Negative Rates, Monetary Policy Transmission and Cross-Border Lending via International Financial Centers*

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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 centers (IFCs) – the United Kingdom and Hong Kong, as well as Ireland – we examine how NIRP in the economies where banks have their headquarters influences cross-border lending from financial-centre affiliates. Outside of NIRP periods, tighter monetary policy in affiliates' headquarter country is associated with a reduction in cross-border lending from the UK and Hong Kong to non-bank borrowers abroad. In contrast, we find evidence that NIRP impairs the bank-lending channel for cross-border lending to non-bank sectors from the UK and Hong Kong, especially for those banks that have only a weak deposit base in these IFCs – and are thus relatively more exposed to NIRP in their headquarters. Consistent with these IFC findings, using euro-area data that includes bank-level information for France, we find that NIRP also impairs headquarter-banks' lending to bank borrowers in IFCs, which include their IFC affiliates.

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

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

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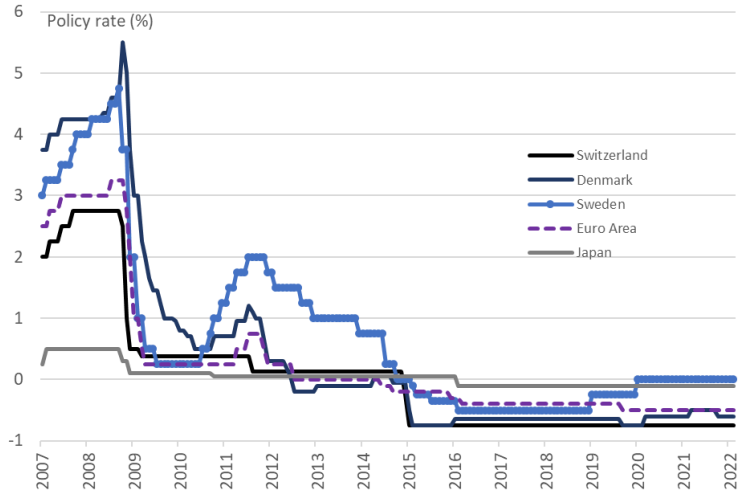
1. Introduction

Following the 2007-2008 global financial crisis (GFC), several advanced economies introduced negative interest rate policies (NIRP). Since 2012, central banks in Denmark, the euro area, Japan, Sweden and Switzerland have adopted NIRP to stimulate macroeconomic activity against a backdrop of low natural real rates of interest (Holsten et al., 2017), as Figure 1 shows.[1] Only since 2022 have the (majority of) central banks that enacted NIRP raised rates into positive territory.[2]

Figure 1 – Time series 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.

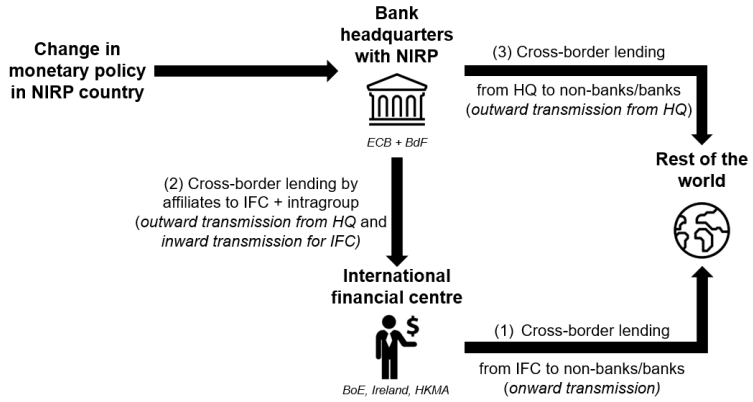
This paper examines whether NIRP alter the transmission of monetary policy through cross-border bank lending. NIRP have stimulated a large body of research (see Brandão-Marques et al., 2021; Heider et al., 2021; Balloch et al., 2022 for surveys). The existing literature has analyzed a range of outcomes, including NIRP's effects on money-market rates, the yield curve, bank lending, non-bank financial institutions (NBFIs), as well as macroeconomic growth and inflation. However, as Brandão-Marques et al. (2021) emphasize, there has been limited study into the cross-border effects of NIRP to date, with most studies focusing on domestic effects.[3] We seek to fill this gap by analyzing the effects of NIRP on

[1] For Denmark and Switzerland, policymakers in part turned to NIRP to deal with currency appreciation pressures, in addition to broader macroeconomics stabilization.
[2] While our dataset does not span the recent tightening of monetary policy, we discuss the implications of our work for this period in the introduction and conclusion of the paper.
[3] The limited number of studies that do analyze 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

banks' cross-border lending. Specifically, we ask whether NIRP has significantly altered the transmission of monetary policy through cross-border bank lending, focusing on international financial centres (IFCs).[4]

To do this, we use confidential bank-level data for multiple countries tracking the size and composition of cross-border claims at quarterly frequency. Figure 2 summarizes our scope. We first focus on transmission through IFCs, using data from the United Kingdom (UK) and Hong Kong, as well as Ireland. These datasets capture bank affiliates whose nationality differs from the IFC in which they are based (e.g., French bank operating in the UK). So, we study how NIRP in a bank's headquarter country influences the "onward transmission" of its headquarter monetary policy through the IFC-affiliates' cross-border lending (Link 1). We complement this with insights on international lending from bank-headquarter regions where NIRP has been enacted – specifically France and the euro area more broadly ("outward transmission" for the headquarter, or "inward" for the IFC).[5] In particular, we compare the transmission of headquarter monetary policy via headquarter banks to IFCs (Link 2) with the "outward transmission" via headquarter banks to the rest of the world (Link 3)**.**

Figure 2 – Graphical summary of the paper



Our IFC focus is primarily motivated by their substantive role in global banking. In past decades, cross-border banking flows have grown to account for a non-negligible share of total private credit (Bruno

spillovers from ECB NIRP. Notwithstanding this, Arteta et al. (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 center' (IFC) is host to major financial activities, with a significant share performed by foreign international banking groups.

[5] France and Ireland are both members of the euro area, but as Ireland has a large volume of (global) cross-border lending activities we treat it as an IFC, with a role of "pseudo-control" for Link 1 (see below).

and Shin, 2015), a disproportionate share being intermediated by IFCs (Bippus et al., 2023; Eguren-Martin et al., 2023). The UK, the largest banking centre, had cross-border banking claims summing to around one-fifth of all such claims covered in the BIS Locational Banking Statistics as of end-2019. Moreover, growth in cross-border flows has outstripped that of domestically-oriented credit in recent decades (Correa et al., 2022). For the IFCs we focus on, the share of cross-border lending in total bank lending reached near one-half as of end-2019 (42% UK, 46% Ireland, 55% Hong Kong).

As such, changes in monetary policy rates can have substantive spillover effects through IFCs (Hills et al., 2019). Moreover, as Bussière et al. (2021b) document, the nature and types of cross-border lending by global banks from IFCs tend to differ from the cross-border lending they issue from their headquarters. For example, given the economies of scale and scope that bank affiliates in IFCs may benefit from – e.g., the agglomeration of other specialised financial services, like legal services and consultancies, which support cross-border lending nearby (Park and Essayyad, 1989) – decisions about a banking groups' global portfolio tend to be made from their IFC offices, rather than their headquarters. Indeed, Bussière et al. (2021b) show these factors can be especially important for cross-border lending to non-bank borrowers, making these flows more responsive to global cyclical factors. 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.

Others have *excluded* IFCs from studies of cross-border bank lending with aggregated data (Takats and Temesvary, 2020, 2021) since IFC lending can be driven, at least in part, by different factors (e.g., carry trade, arbitrage and hedging) to traditional banking-based considerations (Bussière et al., 2021a). However, our study examines the relevance of NIRP for both financial- and corporate-sector cross-border lending *from IFCs*. Our focus on IFCs is made possible by the fact we have access to bank-level data for specific IFCs. Although there are some differences across them, these confidential data, particularly on cross-border banking activities, are collected according to common standards (e.g., feeding into BIS data collection).[6] By using data for multiple IFCs, we can compare and contrast results across countries, exploring how bank and country characteristics interact with NIRP and the international transmission of monetary policy more broadly.

