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CENTRAL BANKING BELOW ZERO: THE IMPLEMENTATION OF NEGATIVE INTEREST RATES IN EUROPE AND JAPAN

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Abstract

This paper provides an overview of the operational implementation of negative interest rates in Europe and Japan. Drawing attention to the fact that there is precedent for negative policy rates and negative money market rates, the paper addresses conceptual issues and summarizes measures which define negative interest rate policy. Based on detailed institutional analysis and an examination of the interaction of negative interest rate policies with balance sheet policies, it is argued that there is substantial heterogeneity in the purpose, design and operational specificities of negative interest rate policies across economies, with significant consequences for effective money market rates, private sector funding conditions, and expectations. Summarizing transmission channels of negative rates to the real economy and their potential benefits and risks, the paper calls attention to potential adverse effects resulting from the interaction of negative interest rate policy with tighter liquidity and capital standards adopted since the Global Financial Crisis.

Keywords: negative interest rates, central banking, policy rates, market rates, balance sheet policies

JEL Classification: E5, E52, E58

Abbreviations

BIS	Bank for International Settlements
BNB	Bulgarian National Bank (central bank of Bulgaria)
BOJ	Bank of Japan (central bank of Japan)
CBBH	Central Bank of Bosnia and Herzegovina (central bank of Bosnia and Herzegovina)
DN	Danmarks Nationalbank (central bank of Denmark)
ECB	European Central Bank (central bank of the euro area)
ERM-II	European Exchange Rate Mechanism II
IMF	International Monetary Fund
MNB	Magyar Nemzeti Bank (central bank of Hungary)
NB	Norges Bank (central bank of Norway)
NIRP	Negative Interest Rate Policy
QE	Quantitative Easing
SR	Sveriges Riksbank (central bank of Sweden)
SNB	Swiss National Bank (central bank of Switzerland)
TARGET 2	Trans-European Automated Real-time Gross settlement Express Transfer (the Eurosystem's real-time gross settlement system)
TLTRO-II	2nd round of the ECB's Targeted Longer-Term Refinancing Operations

Contents

1. INTRODUCTION

The introduction of negative interest rate policies (NIRPs) across economies worldwide between mid-2014 and early 2016 has attracted the attention of international policymakers and the global public in a way few central bank policies have done before. The zero lower bound had been broken, and with it much of the theoretical thinking that had guided policymakers over the past decades. As debate on the relative merits and drawbacks of negative interest rates continues, this paper seeks to highlight several key aspects of negative rates that so far, despite the topic's prominence, have received less attention in the literature.

The paper starts by outlining several conceptual issues related to NIRPs, including historical precedents of negative rates, the policy's general characteristics, and definitional challenges. This is followed by an overview of the operational implementation of negative interest rates in Europe and Japan, with particular emphasis on the balance sheet policies that have accompanied negative rates. Finally, the transmission of negative rates to the real economy, and their impact and effectiveness within the context of increased regulation since the Global Financial Crisis, are addressed.

Based on this, the paper will present three main arguments. The first argument is that negative policy rates and negative money market rates are not entirely new. Monetary authorities have experimented with negative policy rates before and money market rates have occasionally turned negative in several economies in the past. What is new is the explicit nature of recent negative interest rate policies, central banks' communication of these policies, and the coordination of different policy levers to simultaneously lower policy rates and money market rates more significantly and more permanently below zero.

The second argument is that the purpose, design and operational specificities of NIRPs and related policies differ substantially around the world, which affects the ultimate impact these policies have on a country's economy. Motivations for adopting negative rates and their technical implementation have differed considerably among countries depending on central banking traditions and macroeconomic conditions, leading to substantial divergence of money market rates and effective average rates. These differences matter for how wholesale rates translate into retail rates, how expectations and private sector funding conditions are affected, and how a country's economy ultimately reacts.

Finally, the changes taking place in international finance since the Global Financial Crisis have substantially changed the context in which monetary policy is being applied. Restrictions on banks' balance sheet space and profitability pressures have challenged traditional business models and limited arbitrage across asset classes and markets. This affects the transmission of monetary policy across interest rates and exchange rates, as the breakdown of the Covered Interest Parity Condition forcefully demonstrates (Borio, McCauley, McGuire, and Sushko, 2016). Greater attention to the interaction between regulatory and monetary policies is thus warranted.

1.1 Literature Review

Given the relatively recent adoption of NIRPs, the body of academic literature on the topic is still relatively small. Most work on NIRPs thus far consists of research conducted by international organizations, such as the Bank for International Settlements (BIS) or the International Monetary Fund (IMF), monetary authorities, and financial institutions.

Comprehensive overviews of the operational implementation of NIRPs are given by Bech and Malkhozov (2016) and Jobst and Lin (2016). These authors outline the various measures adopted by central banks around the world to implement negative interest rates and discuss their transmission to the economy on theoretical grounds.

There exist several early empirical analyses of NIRPs, focusing on the effect of the policies on microeconomic behavior, exchange rates, and financial market variables. An early survey-based study of about 13,000 consumers in Europe conducted by ING (Cliffe, 2015) found that the number of people saying they would spend more in response to negative rates on their savings accounts nearly equaled the number of people saying they would spend less. A study by Demiralp, Eisenschmidt, and Vlassopoulos (2016) found that the ECB's NIRP has led to increased bank lending to the non-financial private sector, lower levels of wholesale funding, and increased acquisition of (nondomestic) sovereign bonds in the euro area. Arteta, Kose, Stocker, and Taskin (2016) provide an empirical analysis of the transmission of negative policy rates to other financial variables in the euro area, Sweden Japan, Switzerland, Denmark, and Hungary, up to mid-2016, arguing that NIRPs have worked similarly to conventional monetary policy easing measures in providing more elasticity and improving funding conditions, although these effects appear less pronounced than after comparable rate cuts in positive interest rate territory. Most recently, a study by Hameed and Rose (2016) analyzed the effect of NIRPs on exchange rates using daily-frequency data for 61 countries between January 2010 and May 2016, finding that NIRPs seem to have little effect on observable exchange rate behavior.

The perspectives taken by authors towards NIRPs also differ substantially. Some groups of authors (e.g. Viñals, Gray, and Eckhold, 2016; Blanke and Krogstrup, 2016; Jobst and Lin, 2016) assume a positive view, arguing that NIRPs positively affect the economy by lowering funding costs and raising asset prices. Other groups of authors are more skeptical (e.g. Borio, Gambacorta, and Hofmann, 2015; Caruana, 2016; ESRB, 2016), pointing out potential adverse effects of low and negative rates on the profitability of financial institutions and financial stability.

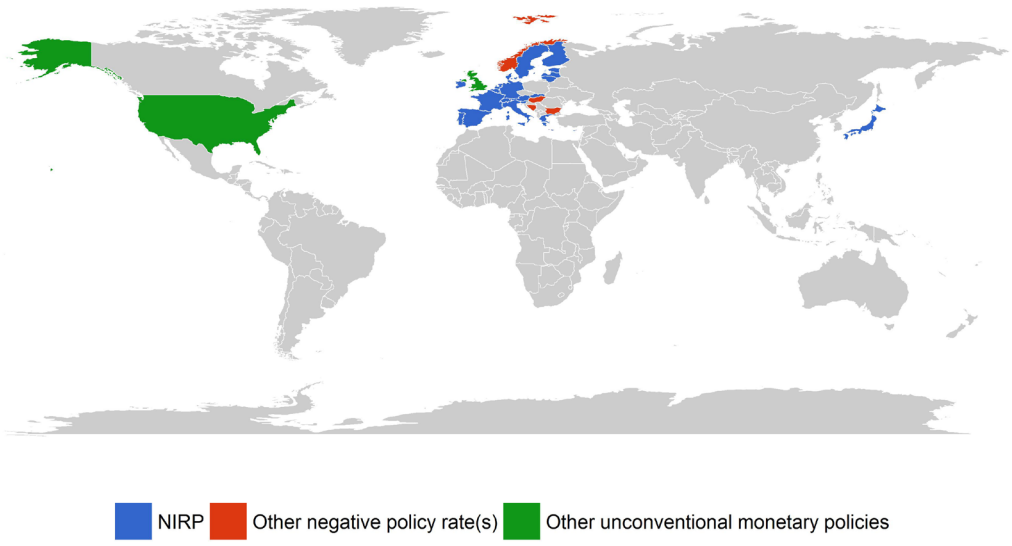
2. CONCEPTUAL CONSIDERATIONS

Central banks have traditionally operated by signaling a target interest rate to the interbank market and engaging in open-market operations, lending to commercial banks, and/or payment of interest on commercial bank reserves as necessary to achieve their target rate (Borio and Disyatat, 2010). The interest rate so established then influences other rates in the economy, across different markets and across the term structure. Like interest rate changes in positive territory, NIRPs are implemented through central bank policy rates, which affect interbank rates, money market rates, and eventually, the theory goes, retail rates.

Negative central bank deposit rates have already been observed in Denmark in 2012–2014 and in Sweden in 2009–2010, whereas effective nominal interbank rates have occasionally turned negative in Switzerland in 2011–2014, in Denmark in 2012–2014, and even briefly in Japan in 2006 (FT, 2016). Real interest rates have been negative for even longer. As such, negative interest rates are by themselves not new. What is new is the official announcement of NIRPs by monetary authorities and the combined application of different measures to push policy rates and nominal interbank rates more substantially and more permanently below zero. These features define NIRPs and distinguish NIRPs from traditional interest rate policy in positive territory.

Some economies have followed this trend into negative territory but have not, strictly speaking, implemented a NIRP. Examples of this are Hungary and Norway, where authorities lowered deposit rates to below zero to affect cross-border financial flows, among others, but maintained positive interbank rates. There are also cases of currency boards where negative rates are simply a consequence of authorities approximating the monetary policy of the anchor economy. This includes Bulgaria and Bosnia and Herzegovina.

Figure 1: Jurisdictions with NIRPs, Other Negative Policy Rates, or Other Unconventional Monetary Policies



Source: Authors' illustration.

