.0004	0.0004	0.0005
	(0.0014)	(0.0014)	(0.0015)	(0.0015)
Recipient country time fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	26,106	26,106	22,925	22,925
R-squared	0.1102	0.1107	0.1205	0.1211
Adjusted R-squared	0.0239	0.0241	0.0269	0.0271
Cluster	Bank-time	Bank-time	Bank-time	Bank-time

Note: The dependent variable is log changes in cross-border lending to non-bank sector. Columns 3 and 4 exclude lending to non-bank sector in the home country of the foreign banks. The data are quarterly from 2005Q1 to 2019Q4 for a panel of foreign bank branches in Hong Kong. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A2 - a: UK results for cross-border lending to non-bank sector by breakdown of borrower type

Exclude lending to EA for EA banks		(1)	(2)	(3)	(4)	(5)	(6)
Loans to non-bank sectors		All from 2014	All from 2014	NBFI	NBFI	Corporates	Corporates
ΣΔr (home)_t-1		-0.0111	-0.0416	0.00277	0.00482	-0.0337	-0.0737***
	p-value	0.637	0.103	0.957	0.928	0.124	0.00204
ΣΔr (home)_t-1 to t-2		0.00780	-0.0234	0.0200	0.0186	-0.0278	-0.0805**
	p-value	0.798	0.448	0.768	0.795	0.408	0.0158
ΣΔr (home)_t-1 to t-3		-0.0276	-0.0744*	-0.105	-0.110	-0.0480	-0.122***
	p-value	0.471	0.0603	0.216	0.223	0.268	0.00403
ΣΔr (home)_t-1 to t-4		-0.00423	-0.0325	-0.0439	-0.0309	-0.0630	-0.110**
	p-value	0.921	0.453	0.655	0.764	0.189	0.0189
ΣΔSpr (home)_t-1		-0.0293	-0.0575**	-0.0565	-0.0686	-0.0305	-0.0607***
	p-value	0.109	0.0114	0.287	0.232	0.108	0.00745
ΣΔSpr (home)_t-1 to t-2		-0.0200	-0.0358	-0.0545	-0.0578	-0.0177	-0.0146
	p-value	0.413	0.242	0.462	0.476	0.513	0.660
ΣΔSpr (home)_t-1 to t-3		-0.0527*	-0.0784**	-0.155*	-0.155	-0.0216	-0.0177
	p-value	0.0704	0.0334	0.0797	0.110	0.491	0.652
ΣΔSpr (home)_t-1 to t-4		-0.0249	-0.0447	-0.0960	-0.113	-0.0245	-0.00107
	p-value	0.434	0.278	0.348	0.313	0.493	0.982
ΣΔr (home)_t-1 * Negative			0.111		0.0248		0.170***
	p-value		0.106		0.835		0.000773
ΣΔr (home)_t-1 to t-2 * Negative			0.126		-0.0201		0.235***
	p-value		0.182		0.909		0.00411
ΣΔr (home)_t-1 to t-3 * Negative			0.255**		0.0122		0.470***
	p-value		0.0267		0.954		1.98e-05
ΣΔr (home)_t-1 to t-4 * Negative			0.168		-0.0639		0.380***
	p-value		0.182		0.778		0.00297
ΣΔSpr (home)_t-1 * Negative			0.0705**		0.0518		0.0673**
	p-value		0.0106		0.375		0.0215
ΣΔSpr (home)_t-1 to t-2 * Negative			0.0350		0.0472		-0.00809
	p-value		0.338		0.562		0.842
ΣΔSpr (home)_t-1 to t-3 * Negative			0.0929**		0.0769		0.0337
	p-value		0.0380		0.428		0.499
ΣΔSpr (home)_t-1 to t-4 * Negative			0.0476		0.137		-0.0464
	p-value		0.351		0.199		0.411
Recipient country time fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls		Yes	Yes	Yes	Yes	Yes	Yes
Low dummies		Yes	Yes	Yes	Yes	Yes	Yes
Home Country Controls		Yes	Yes	Yes	Yes	Yes	Yes
Observations		16,828	16,828	9,183	9,183	12,196	12,196
R-squared		0.1122	0.1134	0.1374	0.1379	0.1336	0.1371
Adjusted R-squared		0.0181	0.0186	0.0157	0.0147	0.0227	0.0256
Cluster		Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: The dependent variable is log changes in cross-border lending to non-bank sector. Again, all dependent variables exclude lending to the home country of the foreign banks. The dependent variables in Columns 1 and 2 are log changes in cross-border lending to non-bank sector, while the breakdown into loans to NBFIs and corporates are presented in columns (3 & 4) and (5 & 6) respectively. The data are quarterly from 2014Q1 to 2019Q4 for a panel of foreign banks resident in the UK. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A2- b: IE results for cross-border lending to non-bank sector by breakdown of borrower type