[6] IFC bank data are collected by the UK, Hong Kong and Ireland in accordance with the BIS guidelines, definitions and requirements for reporting international banking statistics.

This IFC focus is especially valuable for studying the cross-border effects of NIRP, given the otherwise limited scope for exploiting cross-country heterogeneity. 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. 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 breadth and heterogeneity in bank affiliates' nationality is crucial for our identification. In addition, the intragroup funding links which foreign affiliates in IFCs maintain with their headquarter banks allow us to examine the role of internal capital markets in monetary policy transmission. Intragroup funding from headquarters is non-negligible and for a sizeable share of IFC affiliates, it is the most important funding source. Finally, cross-border lending activity by foreign affiliates accounts for the majority of IFCs' cross-border lending. According to BIS statistics, well over half of all cross-border lending from the UK (above 65%) and Ireland (above 80%) is done by foreign affiliates.[7]

Our analysis is structured around two broad and potentially competing channels: international bank lending and international risk taking. According to the first, reductions in policy rates in positive territory can reduce banks' funding costs and result higher overall lending quantities. However, NIRP may impair this transmission by limiting the extent to which funding costs can be reduced. For instance, banks' retail deposit rates may be bound below at low or negative rates, given incentives for households and businesses to hold cash rather than bank deposits.[8] Thus, reductions in interest rates in negative territory 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. To maximize returns, this could result in search-for-yield-type behaviour that generates increases in riskier lending (Dell'Ariccia et al., 2014). When policy rates are low or negative, this effect could be more pronounced as bank profit margins are squeezed more. For example, if reductions in policy rates pass through to lending rates, but do not pass through to bank-funding costs due to NIRP, banks' net-interest margins will fall. Because of this, NIRP may incentivize

[7] Similarly, for Hong Kong, the statistics cited in Section 3.1 indicate that cross-border lending to bank and non-bank sectors abroad by foreign branches is >50% (65% and 50% respectively) of total cross-border lending.

[8] 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) emphasize that rates on corporate deposits have fallen by more than those on retail deposits in regions that have used NIRP. The lower bound on retail deposits does not apply to wholesale funding.

greater risk-taking by banks (Bittner et al., 2022).[9] Greater risk-taking could materialize in the form of higher lending volumes to riskier sectors (our focus) and/or a change in the composition of lending towards riskier borrowers within sectors (which our data is unable to capture).[10]

While these channels operate domestically, they are likely to apply to cross-border lending[11] – which may itself be riskier – too.[12] 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, banks may seek returns by extending more lending to higher return-yielding, potentially riskier 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 onward transmission of headquarter monetary policy via IFC affiliates' cross-border lending to non-bank sectors changes when headquarter policy rates are negative. Our results for the UK and Hong Kong suggest that 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 from IFCs to other banks (interbank and intragroup), we neither find evidence of bank-lending impairment or risk taking.

Second, we exploit heterogeneity across IFC affiliates, focusing on their reliance on local deposits and intragroup funding, to shed light on the transmission mechanism to non-bank credit. We find that the funding structure of IFC affiliates (particularly their reliance on local deposit funding in IFCs) is an important factor in determining the extent of bank-lending impairment when their headquarter policy rate turns negative. Results for the UK and Hong Kong suggest that the impairment is smaller for IFC

[9] 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.

[10] Our paper looks at the volume of lending to non-bank sectors (corporates/NBFIs) abroad. Whether lending to external sectors is riskier per se than lending to domestic sectors depends on a range of factors such as the sector in question, the screening technology available, the amount of collateral etc.

[11] Albrizio et al. (2020), find evidence for an international "bank-lending channel" through cross-border lending, but note that the mechanisms underlying this channel are an active field of research. Their focus is on the spillovers from systemically important countries, while our approach looks at monetary transmission at an international level. They do not consider changes due to low/negative interest rates.

[12] Much of cross-border lending to non-financial firms are syndicated loans (Doerr and Schaz (2021) show a strong positive correlation between total cross-border credit and syndicated credit and suggest that after the GFC it represented at least 2/3 of total cross-border lending to high and middle income countries). Becker and Benmelech (2021) show that in the US, syndicated loans in the aggregate are rated riskier than corporate bonds.

affiliates that are more reliant on IFC deposits (denominated largely in local currency and USD) and thus whose funding tends to be less exposed to negative rates in their home countries. Although this heterogeneity is less apparent for banks in Ireland, this is consistent with the suggested mechanism since Irish-resident banks themselves were subject to euro-area NIRP (acting as a pseudo-control group in our empirical analysis here), unlike UK- and Hong Kong-resident institutions.

Third, our results indicate that intragroup *funding* from headquarter offices is somewhat less sensitive to changes in headquarter 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' IFC affiliates via intragroup funding.

Finally, we complement these IFC results by assessing cross-border lending from a headquarter country, France, and the outward transmission of euro area monetary policies. Consistent with the impairment of intragroup lending from headquarters to IFCs that we uncover for the UK and Hong Kong, we find that bank lending from French-headquartered to IFC banks is less sensitive to changes in euro area monetary policy when NIRP is in place. We also show that IFC affiliates' lending to non-banks in their own economies also becomes less sensitive to headquarter policy rates during NIRP, suggesting impairment of the inward transmission and in line with the results for onward transmission, again highlighting the role of global banking for the international transmission of monetary policy.

Together, our results have important implications. First, the fact we find evidence of impairment in the international bank-lending channel through some IFCs suggests that the cross-border spillovers – through international lending – of monetary policy can be less severe when headquarter countries enact NIRP. As countries have tightened monetary policy and left NIRP regimes, our results suggest that the cross-border spillovers of monetary policy tightening may be associated with larger reductions in cross-border non-bank lending from IFCs through these channels than we have seen in the 2010s. Second, our results indicate that IFCs play an important role in intermediating funds across borders for non-financial firms, emphasizing the importance of considering their role in cross-border shock transmission. Third, and related to that, our findings indicate that foreign affiliates' activities in IFCs are responsive to economic conditions in their headquarters. So, to assess the cross-border effects of monetary policy it is important to 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 describes the bank-level data for our three IFCs, outlines our empirical specification and summarizes the results. Section 4 complements this analysis using euro-area data, with a deep dive using more granular data for France. Section 5 concludes.

Related Literature

Our work is part of a broader International Banking Research Network 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. Within that, our paper complements Cao et al. (2023), who focus on the transmission of core countries' low and negative interest rates to small-open economies.

Alongside Cao et al. (2023), our primary contribution to the broader academic literature on NIRP comes from our analysis of cross-border banking lending, with the particular novelty of our paper coming from its IFC focus. On the face of it, our main finding – that NIRP impairs the bank-lending channel for cross-border lending from IFC to non-bank sectors – highlights a notable difference between cross-border and domestic lending. As Brandão-Marques et al. (2021, p. 32) state, that domestic evidence, much of which focuses on lending to non-banks, "*suggests that the effects of rate cuts below zero on bank lending […] largely resemble those of cuts in positive territory*." For instance, using different types of data, Lopez et al. (2020), Demiralp et al. (2021), Bottero et al. (2022), Basten and Mariathasan (2023), and Grandi and Guille (2023) show that NIRP had an expansionary effect on domestic bank lending. Nor do we find strong evidence of greater risk-taking in response to NIRP from our cross-border data, in contrast with domestic analyses (Bubeck et al., 2020; Bittner et al., 2022; Basten and Mariathasan, 2023).

