

Brown, Martin

Article

Negative Interest Rates and Bank Lending

CESifo Forum

Provided in Cooperation with:

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Brown, Martin (2020) : Negative Interest Rates and Bank Lending, CESifo Forum, ISSN 2190-717X, Ifo Institut – Leibniz-Institut für Wirtschaftsforschung an der Universität München, München, Vol. 21, Iss. 01, pp. 18-23

This Version is available at:

<https://hdl.handle.net/10419/216257>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Martin Brown

Negative Interest Rates and Bank Lending



Martin Brown
University of
St. Gallen

Since 2014 four monetary authorities in Europe have set their nominal reference rates below zero. As an instrument of unconventional monetary policy, negative interest rates should increase aggregate demand by increasing credit supply. The transmission of negative rates to real economic activity thus depends crucially on their impact on intermediation activity in the banking sector. How banks adapt their asset structure and liability structure also determines how negative interest rates impact on financial stability. Recent empirical evidence suggests that exposure to negative interest rates leads to an acceleration of bank lending. However, this is accompanied by an increase of risk taking in the banking sector.

NEGATIVE RATES AS AN UNCONVENTIONAL POLICY TOOL IN EUROPE

Under conventional policy, monetary authorities such as the European Central Bank (ECB) influence the conditions for credit activity, and thus aggregate demand, by steering the money market rate. Conventional monetary policy tools involve setting both an upper bound and a lower bound for interest rates in the money market: central banks set the interest rate at which banks can borrow reserves as well as the rate at which banks can deposit reserves. No-arbitrage conditions dictate that the money market rate must lie between this upper and lower boundary. Open market operations (e.g., repurchase agreements) allow the central bank to fine-tune the level of the money market rate between these goalposts.

In June 2014, the ECB set its interest rate on (excess) reserves deposited by commercial banks below zero for the first time. Since then, the Deposit Facility Rate has been gradually lowered from -0.1 percent to -0.5 percent. For the ECB, the negative deposit facility rate is only one instrument of unconventional monetary policy aimed at strengthening aggregate demand in order to meet its inflation target of close to, but below, 2 percent. The ECB's

toolkit of unconventional measures also includes asset-purchase programs aimed at easing credit conditions through a direct impact on long-term borrowing rates. In addition, targeted long-term refinancing operations are aimed at providing banks with sufficient loanable funds to expand lending.¹ The role of negative rates in this toolkit can be seen as one of increasing banks' incentives to expand lending, rather than hoarding loanable funds in the form of central bank reserves.

As a knock-on effect of the ECB's negative interest rate policy, monetary authorities in Switzerland, Denmark, and Sweden have also lowered their rates below zero since 2015 (see Figure 1). This reaction primarily served to prevent a strengthening of the respective currencies against the euro with negative consequences for aggregate demand and price levels. As a traditional safe haven of international capital flows (Auer 2015), Switzerland has been particularly affected by negative rates in the eurozone. The Swiss National Bank (SNB) maintains a policy rate of -0.75 percent in economic conditions that can arguably be characterized by steady (albeit low) growth, booming real asset prices, and full employment.²

NEGATIVE RATES AND BANK LENDING: THE CREDIT CHANNEL OF MONETARY POLICY

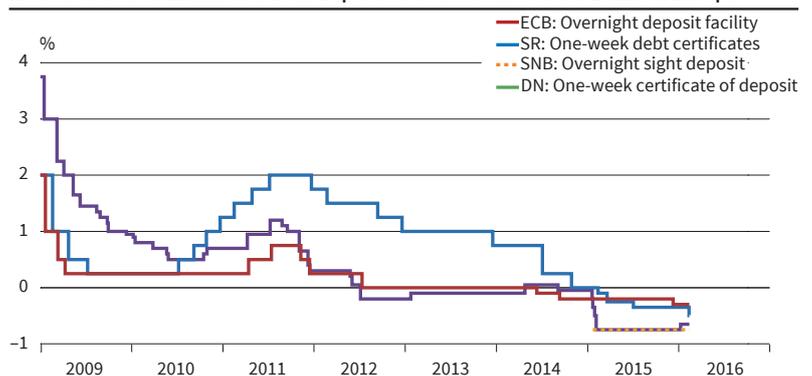
The interest-rate channel of monetary policy postulates that lower interest rates raise the demand for credit by consumers and firms in order to finance additional (durable) consumption and investment.³ By comparison, the credit channel of monetary policy emphasizes that lower policy rates increase the supply of credit. Hereby multiple, complementary mechanisms could be at play. First, lower rates lead to an increase in the net worth and collateral value