Exclude lending to EA for EA banks	(1)	(2)	(3)	(4)	(5)	(6)
Loans to non-bank sectors	All from 2014	All from 2014	NBFI	NBFI	Corporates	Corporates
ΣΔr (home)_t-1	0.003	-0.002	0.001	-0.0161***	0.002	-0.005
p-value	0.245	0.773	0.664	0.004	0.316	0.287
ΣΔr (home)_t-1 to t-2	0.004	-0.000	-0.001	-0.0343***	0.00374*	-0.006
p-value	0.215	0.953	0.717	0.000	0.098	0.399
ΣΔr (home)_t-1 to t-3	0.003	-0.002	-0.002	-0.0477***	0.002	-0.010
p-value	0.504	0.848	0.646	0.000	0.515	0.235
ΣΔr (home)_t-1 to t-4	0.001	-0.005	-0.006	-0.0609***	0.002	-0.020
p-value	0.847	0.629	0.200	0.000	0.688	0.069
ΣΔSpr (home)_t-1	0.059	0.056	0.104***	0.037	0.0731**	0.053
p-value	0.103	0.306	0.000	0.422	0.023	0.231
ΣΔSpr (home)_t-1 to t-2	0.102**	0.088	0.205***	0.112**	0.122***	0.028
p-value	0.019	0.124	0.000	0.013	0.001	0.603
ΣΔSpr (home)_t-1 to t-3	0.0886*	0.061	0.253***	0.163***	0.124***	-0.022
p-value	0.060	0.304	0.000	0.001	0.002	0.695
ΣΔSpr (home)_t-1 to t-4	0.070	0.063	0.277***	0.236***	0.124***	-0.010
p-value	0.148	0.298	0.000	0.000	0.002	0.854
ΣΔr (home)_t-1 * Negative		0.004		0.0167***		0.005
p-value		0.421		0.002		0.293
ΣΔr (home)_t-1 to t-2 * Negative		0.003		0.0326***		0.006
p-value		0.605		0.000		0.335
ΣΔr (home)_t-1 to t-3 * Negative		0.003		0.0454***		0.009
p-value		0.689		0.000		0.283
ΣΔr (home)_t-1 to t-4 * Negative		0.005		0.0541***		0.0182*
p-value		0.595		0.000		0.082
ΣΔSpr (home)_t-1 * Negative		-0.030		0.039		-0.037
p-value		0.539		0.373		0.394
ΣΔSpr (home)_t-1 to t-2 * Negative		-0.040		0.055		0.023
p-value		0.422		0.231		0.630
ΣΔSpr (home)_t-1 to t-3 * Negative		-0.040		0.044		0.073
p-value		0.428		0.334		0.138
ΣΔSpr (home)_t-1 to t-4 * Negative		-0.070		-0.029		0.056
p-value		0.210		0.561		0.297
Recipient country time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Low dummies	Yes	Yes	Yes	Yes	Yes	Yes
Home Country Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,070	4,070	4,070	4,070	4,070	4,070
R-squared	0.3533	0.3550	0.3388	0.3457	0.4938	0.5021
Adjusted R-squared	0.220	0.219	0.203	0.208	0.389	0.397
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: The dependent variable is log changes in cross-border lending to non-bank sector. Again, all dependent variables exclude lending to the home country of the foreign banks. The dependent variables in Columns 1 and 2 are log changes in cross-border lending to non-bank sector, while the breakdown into loans to NBFIs and corporates are presented in columns (3 & 4) and (5 & 6) respectively. The data are quarterly from 2014Q1 to 2019Q4 for a panel of foreign banks resident in Ireland. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A2- c: HK results for cross-border lending to non-bank sector by breakdown of borrower type