Nevertheless, our cross-border results do highlight differences across banks that are mirrored in the literature on domestic lending. In particular, the fact impairment international bank-lending is especially prominent for banks with a weak deposit base in IFCs and are thus relatively more reliant on deposit funding in their headquarters, chimes with Heider et al. (2019) and Lopez et al. (2020). The former find that NIRP led to less domestic lending by euro area banks with greater reliance on deposit funding, while the latter focus on a panel of 27 advanced and European countries.

Our work is also related to literature studying the transmission of monetary policy through cross-border bank lending. Buch et al. (2019) summarize the results of a previous IBRN initiative studying the cross-border spillovers of conventional and unconventional monetary policies. Within that, Hills et al. (2019) emphasize an important cross-border dimension of spillovers through IFCs. We build on this literature by showing 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. The findings of Bussière et al. (2021b) 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 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 indicators for both of these in our empirical framework, and assess them collectively.

We structure our analysis around two broad channels for cross-border bank lending: the international bank-lending and international risk-taking channels. In the context of NIRP and monetary transmission through cross-border lending, these two mechanisms have potentially counteracting effects on the quantity of international lending following changes in monetary policy. Although our empirical framework cannot perfectly distinguish both of these channels, the sign of our estimates will highlight which, if any, channel plays a more important role. 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). In principle, this channel can in turn affect banks' domestic lending as well as their cross-border lending – it is not specific to their global operations. However, heterogeneity in banks' lending response can arise with respect to these global operations. For global banks more likely to lend internationally, internal funding can help to mitigate constraints and so insulate banks' from changes in monetary policy – as Cetorelli and Goldberg (2012a,b) show.

Notwithstanding the role of banks' global operations, NIRP may interact with the bank-lending channel too. 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' retail deposit rates may be bound below and so reductions in monetary policy rates may not feed through into lower funding costs for banks (e.g., Eggertsson et al., 2019). As a consequence, reductions in policy rates in negative territory may pass-through into bank lending to a lesser extent.[13] And, for banks more reliant on internal funding, the degree to which pass-through is muted may be even greater.

Overall, then, this channel lends itself to the following hypotheses. First, looser monetary policy should be associated with more bank lending – and vice versa for tighter policy. Second, the response of bank lending to changes in monetary policy should be more muted in periods of NIRP. Third, for global banks more reliant on internal funding, the responsiveness of their bank lending to monetary policy, both during and out of NIRP periods, should be more muted.

2.2. International Risk-Taking Channel

Alongside this, monetary policy can operate through a risk-taking channel on banks' balance sheets, as Dell'Ariccia et al. (2014) emphasize. In particular, reductions in policy rates can reduce banks' profit

[13] 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.

and net interest margins. Seeking to maximize 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, or if negative rates are accompanied by forward guidance to suggest that policy rates will remain lower for longer, 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 incentivize more risk-taking by banks than equivalent rate cuts in positive territory. In this case, then, looser monetary policy could increase risky lending by *even more* when NIRP is in place – working in the opposite direction to the bank-lending channel. Though, of course, there may again be heterogeneity across banks; for instance, for banks with securities investments, lower rates may themselves come with capital gains that offset these effects.

While these risk-taking effects are also not specific to a banks' global operations, there are good reasons to expect the global dimension of risk-taking to be an important dimension of bank heterogeneity here (e.g., Correa et al., 2022). Access to global markets offers a potentially broader spectrum of returns for banks, both across asset classes and geographically – some of which may well be riskier. Therefore, the extent to which NIRP amplifies the response of bank lending to looser monetary policy could be *even greater* for cross-border lending.

3. Lending from International Financial Centers

We first analyze monetary transmission through banks in IFCs, focusing on how changes in interest rates and spreads in banks' headquarters influence cross-border lending to the rest of the world from affiliates in IFCs ("onward transmission"). For example, we assess how changes in European Central Bank (ECB) monetary policy influence UK-resident French banks' cross-border lending.

3.1. Data

We use three bank-level balance-sheet datasets from the UK, Hong Kong and Ireland. The data are compiled by national central banks and banking supervisors where they are privately held and, therefore, we are restricted to using them independently to maintain confidentiality. They cover cross-border lending, disaggregated by recipient country, permitting a rich specification of fixed effects to

control for potential confounders in our regressions. Banks' nationalities are recorded according to the location of ultimate parent company (i.e., holding company) and not the nationality of its largest shareholder,[14] allowing us to use this information to identify banks facing NIRP in their headquarters.

Cross-border lending data is also disaggregated by type of the claim (e.g., loan or debt instrument), as well as by receiving sector (bank and non-bank sectors). In line with international data collection efforts under the umbrella of the BIS (Avdjiev et al., 2015), the level of disaggregation by receiving sectors was further expanded from 2014 onwards, allowing us to examine not only claims on all non-banks but, within this, claims on the corporate or NBFI sector.[15] We thus focus on both a sample starting in 2005Q1 (following Claessens et al., 2016) as well as a more recent sample starting in 2014Q1 or 2015Q1 with more disaggregated insights.[16] For our study, this latter sample has the further benefit of focusing on a period in which NIRP were implemented.

The datasets also include broader information on banks' balance sheets, which we use to construct control variables and to consider bank-level heterogeneity in policy transmission. From 2014Q1 onwards, this balance-sheet data also includes information on affiliates' intragroup-funding reliance.

The lending data for all three countries is volatile in its raw form. So, we 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 cleaning procedure for all three regions, albeit with some differences to account for dataset specificities. We only keep links where cross-border lending is at least £100mn in size (UK data).[17] To circumvent possible data errors and the effect of outliers, we drop growth rates outside the -100/500% range. We then winsorize the dependent variable so that growth rates are not greater than 100% in absolute value. Finally, we keep only bank-time-country combinations with at least 8 consecutive observations. Control variables in our regressions are winsorized at the 1% level. Summary statistics for the UK, Hong Kong and Ireland data are reported in Appendix A. We discuss features of the data for each region in turn.

[14] For example, a 'UK-owned' bank means that its ultimate parent is UK incorporated.
[15] For the case of Hong Kong, the disaggregation of non-bank sector into corporates and NBFI has only become available since 2015Q1.
[16] Data runs until 2019Q4 in the case of Hong Kong and Ireland, and 2019Q3 in the case of the UK.
[17] 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).

United Kingdom

The UK is the world's largest IFC for cross-border banking, with its external liabilities totalling over 250% of UK GDP (Beck et al., 2023). Our cleaned dataset, from the Bank of England's statistical reporting forms, features numerous foreign-affiliate branches and subsidiaries (154 foreign affiliates in total as of 2019Q3). At the end of 2019, cross-border lending (loans) to bank and non-bank sectors abroad accounted for more than 75% and 60% of the total cross-border volumes by all banks in the UK respectively. Importantly for this study, a significant number of affiliates (both branches and affiliates) are from countries which have implemented negative rates (with EA, Japanese, Swiss, Swedish and Danish affiliates all playing a significant role). These foreign affiliates undertake a range of different activities, in particular investment banking, trading and foreign lending.

Hong Kong

Like the UK, Hong Kong also hosts a large number of foreign banks. For 2019, our cleaned dataset contains 148 foreign banks operating in Hong Kong, of which 131 are branches. Foreign banks whose home countries have implemented NIRP (e.g., banks for the euro area and Japanese banks) are solely established as foreign bank branches in Hong Kong, not subsidiaries.[18] 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.

[18] Hills et al. (2019) document that the liability structure of Hong Kong foreign subsidiaries is very similar to that of other domestic banks in Hong Kong, which largely fund their business by local deposits. In contrast, the funding structure of foreign bank branches is relatively more diversified, with intragroup and deposit funding accounting for a similar share on average.

Ireland

Ireland is also an important IFC for cross-border banking, with numerous international investment banks operating within its International Financial Services Centre (IFSC). Our cleaned dataset for Ireland includes 58 foreign affiliate banks, whose external liabilities sum to 71% of Irish GDP. Again, these banks include those with headquarters in both euro-area and non-euro-area countries (e.g., the US, UK, Switzerland) and a range of those (both branches and subsidiaries) are from countries which have implemented negative rates at home (including other euro-area countries).