¹ For an overview of current ECB policy measures, see: <https://www.ecb.europa.eu/mopo/implementation/omt/html/index.en.html> and <https://www.ecb.europa.eu/mopo/implementation/omo/tltro/html/index.en.html>.

² For an up-to-date analysis of business cycle conditions for Switzerland, see <https://kof.ethz.ch/en/publications/kof-analysen.html>.

³ For a textbook presentation of the transmission channels of monetary policy, see Mishkin (2018).

Figure 1
Interest Rates on Excess Reserves Deposited at Selected Central Banks in Europe



DN = Danmarks Nationalbank; ECB = European Central Bank; SNB = Swiss National Bank; SR = Sveriges Riksbank.
Source: Bech and Malkhozov (2016).

© ifo Institute

of households and firms, thus improving the creditworthiness of (some) bank clients (balance-sheet channel). Second, lower interest rates increase the supply of loanable funds to banks (bank-lending channel). Third, lower interest rates strengthen bank profitability and net worth, allowing banks to access market funding at lower costs and/or expand their lending in the presence of prudential regulation (bank-balance-sheet channel).

In the following I shall focus my attention on the bank-lending channel, the bank-balance-sheet channel, as well as the related ‘deposits channel’ as proposed by Drechsler et al. (2017 and 2020). The objective is to provide a systematic discussion of how negative interest rates could impact on the credit channel of monetary policy.

The Bank-Lending Channel: Deposit Supply and the Compression of Bank Margins

The bank-lending channel of monetary policy builds on the conjecture that (i) the supply of (insured) customer deposits to banks increases when the policy rate falls,⁴ and that (ii) banks face frictions in replacing customer deposits with other sources of funding. Thus, when policy rates fall, the supply of loanable funds to banks increases, enabling an expansion of credit. Kashyap and Stein (2000) provide evidence consistent with a bank-lending channel: they document that less liquid US banks are more likely to expand their lending when interest rates fall. This is especially the case for smaller (and thus arguably more deposit-dependent) banks.

To what extent could the bank-lending channel be disrupted when policy rates go negative? A widespread conjecture is that there is a discontinuity in the impact of policy rates on customer deposit supply when policy rates hit negative territory. In particular, the pass-through of policy rates to deposit rates

may be muted as deposit rates reach the nominal zero rate. In the extreme case, where all consumers and firms can frictionlessly store cash as a liquid safe asset, the supply of bank deposits would be bound at zero.

Recent evidence by Eggertson et al. (2019) based on Swedish data suggests that – on average – nominal rates on deposits may indeed be bound at zero (Figure 2, left). However, a more granular analysis by Altavilla et al. (2019) paints a more differentiated picture. Their data reveals that a considerable share of deposits by nonfinancial corporations in the eurozone are priced below zero (Figure 2, right). Together, this evidence on deposit pricing in Europe suggests that the bank-lending channel may be impaired under negative policy rates: it is very likely that negative rates are associated with a limited pass-through of policy rates to deposit rates.