Exclude lending to EA for EA banks		(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable. *Loans to:*		All from 2015	All from 2015	NBFI	NBFI	Corporates	Corporates
ΣΔr (home)_t-1		-0.0019	-0.00536	-0.0181	-0.0716	-0.00888	-0.0126
	p-value	0.824	0.568	0.84	0.462	0.399	0.279
ΣΔr (home)_t-1 to t-2		-0.0184	-0.027**	-0.0558	-0.0857	-0.0389**	-0.0474***
	p-value	0.165	0.0456	0.556	0.392	0.0181	0.00931
ΣΔr (home)_t-1 to t-3		-0.0222	-0.0329*	-0.0598	-0.0135	-0.0509**	-0.0564**
	p-value	0.21	0.0684	0.576	0.895	0.0384	0.0312
ΣΔr (home)_t-1 to t-4		-0.0204	-0.0421*	0.13	0.0457	-0.0536*	-0.0733**
	p-value	0.378	0.0786	0.288	0.705	0.0998	0.0403
ΣΔSpr (home)_t-1		0.00672	-0.00949	0.12**	0.114*	0.0172	0.00571
	p-value	0.676	0.594	0.0438	0.061	0.422	0.82
ΣΔSpr (home)_t-1 to t-2		-0.00651	-0.0351	0.0228	0.000739	-0.025	-0.0485*
	p-value	0.74	0.103	0.769	0.993	0.274	0.0682
ΣΔSpr (home)_t-1 to t-3		0.00394	-0.0268	0.126*	0.116	-0.0168	-0.0333
	p-value	0.863	0.3	0.0931	0.139	0.566	0.328
ΣΔSpr (home)_t-1 to t-4		0.0114	-0.0308	0.177*	0.15	-0.0448	-0.0846*
	p-value	0.704	0.367	0.0984	0.188	0.249	0.0644
ΣΔr (home)_t-1 * Negative			-0.0741		0.0633		-0.0736
	p-value		0.221		0.798		0.367
ΣΔr (home)_t-1 to t-2 * Negative			-0.0242		-0.196		0.0588
	p-value		0.788		0.657		0.605
ΣΔr (home)_t-1 to t-3 * Negative			-0.0859		-0.583		0.159
	p-value		0.481		0.333		0.289
ΣΔr (home)_t-1 to t-4 * Negative			0.0277		0.407		0.165
	p-value		0.838		0.571		0.314
ΣΔSpr (home)_t-1 * Negative			0.0446		0.0836		-0.00934
	p-value		0.117		0.564		0.77
ΣΔSpr (home)_t-1 to t-2 * Negative			0.119***		0.178		0.0815*
	p-value		0.00419		0.413		0.0762
ΣΔSpr (home)_t-1 to t-3 * Negative			0.094*		0.0568		0.0477
	p-value		0.0551		0.814		0.367
ΣΔSpr (home)_t-1 to t-4 * Negative			0.148**		0.294		0.11*
	p-value		0.014		0.331		0.0978
Recipient country time fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls		Yes	Yes	Yes	Yes	Yes	Yes
Negative dummies		Yes	Yes	Yes	Yes	Yes	Yes
Home country controls		Yes	Yes	Yes	Yes	Yes	Yes
Observations		11,452	11,452	1,336	1,336	8,374	8,374
R-squared		0.1224	0.1239	0.3778	0.3972	0.1386	0.1406
Adjusted R-squared		0.0285	0.0290	0.173	0.189	0.0383	0.0390
Cluster		Bank-time	Bank-time	Bank-time	Bank-time	Bank-time	Bank-time

Note: The dependent variable is log changes in cross-border lending to non-bank sector. Again, all dependent variables exclude lending to the home country of the foreign banks. The dependent variables in Columns 1 and 2 are log changes in cross-border lending to non-bank sector, while the breakdown into loans to NBFIs and corporates are presented in columns (3 & 4) and (5 & 6) respectively. The data are quarterly from 2015Q1 to 2019Q4 for a panel of foreign bank branches resident in Hong Kong. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A3 - a: UK results for cross-border lending and funding vis-à-vis banks