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. Unlike France, we treat Ireland as an IFC in our study, given the scale of cross-border lending from Ireland. However, 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. Consequently, we view Ireland as a 'pseudo control' group in our analysis of IFCs, and so discuss some of the Irish results separately.

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 (Link 1, Figure 2).

To answer the first half of this question, our dependent variable of interest $\Delta y_{b,j,t}$ captures the exchange-rate valuation-effect-adjusted log-change in the stock of cross-border lending of each bank b that resides in a given IFC, with a nationality hq, to different recipient countries j at a quarterly time frequency t. We exclude lending from the IFC back to the bank's headquarters (i.e., cases where $j = hq$); for the Irish case, we do this by excluding all lending from affiliates in Ireland to any euro-area economy. The regression specification is:[19]

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

[19] The exchange-rate adjustment of our dependent variable ensures that lending quantities are not affected by mechanical exchange-rate valuation effects that could – among other factors – arise from changes in monetary policy. Exchange-rate valuation-effect adjustments are carried out according to BIS norms for all datasets (BIS 2019, section 8).

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.[20] 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. For euro area countries, we use the same short-term interest rate, but different long-term rates; so, our specification does allow for some heterogeneity in the implicit stance of monetary within the region.

$\beta_{1,k}$ and $\beta_{2,k}$ reflect the average association between changes in banks' headquarter short-term interest rates and yield-curve spread, respectively, and cross-border lending by 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. These capture the overall dynamic effects over the course of a calendar year. Consistent with both the international bank-lending and risk-taking channels outlined in Section 2, we hypothesize 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.

Lagged bank-time controls are collected in $\boldsymbol{X}_{b,t-1}$. These include bank balance sheet characteristics and macroeconomic controls for the headquarter macroeconomy. In our baseline regression, we include controls for banks' capital ratio, liquid-asset share, core-deposit ratio,[21] and 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

[20] In a robustness exercise we check that the main results presented in Table 1 hold for including changes in the yield-curve spreads and short-term interest rates separately. Results are available on request.
[21] 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.

impaired by capital constraints.[22] 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 to account for all observed and unobserved bank-specific factors that are time or recipient-country invariant. The joint recipient-country and time fixed effects $f_{j,t}$ follow the method pioneered by Khwaja and Mian (2008) and control for variation in recipient countries that can vary over time, including bilateral exchange rates and, to some extent, changes in the demand for credit.[23] By capturing potentially endogenous macroeconomic and financial conditions, that are both observed and unobserved, the combination of bank-time controls and fixed effects ($f_{j,t}$, in particular) ensures that we identify changes in monetary policy through interest-rate and yield-curve-slope changes that are orthogonal to these factors.[24]

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:

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

[22] 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.

[23] A tighter identification of loan supply may be possible in richer cross-country datasets which also feature a sectoral or even firm-level dimensions.

[24] We conduct a robustness exercise that additionally controls for expectations about the outlook in headquarter countries, which may additionally be correlated with changes in headquarter monetary policy in Section 3.3.

where $\mathbf{1}_{b,t-k}^{hq}$ is an indicator that is 1 in periods where the policy interest rate in bank b's headquarters (hq) is negative, and 0 otherwise. Unlike the short-term interest rate variable $\Delta r_{b,t-k}^{hq}$, which we define using market interest rates 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 rates.

The interaction terms, $\left(\Delta r_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$ and $\left(\Delta Spr_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$, show how NIRP influences the transmission of short-term rate and spread changes, respectively. The associated coefficients, $\delta_{1,k}$ and $\delta_{2,k}$, 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 transmission through IFC affiliates' cross-border lending.

The channels we outline in Section 2 do not have a one-for-one mapping with the short-term interest rate and yield-curve spread interactions, so we analyze these collectively. To the extent that NIRP impairs the bank-lending channel, the cumulated interaction coefficients will 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 spreads will 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 generates risk-taking through banks' profitability, then 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 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 Center Results

This section presents results for the cross-border lending of foreign affiliates located in IFCs. As cross-border lending can be disaggregated into non-bank and bank sectors, we study them separately to gain a more comprehensive view on the effects of NIRP on the onward transmission of monetary policy. In what follows, we first discuss the results for loans to the non-bank sector. Next, we consider the importance of internal capital markets and the funding structure of IFC affiliates more generally for the transmission channel. For the latter, we exploit cross-sectional heterogeneity at the IFC affiliate-level.

Finally, we examine the effects on cross-border flows vis-à-vis banking sectors as well as domestic lending in IFCs (i.e., inward transmission).

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

(i) Baseline results

Table 1 presents results for IFC affiliates' cross-border lending to the non-bank sector for the full 2005Q1-2019Q4 sample. As mentioned, since our focus is on the onward transmission of headquarter-country monetary policy via IFC affiliates' cross-border lending, we exclude banks' bilateral lending back to their headquarters, as any changes in headquarter monetary policy may directly affect banks' lending to the borrowers at home.[25,26]

Columns (1)-(3) present results for equation (1) for UK, Ireland and Hong Kong, respectively. The cumulated coefficients ($\sum_{k=1}^{K}\hat{\beta}_{1,k}$ 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 2005-2019 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 rates and 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)), where a 1pp cut in short rates leads to a 2.74pp increase in lending growth. The seemingly weak average transmission effects may be because equation (1) has not explicitly accounted for potential differences in the monetary transmission between positive and negative rates periods, which in turn may mask the average effect on a net basis.

To address this, we estimate equation (2) to assess how NIRP influences the cross-border transmission of short-term rates and 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

[25] Results are qualitatively similar when lending to the home country is included. For details, see appendix tables A1-a to A1-c, respectively.

[26] For EA banks, we treat lending to the EA 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.

the standalone changes in short-term interest rates ($\sum_{k=1}^{K}\hat{\beta}_{1,k}$) turn statistically significant and peak at a three-quarter horizon, indicating that 1pp short-rate cut in headquarter countries is associated with a 4.45pp increase in cross-border lending growth by IFC affiliates (column (4)). Inspecting the interaction coefficients indicates that this channel appears to be more than offset when headquarter policy rates turn negative (so that a 1pp cut in short rates is associated with a 22pp decline in lending growth), as indicated by the positive and significant coefficient on the associated interaction term between short-term interest rate changes and the negative rate dummy ($\sum_{k=1}^{K}\hat{\delta}_{1,k}$ = 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, suggesting that affiliates in Hong Kong (vs. those in the UK) respond somewhat differently to short- and long-term interest rates. For Ireland, a pseudo-control in our study owing to its euro-area affiliation, effects are statistically insignificant, although interaction terms with changes in short rates are predominantly positive.

Overall, this provides some evidence suggesting that the onward transmission of monetary policy via (UK and Hong Kong) IFC affiliates' cross-border lending to non-bank sectors changes when headquarter policy rates are negative, and that an impaired bank-lending channel appears to dominate the risk-taking channel.

(ii) Sectoral breakdown by lending to corporates and NBFIs

Data disaggregation allows us to further examine whether the effect of NIRP could vary across different types of non-bank borrowers (i.e., corporates vs. NBFIs), which is relevant for policymakers with regards to the change in credit supply condition for different types of borrowers. We focus on loans to non-bank sectors to abstract from other activities (e.g., foreign-exchange 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 2. For ease of presentation, we consistently report our results cumulated over 4 quarters, while showing in square brackets 3-quarter results where necessary if there is evidence of impairment at this horizon. The complete results are presented in the Appendix.