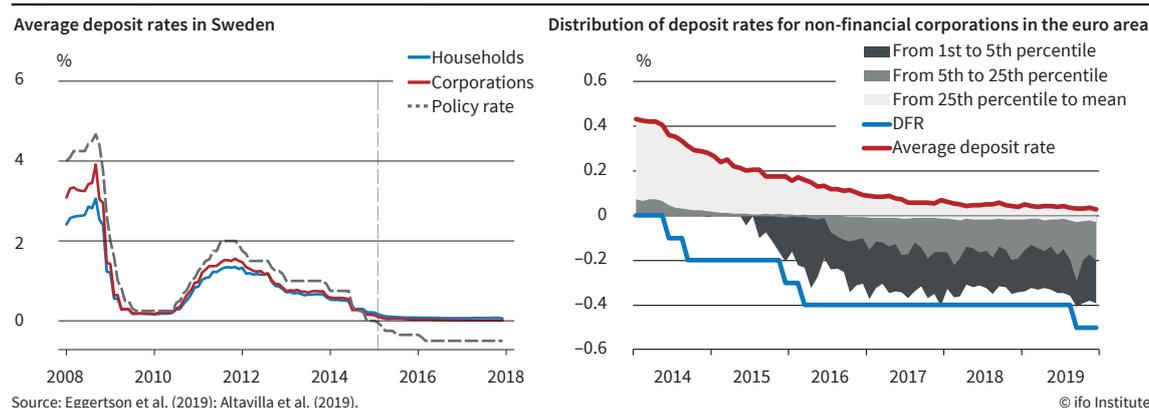
A key debate among policymakers is whether the limited pass-through of negative policy rates to deposit rates leads to a significant compression of bank spreads and lower profitability. The recent empirical evidence is inconclusive on how low/negative policy rates impact on bank profitability. Cross-country evidence by Borio et al. (2017) suggests that lower short-term interest rates are associated with lower bank profitability. Claessens et al. (2018) confirm this finding and document that the impact of an interest rate decrease on bank profitability is stronger when the level of the policy rate is already low. By contrast, Altavilla et al. (2018) provide evidence suggesting that – once the endogeneity of policy rates is accounted for – there was no impact of low short-term interest rates on bank profitability in the eurozone over the 2007–2017 period.

The Bank-Balance-Sheet Channel: Interest Rate Risk and Bank Valuation

The key mechanism behind the bank-balance-sheet channel of monetary policy is maturity transformation. Most financial institutions display a positive

⁴ For a micro-foundation consider e.g., a portfolio model of money demand (Tobin 1958). A large empirical literature documents the interest-rate sensitivity of money holdings (see e.g., Knell and Stix 2005).

Figure 2
Negative Policy Rates and Interest Rates on Deposits



maturity/duration mismatch on their balance sheet: the contractual duration of their assets (e.g., fixed rate mortgages and investment loans) is on average longer than that of liabilities (e.g., customer deposits). This exposes banks to interest rate risk, which is beneficial in the case of falling rates. From an income-statement view, a decline in interest rate levels thus reduces banks' interest expenses faster than it reduces interest revenues. From a balance-sheet view, a decline in interest rate levels leads to a stronger increase in the net present value of a bank's assets than liabilities, raising net worth. Improved profitability and equity values can enable banks to source cheaper funding and thus expand credit activity. Alternatively, if banks are constrained by prudential capital requirements, an increase in net worth allows them to expand lending.

Jimenez et al. (2012) provide supporting evidence for the bank-balance-sheet channel of monetary policy. They analyze how bank loan supply in Spain reacts to changes in the level of eurozone interest rates over the period 2002–2008. Their results show that banks with weaker balance sheets (in terms of liquidity and capitalization) are more likely to expand lending following interest rate declines.⁵ Supporting the mechanism of a bank-balance-sheet channel driven by interest-rate-risk exposure, Gomez et al. (2016) document that US banks with stronger maturity mismatches display a stronger sensitivity of lending to policy rate levels.

Could the bank-balance-sheet channel be disrupted as interest rates go negative? Heider et al. (2018) suggest that the positive effects of falling policy rates may be reversed when interest rates go negative. As discussed above, banks may face an effective zero bound on deposit interest rates. Thus, while banks are forced by competition to reduce their lending rates, they no longer benefit from a faster/more significant reduction in their funding costs.

