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Negative interest rates and the signalling channel

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130

Politikberatung
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Negative Interest Rates and the Signalling Channel

IMPRESSUM

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DIW Berlin: Politikberatung kompakt 130

Kerstin Bernoth*
Alexander Haas**

Negative Interest Rates and the Signalling Channel

In-Depth Analysis

PE 626/070

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Berlin, September 2018

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Table of contents

List of Abbreviations	2
Executive Summary	3
1 Introduction	4
2 Classic Monetary Policy Transmission	9
3 Financial Stability Concerns	13
4 Weighing the Costs and Benefits.....	16
4.1 On the effectiveness of negative interest rates	17
4.2 Negative interest rates and bank profitability.....	18
4.3 On the optimality of negative interest rates	20
5 Closing Remarks	22
References.....	23

Abstract

While negative interest rates stimulate the real economy by enhancing credit supply and improving the wealth situation of firms and households, they might come with side effects with regard to banking and financial stability. In an assessment of the trade-off between the ability of a central bank to use negative policy rates to signal lower future deposits rates, against the potential costs on bank profitability, we find that the signalling effect dominates. Thus, a negative interest rate policy is an effective monetary policy tool, even when deposit rates are bound by zero.

List of Abbreviations

APP	Expanded Asset Purchase Programme
ECB	European Central Bank
EONIA	Euro OverNight Index Average
LIBOR	London Interbank Offered Rate
DFR	Deposit Facility Rate
NFC	Non-financial Corporation
RD	Nominal Deposit Rate
RR	Nominal Reserve Rate
SMP	Securities Market Programme
ZLB	Zero lower bound

List of boxes

Box 1: Why do banks hold excess reserves?	8
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List of figures

Figure 1: ECB deposit facility rate and EONIA negative	5
Figure 2: Euro area household deposit rates bound by zero	6
Figure 3: Euro area bank net interest margins in decline	6
Figure 4: Liquidity in the euro area banking system on the rise.....	7
Figure 5: Stylized bank balance sheet	9
Figure 6: Crisis scenario with different monetary policy responses	18
Figure 7: Output decomposition in response to a negative rates shock.....	19
Figure 8: Bank profitability in response to a negative rates shock.....	19
Figure 9: Optimal policy under discretion and commitment.....	21

Executive Summary

- Confronted with below target inflation, sluggish growth, and increasing financial market uncertainty, on June 5, 2014, the ECB's Governing Council decided to decrease its deposit facility rate into negative territory. Since then, it has pursued a negative interest rate policy.
- Due to a zero lower bound constraint on returns to retail deposits, this policy has created a wedge between reserve and deposit rates in the euro area. Despite this, banks hold record levels of excess liquidity. This can be attributed to demand as well as supply factors.
- The banking system plays an important role for the transmission of monetary policy to the real economy. Our analysis suggests that negative interest rates have a significant impact on this transmission by changing the relative importance of the classic transmission channels.
- While in aggregate, negative interest rates seem to stimulate the real economy by enhancing credit supply and improving the wealth situation of firms and households, they might come with side effects with regard to financial stability.
- Our analysis of the impact of negative interest rates on financial stability yields the following results for the euro area: (i) empirical evidence suggests only a limited amount of additional risk-taking by banks; (ii) private sector inefficiencies due to the large provision of liquidity cannot be ruled out, even though there is no consensus on their quantitative extent; (iii) so far, there is little empirical evidence for excessive cash hoarding; and (iv) there is only very limited empirical evidence for adverse effects of the ECB's negative rate policy on bank profitability.
- To quantitatively weigh the costs and benefits of the ECB's negative interest rate policy, we use a macroeconomic model by de Groot and Haas (2018). In this model, a novel signalling channel of negative interest rates complements the classic transmission channels, highlighting one additional benefit of negative rates: Even with classic monetary policy transmission constrained by the zero lower bound on deposit rates, a cut of the policy rate into negative territory can be expansionary as the central bank signals that it will hold deposit rates lower for longer, which lowers interest rate expectations and stimulates economic activity.

- In an assessment of the trade-off between the ability of a central bank to use negative policy rates to signal lower future deposits rates, against the potential costs on bank profitability, we find that the signalling effect dominates. In this modelling framework, a negative interest rate policy is an effective monetary policy tool, even when deposit rates are bound by zero.
- A negative interest rate policy stimulates bank net worth. Significant capital gains and a more favourable economic environment, that induces banks to increase credit supply to the real economy, outweigh the costs of negative rates. A simple welfare analysis yields that under reasonable conditions, negative interest rates might constitute an optimal crisis response.
- We conclude that the ECB's negative interest rate policy has most likely been an effective monetary policy tool and a complement to its rate forward guidance policy.
- An effective banking regulation and an alert banking supervision are crucial to ensure that the benefits of the ECB's current negative interest rate policy continue to outweigh its costs.

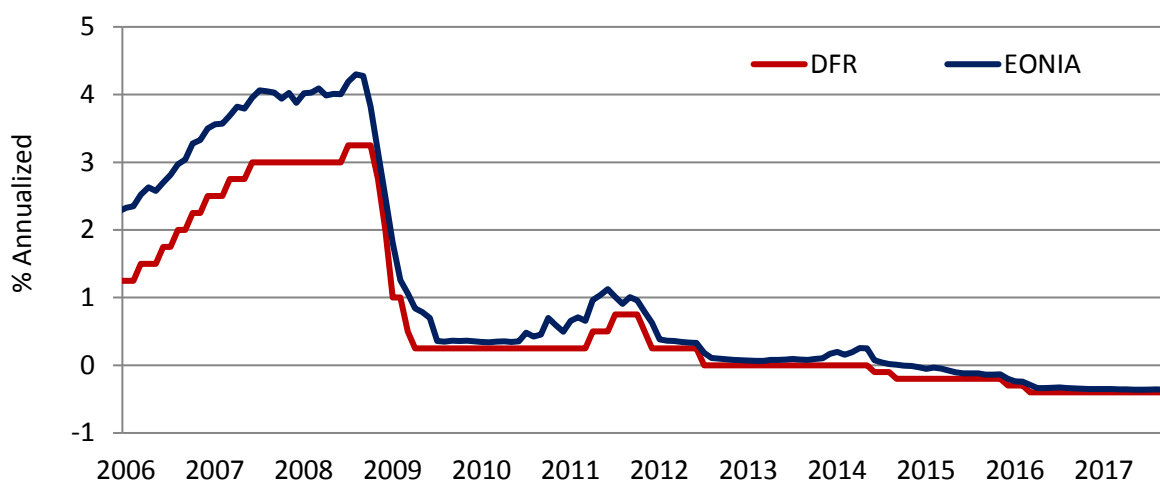
1 Introduction

Since the 2007/08 financial crisis and the subsequent Great Recession, negative nominal interest rates have become an additional policy tool for central banks in many developed countries. Confronted with below target inflation, sluggish growth, and increasing financial market uncertainty, on June 5, 2014, the Governing Council of the European Central Bank (ECB) decided to decrease the deposit facility rate (DFR), the interest rate banks receive for holding overnight deposits at the central bank, to -0.10%. The DFR was further lowered in increments of 10 basis points to its current level of -0.40% on March 16, 2016.¹ As expected in times of excess reserves