Columns (1)-(3) present estimates of the interaction regression (2) for all cross-border lending to non-banks using the shorter 2014-2019 sample. This sample more closely brackets the periods in which NIRP were enacted, relying more on differences across NIRP-headquartered and non-NIRP-headquartered banks. Despite this, the findings echo those from the 2005-2019 in Table 2. For the UK (via short rates) and Hong Kong (via spreads), we find some evidence of an impaired international bank lending channel. For UK affiliates, a 1pp cut in short-term policy rates in a headquarters within positive territory is associated with a 7.44pp increase in cross-border non-bank lending growth from the UK over three quarters; in contrast, a 1pp policy-rate cut in negative territory is associated with an 18pp decrease in the same quantity. As in Table 1, we do not find evidence of any significant change in transmission through cross-border lending for Irish affiliates.

Our results for loans to corporates (columns (4)-(6)) sharpen the earlier findings for impairment of monetary policy transmission via the UK and Hong Kong during NIRP for the aggregate non-bank sector. The evidence is more mixed for lending to the NBFI sector (columns (7)-(9)).

For the UK, the impairment effect on lending to non-bank sector under the NIRP is largely driven by lending to corporates (column (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 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 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)).[27] For Ireland, we find evidence of impaired bank-lending

[27] 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, 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.

channel working through changes in short-term interest rates for both lending to corporates and NBFIs during negative rate periods (columns (5) and (8)).

To support these conclusions, we also conduct a robustness exercise where we additionally control for headquarter-country expectations about the economic outlook. We wish to control for these expectations to account for the fact that headquarter monetary policy might be set as a function of the outlook (Romer and Romer, 2004). This amounts to a Taylor-Rule-type approach, where we orthogonalize changes in policy with respect to GDP and inflation projections, which we source from the OECD's Economic Outlook (Lloyd and Manuel, 2024). Table A11 shows that our key results remain robust.[28]

(iii) Transmission to the intragroup funding of IFC affiliates

So far, the baseline results suggest that impaired bank lending channel for UK and Hong Kong affiliates tends to play a more dominant role in determining the monetary policy transmission when headquarter policy rates turn negative. As mentioned in Section 2.1, the impairment in the bank-lending channel can stem from the limited pass-through of policy rate reductions to the funding costs of headquarter banks, which may affect the lending sensitivity of IFC affiliates via internal capital markets. Given the importance of intragroup funding for IFC affiliates, in particular from headquarters, NIRP-induced changes in outward transmission could have non-negligible effects on IFC affiliates' balance sheets, triggering a change in the international bank lending channel. To better understand the transmission mechanism involved in the impaired bank lending channel, it is useful to investigate the potential transmission of home-country monetary policy from the banks' headquarter offices to the intragroup funding of their IFC affiliates under the NIRP – link (2) in Figure 2.

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 exclude the recipient country-time-fixed effect from the regression. The results are

[28] The country coverage for a consistent dataset of macroeconomic forecasts is limited, which affects the estimation sample in our robustness exercise. This impacted the HKMA sample most significantly as data coverage for China, India & Indonesia was discontinued whose affiliates engage in cross-border lending to corporates. Despite these data limitations, evidence for the key messages remain robust. Results using the reduced estimation sample and excluding the Taylor-Rule controls are very similar and are available upon request.

shown in columns (1) to (3) of Table 3. It is worth noting that the intragroup funding from headquarter offices cannot be separated out for the case of Ireland due to data limitations. Therefore, the Irish results, where we do not find evidence of impairment anyway, may not be directly comparable to the UK's and Hong Kong's results.

The Hong Kong and UK, albeit less significantly, results both indicate that there is some 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 in Hong Kong tend to experience a 19.1pp rise in three-quarter intragroup funding growth from headquarters in response to a 1pp loosening in the home-country monetary policy stance. However, this channel is found to be impaired during the NIRP periods, with a 1pp cut in headquarter policy associated with a 27pp decline in intragroup lending to Hong Kong affiliates, indicated by the positive and significant coefficient on the interaction term $\left(\Delta r_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq}\right)$. For the UK, the evidence of transmission and impairment is weaker, although the interaction term is still positive and significant at some horizons. Consistent with Tables 1-3, Irish results (our pseudo control) are insignificant.

For Hong Kong and the UK, the results suggest some weaker sensitivity of intragroup funding provided by headquarter office to changes in home-country monetary policy stance under the NIRP. So, as the 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 Tables 1 and 2, 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. [29]

3.3.2. Exploring heterogeneities across banks

In this section, we exploit heterogeneity across IFC affiliates to further test the mechanism leading to this impairment. In particular, we explore the extent to which the transmission mechanism varies with respect to observable bank characteristics. We focus on whether the reliance on local deposits of IFC affiliates could increase or decrease their exposure to negative rates in their headquarters in order to

[29] Results for intragroup funding from all sources (i.e., including not only the headquarter but affiliates based in other jurisdictions) are qualitatively similar and available on request.

complement the direct evidence on the relevance of the intragroup funding channel from affiliates home countries presented in the previous section.

Our main hypothesis is that 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),[30] so that the funding costs of these local deposits are not affected by the negative policy rate in the headquarters of the IFC affiliates. IFC affiliates in Ireland are an exception, as their local deposits will largely be subject to euro-area NIRP. Irish-resident banks therefore act as a pseudo-control group: insignificant results would be consistent with the workings of this mechanism.

To test the above, we employ three empirical specifications for cross-border lending to non-banks of IFC affiliates. First, we estimate the same interaction regression model as before, 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' deposit reliance, banks are classified into those that heavily rely on local deposits if their average share of local deposit 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 local deposit funding.

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:

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

[30] 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.

$$+\sum_{k=1}^{K}\left[\mu_{1,k}\Delta r_{b,t-k}^{hq}+\mu_{2,k}\Delta Spr_{b,t-k}^{hq}\right]*High\_BSF_b$$

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

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

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

where $High\_BSF_b$ denotes a dummy variable that takes the value unity if the average value of the local deposit share of IFC affiliates 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 lower reliance on local deposit funding to be more exposed to NIRP than their peers with higher local deposit funding reliance. We therefore expect the corresponding coefficients on the triple interaction term are expected to be negative (i.e., $\sum_{k=1}^{K}\theta_{1,k}<0$ and $\sum_{k=1}^{K}\theta_{2,k}<0$)..

In addition to this specification, we also consider a third approach by replacing the dummy variables with the time-varying continuous variables of IFC affiliates' local deposit funding share respectively (i.e., $BSF_{b,t-K-1}$) for the triple interaction specification as a robustness check.[31] Specifically, the factor 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 $\sum_{k=1}^{K}\theta_{2,k}<0$.

Table 4 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.[32] Specifically, columns (1) to (6) present the split regression results for the three

[31] This specification also allows for a further robustness check for the case of the UK and Hong Kong, namely, the inclusion of interaction terms of local monetary policy changes (rates and spreads) with the respective measure of bank heterogeneity. The results below are robust to the inclusion of these terms, which are themselves not significant, and available on request.

[32] The corresponding regression results for IFC-affiliates' cross-border lending to corporates are qualitatively similar to those for lending to non-banks. The results are available upon request.

IFCs, while columns (7) to (12) show the two triple-interaction 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.

Overall, we find 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 4). 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)).

As discussed previously, 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. 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.[33]

Taking these findings together, there is evidence to suggest the extent of onward transmission of monetary policy under the NIRP via IFC affiliates' cross-border lending to non-bank sectors does vary across banks. Although there is some heterogeneity, largely in line with the hypothesis of impaired international bank-lending channel, IFC affiliates reliance on local deposit funding appears to be an

[33] 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 A1 and A3), thus making them relatively more shielded from the impact of NIRP.

important factor in determining the extent of impairment in the bank-lending channel when their headquarter policy rate turns negative.