Exclude lending to EA for EA banks	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Loans to bank sectors	Intragroup+Interbank		Intragroup Lending		Intragroup Funding from home country		Intragroup Funding from all sources
ΣΔr (home)_t-1	0.00792	0.00116	0.0961	0.0680	-0.121**	-0.199***	-0.173***
	0.717	0.958	0.138	0.284	0.0161	0.000961	0.000233
ΣΔr (home)_t-1 to t-2	-0.0267	-0.0269	0.0409	-0.00753	-0.0612	-0.0882	0.00511
	0.307	0.315	0.654	0.937	0.251	0.184	0.906
ΣΔr (home)_t-1 to t-3	-0.0608*	-0.0601*	0.0993	0.0662	-0.0257	-0.0610	0.0153
	0.0593	0.0702	0.362	0.558	0.712	0.484	0.795
ΣΔr (home)_t-1 to t-4	-0.0344	-0.0317	0.108	0.0848	0.0132	0.0127	0.117**
	0.328	0.384	0.358	0.483	0.836	0.862	0.0294
ΣΔSpr (home)_t-1	-0.0186	-0.0215	0.0443	0.0205	-0.138***	-0.227***	-0.223***
	0.398	0.341	0.377	0.687	0.00221	0.000101	4.05e-06
ΣΔSpr (home)_t-1 to t-2	-0.0338	-0.0311	0.0231	-0.000641	-0.0598**	-0.0582	-0.0137
	0.215	0.269	0.768	0.994	0.0267	0.383	0.775
ΣΔSpr (home)_t-1 to t-3	-0.0602*	-0.0558	0.0791	0.0653	-0.0483*	-0.0264	0.0188
	0.0750	0.114	0.395	0.505	0.0949	0.713	0.784
ΣΔSpr (home)_t-1 to t-4	-0.0542	-0.0503	0.113	0.0973	-0.0458	0.00517	0.0714
	0.167	0.223	0.275	0.373	0.186	0.943	0.381
ΣΔr (home)_t-1 * Negative		0.0970		-0.0212		0.227	0.0796
		0.362		0.900		0.182	0.517
ΣΔr (home)_t-1 to t-2 * Negative		0.0181		0.00825		0.0737	-0.0936
		0.903		0.971		0.788	0.550
ΣΔr (home)_t-1 to t-3 * Negative		0.0902		-0.0908		0.183	-0.0117
		0.644		0.754		0.563	0.949
ΣΔr (home)_t-1 to t-4 * Negative		0.0657		-0.0533		0.711**	0.300
		0.760		0.863		0.0141	0.256
ΣΔSpr (home)_t-1 * Negative		0.00221		0.0317		0.147**	0.0666
		0.965		0.700		0.0442	0.371
ΣΔSpr (home)_t-1 to t-2 * Negative		-0.0451		-0.0259		0.0179	-0.101
		0.459		0.791		0.800	0.106
ΣΔSpr (home)_t-1 to t-3 * Negative		-0.0633		-0.127		-0.0145	-0.110
		0.434		0.331		0.858	0.214
ΣΔSpr (home)_t-1 to t-4 * Negative		-0.0455		-0.151		-0.0574	-0.102
		0.631		0.310		0.521	0.252
Recipient country time fixed effects	Yes	Yes	Yes	Yes	No	No	No
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Low dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Home Country Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,720	30,720	5,349	5,349	1,752	1,752	7,224
R-squared	0.1166	0.1169	0.1715	0.1731	0.0588	0.0685	0.0293
Adjusted R-squared	0.00889	0.00873	0.00182	0.00103	-0.00615	-0.00308	0.0117
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank	Bank	Bank

Note: This table presents the estimation result for log change in cross-border lending to bank sector (columns 1 and 2), intragroup lending to affiliates (columns 3 and 4), intragroup funding from headquarter (columns 5 and 6) and intragroup funding from all sources (column 7). The data are quarterly from 2005Q1 to 2019Q4 for a panel of foreign banks resident in the UK. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A3 - b: IE results for cross-border lending and funding vis-à-vis banks