¹ Compared to other central banks that adopted a negative rate policy, both the ECB's phase-in of negative rates as well as its eventual level are not exceptional: In Switzerland, the Swiss National Bank set its target range for the 3-month LIBOR CHF at -0.75% to 0.25% in December 2014, and lowered this range to -1.25% to -0.25% in January 2015. In Sweden, the Riksbank set its deposit rate to -0.5% in July 2014. In February 2015, it set its deposit rate and repo rate to -0.85% and -0.1%, respectively. In February 2016, the deposit rate and repo rate reached their lowest point of -1.25% and -0.5%, respectively. In Denmark, the Danmarks Nationalbank set its certificates of deposit rate at -0.05% in September 2014, reaching its lowest point of -0.75% in February 2015 (de Groot and Haas, 2018).

in the banking system, the Euro OverNight Index Average (EONIA), an interbank market measure that states the rate at which banks accept deposits from and provide loans to each other, has traced the behaviour of the DFR closely (Figure 1).

Figure 1: ECB deposit facility rate and EONIA negative



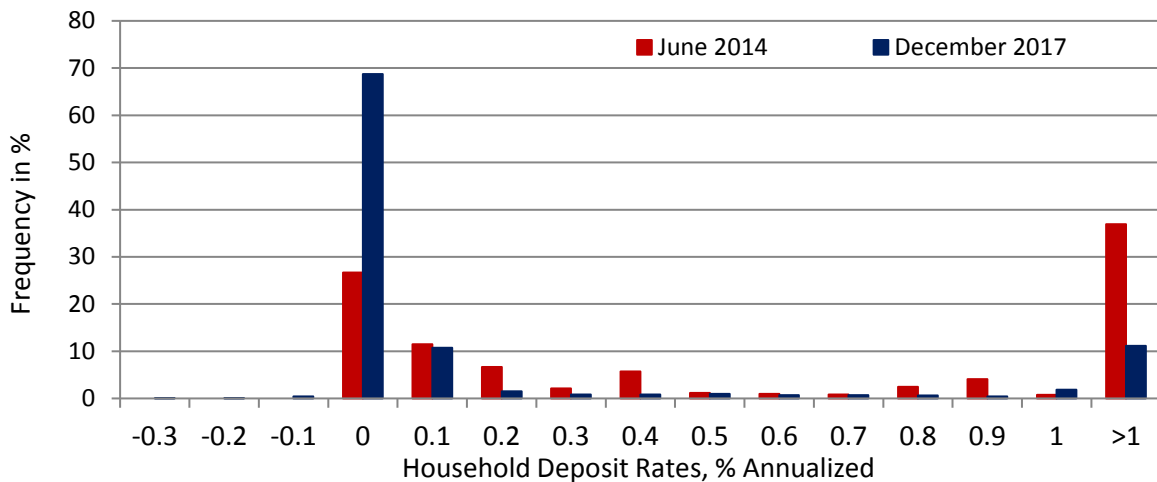
Source: ECB Statistical Data Warehouse.

Holding excess liquidity in a negative interest rate environment is costly for banks if they cannot pass these low rates on to their depositors.² While banks in the euro area seem to have been partially successful in introducing very low, if not negative, deposit rates to commercial depositors (see Eisenschmidt and Smets, 2018), Figure 2 shows that this does not seem to be true for retail depositors: Comparing the deposit rates banks offered to retail customers in July 2014, immediately following the introduction of negative policy rates, with rates offered in December 2017, a sizeable fraction of banks had lowered their deposit rate but the pass-through was clearly incomplete. The banking sector seems constrained by a zero lower bound problem on retail deposit rates.³

² To store excess liquidity overnight, banks have two options: (i) They find demand for liquidity in the interbank market or, (ii) they use a central bank's deposit facility. With the ECB's DFR and the EONIA negative, both options are associated with costs for banks.

³ As McAndrews (2015) argues, this might be due to the fact that the costs of avoiding negative rates by substituting currency for deposits is lower for retail depositors than for larger businesses and institutional investors.

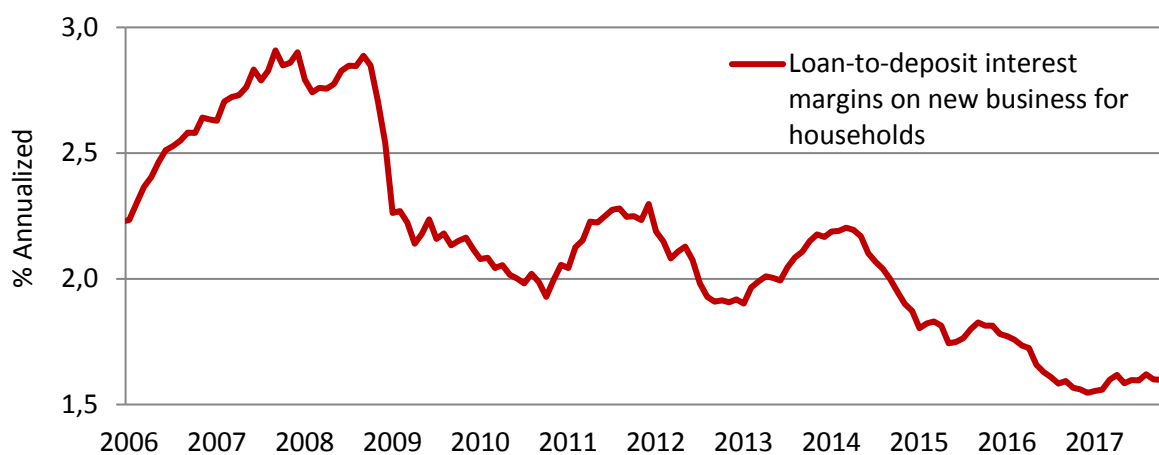
Figure 2: Euro area household deposit rates bound by zero



Source: de Groot and Haas (2018). Eisenschmidt and Smets (2018) provide a similar overview for euro area NFC deposit rates.