2.1 Operational Characteristics

Motivations for adopting a NIRP and operational implementation differed across economies. Whereas price stability was a major concern in the euro area and Japan, the exchange rate was a primary factor in many other economies. NIRPs were typically implemented on the back of large interbank liquidity balances, which were a result of quantitative easing policies (especially in the euro area and Japan) or financial inflows from abroad (Switzerland, for example). The economies that implemented a NIRP generally employed some form of interest rate corridor, limited at the upper end by a lending rate that is applied when banks draw on central bank credit and at the lower

end by a deposit rate that applies to reserves banks hold with the central bank.[1] Interbank rates were typically closer to the lower limit of the corridor after the Global Financial Crisis (Grossmann-Wirth and Vari, 2016), given the large-scale liquidity injections undertaken by central banks in response to the crisis. In this context, NIRPs were implemented by lowering the central bank deposit rate into negative territory, followed by downward adjustment of other policy rates, until the interbank overnight rate reached the desired negative level.

Since the interbank overnight rate is the interest rate that applies when commercial banks lend central bank reserves to each other, it represents the marginal price of central bank liquidity. While the interbank rate is the rate that ultimately affects other market rates in the economy, it is not necessarily equal to the average rate that applies across the total volume of commercial bank reserves, which determines the impact on bank profitability. The average rate depends on the quantity and price of different classes of reserves, so if a substantial share of reserves is *not* subject to the negative marginal rate, the average rate and the marginal rate will be very different. Indeed, it has been observed that marginal rates and average rates diverge substantially in many cases, as average rates are not necessarily lowest in those economies with the lowest (i.e. the most negative) policy rates (Bech and Malkhozov, 2016).

Several economies have tiered reserve systems, where only a share of the reserves is subject to the negative marginal rate. Other economies introduced such systems together with NIRPs. In yet other economies, central banks maintain exemption thresholds, and only reserves above these thresholds face the negative marginal rate. Finally, in some cases open-market operations or special central bank facilities provide sources and uses for central bank liquidity at rates that are different from the negative marginal rate. All of these operations serve to exempt part of commercial bank reserves from the impact of NIRPs (the corresponding reserves would fall under item 2 in Table 2), but leave the negative marginal rate untouched. In the words of Jobst and Lin (2016): “The exemption threshold should be as high as possible to minimize the banks’ average cost of holding excess reserves while being sufficiently low to transmit the marginal policy rate to money markets.”

The impact of NIRPs on commercial bank profitability and the real economy also depends on the availability of alternative uses for central bank reserves that provide less negative return (see also Cœuré, 2014). Commercial banks can attempt to reduce their reserve positions by depositing their holdings at an alternative central bank facility, such as a current account or a long-term deposit facility, which is not subject to negative rates. They may purchase government or central bank securities, particularly longer maturities (since short maturities correlate more strongly with short-term policy rates). They may choose to lend to riskier counterparties in the interbank market, depending on degree of market competition and market fragmentation (the latter is a particular concern in the euro area). They could increase required reserves by extending more loans (although this would be a very protracted process). Finally, banks may choose to accelerate repayment of debt to the central bank or attempt to substitute reserves for physical currency, although the latter is not typically feasible given the costs involved. Ultimately, however, central bank liquidity circulates in a closed system and as such cannot be eliminated by other means (Demiralp et al., 2016; Andresen, Kristoffersen, and Risbjerg, 2015).

[1] This is different from the United States, where an interest rate corridor was only implemented after the Global Financial Crisis with the introduction of interest payments on excess reserves.

Table 1: General Structure of Commercial Banks' Balance Sheets

Assets	Liabilities
1. Central bank reserves subject to negative marginal rate	7. Demand deposits
2. Central bank reserves exempted from negative marginal rate	8. Restricted (time/savings) deposits
3. Claims on private sector (loans etc.)	9. Foreign currency deposits
4. Government securities	10. Money market instruments
5. Central bank securities	11. Foreign liabilities
6. Foreign assets	12. Public sector deposits
	13. Credit from central bank
	14. Equity capital

Source: Authors' illustration.

On the retail side, interest rate decreases raise the value of banks' assets while simultaneously reducing return on assets. Reduced return on assets lowers banks' profit margins, which they can attempt to compensate for by decreasing deposit rates or increasing lending rates. With the exception of deposit rates for large corporate customers in Switzerland, Denmark, and Germany, banks have so far been reluctant to implement negative deposit rates to pass on the cost of negative reserves to consumers (Jobst and Lin, 2016; Shotter, 2016). Similarly, the ability of banks to increase lending rates is limited by competition.

Table 2: Central Bank Systems with Negative Policy Rates

Economy	Objective	Combined Measures	Negative Deposit Rate	Negative Interbank Rate	Deposit Rate as of 09/2016
Euro area	Price stability	Asset purchase program	2014/06	2014/10	–0.40%
Sweden	Price stability	Asset purchase program	2014/07 (before 2009/07 to 2010/08)	2015/02	–1.25%
Denmark	Exchange rate stability	Foreign exchange intervention	2014/09 (before 2012/07 to 2014/03)	2015/01 (before 2012/07 to 2014/03)	–0.65%
Switzerland	Exchange rate stability, price stability	–	2015/01*	2015/01* (before 2011/08 to 2014/11)	–1.25% (3m CHF Libor minimum)
Norway	Price stability	–	2015/09	–	–0.50%
Bulgaria	Mirror ECB policy stance	Implicitly foreign exchange intervention	2016/01	2016/01	–0.40% (Equivalent to ECB deposit rate)
Japan	Price stability	Asset purchase program	2016/02	2016/02	–0.10% (Marginal deposit rate)
Hungary	Price stability, exchange rate stability	Asset purchase program	2016/03	–	–0.05%
Bosnia and Herzegovina	Mirror ECB policy stance	Implicitly foreign exchange intervention	2016/07	–	–0.20% (50% of ECB deposit rate)

continued on next page

Table 2 *continued*

Economy	Main Policy Rate as of 09/2016	Lending Rate as of 09/2016	Reserve Tiers	Balance Sheet Structure in 2006	Balance Sheet Structure in 2015
Euro area	0.00%	0.25%	None	Foreign exchange holder/Banker's banker	Treasuries holder /Banker's banker
Sweden	–0.50%	0.25%	None	Foreign exchange holder/Note issuer	Foreign exchange holder/Government's banker
Denmark	0.00%	0.05%	2	Private sector lender/Banker's banker	Foreign exchange holder/Banker's banker
Switzerland	–0.75% (Sight deposit rate)	–0.25% (3m CHF Libor maximum)	2	Foreign exchange holder/Banker's banker	Foreign exchange holder/Banker's banker
Norway	0.50%	1.50%	2	Foreign exchange holder/Government's banker	Foreign exchange holder/Government's banker
Bulgaria	–	0.00% (Base interest rate)	2	Foreign exchange holder/Government's banker	Foreign exchange holder/Banker's banker
Japan	0.00%	0.10% (Loan support program)	3	Treasuries holder/ Government's banker	Treasuries holder/ Banker's banker
Hungary	0.90%	1.15%	None	Foreign exchange holder/Banker's banker	Foreign exchange holder/Banker's banker
Bosnia and Herzegovina	–	–	2	Foreign exchange holder/Banker's banker	Foreign exchange holder/Banker's banker

Monetary authorities and Jobst and Lin (2016); balance sheet structure according to Pattipeilohy (2016); *Swiss interbank overnight rate periodically turned negative 2012/07–2014/03; 3m CHF Libor rate permanently turned negative 2014/12 when SNB set negative lower bound for 3m CHF Libor.

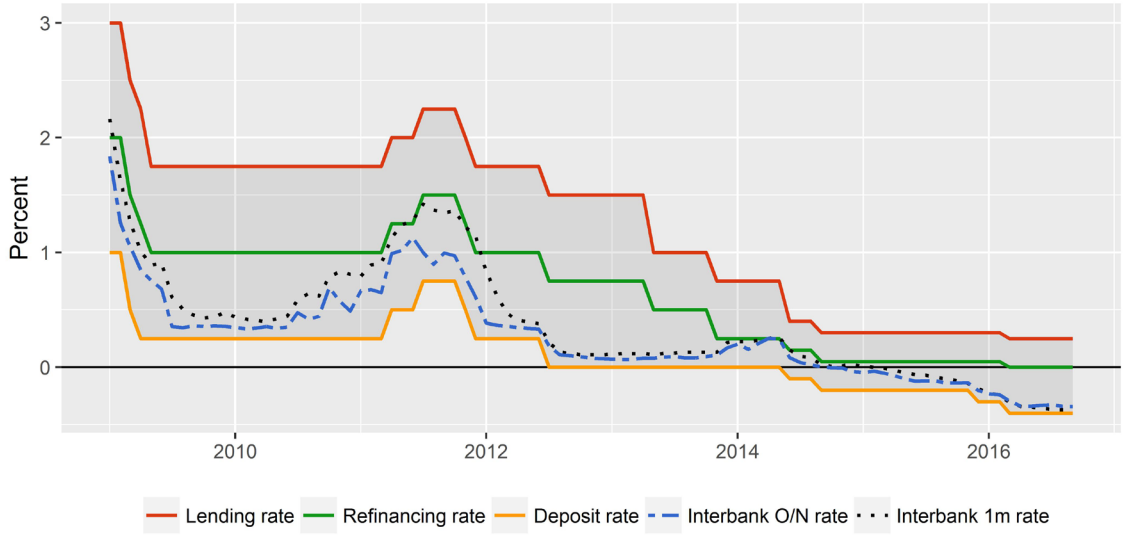
Both the operational implementation of negative interest rates and market structure influence the effective money market rate, which is the rate that ultimately affects retail rates and the real economy. The following section will address each of these areas in turn for those economies that have implemented negative rates.