The Deposits Channel: Market Power in the Deposit Market

Novel evidence by Drechsler et al. (2020) suggest that changes in monetary policy conditions have little effect on the strength of bank balance sheets. They confirm a significant contractual maturity mismatch for US banks. However, they document that due to market power in the deposit market, this mismatch does not lead to effective interest-rate-risk exposure for banks. Rather, their analysis shows that banks' net interest margins and equity valuations are largely insensitive to monetary policy shocks.⁶ In a related paper (Drechsler et al. 2017), the authors argue that bank market power – rather than interest

rate risk – is the mechanism through which monetary policy is transmitted through bank balance sheets. In the spirit of oligopolistic models of financial intermediation,⁷ they argue that banks face an inelastic supply of deposits from households and firms. Due to their market power banks adjust their deposit rates only partially to changes in policy rates. As a consequence, a decline in policy rates leads to lower intermediation spreads, which lead to an increase in the supply of customer deposits to banks.

Similar to the bank-lending channel, the 'deposits channel' of Drechsler et al. (2017) suggests that the supply of loanable funds to banks increases when policy rates fall. Novel to the deposits channel is, however, the emphasis on market power in the deposit market as the underlying mechanism. Consistent with their conjecture, Drechsler et al (2017) document that the reaction of bank lending to policy rate changes is stronger for banks with more local market power.

What would negative policy rates imply for the deposits channel of monetary policy? The key question is whether banks maintain (some) market power over (some) customers as policy rates enter negative territory. As discussed above, recent evidence suggests that deposit rates are bound at zero for most bank customers. In the aggregate this would suggest a weakening of the deposits channel as banks face an increasingly elastic deposit supply. However, as argued by Altavilla et al. (2019) and illustrated by Figure 2 above, this may not be the case for all customers of all banks: relationship lending may allow some banks to maintain market power over some lenders even in the negative interest rate domain. More generally, the pass-through of negative interest rates to deposit rates, bank funding, and bank lending is likely to differ substantially across banks, depending on local competitive conditions and a bank's client structure.

NEGATIVE INTEREST RATES AND BANK LENDING: THE EVIDENCE

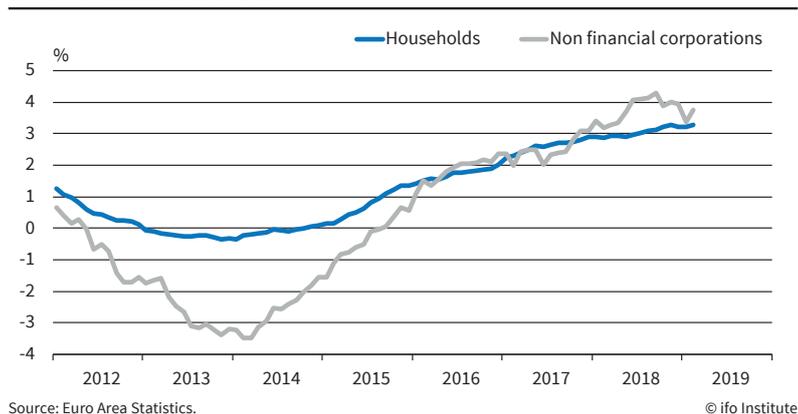
Aggregate data suggests an acceleration of bank lending in the eurozone between 2014 and 2019 (Figure 3). However, it is far from clear if the negative interest rate policy contributed to this expansion of credit. As discussed above, over this period the ECB pursued significant further unconventional policies aimed at easing liquidity conditions in the banking sector as well as long-term credit conditions. Recent empirical studies therefore aim at disentangling the causal effects of negative rates on bank lending and risk taking by comparing the reaction of banks which were differentially affected by the introduction of rates in the eurozone and in neighbouring countries.

⁵ In related research the same authors show that low interest rates are associated with riskier lending by banks with weak balance sheets (Jimenez et al. 2014).

⁶ This finding is consistent with recent evidence for the eurozone by Altavilla et al. (2019) discussed above.

⁷ See, for example, the Monti-Klein model as presented in Freixas and Rochet (2008).