While the pass-through of low and negative policy rates to deposit rates has been incomplete, the average rate for new loans has decreased significantly in recent years. As a result, euro area banks' net interest margins, i.e. the difference between the weighted average loan and deposit rate for households, have declined considerably since the introduction of negative policy rate (Figure 3). To the degree that banks were not able to compensate for this through charges on bank accounts and additional fees for costumers, the decline in net interest margins has weighed on profitability.

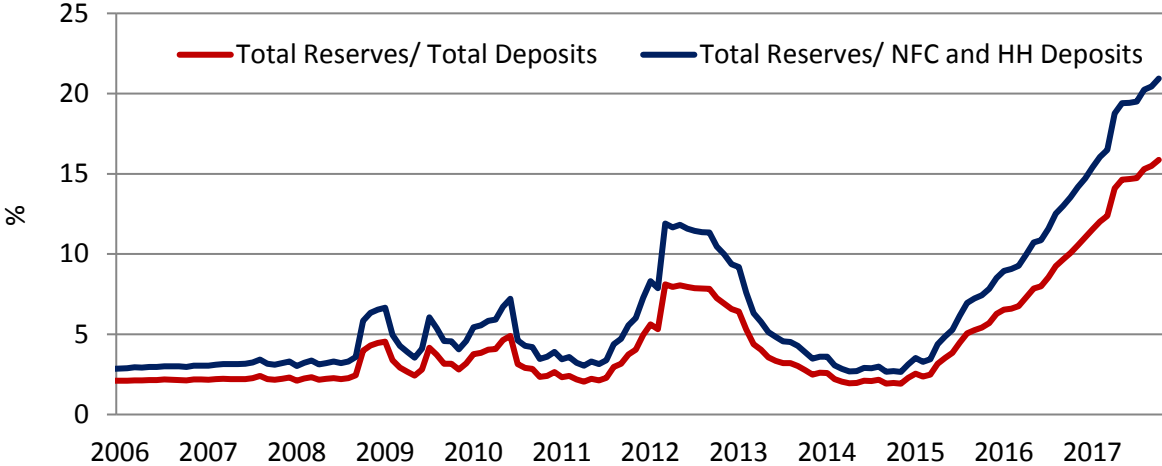
Figure 3: Euro area bank net interest margins in decline



Source: ECB Statistical Data Warehouse.

Despite the fact that holding excess reserves is associated with costs for banks, the euro area banking system as a whole has strongly increased its total liquidity holdings in recent years. At the end of 2017, euro area banks held more than 20% of household (HH) and non-financial co-operation (NFC) deposits in the form of highly liquid reserves (Figure 4). There are a number of reasons for this development, which are highlighted in Box 1.

Figure 4: Liquidity in the euro area banking system on the rise



Source: ECB Statistical Data Warehouse.

Box 1: Why do banks hold excess reserves?

The size of excess reserves on bank balance sheets is determined by supply and demand factors. Banks' demand for liquidity in excess of their minimum reserve requirement involves a trade-off decision. On one hand, banks ask for excess reserves in order to satisfy the demand for cash from the public and to act as a buffer against random liquidity shocks. On the other hand, holding excess reserves may impose costs on banks. These include opportunity costs for not investing in interest-bearing assets and direct costs associated with possible negative interest rates. The central bank is a main contributor to the supply of (excess) reserves, since it holds the monopoly of currency creation. In normal times, liquidity in the banking system is scarce and a central bank satisfies the liquidity needs of the banking sector more or less exactly. As such, the monetary authority keeps close control over money market rates.

In tranquil times, the costs of holding excess liquidity outweigh the benefits, as witnessed by the constantly low levels of excess reserves in the Eurosystem before 2008 (see Figure 4). In the course of the financial crisis, the benefits of excess reserves holdings increased. Banks were reluctant to redistribute liquidity among themselves via interbank lending, as they did before the crisis. The reason was a lack of trust in the solvency of individual banks and the functioning of the redistribution function of the interbank market. As a result, banks started to hoard liquidity. At the same time, the opportunity costs for holding reserves above the minimum reserve requirement decreased with a continuous decline in the interest rate level on financial assets. Both these developments had a stimulating effect on demand for excess reserves. However, when interest rates on excess reserves turned negative in June 2014, the marginal costs of holding excess reserves increased again due to an increase in direct costs. Thus, the initial increase in banks' demand for excess reserves was once again dampened.

The increased demand for liquidity was matched by the ECB's willingness to supply it. In responding to the financial crisis, the European monetary authority implemented a series of credit-easing policies. This included a switch to a main refinancing system of full allotment in October 2008, which means that banks can borrow as much liquidity as they want, as long as they have sufficient eligible collateral. With the start of its expanded asset purchase programmes (APP) in March 2015, in which private and public sector securities are purchased on a monthly basis to address the risks of too prolonged a period of low inflation, the ECB began to provide even more liquidity than the banking sector demanded. Unlike the previous Securities Market Programme (SMP), all current purchase programmes are non-sterilized interventions. Consequently, the amount of excess reserves in the banking system expanded greatly. By July 2018, the ECB held around 2.5 trillion Euros of public and private securities, an increase in excess reserves that was independent of banks' demand for liquidity. Thus, the marginal costs for banks associated with excess liquidity holdings rose, not just with each interest rate cut, but also with each round of additional asset purchases.

2 Classic Monetary Policy Transmission

The banking system contributes substantially to economic growth and development, not just by providing a clearing and settlement system, but also by channelling financial resources between savers and borrowers, thus ensuring the stimulation of investments and the efficient allocation of financial risk. More specifically, banks can use their liquidity in three ways: (i) to buy assets (e.g. private sector assets and securities or government bonds); (ii) to grant loans to governments, households, or firms; or (iii) to keep it as reserves on their current account with the central bank. Banks' reserve holdings consist of minimum reserve requirements and excess reserves. The level of reserve requirements is determined by the central bank and is proportional to the amount of deposit liabilities that a bank owes to its customers.⁴ All of these positions are listed on the asset side of a typical bank's balance sheet (Figure 5). Banks receive liquidity in form of deposits from borrowers (households, firms, banks, and institutions), borrowings from the central bank or other financial institutions, and from the issuance of securities, such as bonds and equities. These items comprise the liability side of a commercial bank's balance sheet. Bank capital measures a bank's net worth, which equals the difference between total assets and total liabilities. It is also listed on the liability side of the balance sheet such that the accounting equation is satisfied and total assets are equal to the total of liabilities.