3. OPERATIONAL IMPLEMENTATION

3.1 Euro Area

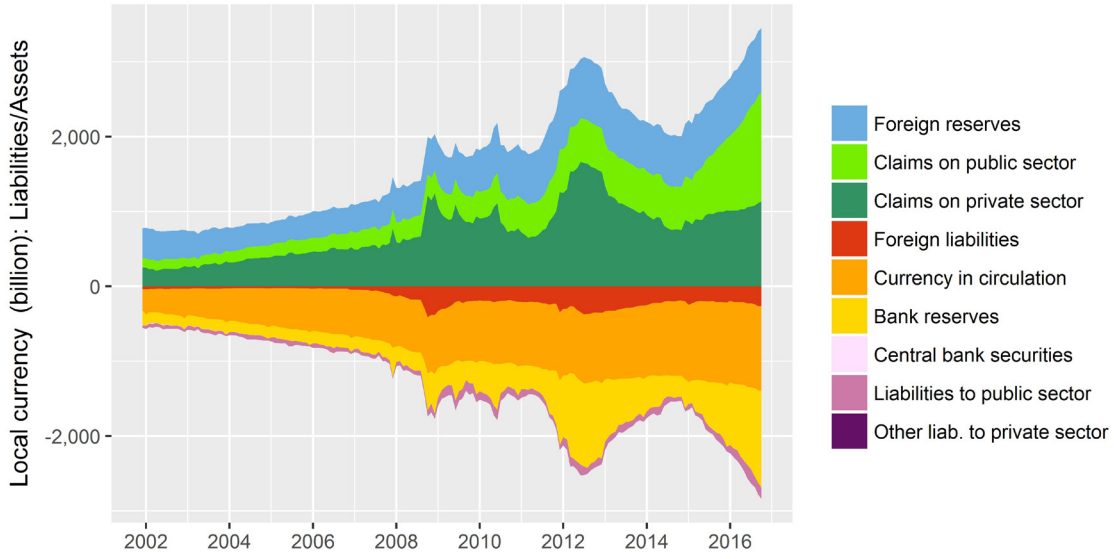
In summer 2014, the European Central Bank set off the move into negative interest rate territory by lowering its deposit rate sufficiently to pull the interbank overnight rate below zero. In response to subdued inflation figures (ECB, 2014b), the ECB implemented a NIRP by simultaneously lowering all policy rates that make up its interest rate corridor, namely the marginal lending facility rate (the upper bound of the corridor), the main refinancing operations rate (traditionally the central policy rate target), and the deposit rate (the lower bound of the corridor).

Figure 2: Euro Area Policy Rates and Money Market Rates



Source: European Central Bank, CEIC.

Figure 3: Euro Area Central Bank Balance Sheet



Source: IMF International Financial Statistics.

Interbank rates in the euro area have traditionally been closer to the center of the corridor, but started moving closer to the lower end of the corridor when the ECB began implementing large-scale asset purchase programs that injected additional liquidity into interbank markets. Money market rates followed the downward trend of the deposit rate, with the Euro OverNight Index Average (EONIA, the euro area interbank overnight rate) turning negative in October 2014, and the one-month Euro Interbank Offered Rate (Euribor) following closely.

Together with the adoption of a negative rate on its deposit facility, the ECB also decided that commercial banks' current account balances in excess of the minimum reserve requirement (reserve requirements in the euro area are currently between

0% and 1%, averaged over a six-week maintenance period) would henceforth be remunerated at the negative deposit rate, as opposed to the zero current account rate (ECB, 2014a, 2016a). This prevents commercial banks from engaging in arbitrage by shifting reserves between accounts to avoid the negative interest rate. Required reserve holdings thus earn the main refinancing operations rate (currently 0%), whereas excess reserves earn the negative deposit rate.

The large amount of reserves on the liability side of the ECB's balance sheet, classified as a "banker's banker pattern" by Pattipeilohy (2016), correlates with an increasing volume of claims on public and private sectors of euro area economies on the asset side. Where the ECB's assets were traditionally dominated by holdings of foreign reserves before the Global Financial Crisis, the largest share of its asset holdings since 2015 is made up of government securities. This change in asset composition is a by-product of the ECB's asset purchase programs, the latest iteration of which complemented the introduction of the NIRP (Bech and Malkhozov, 2016).

One factor affecting the eventual impact of the ECB's NIRP on bank profitability and the composition of banks' aggregate reserve holdings is the second round of the ECB's Targeted Longer-Term Refinancing Operations (TLTRO-II), introduced in March 2016. The program consists of targeted measures to provide financial institutions with central bank liquidity under special conditions designed to incentivize lending to the real economy.

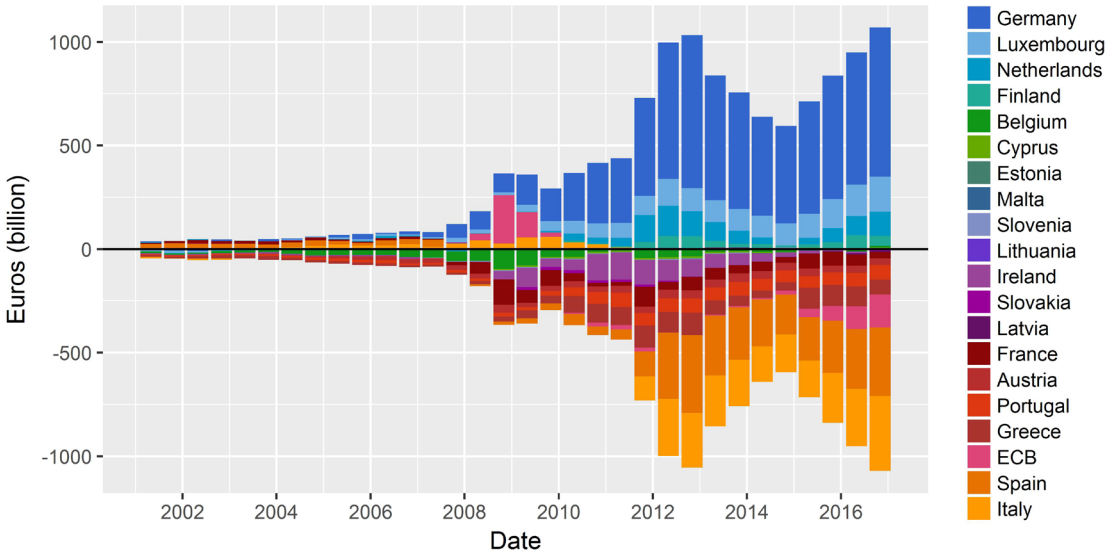
Currently, financial institutions drawing on ECB credit are charged a positive rate of interest on the quantity taken out, on top of which they need to pay the negative policy rate applying when holding this liquidity at the ECB's deposit facility. Under the TLTRO-II program, banks reaching a certain lending target will not need to pay interest on the amounts of liquidity received from the ECB, while banks that significantly outperform their lending targets will even receive interest on their outstanding credit. In effect, such banks would be borrowing at a negative rate and thus would have to pay back a smaller amount of central bank reserves than they initially borrowed. By doing so, the ECB effectively returns part of the cost of holding reserves to financial institutions in return for increased lending to the real economy. Under optimal circumstances, this "reimbursement" and the negative rate charged on reserve holdings would cancel each other out (Merler, 2016). In December 2016, the total amount allotted to euro area banks under the TLTRO-II program stands at 506.7 billion euros (ECB, 2016c).[2]

The implementation of the NIRP has presented certain challenges unique to the euro area. European financial institutions trade central bank liquidity within the Eurosystem's Trans-European Automated Real-time Gross settlement Express Transfer (TARGET 2) system, which spans all member countries of the European Monetary Union. Against the background of the European economic crisis, TARGET 2 balances have diverged strongly, with banks in net creditor countries having accumulated large net surplus positions and banks in net deficit countries having accumulated large net deficit positions. Since NIRP applies to commercial banks' holdings of central bank reserves, the policy affects those countries with large surplus positions more than others

[2] The TLTRO-II program consists of three rounds of refinancing operations. During the first round in June 2016, 514 institutions obtained a total of 399.3 bn euros of funding. During the second round in September 2016, 249 institutions obtained a total of 45.3 bn euros of funds. During the third round in December 2016, 200 institutions obtained a total of 62.2 bn euros of funds.

(Shotter, 2016).[3] The impact of NIRP in the euro area is thus distributed unequally across the monetary union.

Figure 4: Eurosystem TARGET 2 Positions



Source: CEIC.

A further challenge is the impact of the NIRP on the profitability of financial institutions in Europe. Bank profitability has been a long-standing issue for many euro area countries (Albertazzi and Gambacorta, 2009), and recent indicators point to a further decline of profitability (ECB, 2016b).

According to Bech and Malkhozov (2016), money market trading volumes have remained stable following the introduction of the NIRP. They report that banks have extended maturities and increased lending to riskier counterparties in the periphery following the adoption of the policy, which (together with the introduction of the Single Supervisory Mechanism, stronger economic and financial conditions, etc.) may have improved market access for banks in the periphery. Such measures may give the impression that market fragmentation has decreased, but the renewed divergence of TARGET 2 balances since 2014 suggests that this may not necessarily have been the case (Six and Tahiri, 2016).