Exclude lending to EA for EA banks		(1)	(2)	(3)	(4)	(5)	(6)
Loans to bank sectors		Intragroup+Interbank		*Intragroup Lending*		*Intragroup Funding*	
ΣΔr (home)_t-1		0.004	0.000	-0.002	-0.010	-0.001	-0.005
	p-value	0.217	0.984	0.505	0.287	0.617	0.475
ΣΔr (home)_t-1 to t-2		0.006	0.007	-0.003	-0.017	-0.001	-0.007
	p-value	0.213	0.707	0.355	0.145	0.848	0.420
ΣΔr (home)_t-1 to t-3		0.0114**	0.019	-0.002	-0.021	-0.001	-0.003
	p-value	0.031	0.268	0.676	0.134	0.773	0.758
ΣΔr (home)_t-1 to t-4		0.0141**	0.0412**	-0.002	-0.0271*	-0.001	-0.001
	p-value	0.027	0.022	0.689	0.076	0.815	0.928
ΣΔSpr (home)_t-1		-0.001	-0.001	-0.000	-0.000	0.001	0.001
	p-value	0.518	0.534	0.958	0.896	0.561	0.564
ΣΔSpr (home)_t-1 to t-2		0.001	0.001	0.001	0.001	0.002	0.002
	p-value	0.730	0.686	0.431	0.480	0.381	0.392
ΣΔSpr (home)_t-1 to t-3		0.003	0.004	0.003	0.002	0.003	0.003
	p-value	0.226	0.191	0.199	0.233	0.264	0.276
ΣΔSpr (home)_t-1 to t-4		0.004	0.004	0.00505*	0.00481*	0.004	0.003
	p-value	0.249	0.200	0.063	0.073	0.264	0.278
ΣΔr (home)_t-1 * Negative			0.004		0.009		0.003
	p-value		0.816		0.337		0.572
ΣΔr (home)_t-1 to t-2 * Negative			-0.001		0.016		0.007
	p-value		0.974		0.188		0.403
ΣΔr (home)_t-1 to t-3 * Negative			-0.007		0.021		0.002
	p-value		0.669		0.124		0.807
ΣΔr (home)_t-1 to t-4 * Negative			-0.0287*		0.0273*		0.000
	p-value		0.099		0.074		0.990
ΣΔSpr (home)_t-1 * Negative			0.036		0.037		0.005
	p-value		0.410		0.487		0.901
ΣΔSpr (home)_t-1 to t-2 * Negative			0.030		0.076		0.041
	p-value		0.615		0.209		0.404
ΣΔSpr (home)_t-1 to t-3 * Negative			-0.024		0.089		0.058
	p-value		0.682		0.173		0.287
ΣΔSpr (home)_t-1 to t-4 * Negative			-0.069		0.076		0.075
	p-value		0.241		0.288		0.212
Recipient country time fixed effects		Yes	Yes	Yes	Yes	No	No
Bank fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls		Yes	Yes	Yes	Yes	Yes	Yes
Low dummies		Yes	Yes	Yes	Yes	Yes	Yes
Home Country Controls		Yes	Yes	Yes	Yes	Yes	Yes
Observations		8,272	8,272	8,272	8,272	8,272	8,272
R-squared		0.2714	0.2725	0.5807	0.5824	0.4535	0.4542
Adjusted R-squared		0.126	0.127	0.497	0.499	0.345	0.345
Cluster		Bank-time	Bank-time	Bank-time	Bank-time	Bank	Bank

Note: This table presents the estimation result for log change in cross-border lending to bank sector (columns 1 and 2), intragroup lending to affiliates (columns 3 and 4), intragroup funding from all sources (columns 5 and 6). The data are quarterly from 2005Q1 to 2019Q4 for a panel of foreign banks resident in Ireland. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A3 - c: HK results for cross-border lending and funding vis-à-vis banks