Figure 5: Stylized bank balance sheet

Assets		Liabilities
Loans		Deposits
Assets and securities		Borrowings
Central bank cash	Reserve requirement	Securities issued
	Excess reserves	Bank capital
Total		Total

⁴ Reserve requirements of individual credit institutions are calculated as a fixed fraction of short-term liabilities (1%, since 2012) minus standardized deductions and a lump-sum allowance. See <https://www.ecb.europa.eu/mopo/implement/mr/html/calc.en.html> for details.

The central bank holds the monopoly on currency issuance and, therefore, can closely determine the level of short-term interest rates and the amount of base money that is distributed on a weekly basis to the banking sector. These monetary policy decisions influence the liquidity and income situation of banks. To a large extent, bank profits are determined by the net interest margin, which is the spread between the interest rate they pay to savers or the central bank in exchange for liquidity and the return they receive from loans, assets, and reserve holdings. In response to changes in monetary policy, banks adjust their balance sheets. As a result, bank behaviour contributes to the transmission of monetary policy to real economic activity in multiple dimensions, most importantly through an interest rate channel, a credit channel, and a risk-taking channel. Recent empirical evidence suggests that a negative interest rate policy might significantly impact this classic monetary policy transmission:

The interest rate channel: What matters for financial intermediaries' income is not the interest rate level per se, but the net interest margin, which is the spread between the interest rate they pay and the interest rate they earn for a unit of money they intermediate. In normal times, when the central bank lowers its policy rate, competition among banks leads them to pass these lower refinancing costs on to their clients. Thus, banks adjust their interest rates on loans and deposits to keep their net interest margin and, thereby, their income relatively stable. The speed and amplitude of this interest rate pass-through depends on a multitude of factors, such as the degree of competition among banks, but also the balance sheet situation of banks and their borrowers. Further, it is very likely to be limited by the zero lower bound on nominal interest rates. In general, a broad adjustment of interest rates in the economy affects consumption and investment decisions. Ultimately, this affects aggregate economic activity and prices. In a negative interest rate environment, this transmission mechanism is disturbed, as banks find it difficult to pass negative policy rates on to depositors (Figure 2). Empirically, while retail deposit rates have declined in recent years, they seem to be bounded at, or closely below, zero. If this is the case, and banks want to preserve their net interest margin, they have little incentive to lower loan rates one for one in response to a monetary policy easing into negative territory. The decline in net interest margins in recent years (Figure 3) indicates that, ultimately, banks have settled for partial pass through to loan rates. The interest rate channel has not completely dried up. **Transmission of monetary policy via the interest rate channel is weaker in a negative rates environment than in regular times.**

The credit channel: This transmission channel operates via its effect on both demand and supply of bank credit. More specifically, one differentiates between the 'bank lending channel' and the 'balance sheet channel'. The former operates via the effect of monetary policy changes on bank balance sheets. As argued by Bernanke and Blinder (1988), expansionary monetary policy – in particular involving outright asset purchases – eases banks' borrowing constraint by an increase in the supply of reserves. This increase in the availability of liquidity raises the willingness of banks to extend loans at a given level of interest rates, thus stimulating the economy. The balance sheet channel is based on the idea that changes in the monetary policy stance affect borrowers' balance sheets and income statements, therefore also affecting credit demand. More precisely, a fall in key interest rates typically causes asset prices to increase. As this raises the net worth of firms and households and increases the value of their potential collateral, they find it easier to take out loans. This accelerates economic growth.

Negative interest rates in combination with the ECB's unconventional monetary policy measures have been successful in providing additional liquidity. In aggregate, this has resulted in credit growth and slowly falling lending rates, thereby easing overall financial conditions in the aftermath of the Great Recession. Significant capital gains on high-yield legacy assets (Altavilla et.al, 2017), bank portfolio re-balancing toward non-domestic government bonds, as well as a stronger reliance on wholesale funding (Demiralp et al., 2017) have been strategies of banks to deal with increasing costs of excess returns in a negative rate environment. The increasing willingness of banks to provide loans was matched by an uptick in borrower creditworthiness and a decline in the stock of non-performing loans (see Jobst and Lin, 2016). As predicted by economic theory, rising asset prices due to very low interest rates have been successful in increasing borrowers net worth and the value of potential collateral, thus allowing both households and firms to take out new loans. **Transmission of monetary policy via the credit channel (i.e. bank lending and balance sheet channel) appears broadly uninhibited by negative nominal rates.**

The risk-taking channel: Rajan (2005) and Borio and Zhu (2008) were among the first to suggest that monetary policy may transmit to the real economy via its impact on the risk perception and risk taking of banks. Here, asset and liability side effects can be differentiated: On the asset side, accommodative monetary policy lowers the income from financial assets on bank balance sheets, which may drive a wedge between actual returns and nominal return targets. This triggers a 'search for yield' behaviour of banks that comes with a greater willingness to take on more

risk. Further, this effect may be reinforced by the positive impact of low interest rates on asset and collateral values, which modifies bank estimates of probabilities of default, loss-given-default, and, ultimately, risk perception. On the liability side, Adrian and Shin (2009) argue that since lower interest rates decrease the cost of debt, banks may find it profitable to increase their leverage ratio and to finance themselves more by issuing debt instead of equity. In view of the limited-liability protection implicitly contained in debt contracts, this might further increase banks' willingness to take on more risk.