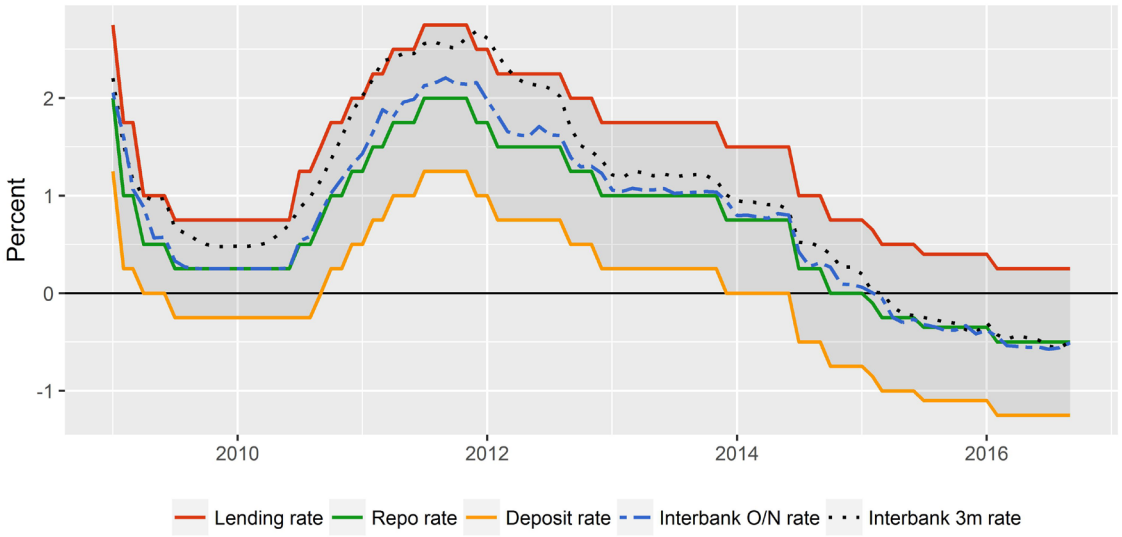
3.2 Sweden

Following the ECB's announcement of a negative deposit rate, the Swedish central bank, Sveriges Riksbank (SR), implemented a negative deposit rate in July 2014 to tackle subdued inflation figures (Arteta et al., 2016; Chantapacdepong and Hemvanich, 2016). While Sweden maintains no explicit exchange rate target, the central bank indicated that it would be prepared to intervene in the foreign exchange market if krona appreciation were to threaten price stability (Bech and Malkhozov, 2016). Deputy Governor of the Riksbank Cecilia Skingsley also stressed the importance of external

[3] As of November 2016, the combined TARGET 2 balances of German financial institutions make up 67% of all TARGET 2 surpluses. The combined TARGET 2 balances of financial institutions in Italy and Spain make up 65% of all TARGET 2 deficits.

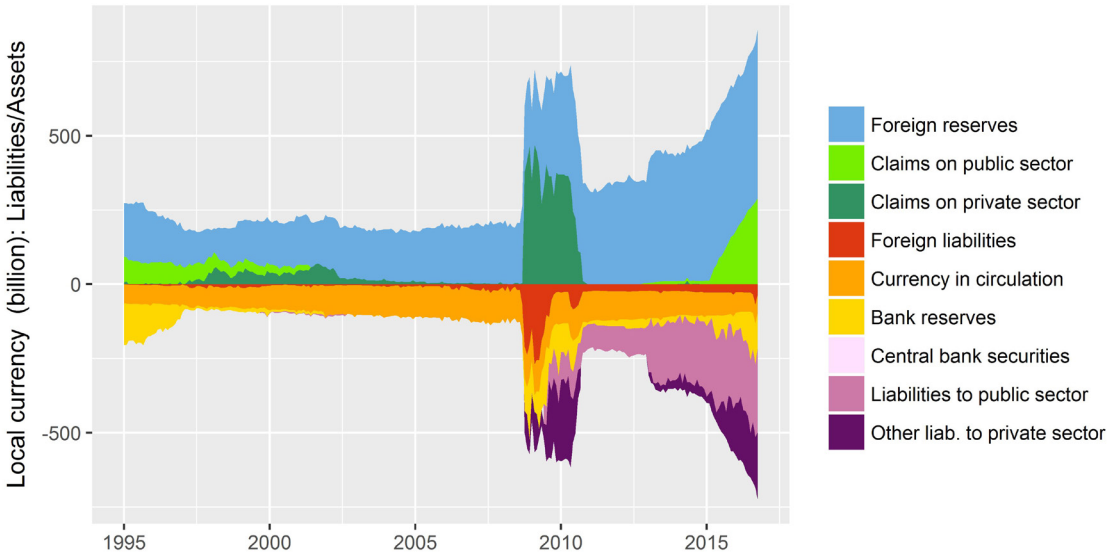
factors to the Swedish economy in a speech in April 2016, arguing that Sweden "must in principle accept the international real interest rate as given" (Skingsley, 2016a).

Figure 5: Sweden's Policy Rates and Money Market Rates



Source: Sveriges Riksbank, CEIC.

Figure 6: Sweden's Central Bank Balance Sheet



Source: IMF International Financial Statistics.

The SR's deposit rate had already been negative for an extended period between July 2009 and August 2010. Authorities subsequently reinstated a positive deposit rate again for some time before returning to a negative rate in July 2014. As money market rates in the Swedish economy traditionally follow the repo rate at the center of the SR's interest rate corridor more closely, effective interbank rates are not primarily affected by the deposit rate, however. Interbank rates instead only became negative once the repo rate was taken below zero on 18 February 2015. The Stockholm

Interbank Offered Rate (Stibor) tomorrow/next rate and the Stibor 3-month rate turned negative in April 2015.

Unlike other central banks that split commercial bank reserves into different tiers in order to manage the average interest rate on reserves more precisely, the SR conducts daily open-market operations to drain reserves and replace them with debt securities and other liabilities that have a higher (i.e. less negative) yield (Bech and Malkhozov, 2016). Again, these measures serve to keep the effective interbank rate closer to the repo rate at the center of the interest rate corridor, and prevent it from dropping to the deposit rate at the lower end of the corridor.

The introduction of the NIRP was accompanied by other measures, specifically a large-scale government bond purchase program, which is on track to turn the central bank from a "foreign exchange holder" to a "treasuries holder" (following the terminology of Pattipeilohy, 2016). The liability side of the central bank's balance sheet has traditionally been dominated by currency in circulation, whereas the composition of liabilities post-crisis has been dominated by liabilities to the government. In part, this reflects the declining role of cash in the Swedish economy (Skingsley, 2016b), which has been an important empirical case in the ongoing debate surrounding the role of physical currency in contemporary society and within the context of NIRPs, as consumers' increasing reliance on electronic money is seen by some commentators as one way of enforcing NIRPs for retail deposits more effectively (Rogoff, 2016; McAndrews, 2016).

As a result of the increasing amount of foreign exchange reserves and the recent asset purchase program, the aggregate size of the SR's balance sheet has surpassed 800 billion Swedish krona. The only instance when aggregate assets came close to this figure was in the aftermath of the Global Financial Crisis, when drawing on the swap agreement between the SR and the US Federal Reserve led to a temporary spike in foreign liabilities and claims on the private sector (SR, 2009, p. 71).

3.3 Denmark

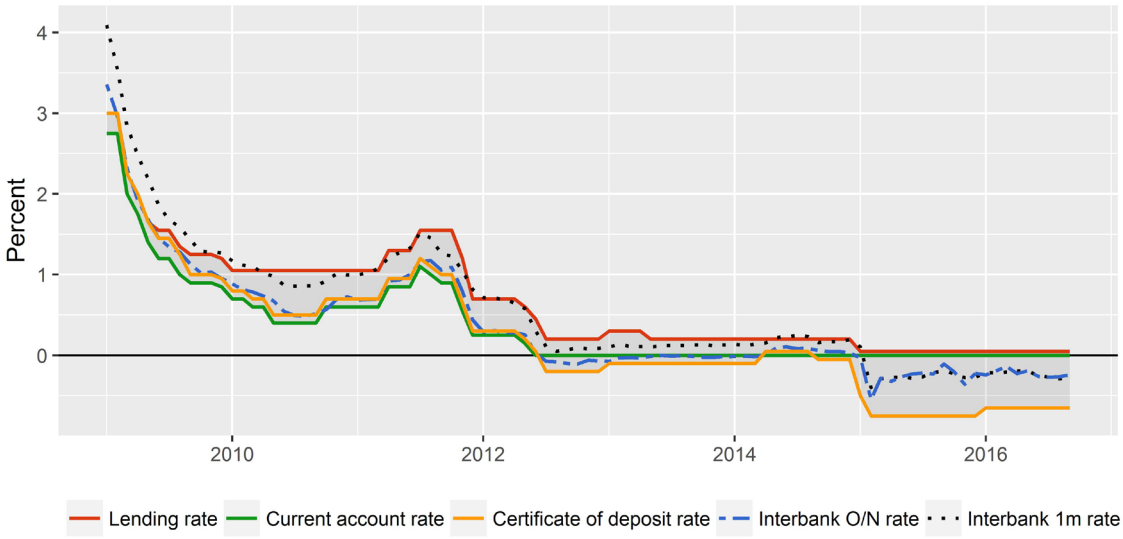
The adoption of a NIRP by the ECB led to a reaction in those economies that were pegging to the euro at the time, including Denmark and Switzerland. The Danish central bank, the Danmarks Nationalbank (DN), took its certificate of deposit rate below zero on 5 September 2014 in order to reduce financial inflows and pressure on the exchange rate (Arteta et al., 2016). The interbank tomorrow/next rate turned negative in January 2015 after the certificate of deposit rate was lowered again, with the 1-month Copenhagen Interbank Offered Rate (CIBOR) following closely. The DN had already implemented a negative certificate of deposit rate and a negative interbank tomorrow/next rate from July 2012 to March 2014, after which both rates turned slightly positive again. There was thus some precedent for negative rates, although the adoption of the NIRP in 2014 took interbank rates much further below zero than before.

Central bank policy rates and money market rates in Denmark have a looser relationship due to a thinner interbank market (Andresen et al., 2015), which complicates the definition of an interest rate corridor somewhat. The lower bound of the Danish interest rate corridor had traditionally been defined by the current account rate, which is the rate commercial banks receive when holding reserves with the central bank. The amount of reserves that can be held within the current account is limited, however, and when a commercial bank exceeds its limit, the excess is automatically converted into certificates of deposit (DN, 2016). Since the certificate of deposit rate became negative, reserves that do not fall within the current account limits have

been subject to a negative interest rate, leading the interbank rate to fall significantly below zero.