Figure 3
Credit Growth in the Eurozone



Funding Structure and Bank Lending

Several recent papers use banks' funding structure as an indicator of exposure to negative interest rates. The identifying assumption is that – due to the zero bound on deposit rates for most clients – banks that are heavily funded by customer deposits are more exposed to the negative interest rate policy. Thus, by comparing the lending activity of banks with high shares of deposit funding to banks with low shares of deposit funding, it is possible to disentangle the effect of negative rates from that of other policies and economic conditions.

Heider et al. (2019) study contract-level data from the syndicated loan market over the period 2013–2015 to examine how negative interest rates impact on the lending activity of (large) European banks. The authors compare the volume and risk structure of new syndicated lending by banks during 18 months before and after the introduction of negative rates (in June 2014). In their sample of 69 banks, the ratio of deposit funding varies from on average of 61 percent (high-deposit banks) to 22 percent (low-deposit banks). Their results show that following the introduction of negative rates in 2014 syndicated lending develops significantly more weakly for high-deposit banks than for low-deposit banks. Indeed, their main estimates suggest that negative interest rates reduced lending of high deposit banks by 35 percent relative to that of low deposit banks. In addition, the authors show that following the introduction of negative rates high-deposit banks are more likely to increase their syndicated lending to riskier firms. Heider et al. (2019) conjecture that their findings are driven by a weakening of profitability and net worth of banks that face a zero-lower bound on deposit rates. On the one hand, lower net worth and profitability constrains credit growth (bank-balance-sheet channel). On the other hand, lower net worth and profitability increases risk taking as banks have less skin in the game or search for yield (Dell'Ariscia et al.

2017).⁸ Note, however, that this interpretation presumes a significant correlation between lower policy rates, bank profitability, and net worth, which has been questioned by recent evidence (Drechsler et al. 2020; Altavilla et al. 2018).

Two recent studies replicate the methodology of Heider et al. (2019) for a more representative sample of European banks and loans. Both studies present findings that contradict those of Heider et al. (2019): they show that the

introduction of negative rates leads to a stronger – not weaker – expansion of credit among those banks that are more heavily dependent on deposit funding.⁹ Tan (2019) analyzes confidential ECB data covering balance sheet items and interest rates of 189 banks in the eurozone. As in Heider et al. (2019) his analysis focusses on the period 2013–2015. His findings suggest that following the introduction of negative interest rates high-deposit banks expand credit by 17 percent relative to low-deposit banks. Interestingly, Tan (2019) documents that the relative increase in lending by high-deposit banks is driven entirely by mortgage lending, while there is no difference in lending to nonfinancial corporations. Furthermore, he shows that while high-deposit banks expand lending volumes relative to low-deposit banks, there is no differential impact on bank profitability.

Schelling and Towbin (2018) examine bank lending to nonfinancial corporates in Switzerland during a period of six months before and after the introduction of negative interest rates by the Swiss National Bank (SNB) in January 2015. Their analysis is based on confidential data covering more than 100,000 loans issued by 20 Swiss banks that report to the SNB credit registry. The authors document that following the introduction of negative interest rates the average lending spread of Swiss banks increased. However, banks with high deposit ratios display a significantly weaker increase in their lending spread than banks with low-deposit ratios. Banks with high deposit ratios also display a significant increase in their lending volume compared to banks with low deposit ratios.

The findings of Tan (2019) as well as Schelling and Towbin (2018) are consistent with several elements of the deposit channel of monetary policy as proposed by Drechsler et al. (2018 and 2020): first, changes in policy rates affect intermediation

⁸ See Dell'Ariscia et al. (2017) or Jimenez et al. (2014) for evidence on risk-taking channel of monetary policy. Both studies document that lower policy rates are associated with an increase in risk taking.

⁹ Further studies also document an expansion of lending in response to negative rates: Nucera et al. (2017); Demiralp et al. (2017).

spreads differentially across banks, depending on bank balance sheet structure. Second, banks react to changes in their spreads by altering their loan supply: those banks faced with a relative compression of their lending margins expand credit more. Third, as changes in lending volumes offset changes in spreads, monetary policy rates hardly influence bank profits.