In the Appendix Table A7, we offer complementary analysis which consider heterogeneity with respect to IFC-affiliates' intragroup funding shares complementing the more direct evidence we provided in Section 3.3.1 (iii). Consistent with the direct evidence, 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 may to amplify the impairment in the bank-lending channel. However, we acknowledge that affiliates with higher or lower shares of intragroup reliance will also differ in many other aspects which are hard to control for reducing the conclusions we can draw from this exercise vs. the more direct evidence above. The results are somewhat mixed. 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 via yield spreads as compared to their counterparts under the NIRP. This is evidenced by the positive and statistically significant coefficients on $\left(\Delta Spr_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq} \times High\_BSF_b\right)$ in the triple interaction regression for the UK though not for Hong Kong or Ireland (i.e., columns (8, 10 and 12) vs column (11)), and also in the split regression results to some extent for all three IFCs. However, for the transmission of changes in short rates we obtain contradictory evidence for the UK and Ireland in the split regression approach with larger impairment effects for IFC affiliates located in the UK and Ireland with lower intragroup funding reliance (columns (1) and (3)).

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 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 and domestic lending 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 sub-section, we investigate the effect of NIRP on IFC banks' cross-border interbank loans as well as intragroup banking flows.

Table 5 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.[34]

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 (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 UK and Hong Kong of a significant change in the transmission when headquarter policy rates become negative.[35] 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 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 sectors) seem to be driven largely by lending to unaffiliated banks abroad. For Ireland, there is some evidence

[34] Due to data limitations, 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.
[35] 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.

of 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 limitations, Ireland's result may not be directly comparable with the UK's and Hong Kong's results.

On balance, our results in Table 5 suggest that the onward 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.

The possible reasons for why cross-border lending to non-banks is more impaired during NIRP periods is subject to future research. We conjecture that one possible factor might potentially be the strength of the international risk-taking channel for banks which Correa et al. (2022) establish for the case of lending to non-banks specifically.

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

While there is evidence to support an onward 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 affiliates' domestic lending.[36] 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 sub-section 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 re-estimate regression (2) by replacing the dependent variable with IFC affiliates' domestic lending. We consider lending to domestic non-banks

[36] 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.

– split further into non-financial corporates and NBFIs – and domestic banks. 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 6.[37]

Overall, there is 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 (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 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.[38]

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

[37] As there is no breakdown of domestic lending to NBFIs in Hong Kong, the corresponding result for the case of Hong Kong is not available.
[38] 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.

bank-lending channel during negative interest rate periods in the case of UK, as indicated by the positive and statistically significant coefficient on $(\Delta \text{Spr}_{b,t-k}^{hq} \times \mathbf{1}_{b,t-k}^{hq})$. However, these results are statistically insignificant in the case of Ireland and Hong Kong, respectively (columns (11) and (12)).

Overall, these results 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, similar to the results found in the cross-border lending, the bank-lending channel is also found to be impaired during NIRP.

4. Cross-Border Lending from Banks' Headquarters

To investigate to what extent the findings from Section 3 are reflected at the euro-area level, we now complement the analysis by assessing the transmission of headquarter-country monetary policy through banks' cross-border lending from their headquarters ("outward transmission"). 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 from the perspective of the headquarter. The French data provide a valuable perspective for exploring transmission *to* IFCs, given the scale of cross-border lending from France to IFCs. We summarize our euro-area and French data in Appendix B.

4.1. 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 close to Section 3. The dependent variable is also $\Delta y_{b,j,t}$ the exchange-rate valuation-effect-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. $\Delta r_{b,t-k}^{EA}$ denotes the change in the short-term interest rate at $t-k$ and $\Delta Spr_{b,t-k}^{EA}$ is the change in the yield curve spread. $\mathbf{1}_{b,t-k}^{EA}$ denotes an indicator that takes value 1 when the ECB policy interest rate is negative. The main difference with the specifications in Section 3 is that rates, spreads, and NIRP dummies are now the same for all banks and recipient-country.

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

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

The interpretation of the coefficients of interest also follows Section 3. In particular, our interest lies in the coefficients associated to interactions, $\delta_{1,k}$ and $\delta_{2,k}$, which indicate how 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 outward transmission.

4.2. Results for the euro area and France

We first analyze the aggregate cross-border lending by euro-area banks using data on 288 bank entities as described in Appendix B. We begin the analysis with the aggregate euro-area banks to first gauge the effect of NIRP for the EA as a whole, before moving to granular examples such as the French banks. Table 7 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 prior to NIRP.[39] This is indicative that cross-border lending was not driven by euro-area monetary policy.[40] We conclude that evidence for impairment of the international bank-lending channel is mixed at 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.

We then extend the analysis to the position of headquarters located in a NIRP economy with more granular data. Results of regression (4) for cross-border lending for French banks from France are shown in Table 8. 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.[41] 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)). Due to Ireland belonging to the euro area, this country is excluded from our sample of IFCs – which therefore is limited to the UK and Hong Kong to maximize consistency with Section 3.[42]

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

[39] 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.

[40] 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 show a similar pattern.

41 Results for the full sample of counterparts (financial and non-financial together) is shown in column (2) of Table 7. They are broadly in line with results for EA as a whole, finding no strong evidence of an international bank-lending channel towards the rest of the world prior to NIRP. The advantage of focusing of French data in this section is the higher granularity of the data, allowing to show that the NIPR transmission through IFC occurs via lending to the financial sector.

[42] Results are robust to adding other extra-euro area countries that can be identified as IFCs, such as the US and Switzerland. This is shown in Table A10 in Appendix. Results towards individual IFC are not reported due to the limited number of observations available when singling out specific country.

rate and spreads interacted with the NIRP dummy are positive and significant.[43] These results from France towards IFC affiliates also appear to indicate that the impairment of the international bank-lending channel occurs 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 8 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 IFCs 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. (2021b) 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 8 showing a more significant reaction for cross-border financial lending towards IFCs, 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 IFCs, and suggest an impairment of this mechanism under the NIRP.

Overall, results for French banks – taking the perspective of banks' headquarters – confirm the evidence found in Section 3 that monetary policy in the headquarters' country implies an international bank-lending channel. It complements these findings by showing that the impairment occurs only via lending to financial counterparts, consistent with the intragroup lending results for affiliates in the UK and Hong Kong.

[43] 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.

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. For the UK and Hong Kong, two major IFCs, e find 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 influences lending to financial sectors in financial centres, but there is no evidence of impairment for lending to non-bank borrowers.

Together, our results have important implications. To start with, the fact we find evidence of impairment in the international bank-lending channel through some IFCs suggests that the cross-border spillovers – through international lending – of monetary policy can be less severe when headquarter countries enact NIRP. Our dataset does not span the latest period in which countries have left NIRP regimes. But, if historical relationship is any guide, the results suggest that, going forward, the cross-border spillovers of monetary-policy tightening could be associated with larger reductions in cross-border non-bank lending from IFCs than we have seen in the past decade. Future work could usefully shed light on whether this is indeed the case and also use more detailed data to uncover the strength of the risk-taking channel. More generally, our results indicate that IFCs play an important role in intermediating funds across borders for non-financial firms. Relatedly, 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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Table 1: Onward 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, HK or 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. Tables A4 report the full set of results.