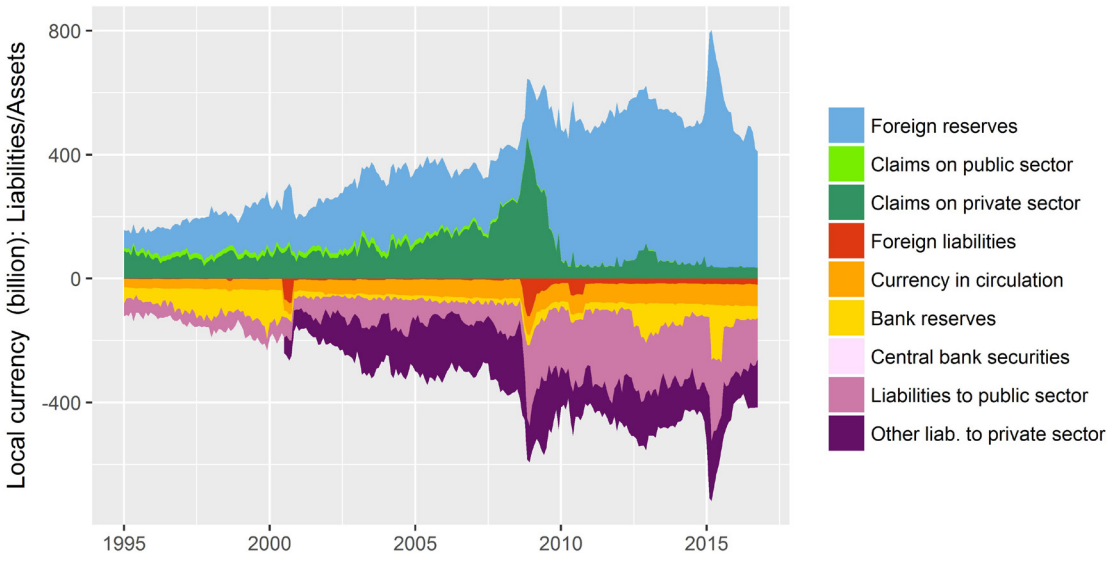
This system, where a lower certificate of deposit rate applies only to a part of total bank reserves, has been in place in Denmark since before the introduction of the NIRP (Jobst and Lin, 2016). The DN has further actively varied current account limits to manage the impact of the NIRP on banks' balance sheets (Bech and Malkhozov, 2016).

Figure 7: Denmark's Policy Rates and Money Market Rates



Source: Danmarks Nationalbank, CEIC.

Figure 8: Denmark's Central Bank Balance Sheet



Source: IMF International Financial Statistics.

Other parts of the Danish government have also been affected by the introduction of the NIRP. Danish tax authorities, for example, had to limit the amount firms could

prepay in taxes in order to receive a modest rate of interest, as prepaid taxes would otherwise present a way to avoid negative interest rates (Campbell and Levring, 2016). The Danish Ministry of Business and Growth, meanwhile, set up a working group to clarify the mechanics and tax treatment of negative mortgage bond coupons (EVM, 2015).

In terms of the central bank's balance sheet, the expansion of total assets and liabilities between the beginning of the century and now reflects Denmark's peg to the euro within the European Exchange Rate Mechanism II (ERM-II) system, of which it is now the only member. Pattipeilohy (2016) classifies the central bank's balance sheet as a "private sector lender" pattern pre-crisis and a "foreign exchange holder" pattern post-crisis on the asset side, and a constant "banker's banker" pattern on the liability side. This classification follows the shift from "claims on the private sector" to "foreign reserves" as the dominant item on the asset side of the DN's balance sheet, as the DN has absorbed increasing amounts of foreign financial inflows on its balance sheet due to the peg of the Danish krone to the euro. It is this accumulation of foreign reserves and associated exchange rate pressure that the adoption of a NIRP was to address. On the liability side, the increase of liabilities to the public sector and the private sector, which was in part due to government surpluses deposited with the central bank, mirrored the accumulation of foreign exchange reserves. Indeed, the Danish government's budget surpluses allowed it to suspend issuance of government bonds in 2015 to relieve pressure on the exchange rate (Duxbury and Cox, 2015).

3.4 Switzerland

The adoption of a NIRP by the ECB was also followed by renewed pressure on the Swiss franc peg to the euro. To relieve pressure from financial inflows and maintain the peg, the Swiss National Bank (SNB) followed Denmark into negative territory on 18 December 2014 (Arteta et al., 2016) by lowering all of its available policy rates and interest rate targets below zero.

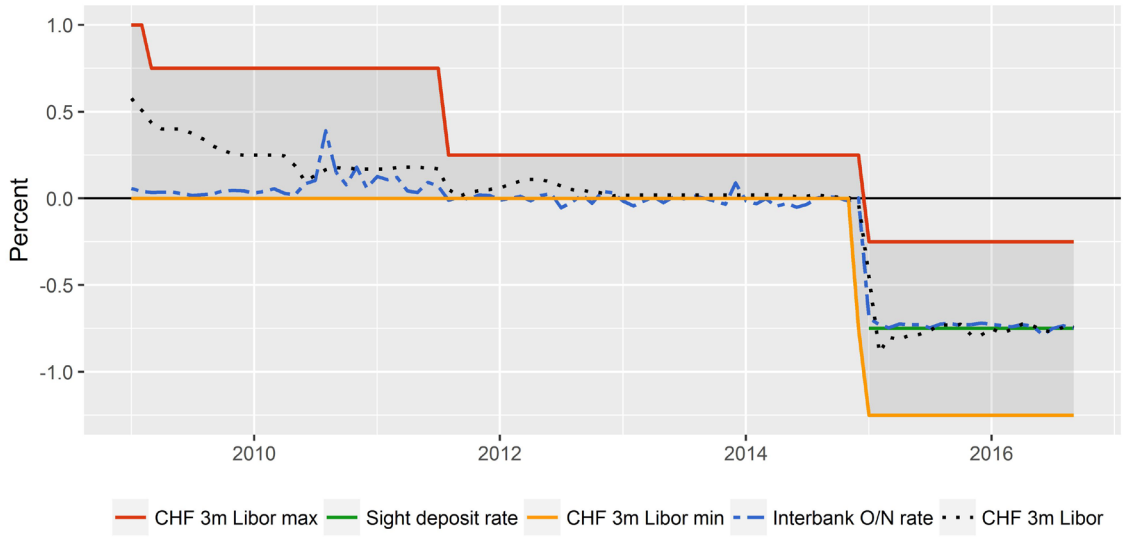
The way negative rates have been implemented in Switzerland is somewhat unique, since the SNB primarily focuses on the Swiss franc London Interbank Offered Rate (Libor) rather than the domestic interbank overnight rate (the most common interest rate target at other central banks). Much in the same way as monetary authorities in other countries maintain a corridor for the interbank overnight rate, the SNB establishes an upper and lower limit for the Swiss franc 3-month Libor rate and adjusts its operations to ensure that the effective market rate stays within these limits. This is currently achieved through a combination of open-market operations and standing facilities, with the former including repurchase agreements, issuance of SNB bills, foreign exchange transactions, and foreign exchange swaps, and the latter including the liquidity-shortage financing facility and the intraday facility (SNB, 2016). When the SNB lowered its target for the Swiss franc 3-month Libor rate below zero in December 2014, the Libor market rate followed within the same month.

Together with the adoption of the NIRP, the SNB also created a new facility for domestic commercial bank reserves, known as "sight deposits". In January 2015, the SNB instituted a negative interest rate on this new facility, subjecting any reserves held in this facility to a negative interest rate. Since the SNB did not remunerate the reserve holdings of commercial banks previously (Bech and Malkhozov, 2016), the Swiss Average Rate Overnight rate (SARON, the country's interbank overnight rate) had occasionally dropped below zero between August 2011 and July 2014. The implementation of the sight deposit facility now put strong downward pressure on interbank rates and sufficed to make both the interbank overnight rate and the Swiss

franc 3-month Libor rate more persistently and more substantially negative. Both rates have since remained close to the sight deposit rate.

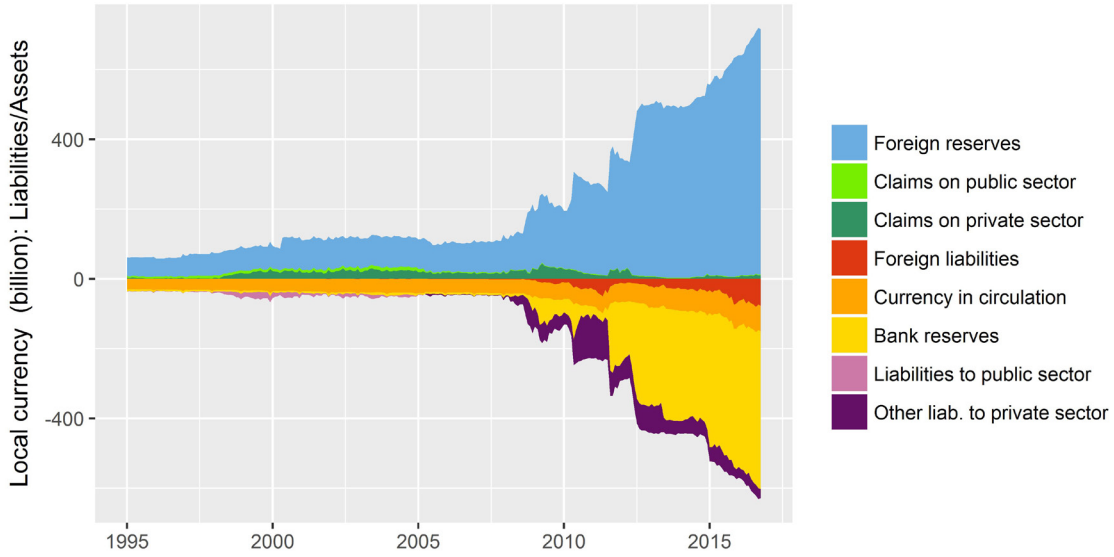
The adoption of the NIRP was further accompanied by the introduction of a tiered reserve system where negative rates only apply to reserves above a certain exemption threshold. The thresholds were set in such a way that certain banks with low reserve holdings were able to obtain wholesale funding at negative rates and place funds with the SNB at zero percent, although this only applied to individual banks and not the system as a whole (Jobst and Lin, 2016).

Figure 9: Switzerland's Policy Rates and Money Market Rates



Source: Swiss National Bank, CEIC.

Figure 10: Switzerland's Central Bank Balance Sheet



Source: IMF International Financial Statistics.