Exclude lending to EA for EA banks	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Loans to bank sectors	Intragroup+Interbank		Intragroup Lending		Intragroup Funding from home country		Intragroup Funding from all sources
ΣΔr (home)_t-1	-0.0177	-0.0231	0.0353	0.0361	0.00047	-0.0731	-0.0167
	0.222	0.122	0.158	0.17	0.988	0.21	0.48
ΣΔr (home)_t-1 to t-2	-0.0272	-0.0341*	-0.0232	-0.0189	0.0322	0.00164	-0.0101
	0.166	0.0913	0.569	0.653	0.624	0.982	0.777
ΣΔr (home)_t-1 to t-3	-0.0491**	-0.0599***	-0.028	-0.0269	-0.125*	-0.191**	0.0209
	0.0301	0.0095	0.573	0.6	0.0923	0.0309	0.654
ΣΔr (home)_t-1 to t-4	-0.0695***	-0.0835***	-0.0144	-0.0163	-0.0135	-0.0389	0.00889
	0.00802	0.00185	0.825	0.812	0.879	0.714	0.882
ΣΔSpr (home)_t-1	-0.0124	-0.0216	-0.0394	-0.0582	0.042	0.0339	0.00539
	0.391	0.147	0.275	0.137	0.414	0.626	0.892
ΣΔSpr (home)_t-1 to t-2	-0.0249	-0.0361*	-0.0149	-0.0118	0.0189	0.0582	0.0295
	0.22	0.0851	0.763	0.822	0.798	0.508	0.542
ΣΔSpr (home)_t-1 to t-3	-0.0437*	-0.0599**	-0.0319	-0.0355	-0.00285	0.0148	0.0773
	0.067	0.0145	0.589	0.571	0.975	0.899	0.192
ΣΔSpr (home)_t-1 to t-4	-0.0712**	-0.0919***	0.0271	0.0238	0.13	0.203	0.0835
	0.0122	0.00178	0.726	0.778	0.233	0.153	0.29
ΣΔr (home)_t-1 * Negative		0.108		-0.047		0.105*	-0.178
		0.407		0.82		0.0791	0.318
ΣΔr (home)_t-1 to t-2 * Negative		0.0424		0.0723		0.3	-0.0147
		0.817		0.794		0.145	0.953
ΣΔr (home)_t-1 to t-3 * Negative		0.102		0.306		0.465*	-0.0251
		0.659		0.357		0.0888	0.937
ΣΔr (home)_t-1 to t-4 * Negative		0.146		0.351		0.315	-0.295
		0.589		0.352		0.326	0.4
ΣΔSpr (home)_t-1 * Negative		0.132***		0.0848		-0.101	-0.0791
		0.00915		0.198		0.2	0.224
ΣΔSpr (home)_t-1 to t-2 * Negative		0.0821		-0.0622		-0.138	-0.101
		0.228		0.502		0.205	0.237
ΣΔSpr (home)_t-1 to t-3 * Negative		0.108		-0.047		-0.125	-0.139
		0.19		0.683		0.351	0.175
ΣΔSpr (home)_t-1 to t-4 * Negative		0.13		-0.0377		-0.266	-0.171
		0.172		0.785		0.102	0.181
Recipient country time fixed effects	Yes	Yes	Yes	Yes	No	No	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Negative dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Home country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	22,288	22,288	4,490	4,490	1,846	1,846	5,090
R-squared	0.1096	0.1104	0.1961	0.1977	0.1535	0.1584	0.1740
Adjusted R-squared	0.0354	0.0356	0.0737	0.0728	0.0797	0.0806	0.0513
Cluster	Bank-time	Bank-time	Bank-time	Bank-time	Bank	Bank	Bank-time

Note: This table presents the estimation result for log change in cross-border lending to bank sector (columns 1 and 2), intragroup lending to affiliates (columns 3 and 4), intragroup funding from headquarter (columns 5 and 6) and intragroup funding from all sources (column 7). The data are quarterly from 2005Q1 to 2019Q4 for a panel of foreign bank branches resident in Hong Kong. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

Table A4: EA banks results for cross-border lending

VARIABLES	(1) Total loans RoW
Σ∆r t-1	-0.0114
p-val	0.4581
Σ∆r t-1 to t-2	0.0222
p-val	0.1088
Σ∆r t-1 to t-3	0.01263
p-val	0.3557
Σ∆r t-1 to t-4	0.00667
p-val	0.6979
Σ∆spread t-1	**-0.0113***
p-val	0.0678
Σ∆spread t-1to t-2	0.0018
p-val	0.8396
Σ∆spread t-1 to t-3	-0.0136
p-val	0.2270
Σ∆spread t-1to t-4	-0.013435
p-val	0.2848
ΣNIRdummy t-1	-0.0327
p-val	0.1471
ΣNIRdummy t-1 to t-2	0.013
p-val	0.5362
ΣNIRdummy t-1 to t-3	-0.0233
p-val	0.2958
ΣNIRdummy t-1 to t-4	**-0.01707****
p-val	0.0496
ΣNIRdummy ∆r t-1	**-0.243***
p-val	0.0593
ΣNIRdummy i∆r t-1 to t-2	**-0.2699****
p-val	0.0364
ΣNIRdummy ∆r t-1 to t-3	-0.1569
p-val	0.1933
ΣNIRdummy ∆r t-1 to t-4	-0.1678
p-val	0.1682
ΣNIRdummy ∆spread t-1	0.0125
p-val	0.2404
ΣNIRdummy ∆spread t-1 to t-2	-0.0096
p-val	0.4936
ΣNIRdummy ∆spread t-1 to t-3	0.005
p-val	0.783
ΣNIRdummy ∆spread t-1 to t-4	0.01303
p-val	0.5538
Leverage ratio (lagged)	0.932
	-0.791
Deposit liab. (lagged)	-0.0166
	-0.0396