So far, the empirical evidence on whether negative interest rates impact bank risk-taking is ambiguous and more research is needed. While a range of studies confirm a negative relationship between short-term interest rates and bank risk-taking (e.g. Altunbas et al., 2010; De Nicolò et al., 2010; and Dell'Ariccia et al., 2013), this result is challenged by more recent studies focusing on the current low/ negative interest rate environment. Analysing data from US commercial and savings banks from 2001 to 2015, Bikker and Vervliet (2017) find no clear evidence that banks increased their risk exposure in a search for yield. So far, banks appear to have been able to maintain their overall level of profits and, hence, have not felt the need to compensate for a reduced net interest income by making more risky investments. However, Bikker and Vervliet (2017) do find that banks significantly lowered their level of credit loss provisioning in recent years. Thus, the buffer against unexpected credit losses shrunk. Heider et al. (2017) shed light on heterogeneities within the banking sector. The authors find that financial institutions that strongly rely on deposit finance, i.e. suffer more severely from a wedge between policy and deposit rate, have decreased their overall quantity of borrowing while at the same time increasing their level of risk-taking. In contrast, the results of the ECB's bank lending survey from April 2018 do not signal a broad-based easing of credit standards over the past year and there appears to be no relationship between lending growth and credit standards in the euro area.⁵ **Transmission of monetary policy via the risk-taking channel appears more nuanced in a negative rates environment, but further research is needed.**

To summarize, empirical and theoretical evidence suggest that negative interest rates have a significant impact on monetary policy transmission by changing the relative importance of the classic transmission channels. While negative interest rates seem to stimulate the real economy

⁵ See <https://www.ecb.europa.eu/stats/pdf/ecb.blssurvey2018q1.en.pdf?8a0ccc5c4d1f982de4528c104bodab86>.

by enhancing credit supply and improving the wealth situation of firms and households, they might come with side effects with regard to financial stability. These concerns will be addressed in section 3, before section 4 introduces a macroeconomic model by de Groot and Haas (2018) to weigh the costs and benefits of a negative interest rate policy.

3 Financial Stability Concerns

An extended period of negative interest rates paired with abundant liquidity in the banking system naturally raises concerns about financial stability. In the following, we briefly describe the most important channels through which a negative interest rate policy might harm the functioning of financial markets and key financial institutions.

Portfolio rebalancing: One particular implication of a negative interest rates policy is that individual banks may try to minimise higher costs of excess liquidity through balance sheet adjustments. In general, an individual bank has several options at hand to reduce its excess liquidity (see Figure 5):

- i) Adjustments on the asset side:
 - a) Increase in loan supply;
 - b) Investment in more profitable assets and securities; and
 - c) Transferring reserves into cash.
- ii) Adjustments on the liability side:
 - a) Reduce borrowings from interbank market, central bank, or other institutions; and
 - b) Reduce the amount of outstanding securities (non-rolling over maturing bonds and securities).

Using confidential bank-level data for the euro area, Demiralp et al. (2017) find that affected banks react to negative policy rates by extending more loans to the non-financial private sector (ia), by acquiring significantly more non-domestic bonds (ib), and by lowering their levels of wholesale funding (iia). With regard to financial stability, these adjustments are relevant if banks increase their exposure to lower quality counterparties in order to boost returns. **However, to this point, the empirical evidence suggests only a limited amount of additional risk-taking by banks (see Chapter 2).**

Inefficient credit provision: As Jobst and Lin (2016) outline, a general risk to financial stability that emerges in a low or negative interest rate environment is that reduced debt service costs could keep credit flowing to otherwise insolvent borrowers. The result is that the exit of non-viable firms is delayed, which hurts the demand prospects of healthy firms by adding to excess capacity and delaying the efficient allocation of capital and labour (Caballero et al., 2008; and Kwon et al., 2015). In addition, very low/ negative lending rates may also delay the corporate restructuring of highly indebted firms. **Inefficiencies due to the large provision of liquidity cannot be ruled out in the current negative interest rate environment, even though there is no consensus on their quantitative extent.**

Cash hoarding: When the nominal return on assets and deposits turns negative, substituting these for cash holdings might become an attractive alternative. In an extreme scenario, with large sectors of the economy becoming cash-based, banks could lose their most important source of funding, which would challenge their role as financial intermediators and pose a threat to the overall stability of the financial sector. Yet, because of costs and inefficiencies associated with holding large amounts of cash in the form of banknotes, the threshold yield, below which a switch to cash hoarding might be triggered, is most likely negative and there is no consensus on how deep negative rates must fall for this distortion to become quantitatively important. **However, to this point, there is little evidence for excessive cash hoarding in the euro area. The annual growth of currency in circulation remains stable.**

Bank profitability: Banks' ability to generate profit is crucial not just for the sustainability of the banking system, but also for a sufficient and efficient credit supply to the whole economy. A potential risk of the ECB's negative interest rate policy is that it may hurt bank profitability, thereby posing a threat for financial stability.

In theory, the overall effect of negative interest rates on bank profitability is ambiguous. While net interest income may decrease, a policy rate below zero is associated with capital gains due to rising asset prices. Moreover, a negative interest rate environment may have a stimulating impact on the economy, which helps the banking system by improving borrower creditworthiness and reducing bank funding costs. Furthermore, even assuming negative direct effects, banks might be able to mitigate a decline in profitability by increasing charges on accounts, raising fee-based revenue or simply reducing their dependence on deposits.

Recent data for the euro area indeed suggests that the loan to deposit interest margins have declined (see Figure 3), while the profit margins on the standard banking maturity transformation of short-term funding and long-term lending have decreased due to a flattening of the yield curve. Whether these developments are associated with a decline in profitability of European banks is still an open debate in the empirical literature. Borio et al. (2017), using data for 109 large international banks headquartered in 14 major advanced economies for the 1995–2012 period, find that unusually low interest rates and an unusually flat term structure erode bank profitability. This result stands in contrast to the findings by Altavilla et al. (2017). Making use of ECB proprietary data, they find that changes in the level and the slope of the term structure are not associated with lower bank profitability once they control for the endogeneity of policy measures. They find that the adverse effects on net interest margins are largely offset by the positive impact on intermediation activity, credit quality, and capital gains derived from increased asset prices. This result is robust even when interest rates are maintained at a negative level for an extended period of time. Jobst and Lin (2016) find supporting evidence for this, adding that the direct costs imposed on bank excess liquidity are, on aggregate, modest relative to the overall size of assets on a typical bank balance sheet. Therefore, they conclude, bank profitability is not very sensitive to negative rates on excess reserves. However, there is a risk that the adverse impact of negative rates on bank profitability may increase non-linearly as the policy rate declines further (Borio et al., 2017). This is in line with the argument of Brunnermeier and Koby (2018), who suggest that if interest rates fall below a critical value that they call the ‘reversal rate’, the detrimental effects on the banking sector outweigh the benefits of lower rates and bank profits decline. **In summary, there is no empirical consensus on the precise impact of negative interest rates on bank profitability, yet. Both the severity and the duration of the negative interest rate policy are crucial adjustment parameters. However, for the euro area, at this time, there is little empirical evidence for a significant negative effect on general bank profitability.**

4 Weighing the Costs and Benefits

While theoretical and empirical evidence suggests that a negative interest rate policy stimulates credit supply and economic growth, it is simultaneously associated with costs for the banking sector and risks to financial stability. In the following we use a macroeconomic model, as outlined in de Groot and Haas (2018), to study both the classic transmission channels described above and the non-standard costs of negative interest rates.