Switzerland is a prime example of how average rates are not lowest in those economies with the lowest policy rates. While the Swiss sight deposit rate appears to be among the most negative policy rates set by advanced economies' monetary authorities, the average rate is high relative to other economies, since only a small amount of reserves is effectively subject to negative remuneration (see Bech and Malkhozov 2016 for a comparison).

The balance sheet of the SNB has traditionally been dominated by foreign reserves on the asset side ("foreign exchange holder" pattern) and base money (currency in circulation and bank reserves) on the liability side ("banker's banker" pattern). With the explicit adoption of the franc-euro peg in 2011, however, foreign exchange reserves continued growing rapidly as a result of large-scale foreign exchange market interventions conducted by the SNB. These foreign exchange market interventions were accompanied by an expansion of domestic central bank liquidity. As in the case of Denmark, the large volume of financial inflows reflects the exchange rate pressure the SNB was facing, which the NIRP was designed to address. When pressure on the exchange rate did not let off, however, the SNB abandoned the franc-euro peg in early 2015.

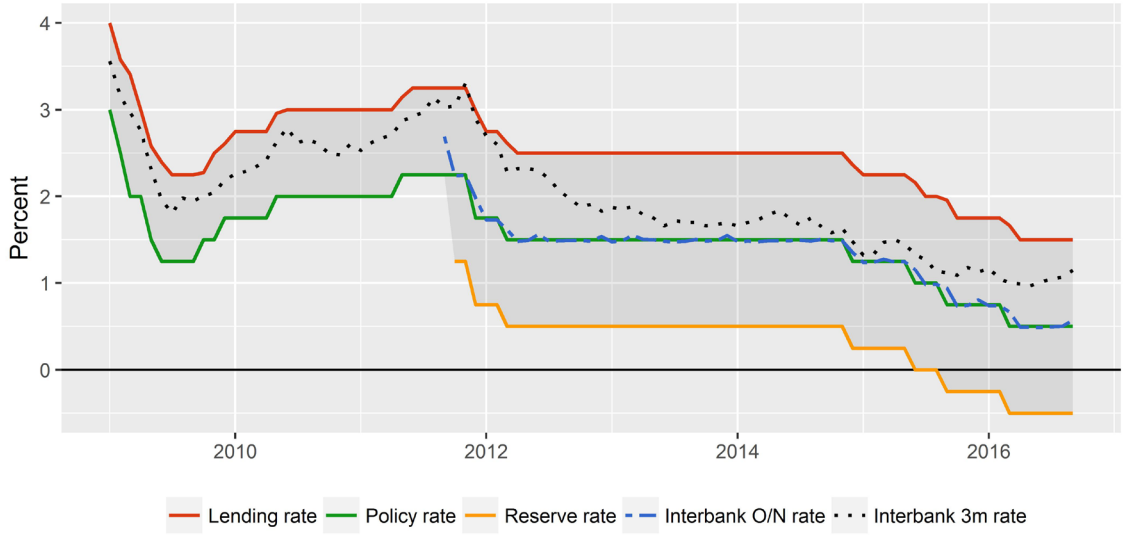
3.5 Norway

Although Norway did not explicitly adopt a NIRP, the Norwegian central bank, Norges Bank (NB), did lower its reserve rate below zero in September 2015 in response to concerns over price stability (Jobst and Lin, 2016). The reserve rate is the policy rate paid by the NB on excess reserve holdings by commercial banks and thus represents the lower limit of the interbank interest rate corridor, whereas the lending rate (also known as the "D-loan" rate) represents the upper limit (Bernhardsen and Lund, 2015). The reserve rate was first introduced in 2011, together with a quota (tiered) reserve system for commercial bank deposits at the central bank. Since the Norwegian Overnight Weighted Average rate (NOWA, Norway's interbank overnight rate, also first quoted in 2011) has generally stayed close to the NB's key policy rate at the center of the interest rate corridor, the interbank overnight rate did not turn negative when the reserve rate became negative.

Reserve holdings of Norwegian commercial banks within their respective quota limits are remunerated at the key policy rate, whereas excess reserve holdings are subject to the negative reserve rate. So long as the total quantity of bank reserves stays below quota thresholds, banks do not need to hold reserves at a negative rate (Bernhardsen and Lund, 2015). Since reserves currently remain below the quota, the interbank overnight rate has remained close to the nonnegative key policy rate. The liability side of the NB's balance sheet reflects the introduction of the quota system in 2011, when liquidity held previously as commercial bank reserves moved into the item "other liabilities to the private sector" as quota-regulated deposits.

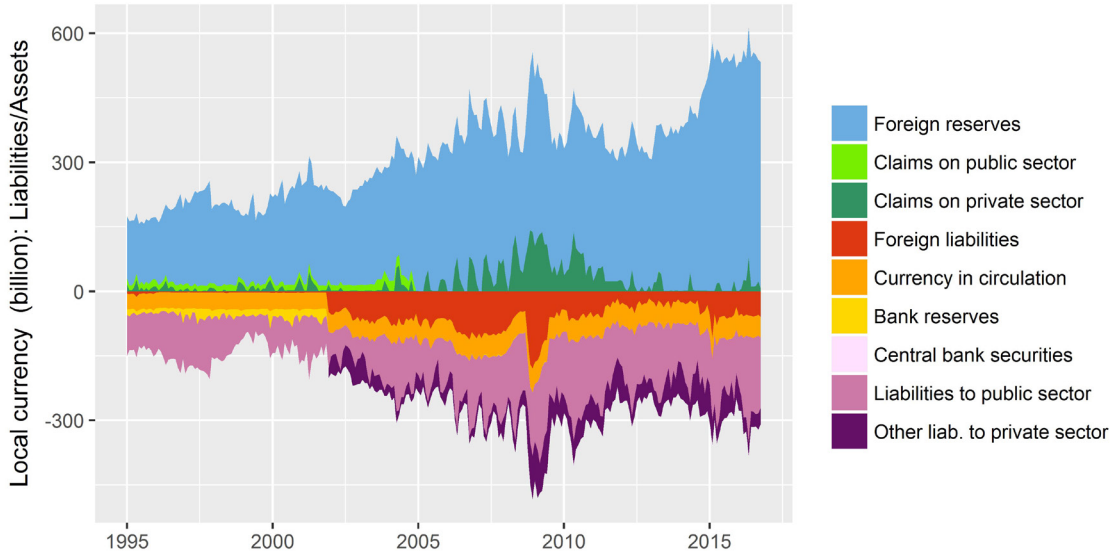
The balance sheet structure of the NB is classified as a "foreign exchange holder" pattern on the asset side and a "government banker" pattern on the liability side by Pattipeilohy (2016), due to the large amount of foreign reserves (assets) and government deposits (liabilities) held by the central bank. The NB has not intervened in the foreign exchange market since January 1999, but manages the foreign reserve holdings of Norway's pension fund and foreign exchange revenues accruing from petroleum sales (NB, 2014a, 2014b).

Figure 11: Norway's Policy Rates and Money Market Rates



Source: Norges Bank, CEIC.

Figure 12: Norway's Central Bank Balance Sheet



Source: IMF International Financial Statistics.

3.6 Bulgaria

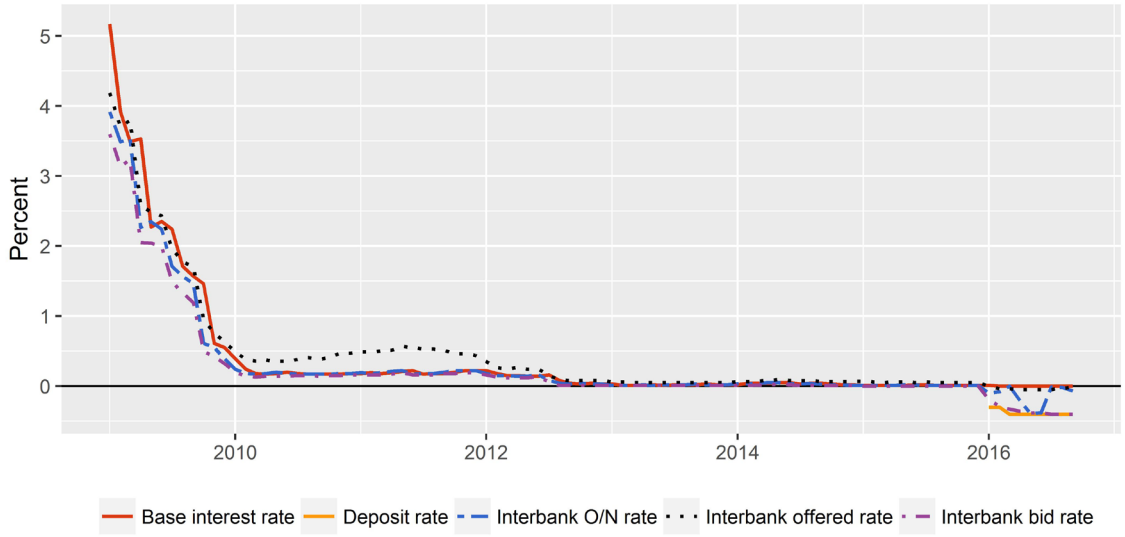
Since 1997, Bulgaria has been operating under a currency board, which linked the country's currency, the Bulgarian lev, to the German mark and later to the euro (BNB, 2015a). The Bulgarian National Bank (BNB) thus mirrors the ECB's policy stance, despite not being a member of the euro area or the ERM-II. In line with this arrangement, on 4 January 2016 the BNP adopted "Ordinance 21" , a collection of decisions that introduced a definition of "excess reserves" (the reserve requirement ratio currently stands at 10%) as well as a negative interest rate on these excess reserves (BNB, 2015b). It was decided that the interest rate on excess reserves would

equal that on the ECB's deposit facility when the ECB's deposit rate is negative, and zero when the ECB's deposit rate is zero or positive.