Asset Structure and Bank Lending

The exposure and reaction of banks to negative rates depends not only on the structure of their liabilities, but also on the structure of their assets. In particular, banks' earnings on short-term liquid assets are directly impacted by negative money market rates as yields on short-term assets erode. Two recent studies show that – in line with the goals of this unconventional policy tool – negative interest rates lead to a rebalancing of banks asset holdings from safe, liquid assets to less liquid and riskier private-sector loans.

Bottero et al. (2019) examine the reaction of Italian banks to the June 2014 introduction of negative rates in the eurozone. Their main analysis is based on confidential bank-balance sheet data and loan-level data on business lending from the Bank of Italy credit registry. The authors compare the lending activity of banks with large holdings of liquid assets before 2014 to banks with low holdings of liquid assets. Their analysis documents that banks with large holdings of liquid assets rebalance their asset portfolios more after the introduction of negative rates. Banks with high liquidity display a stronger reduction of their liquid asset holdings and a stronger increase in lending to nonfinancial corporates. Examining the risk structure of bank lending, the authors show that banks with high liquidity display a stronger allocation of credit to smaller firms and firms with lower credit ratings. Together these results suggest that negative interest rates lead to a rebalancing of asset holdings from low-yield liquid assets to higher-yield private-sector loans.

Basten and Mariathan (2018) examine the asset and liability management of Swiss banks in reaction to the introduction of negative rates in January 2015. In Switzerland, each bank was allocated a quota of excess reserves below which the negative rates would not imply. This quota was set on a bank-by-bank level and equal to 20 times a bank's regulatory reserves at the end of 2014. This implies that banks with high ratios of central bank reserves to deposits were more exposed to the negative interest rate policy. Basten and Mariathan (2018) employ confidential regulatory data at the bank level to examine how the balance sheet and revenue structure of banks changed, depending on the extent to which they exceeded their quota for 'free' excess reserves. Their results confirm a more significant

rebalancing of assets by those banks most exposed to the negative rates. In the Swiss case, banks with high levels of reserves display a stronger reallocation of assets from central bank reserves to mortgage loans and marketable securities. The exposed banks also adjust their funding structure by reducing capital market funding (mortgage backed bonds). The authors thus demonstrate that structural shifts in asset and liability holdings induced by negative interest rates may not only trigger changes in the credit risk exposure, but impact on interest-rate risk and liquidity risk within the banking sector.

CONCLUSION

Does the credit channel of monetary policy break down when policy rates go below zero? Recent evidence suggests otherwise: negative rates – just like lower positive policy rates – lead to an expansion of bank credit. While negative interest rates may compress intermediation spreads for banks that are heavily reliant on deposit funding, these banks seem to react by expanding lending to maintain profit levels. At the same time, banks that hold large volumes of safe liquid assets rebalance their portfolios towards less liquid and riskier lending to firms and households.

At the same time, negative policy rates – again, like low, positive rates – also seem to increase bank risk taking: banks' exposure to credit risk is heightened as they issue riskier loans to nonfinancial corporates. Moreover, banks' exposure to liquidity risk and interest rate risk seems to increase as they substitute away from short-term liquid assets and capital market funding.