*Note: Dependent variable is quarterly % change in (log) lending, winsorised at the 5% level. Standard errors, in brackets, are clustered by bank . *, **, and *** denote statistical significance at respectively 10, 5, and 1% level.*

Table A5: French results for cross-border lending

Exclude lending to EA	(1)	(2)	(3)	(4)
Counterpart sector:	Financial sector		Non-financial sector	
Recipient countries:	IFC	Others (non-EA)	IFC	Others (non-EA)
ΣΔr (France)_t-1	-0.066	0.093*	0.025	-0.022
p-value	0.358	0.057	0.413	0.269
ΣΔr (France)_t-1 to t-2	-0.212**	-0.034	0.069*	-0.004
p-value	0.043	0.580	0.098	0.870
ΣΔr (France)_t-1 to t-3	-0.157	0.044	0.068	-0.008
p-value	0.226	0.581	0.194	0.801
ΣΔr (France)_t-1 to t-4	-0.156	0.020	0.051	0.022
p-value	0.319	0.834	0.414	0.545
ΣΔSpr (France)_t-1	-0.040	0.025	-0.032	-0.036
p-value	0.567	0.572	0.345	0.106
ΣΔSpr (France)_t-1 to t-2	-0.170	-0.062	0.028	0.003
p-value	0.125	0.382	0.554	0.904
ΣΔSpr (France)_t-1 to t-3	-0.230*	-0.121	0.041	-0.021
p-value	0.099	0.180	0.481	0.558
ΣΔSpr (France)_t-1 to t-4	-0.124	-0.041	0.044	0.002
p-value	0.440	0.691	0.506	0.954
ΣΔr (France)_t-1 * Negative	106.807*	20.553	-1.415	16.307
p-value	0.085	0.588	0.953	0.109
ΣΔr (France)_t-1 to t-2 * Negative	132.734*	25.213	-1.532	20.546
p-value	0.088	0.597	0.960	0.108
ΣΔr (France)_t-1 to t-3 * Negative	168.238*	32.066	-1.763	26.212
p-value	0.087	0.595	0.963	0.104
ΣΔr (France)_t-1 to t-4 * Negative	211.245*	39.920	-3.220	31.923
p-value	0.082	0.591	0.946	0.110
ΣΔSpr (France)_t-1 * Negative	5.290**	0.798	-0.265	0.598
p-value	0.046	0.614	0.804	0.177
ΣΔSpr (France)_t-1 to t-2 * Negative	-3.826	-0.708	-0.138	-0.720*
p-value	0.136	0.659	0.885	0.085
ΣΔSpr (France)_t-1 to t-3 * Negative	2.057***	0.476	-0.261	0.056
p-value	0.008	0.284	0.419	0.672
ΣΔSpr (France)_t-1 to t-4 * Negative	4.496**	0.797	-0.342	0.442
p-value	0.042	0.549	0.703	0.230
Σ Negative_t-1	1.500*	0.198	-0.167	0.111
p-value	0.051	0.661	0.592	0.381
Σ Negative_t-1 to t-2	12.680*	2.352	-0.195	1.862
p-value	0.083	0.598	0.945	0.120
Σ Negative_t-1 to t-3	12.680*	2.352	-0.195	1.862
p-value	0.083	0.598	0.945	0.120
Σ Negative_t-1 to t-4	12.680*	2.352	-0.195	1.862
p-value	0.083	0.598	0.945	0.120