Given the currency board arrangement, both the LEv OverNight Index Average rate (LEONIA, Bulgaria's interbank overnight rate) and the Sofia Interbank Offered Rate (SOFIBOR) closely follow the interest rates in advanced economies, particularly the euro area. Together with the introduction of a negative deposit rate, the interbank overnight rate became negative in January 2016. The deposit rate (itself closely followed by the interbank bid rate) now acts as a lower bound for movement in interbank markets.

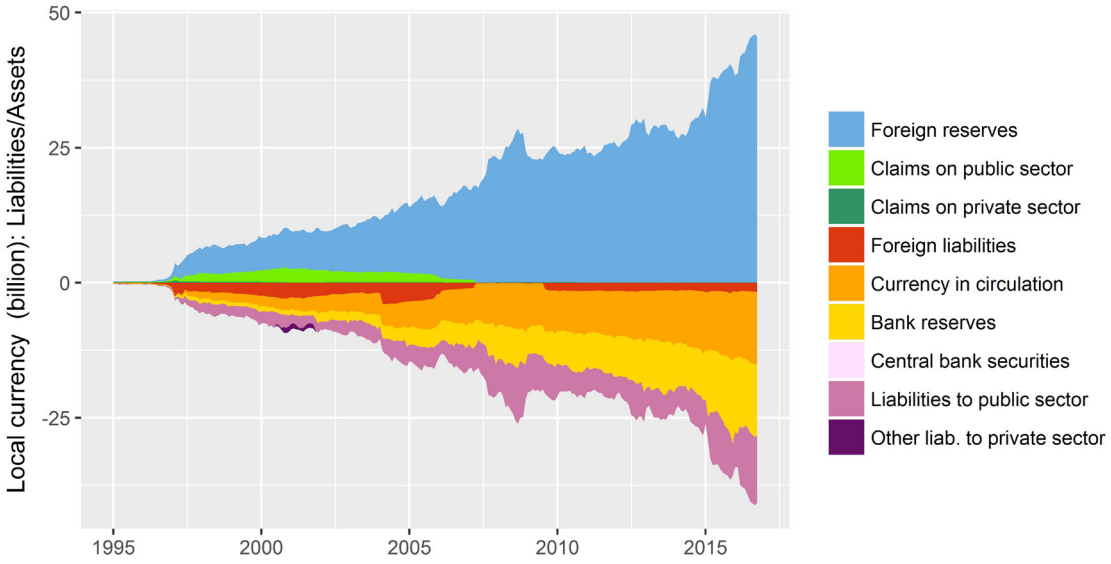
The exchange rate peg of the Bulgarian lev to the euro is reflected in the large amount of foreign reserves held by the central bank, classified as a "foreign exchange holder" pattern by Pattipeilohy (2016). The liquidity introduced into interbank markets due to foreign exchange market interventions changed the structure of the liability side of the BNB's balance sheet from a "government banker" pattern pre-crisis into a "banker's banker" pattern post-crisis. The adoption of a negative deposit rate by the BNB accompanies continued foreign exchange market intervention to maintain the fixed exchange rate.

Figure 13: Bulgaria's Policy Rates and Money Market Rates



Source: Bulgarian National Bank, CEIC.

Figure 14: Bulgaria's Central Bank Balance Sheet

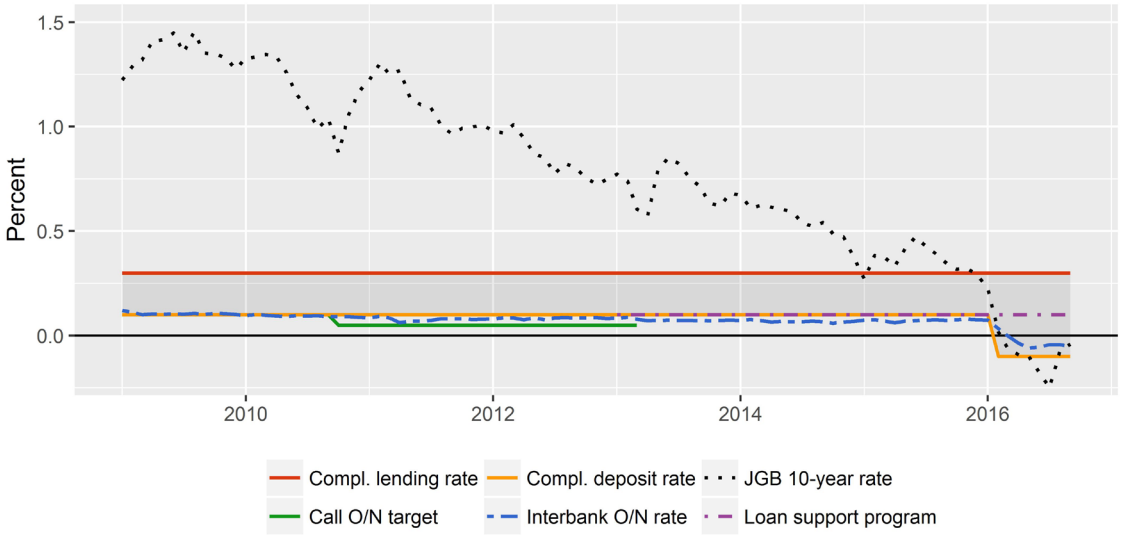


Source: IMF International Financial Statistics.

3.7 Japan

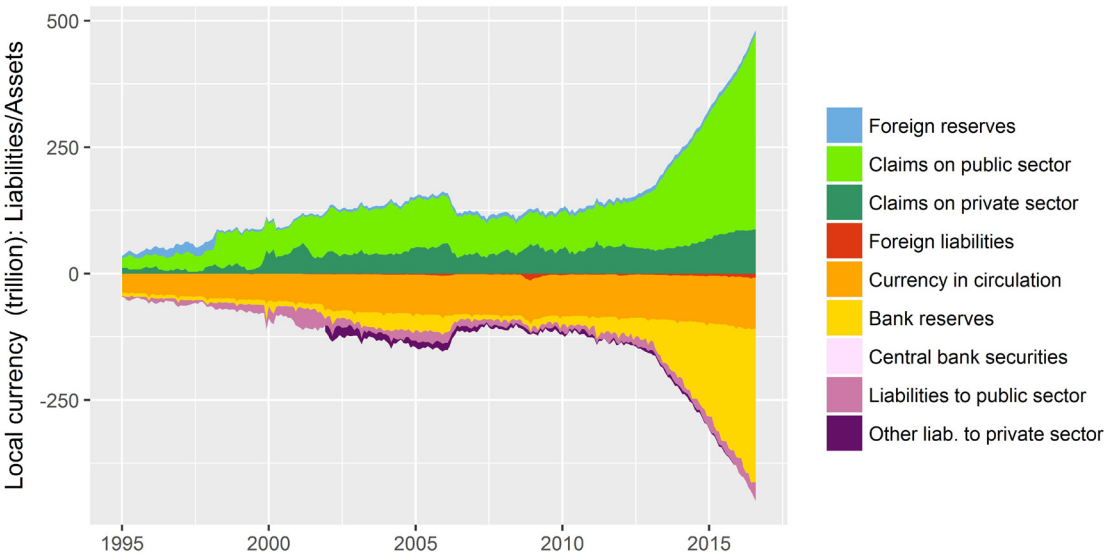
The Bank of Japan (BOJ) announced that it would adopt a NIRP on 29 January 2016, with the explicit goal of providing additional easing of monetary policy conditions. The policy was implemented in February 2016 for the purpose of addressing subdued inflation figures (Arteta et al., 2016). The BOJ instituted a negative rate on its complementary deposit facility in February 2016, which pulled the uncollateralized overnight call rate (Japan's interbank overnight rate) below zero in February 2016.

Figure 15: Japan's Policy Rates and Money Market Rates



Source: Bank of Japan, CEIC, S&P Capital IQ.

Figure 16: Japan's Central Bank Balance Sheet

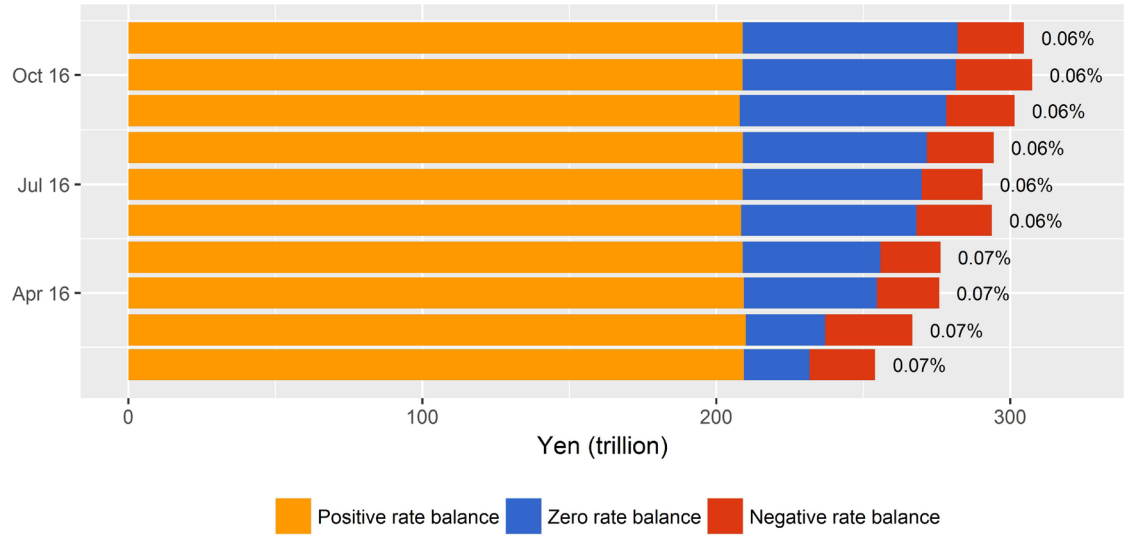


Source: IMF International Financial Statistics.