In particular, we provide an assessment of the trade-off between the ability of a central bank to use negative policy rates to *signal* lower future deposits rates, against the potential costs on bank profitability.⁶ The analysis suggests that when the model is calibrated to euro area data, the signalling channel dominates and negative interest rates will have induced a rise, and not a fall, in bank profitability. **Thus, we conclude the ECB's negative interest rate policy has most likely been an effective monetary policy tool and a complement to its rate forward guidance policy.**

A full exposition of the macroeconomic model used in this section is given in de Groot and Haas (2018).⁷ For the purpose of this briefing, we concentrate on a concise summary of the main features: The model is a standard New Keynesian model with financial frictions along the lines of Gertler and Karadi (2011). In the model, banks channel savings from households to firms that require external financing to invest in capital formation. The banks in the model are subject to an agency problem which means that the spreads between loan and deposit rates depend intimately on banks' net worth. Banks in the model also hold central bank reserves. The interest rate for reserves is the policy instrument of the central bank.⁸ In normal times, arbitrage ensures that the return on deposits is equal to the interest rate paid on reserves. It is only when the interest paid on reserves becomes negative, i.e. when the central bank opts for a negative interest rate policy, that the two interest rates diverge as banks are unable to pass negative interest rates on to depositors (see Figure 2).

⁶ The bank cost channel is similar to the one studied by Eggertsson et al. (2018) and Brunnermeier and Koby (2018). However, unlike de Groot and Haas (2018), these authors do not study the central bank's ability to signal future actions with its use of negative interest rates.

⁷ de Groot and Haas (2018) also contains additional quantitative analyses, verifying the robustness of the results.

⁸ Note that this is line with the institutional setup of the euro area.

4.1 On the effectiveness of negative interest rates

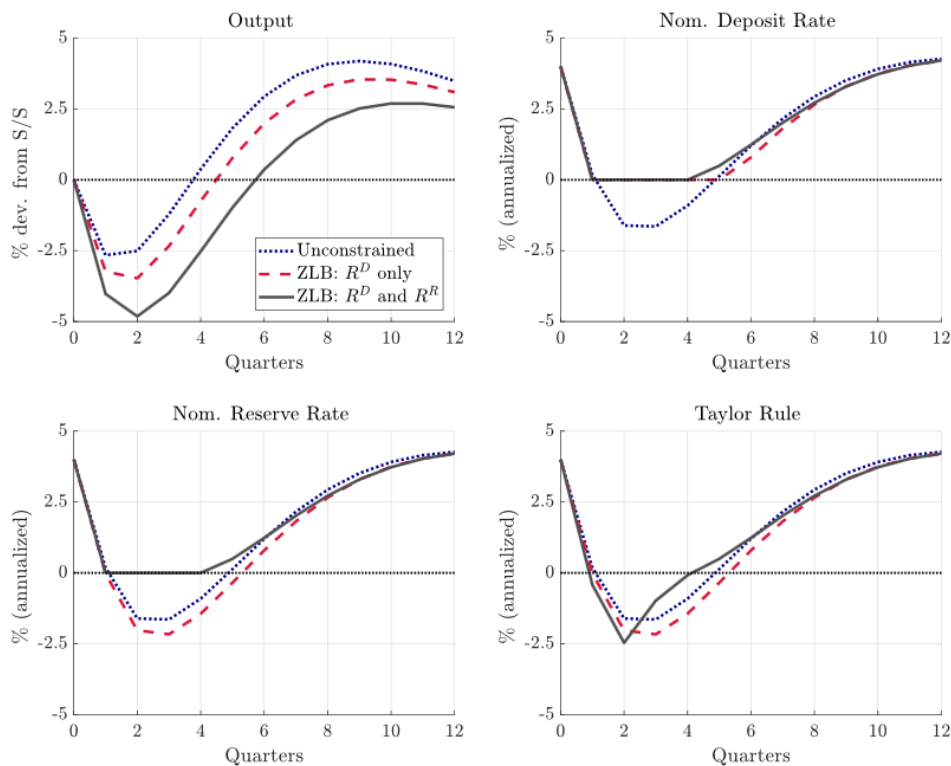
If deposit rates are bound by zero, and if deposit rates determine households' spending and savings decisions, how are negative interest rates effective? In the model, households' spending and savings decisions depend not only on what interest rates they face today but also on their expectations about interest rates in the near future. The signalling channel of negative interest rates works by altering these expectations. Households know that, historically, the ECB has adjusted policy rates gradually. Thus, households observing that the policy rate is negative today, realize that, although the return on deposits will not turn negative, they can expect deposit rates to remain at zero for longer. In response, households cut back on saving and increase spending today. This stimulates economic activity.

In the model, the signalling channel of negative interest rates (i.e. the expectation of lower deposit rates in the future) dominates any contractionary effects coming from the banking sector. Figure 6 illustrates this, with an example of a negative aggregate demand shock that depresses economic output. In this crisis scenario, the recession is smallest in the fictitious case when the central bank is completely unbridled by the zero lower bound. In this case, both reserve and deposit rates turn negative, stimulating demand and boosting output (blue line). When the deposit rate cannot fall below zero, as observed in the euro area, a negative reserve rate policy (red line) still is more expansionary than the case in which the central bank is not willing to reduce the policy rate below zero (black line). The signalling channel is evident in the top-right panel of Figure 6 where the deposit rate in the negative interest rate policy case (red line) is still bound by zero but remains at zero for longer and rises more gradually.⁹ de Groot and Haas (2018) show that the expansionary effect of a negative interest rate policy can be significant. In their baseline scenario with a zero lower bound binding for one year, the effect on economic activity of a 25 basis point cut in the policy rate is around 50% of the stimulus effect on the same size cut in normal times. As they illustrate, this expansionary effect becomes smaller in deeper crises (i.e. when the zero lower bound on deposit rates is binding for longer), but remains positive as long as the central bank continues to adjust policy only gradually.¹⁰

⁹ In this environment, the central bank's past, gradual behaviour is a virtue. Without gradualism, the signalling channel would not operate.