REFERENCES

- Altavilla, C., L. Burlon, M. Giannetti and S. Holton (2019), "Is There a Zero Lower Bound? The Effects of Negative Policy Rates on Banks and Firms", *ECB Working Paper* 2289.
- Altavilla, C., M. Boucinha and J. L. Peydro (2018), "Monetary Policy and Bank Profitability in a Low Interest Rate Environment", *Economic Policy*, October, 533–583.
- Auer, R. (2015), *A Safe Haven: International Demand for Swiss Francs during the Euro Area Debt Crisis*, Swiss National Bank Quarterly Bulletin 2015/2.
- Basten, C. and M. Mariathan (2018), "How Banks Respond to Negative Interest Rates: Evidence from the Swiss Exemption Threshold", *CESifo Working Paper* 6901.
- Bech, M. and A. Malkhozov (2016), *How Have Central Banks Implemented Negative Policy Rates?*, BIS Quarterly Review, March, https://www.bis.org/publ/qtrpdf/r_qt1603e.htm.
- Borio, C, L. Gambacorta and B. Hofmann (2017), "The Influence of Monetary Policy on Bank Profitability", *International Finance* 20, 48–63.
- Bottero M., C. Minoiu, J. L. Pedro, A. Polo, A. F. Presbitero and E. Sette (2019), "Negative Monetary Policy Rates and Portfolio Rebalancing: Evidence from Credit Register Data", *IMF Working Paper* 2019/44.
- Claessens, S., N. Coleman and M. Donnelly (2018), "Low-for-Long Interest Rates and Banks' Interest Margins and Profitability: Cross-Country Evidence", *Journal of Financial Intermediation* 35, 1–16.
- Dell'Ariccia, G., L. Laeven and G. A. Suarez (2017), "Bank Leverage and Monetary Policy's Risk-Taking Channel: Evidence from the United States", *The Journal of Finance* 72, 613–654.

- Demiralp, S., J. Eisenschmidt and T. Vlassopoulos (2017), *Negative Interest Rates, Excess Liquidity, and Bank Business Models: Banks' Reaction to Unconventional Monetary Policy in the Euro Area*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2941377.
- Drechsler, I., A. Savov and P. Schnabl (2017), "The Deposits Channel of Monetary Policy", *Quarterly Journal of Economics* 132, 1819–1876.
- Drechsler, I., A. Savov and P. Schnabl (2020), "Banking on Deposits: Maturity Transformations Without Interest Rate Risk", *NBER Working Paper* 24582.
- Eggertsson, G. B., R. E. Juelsrud, L. H. Summers and E. G. Wold (2019), "Negative Nominal Interest Rates and the Bank Lending Channel", *NBER Working Paper* 25416.
- English, W. B., S. J. Van den Heuvel and E. Zakrajšek (2018), "Interest Rate Risk and Bank Equity Valuations", *Journal of Monetary Economics* 98, 80–97.
- Freixas, X. and J. C. Rochet (2008), *Microeconomics of Banking*, MIT Press, Cambridge MA.
- Gomez, M., A. Landier, D. Sraer and D. Thesmar (2016), *Banks' Exposure to Interest Rate Risk and the Transmission of Monetary Policy*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2220360.
- Heider, F., F. Saidi and G. Schepens (2019), "Life below Zero: Bank Lending under Negative Policy Rates", *Review of Financial Studies* 32, 3728–3761.
- Jiménez, G., J. L. Peydró, J. Saurina and S. Ongena (2012), "Credit Supply and Monetary Policy: Identifying the Bank-Balance-Sheet Channel with Loan Applications", *American Economic Review* 102, 2301–2326.
- Jiménez, G., S. Ongena, J. L. Peydró and J. Saurina (2014), "Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say about the Effects of Monetary Policy on Credit Risk-Taking?", *Econometrica* 82, 463–505.
- Kashyap, A. K. and J. C. Stein (2000), "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?", *American Economic Review* 90, 407–428.
- Knell, M. and H. Stix (2005), "The Income Elasticity of Money Demand: A Metaanalysis of Empirical Results", *Journal of Economic Surveys* 19, 513–533.
- Nucera, F., A. Lucas, J. Schaumburg and B. Schwaab (2017), "Do Negative Interest Rates Make Banks Less Safe?", *Economics Letters* 159, 112–115.
- Schelling, T. and P. Tobin (2018), *Negative Interest Rates, Deposit Funding, and Bank Lending*, [www.snb.ch › reference › source › sem_2018_09_21_towbin.n.pdf](http://www.snb.ch/~/media/Reference/Sources/sem_2018_09_21_towbin.n.pdf).
- Tan, G. (2019), "Beyond the Zero Bound: Negative Policy Rates and Bank Lending", *DNB Working Paper* 649.
- Tobin, J. (1958), "Liquidity Preference as Behavior Towards Risk", *The Review of Economic Studies* 25, 65–86.