Table 2: Onward 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-1 to t-4	-0.0325 [-0.0744* Q3]	-0.00525	-0.0421*	-0.110** [-0.122*** Q3]	-0.0198*	-0.0733**	-0.0309 [-0.110 Q3]	-0.0609***	0.0457
	0.453 [0.0603 Q3]	0.629	0.0786	0.0189 [0.00403 Q3]	0.0685	0.0403	0.764 [0.223 Q3]	2.78E-08	0.705
ΣΔr (home)_t-1 to t-4 * Negative	0.168 [0.255** Q3]	0.0054	0.0277	0.380*** [0.470*** Q3]	0.0182*	0.165	-0.0639 [0.0122 Q3]	0.0541***	0.407
	0.182 [0.0267 Q3]	0.595	0.481	0.00297 [0.0000 Q3]	0.0816	0.289	0.778 [0.954 Q3]	6.170E-07	0.333
ΣΔSpr (home)_t-1 to t-4	-0.0447 [-0.0784** Q3]	0.0631	-0.0308	-0.00107 [-0.0607*** Q1]	-0.0102	-0.0846*	-0.113 [-0.155 Q3]	0.236***	0.15
	0.278 [0.0334]	0.298	0.367	0.982 [0.00745 Q1]	0.854	0.0644	0.313 [0.110 Q3]	5.53E-07	0.188
ΣΔSpr (home)_t-1 to t-4 * Negative	0.0476 [0.0929** Q3]	-0.0696	0.148**	-0.0464 [0.0673** Q1]	0.0558	0.11*	0.137 [0.0769 Q3]	-0.0288	0.294
	0.351 [0.0380 Q3]	0.21	0.014	0.411 [0.0215 Q1]	0.297	0.0978	0.199 [0.428 Q3]	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. We report four-quarter cumulative effects. Q3 indicates t-1 to t-3 cumulative effects and Q1 indicates t-1 results on impact. Tables A5 report the full set of results. 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 3: Direct transmission of home-country monetary policy to banks resident in the IFCs via intragroup funding channel

	(1)	(2)	(3)
Dependent variable:	Intragroup funding from home country		
	UK	IE^	HK
ΣΔr (home)_t-1 to t-4	-0.0888 [-0.0566 Q1] 0.330	-0.00115	-0.0389 [-0.191** Q3] 0.714
	[0.293 Q1]	0.928	[0.0309]
ΣΔr (home)_t-1 to t-4 * Negative	0.128 [0.283* Q1] 0.653	0.000158	0.315 [0.465* Q3] 0.326
	[0.0772 Q1]	0.99	[0.0888]
ΣΔSpr (home)_t-1 to t-4	-0.104	0.00347	0.203
	0.234	0.278	0.153
ΣΔSpr (home)_t-1 to t-4 * Negative	0.0666	0.075	-0.266
	0.493	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. We report four-quarter cumulative effects. Q3 indicates t-1 to t-3 cumulative effects and Q1 indicates t-1 results on impact. Tables A6 report the full set of results.. 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 (column 2). Intragroup funding here is from all countries instead.

Table 4: Exploring how bank heterogeneity in local deposit share affects 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-1 to t-4	-0.0282 [-0.0360* Q3]	-0.112** [-0.128*** Q3]	-0.0551	0.0163	-0.0407**	0.0654	* Deposit Share	-0.0385	-0.114	0.0305	0.0266	0.00159	-0.0491
	0.251 [0.0983 Q3]	0.0310 [0.00242 Q3]	0.222	0.624	0.0187	0.455		0.273	0.218	0.2	0.268	0.972	0.613
ΣΔr (home)_t-1 to t-4 * Negative	0.243* [0.312** Q3]	0.0256 [0.0133 Q3]	0.0658	0.0194*	-0.13	-0.056	* Deposit Share	0.365	0.753	-0.0217	-0.0175	0.333	1.592
	0.0781 [0.0152 Q3]	0.962 [0.976 Q3]	0.15	0.0659	0.55	0.854		0.335	0.481	0.386	0.49	0.211	0.143
ΣΔSpr (home)_t-1 to t-4	-0.0188 [-0.0256 Q3]	-0.0356 [-0.0623* Q3]	0.0226***	-0.0034	-0.0431**	0.0292	* Deposit Share	0.0173	0.121	-0.0062	-0.00741	0.0226	-0.0336
	0.466 [0.267 Q3]	0.417 [0.0871]	0.00472	0.569	0.037	0.748		0.570	0.143	0.326	0.228	0.67	0.776
ΣΔSpr (home)_t-1 to t-4 * Negative	0.0502 [0.0838* Q3]	0.0902 [0.132 Q3]	-0.581***	-0.177	0.187***	-0.0884	* Deposit Share	0.00241	0.258	0.136** [Q3]	0.11* [Q3]	-0.202*	-0.188
	0.355 [0.0762 Q3]	0.398 [0.146 Q3]	0.000048	0.379	0.00458	0.57		0.967	0.264	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. We report four-quarter cumulative effects. Q3 indicates t-1 to t-3 cumulative effects and Q1 indicates t-1 results on impact. 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 (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 5: Onward transmission of home-country monetary policy on cross-border lending to banks via IFCs under negative rate periods

Exclude lending to home countries	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	All interbank loans			of which: intragroup loans		
	UK	IE	HK	UK	IE	HK
ΣΔr (home)_ t-1 to t-4	-0.0317 [-0.0601* Q3]	0.0412**	-0.0835***	0.0848	-0.0271*	-0.0163
	0.384 [0.0702 Q3]	0.0223	0.00185	0.483	0.0763	0.812
ΣΔr (home)_ t-1 to t-4 * Negative	0.0657 [0.0902 Q3]	-0.0287*	0.146	-0.0533	0.0273*	0.351
	0.760 [0.644 Q3]	0.0992	0.659	0.863	0.0739	0.357
ΣΔSpr (home)_ t-1 to t-4	-0.0503 [-0.0558 Q3]	0.00393	-0.0919*** Q4 [-0.0216 Q1]	0.0973	0.00481*	0.0238
	0.223 [0.114 Q3]	0.2	0.00178 [0.147 Q1]	0.373	0.0728	0.778
ΣΔSpr (home)_ t-1 to t-4 * Negative	-0.0455 [-0.0633 Q3]	-0.0693	0.13 [0.132*** Q1]	-0.151	0.0758	-0.0377
	0.631 [0.434 Q3]	0.241	0.172 [0.00915]	0.310	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. We report four-quarter cumulative effects. Q3 indicates t-1 to t-3 cumulative effects and Q1 indicates t-1 results on impact. Tables A6 report the full set of results 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 (column 5).

Table 6: 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-1 to t-4	-0.0218	-4.996*	-0.0747**	-0.0352**	-1.766*	-0.0814**	-0.0157	25.09***		0.0324	1.114	-0.0525
	0.102	0.0832	0.0279	0.0159	0.0937	0.0207	0.476	0.000		0.149	0.21	0.438
ΣΔr (home)_t-1 to t-4 * Negative	0.309**	3.125***	0.433**	0.664**	1.832***	0.462**	-0.288	-23.62***		0.598	-0.819	0.496
	0.0352	0.00911	0.0248	0.0214	0.000324	0.0452	0.246	0.000		0.199	0.338	0.32
ΣΔSpr (home)_t-1 to t-4	-0.00154	-0.951	-0.0784**	-0.0262**	-0.782	-0.0677*	0.0109	0.189		0.0135	-0.109	-0.0561
	0.904	0.378	0.0231	0.0494	0.415	0.0539	0.579	0.305		0.584	0.899	0.467
ΣΔSpr (home)_t-1 to t-4 * Negative	0.0396	10.36	0.0368	0.137	9.262	-0.083	-0.0854	11.69***		0.228**	11.27	-0.0993
	0.473	0.357	0.715	0.115	0.318	0.467	0.373	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. We report four-quarter cumulative effects. 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 7: 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 8: 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.*

Online Appendix

A. Tables

Table A1: 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

Notes: Number of banks: 154. Time period: 2005Q1 to 2019Q4.

Table A2: 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

Notes: Number of banks: 58. Time period: 2005Q1 to 2019Q4.

Table A3: 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

Notes: Number of foreign affiliate banks: 131. Time period: 2005Q1 to 2019Q4.