¹⁰ This result illustrates that, despite the signaling channel operating through expectations, these findings are not driven by the so called forward guidance puzzle present in parts of the theoretical macroeconomic literature (see Del Negro et al., 2012).

Figure 6: Crisis scenario with different monetary policy responses



Note: Impulse responses to a contractionary risk premium shock that induces a crisis scenario in which the deposit rate is constrained at the zero lower bound for 4 quarters. Source: de Groot and Haas (2018).

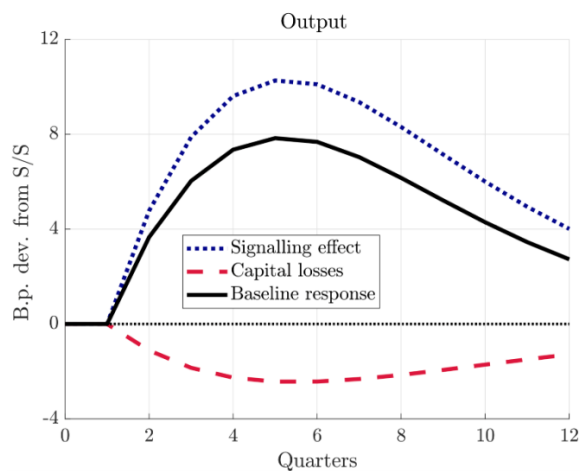
A decomposition of aggregate economic output in response to a negative interest rate policy shock once more illustrates the transmission channels at play. As shown in Figure 7 the contractionary effects of negative interest rates that weigh on the banking sector (summarized as capital losses, red line) are smaller than the expansionary aggregate demand effects via the signalling channel (blue line). **In this modelling framework, a negative interest rate policy is an effective monetary policy tool.**

4.2 Negative interest rates and bank profitability

The ability of banks to generate profit is an important concern in the evaluation of the ECB's negative interest rates policy. As outlined above, this ability is crucial, both for the sustainability of the banking system and for broader financial stability. Figure 8 illustrates the path of bank profitability, and its decomposition, in response to the negative interest rate policy in the base-line specification of the model. In this scenario, negative interest rates are expansionary and

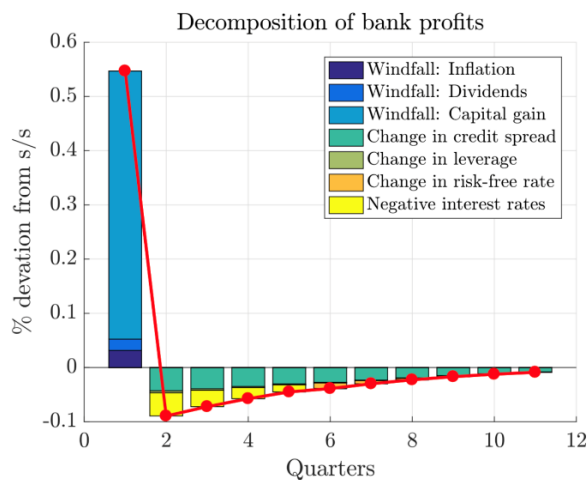
bank profitability increases in response to a decline of policy rates into negative territory. This increase in profits and net worth is largely driven by capital gains as a result of a surge in the value of private sector assets on banks' balance sheets. After the initial rise in profits, tighter bank credit spreads (in green) and the costs of negative rates as a charge on excess liquidity (in yellow) depress bank profits and net worth eventually declines back to its initial level.

Figure 7: Output decomposition in response to a negative rates shock



Note: Output response to a 25b.p. monetary policy (mp) easing when the deposit rate is at the ZLB for 4 quarters. Source: de Groot and Haas (2018).

Figure 8: Bank profitability in response to a negative rates shock



Note: Decomposition of bank profits after a 25b.p. mp easing when the deposit rate is at the ZLB for 4 quarters. Source: de Groot and Haas (2018).

The effect on bank profitability depends on the amount of leverage in the banking system and on the amount of excess reserves in the system. In these exercises, the share ratio of total reserves to deposits is set at 20%, similar to the ratio in the euro area (see Figure 4). A higher share of excess reserves on the banking sector's balance sheet raises the costs of negative interest rates and lowers the overall effectiveness of the negative interest rate policy. But, even doubling the share of total reserves in the system does not reverse the general result that negative interest rates are expansionary. **In this modelling framework, a negative interest rate policy stimulates bank net worth. Significant capital gains, and a more favourable economic environment that induces banks to increase credit supply to the real economy, outweigh the costs of negative interest rates.**

4.3 On the optimality of negative interest rates

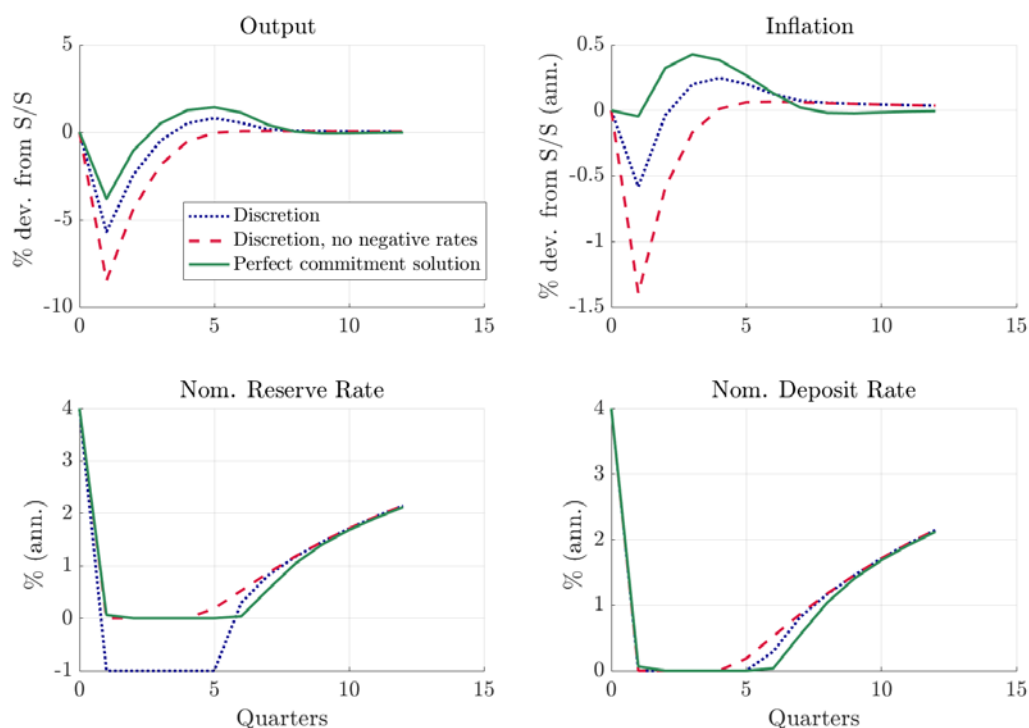
With evidence for negative interest rates to be an effective crisis instrument, we conclude with an investigation of conditions for negative interest rates to also constitute an optimal policy tool. A welfare analysis as outlined in de Groot and Haas (2018) yields two necessary conditions for a negative interest rate policy to be an optimal crisis response: (i) policy makers are constrained to set policy in a discretionary (or time-consistent) manner (i.e. they cannot credibly commit to a desired future interest rate path that they know to be suboptimal ex-post); and (ii) the central bank has a preference for changing interest rates only gradually.