Capital Ratio_t-1	0.535	-0.012	0.911***	0.340
	(0.448)	(0.974)	(0.003)	(0.101)
Core Deposit Share_t-1	0.290	0.007	0.081	0.081
	(0.271)	(0.981)	(0.649)	(0.392)
Securities Share_t-1	0.079	0.019	0.189*	0.049
	(0.711)	(0.921)	(0.087)	(0.435)
Intragroup financing share_t-1	0.133	-0.112	-0.132	-0.067
	(0.523)	(0.399)	(0.496)	(0.469)
Unused commitments share t-1	-0.129	-0.360	0.137	0.064
	(0.686)	(0.209)	(0.310)	(0.395)
Net intragroup position t-1	0.487	0.490**	-0.087	0.050
	(0.146)	(0.032)	(0.829)	(0.789)
Financial cycle indicator (Ctry) t-1	0.108	0.038	0.058	0.100***
	(0.662)	(0.709)	(0.410)	(0.000)
Business cycle indicator (Ctry) t-1	1.939	-0.096	-0.489	-0.291
	(0.375)	(0.878)	(0.483)	(0.114)
GDP Growth (France)_t-1	0.033	0.006	0.006	0.011*
	(0.119)	(0.656)	(0.508)	(0.083)
Inflation (France)_t-1	-0.029	0.001	-0.006	-0.027***
	(0.277)	(0.967)	(0.604)	(0.001)
US monetary policy t-5	-0.036	-0.061	-0.069	-0.056
	(0.856)	(0.574)	(0.427)	(0.279)
UK monetary policy t-5	-0.013	0.021	-0.010	0.002
	(0.651)	(0.194)	(0.313)	(0.770)
Recipient country (Ctry) fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	1404	5490	3028	23620
R-squared	0.03	0.02	0.05	0.02
Adjusted R-squared	0.00	0.01	0.02	0.01
Cluster	Bank-time	Bank-time	Bank-time	Bank-time

*Notes: IFC accounts for United Kingdom and Hong Kong. EA countries are excluded from the sample. The data are quarterly from 2000Q2 to 2017Q4. *, **, and *** denote statistical significance at respectively the 10, 5, and 1% levels.*

Table A6: Outward transmission of EA monetary policy for French banks' cross-border financial lending in euros, with alternative scope for "international financial centres"

Exclude lending to EA	(1)	(2)	(3)
Counterpart sector:		Financial sector	
Recipient countries (scope of IFC):	UK and HK	UK, HK, and US	US, HK, US, and CH
ΣΔr (France)_t-k	-0.212** ^{Q2} [-0.156]	-0.165* ^{Q2} [-0.089]	-0.154* ^{Q2} [-0.081]
	0.043 ^{Q2} [0.319]	0.080 ^{Q2} [0.528]	0.083 ^{Q2} [0.525]
ΣΔr (France)_t-k * Negative	211.245*	189.303*	291.707***
	0.082	0.073	0.004
ΣΔSpr (France)_t-k	-0.230* ^{Q3} [-0.124]	-0.277** ^{Q3} [-0.166]	-0.261** ^{Q3} [-0.135]
	0.099 [0.440]	0.030 [0.252]	0.029 [0.317]
ΣΔSpr (France)_t-k * Negative	4.496**	3.595*	5.493***
	0.042	0.058	0.002
Σ Negative t-k	12.680*	11.286*	17.434***
	0.083	0.075	0.004
Bank fixed effects	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes
Recipient-country fixed effects	Yes	Yes	Yes
Recipient-country controls	Yes	Yes	Yes
Home country controls	Yes	Yes	Yes
Observations	1,404	2,025	2,743
R-squared	0.03	0.03	0.03
Adjusted R-squared	0.00	0.00	0.00
Cluster	Bank-time	Bank-time	Bank-time

*Notes: In this table, we report the peak cumulative effects for the interaction between changes in short-term interest rate and yield curve spreads and the negative rate dummy. Unless otherwise indicated, the peak cumulative effects are at the four-quarter horizon. For the case where the cumulative effects peak at a different horizon, this is specified in superscript and the cumulative effect at four-quarter horizon is reported in blue brackets. The data are quarterly from 2000Q2 to 2017Q4. P-values are reported below coefficient estimates. *, **, and *** denote statistical significance at respectively the 10, 5, and 1% levels.*

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