Table A4 - 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 A4 - 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 A4 - c: HK 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		-0.00973	-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 A5 - 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 A5- 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 A5- 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 A6 - 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	-0.00443	-0.0566	-0.0908*
	0.717	0.958	0.138	0.284	0.914	0.293	0.0661
ΣΔr (home)_t-1 to t-2	-0.0267	-0.0269	0.0409	-0.00753	-0.0295	-0.0420	0.0225
	0.307	0.315	0.654	0.937	0.584	0.545	0.668
ΣΔr (home)_t-1 to t-3	-0.0608*	-0.0601*	0.0993	0.0662	-0.0570	-0.100	-0.0970
	0.0593	0.0702	0.362	0.558	0.395	0.235	0.173
ΣΔr (home)_t-1 to t-4	-0.0344	-0.0317	0.108	0.0848	-0.0600	-0.0888	-0.0154
	0.328	0.384	0.358	0.483	0.426	0.330	0.839
ΣΔSpr (home)_t-1	-0.0186	-0.0215	0.0443	0.0205	-0.0170	-0.0678	-0.0300
	0.398	0.341	0.377	0.687	0.432	0.240	0.527
ΣΔSpr (home)_t-1 to t-2	-0.0338	-0.0311	0.0231	-0.000641	-0.00361	-0.00618	0.0440
	0.215	0.269	0.768	0.994	0.885	0.926	0.401
ΣΔSpr (home)_t-1 to t-3	-0.0602*	-0.0558	0.0791	0.0653	-0.0474	-0.0962	-0.0625
	0.0750	0.114	0.395	0.505	0.109	0.212	0.377
ΣΔSpr (home)_t-1 to t-4	-0.0542	-0.0503	0.113	0.0973	-0.0541	-0.104	-0.0264
	0.167	0.223	0.275	0.373	0.125	0.234	0.748
ΣΔr (home)_t-1 * Negative		0.0970		-0.0212		0.283*	0.360***
		0.362		0.900		0.0772	0.00723
ΣΔr (home)_t-1 to t-2 * Negative		0.0181		0.00825		0.139	0.239
		0.903		0.971		0.535	0.143
ΣΔr (home)_t-1 to t-3 * Negative		0.0902		-0.0908		0.146	0.413
		0.644		0.754		0.574	0.102
ΣΔr (home)_t-1 to t-4 * Negative		0.0657		-0.0533		0.128	0.270
		0.760		0.863		0.653	0.256
ΣΔSpr (home)_t-1 * Negative		0.00221		0.0317		0.0718	0.0756
		0.965		0.700		0.232	0.196
ΣΔSpr (home)_t-1 to t-2 * Negative		-0.0451		-0.0259		-0.00428	-0.0837
		0.459		0.791		0.951	0.131
ΣΔSpr (home)_t-1 to t-3 * Negative		-0.0633		-0.127		0.0681	-0.0286
		0.434		0.331		0.423	0.718
ΣΔSpr (home)_t-1 to t-4 * Negative		-0.0455		-0.151		0.0666	-0.107
		0.631		0.310		0.493	0.274
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	1,838	1,838	7,223
R-squared	0.1166	0.1169	0.1715	0.1731	0.0612	0.0674	0.1373
Adjusted R-squared	0.00889	0.00873	0.00182	0.00103	0.000242	-0.000150	0.000129
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 A6 - 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 A6 - 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 A7: Exploring how bank heterogeneity in intragroup funding reliance affects 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-1 to t-4	-0.0335						* Intragroup Share		-0.0792				
	[-0.0487** Q3]	-0.0827	-0.125***	-0.000822	-0.0592***	-0.0168		0.00280	[-0.153** Q3]	0.0443*	0.0856***	0.0163	0.0874
	0.194								0.320				
	[0.0398 Q3]	0.529	0.00645	0.965	0.00696	0.608		0.941	[0.0313 Q3]	0.063	0.00148	0.588	0.112
ΣΔr (home)_t-1 to t-4 * Negative	0.243 *						* Intragroup Share		-0.0702				
	[0.282** Q3]	-0.382	0.122**	-0.0211	-0.229	-0.323		-0.143	[-0.0712 Q3]	-0.0377	-0.0809***	0.22	0.26
	0.0779								0.861				
	[0.0281 Q3]	0.677	0.0106	0.146	0.209	0.547		0.674	[0.842 Q3]	0.133	0.00428	0.528	0.719
ΣΔSpr (home)_t-1 to t-4	-0.0144						* Intragroup Share		-0.0397				
	[-0.0303 Q3]	-0.0441	-0.00339	-0.0174***	-0.0729***	-0.0317		0.0350	[-0.0921* Q3]	-0.0111***	-0.00903	0.0183	0.113*
	0.616								0.507				
	[0.227 Q3]	0.267	0.766	0	0.00877	0.367		0.352	[0.0995 Q3]	0.00115	0.172	0.594	0.0751
ΣΔSpr (home)_t-1 to t-4 * Negative	0.0224						* Intragroup Share		0.149				
	[0.0321 Q3]	0.226**	-0.284**	0.282*	0.0844	0.219**		-0.0322	[0.281** Q3]	0.0546	0.0899	-0.0102	-0.111
	0.721								0.257				
	[0.563 Q3]	0.0155	0.0106	0.0769	0.33	0.0167		0.693	[0.0238 Q3]	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. We report four-quarter cumulative effects. Q3 indicates t-1 to t-3 cumulative effects and Q1 indicates t-1 results on impact. 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 (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 A8: 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 A9: 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 A10: 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.*

Table A11: Onward 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: Robustness exercise controlling for one-year ahead GDP and inflation forecasts.

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	-0.0843 [-0.132** Q3]	-0.006	-0.0404	-0.175** [-0.19*** Q3]	-0.027**	-0.136	-0.118 [-0.26** Q3]	-0.058***	-0.524*
	0.214 [0.0214 Q3]	0.607	0.683	0.0353 [0.00877 Q3]	0.011	0.215	0.417 [0.037 Q3]	4.00e-08	0.0626
ΣΔr (home)_t-k * Negative	0.208 [0.293** Q3]	0.075 [0.102* Q2]	-0.0715	0.42*** [0.526*** Q3]	0.025**	0.143	-0.0142 [0.133 Q3]	0.234***	1.367*
	0.123 [0.0152 Q3]	0.218 [0.081 Q2]	0.709	2.36E-03 [1.58E-05 Q3]	0.017	0.513	0.954 [0.563 Q3]	1.10E-06	0.0908
ΣΔSpr (home)_t-k	-0.0502 [-0.0897** Q3]	0.006	-0.144	-0.024 [-0.0635* Q1]	0.001	-0.264**	-0.174 [-0.0635* Q3]	0.052***	0.00883
	0.305 [0.0449 Q3]	0.576	0.119	0.681 [0.0687 Q1]	0.988	0.019	0.154 [0.0687 Q3]	8.11e-07	0.982
ΣΔSpr (home)_t-k * Negative	0.0381 [0.0881* Q3]	-0.078	0.19**	-0.0431 [0.0696** Q1]	0.059	0.21*	0.093 [0.0418 Q3]	-0.032	0.284
	0.496 [0.072 Q3]	0.159	0.0487	0.494 [0.0412 Q1]	0.253	0.0572	0.411 [0.678 Q3]	0.524	0.493
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	15,971	4,070	6,007	11,434	4,070	5,335	9,013	4,070	869
R-squared	0.118	0.3554	0.1673	0.144	0.5053	0.1863	0.1392	0.3462	0.4452
Adjusted R-squared	0.0194	0.219	0.0449	0.0265	0.401	0.0572	0.0139	0.208	0.216
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. We report four-quarter cumulative effects. Q3 indicates t-1 to t-3 cumulative effects and Q1 indicates t-1 results on impact. 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. Additional controls are one year-ahead forecasts for GDP and inflation from the OECD's economic outlook. The inflation measure is CPI inflation when available; otherwise, the consumption or GDP deflator are used in this order. Standard errors are clustered by bank-time. P-values below coefficient estimates indicate the level of significance.

B. 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.

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,[44] 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.[45] 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 B1 summarizes the descriptive statistics of the main variables.

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 winsorize 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 winsorized at the 1% level. Table B2 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.[46] To avoid potential simultaneity

[44] Given the other variables used for the analysis are quarterly, we take end-of-quarter data of IBSI data for each individual bank.
[45] Based on national account statistics (MNA) from the ECB Statistical Data Warehouse (SDW).
[46] 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).

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 $t-5$).

Table B1: 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 B2: 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