If a central bank is able to fully and credibly commit to future actions, it can perfectly align markets' expectations of the path of interest rates with its desired path. Under perfect commitment, a central bank has no need to signal lower for longer deposit rates by committing to a costly negative interest rate policy. It will simply use its forward guidance to credibly promise a desired interest rate path. Thus, it is only if a central bank cannot act under perfect commitment (i.e. there are limits to its forward guidance) that negative interest rates will be optimal as a signalling device. However, today's negative interest rates only serve as a credible signalling device for tomorrow's rates if monetary policy is perceived to be incremental. If a time-consistent policy maker has no preference for gradual policy changes, then a lower policy rate signals nothing about the level of policy rates in the future.

Figure 9 illustrates this result. A central bank acting under perfect commitment, i.e. one that cannot renege on its prior promises, will not lower reserve (policy) rates into negative territory but instead make use of forward guidance to promise lower interest rates in the future (green line). This policy option minimizes both the deviation between inflation and target and the output gap. A policy maker without the means to perfectly commit to this policy path and without a preference for smoothing rates cannot replicate this first best result (red line). This policy maker neither uses negative interest rates nor is able to remain at the zero lower bound for as long. As a result, the output and inflation outcomes are substantially worse. However, with a preference for changing interest rates only gradually, a policy maker will find it optimal to reduce the reserve (policy) rate into negative territory (blue line) to signal lower interest rates in the future (the deposit rate remains at the zero lower bound for an additional quarter). While this policymaker is not able to replicate the first-best result, it is able to significantly mitigate the recessionary effects on output and inflation.

The above stated conditions for a negative interest rate policy to be optimal are reasonable requirements: In reality, central banks have limits to credibility, despite recent successful attempts to engage in forward guidance.¹¹ Also, there is robust empirical evidence that central banks have a preference for adjusting interest rates gradually.¹² In this sense, both conditions are likely satisfied with regard to the ECB's negative interest rate policy. **In this modelling framework, the ECB's negative interest rate policy might well constitute an optimal complement to its forward guidance policy.**

Figure 9: Optimal policy under discretion and commitment



Note: Impulse responses to a contractionary risk premium shock that induces a crisis scenario in which the deposit rate is constrained at the zero lower bound for 4 quarters. Source: Preliminary calculations, de Groot and Haas (2018).

¹¹ The ECB began using forward guidance in July 2013. An early assessment of empirical and theoretical arguments surrounding limited central bank credibility can be found in Blinder (2000). A more recent historical overview is given by Bordo and Siklos (2015).

¹² Coibion and Gorodnichenko (2012) provide an overview on the empirical evidence for gradual interest rate adjustments and test competing explanations of policy inertia.

5 Closing Remarks

Confronted with below target inflation, sluggish growth, and increasing financial market uncertainty, on June 5, 2014, the ECB Governing Council decided to decrease its deposit facility rate (DFR) into negative territory. Since then, it has pursued a negative interest rate policy. Due to a zero lower bound constraint on returns to retail deposits, this policy has created a wedge between reserve and deposit rates in the euro area. Despite this, banks hold record levels of excess liquidity.

A very expansionary monetary policy environment comes with both benefits and risks: On the one hand, the empirical and theoretical literature suggests that a negative interest rate policy has a stimulating effect on the real economy via the classic monetary transmission channels plus the signalling channel of negative interest rates. In aggregate, negative policy rates enhance credit supply and improve the wealth situation of firms and households. On the other hand, negative policy rates are associated with risks to financial stability. Potential effects range from downward pressure on net interest margins, and thereby bank profitability, to negative consequences from riskier bank lending behaviour. Excessive cash hoarding and a less efficient capital allocation that keeps credit flowing to otherwise insolvent borrowers complement this list of risks induced by low/ negative interest rates.

In light of these heterogeneous effects, we use a macroeconomic model by de Groot and Haas (2018) to systematically weigh the costs and benefits of the ECB's negative interest rate policy. In an assessment of the trade-off between the ability of a central bank to use negative policy rates to signal lower future deposits rates, against the potential costs on bank profitability, we find that the signalling effect dominates potential costs on bank profitability. In this modelling framework, a negative interest rate policy is an effective monetary policy tool, even when deposit rates are bound by zero. Significant capital gains, and a more favourable economic environment that induces banks to increase credit supply to the real economy, outweigh the costs of negative interest rates. Furthermore, a simple welfare analysis yields that under reasonable conditions, negative interest rates might constitute an optimal crisis response.

But, an economic model is a simplified framework designed to illustrate complex real-world processes. As such, its findings should always be taken with a grain of salt. Empirical observations on financial stability risks, which the model only captures to a limited degree, can help to put these findings into perspective. While, in the euro area, at this time, there is little empirical

evidence suggesting negative interest rates have had a large adverse impact on bank profitability, excessive cash hoarding and increased risk taking, an effective banking regulation and an alert banking supervision are crucial to ensure that the benefits of the ECB's current negative interest rate policy continue to outweigh its costs.

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