The interest rate corridor in Japan has traditionally been defined by the complementary lending rate (upper bound) and the complementary deposit rate (lower bound), although the interbank overnight rate has occasionally dropped below the deposit rate, since access to the deposit facility is not available to all institutions that hold current accounts with the BOJ (IMES, 2012; BOJ, 2016c). The daily interbank overnight rate even dropped briefly into negative territory in 2006 (FT, 2016), before the deposit facility was established. The Loan Support Program, a program designed to stimulate financial institutions' lending to growing industries, is now more often seen as the theoretical upper limit of the corridor.

Together with the introduction of the NIRP, the BOJ put in place a system that divides the balances of reserves commercial banks keep with the central bank into three tiers, each of which is subject to a different rate of interest: (1) the positive rate "basic" balance, remunerated at 0.1%, (2) the zero rate "macro add-on" balance, unremunerated at 0%, and (3) the negative rate "policy rate" balance, subject to a negative rate of -0.1%. Since the bulk of reserves is allocated to the first two tiers, the negative interest rate "only" applies to a fraction of bank reserves. The ratio used to calculate the macro add-on balance is further actively varied. As Sheard (2016) notes, this negative marginal rate has been sufficient to push down the yield curve while keeping the "tax" on the banking system minimal.

Figure 17: Composition of Current Account Balances at the Bank of Japan and Effective Average Rate



Source: BOJ, authors' calculations.

The BOJ has adjusted the operational details of its NIRP several times. In September 2016, it announced that it would also peg the yield of 10-year Japanese government bonds (so-called "JGBs") at around 0%. The yield had declined to below zero in March 2016 and only started climbing again in the final quarter of 2016.

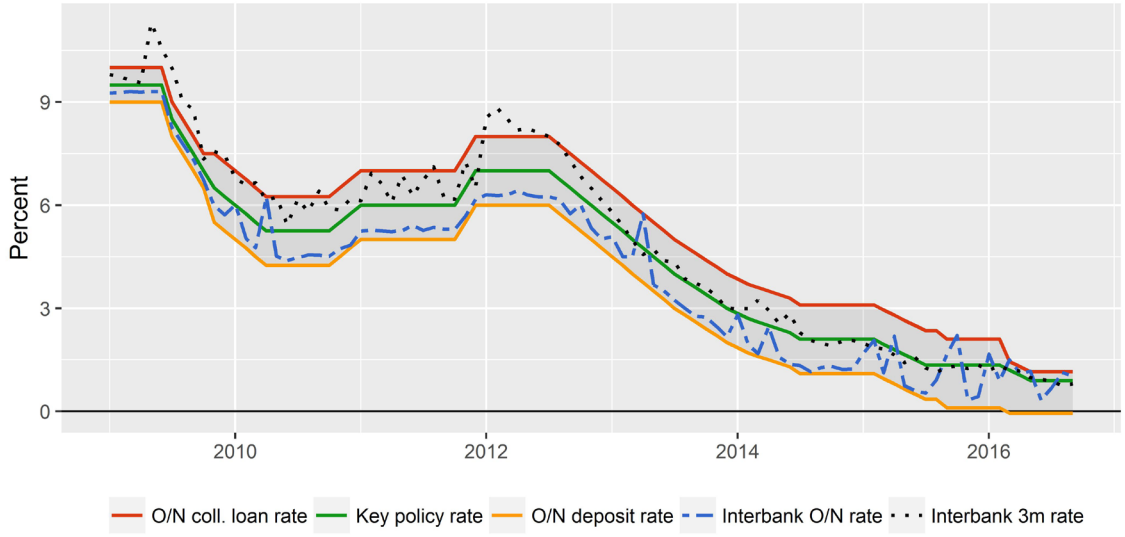
The effect of the BOJ's NIRP on banks' profit margins has been a major point of contention in the debate surrounding the policy in Japan. Japanese banks have experienced a severe compression of lending margins since the introduction of the NIRP, as they have a structural surplus of deposits over loans and since there is little room for the deposit rate to decline even while lending rates are dropping, given the degree of competition in the market (BOJ, 2016a).

The balance sheet structure of the BOJ reflects the quantitative easing policies undertaken from 2001 to 2006, and after 2010, and quantitative and qualitative easing policies undertaken after 2013 (Andolfatto and Li, 2014). In the course of these policies, the BOJ purchased large amounts of Japanese government securities ("Treasuries holder" pattern), which increased the amount of commercial bank reserves ("banker's banker" pattern).

3.8 Hungary

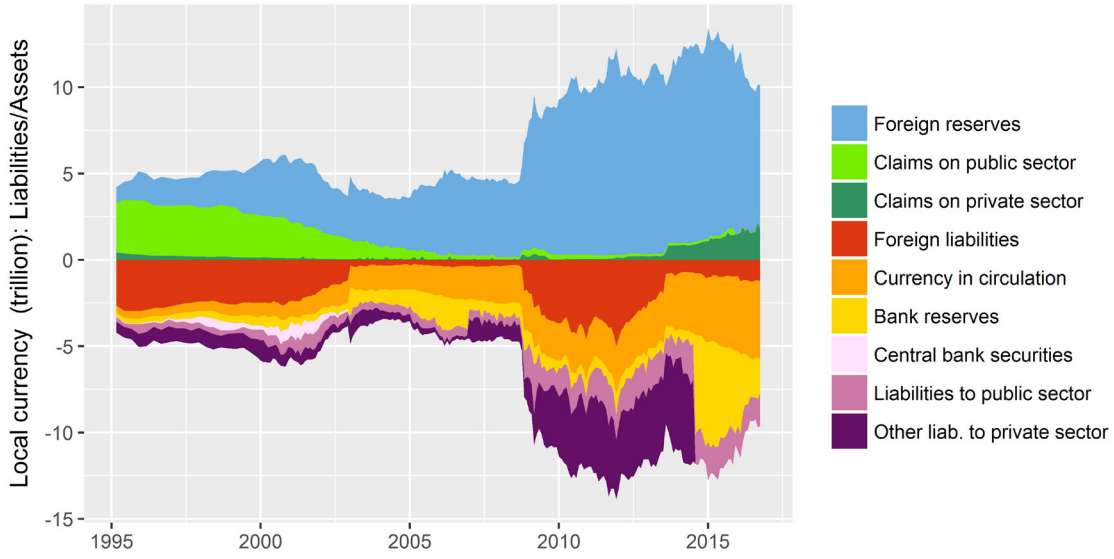
Subdued inflation figures and exchange rate pressure prompted the Hungarian central bank, the Magyar Nemzeti Bank (MNB), to adopt a negative deposit rate on 22 March 2016 (Arteta et al., 2016; Jobst and Lin, 2016). The MNB simultaneously lowered its overnight collateralized loan rate (the upper bound of its interest rate corridor) and the key policy rate (its main policy rate) in such a way as to narrow the interest rate corridor. Since the only rate that was taken below zero was the overnight central bank deposit rate, this policy measure does not represent an instance of a NIRP, however.

Figure 18: Hungary's Policy Rates and Money Market Rates



Source: Magyar Nemzeti Bank, CEIC.

Figure 19: Hungary's Central Bank Balance Sheet



Source: IMF International Financial Statistics.

Since the overall interest rate level in Hungary is still higher than in other European economies, the Budapest Interbank Offered Rate (BUBOR) did not turn negative following the adoption of a negative deposit rate. Money market rates in Hungary are typically closer to the deposit rate, but since late 2015 have been closer to the key policy rate at the center of the interest rate corridor.

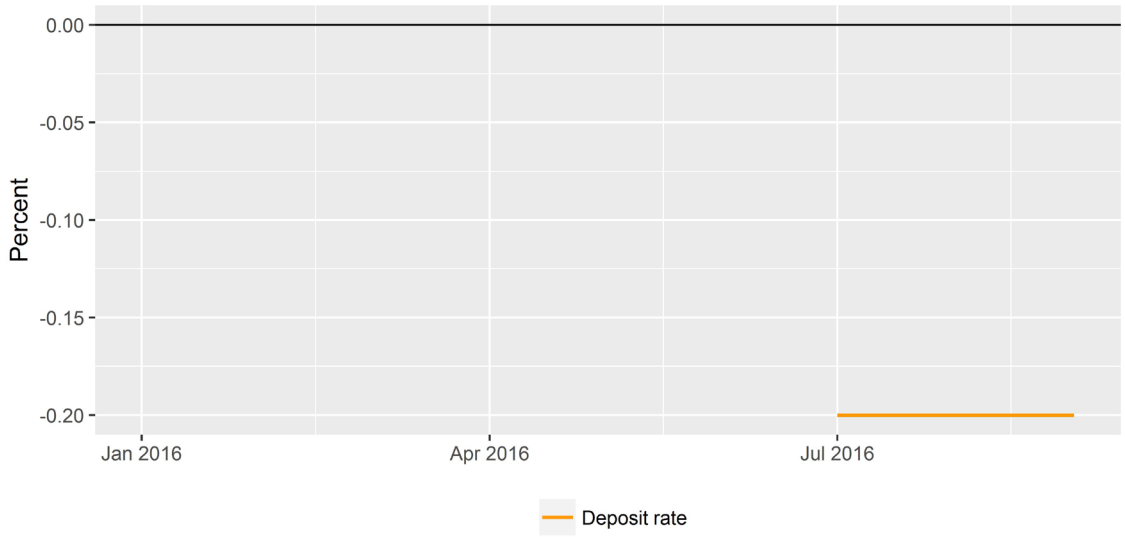
The MNB also provides a 3-month deposit facility that banks can use as an alternative to overnight deposits, which are subject to the negative overnight rate. Since October 2016, quantitative restrictions have been applied to the three-month deposit facility, however, limiting the amount of reserves commercial banks can store in this facility (MNB, 2016; Simon and Balazs, 2016; Simon and Eder, 2016).

The balance sheet of the MNB has expanded in size since the Global Financial Crisis, even as its general structure remained unchanged. Foreign reserves dominate the asset side of the MNB's balance sheet ("foreign exchange holder" pattern) whereas base money dominates the liability side ("banker's banker" pattern). At the same time as the MNB lowered the deposit rate below zero, it also launched an asset purchase program (Jobst and Lin, 2016), which might affect the MNB's balance sheet structure more substantially going forward.

3.9 Bosnia and Herzegovina

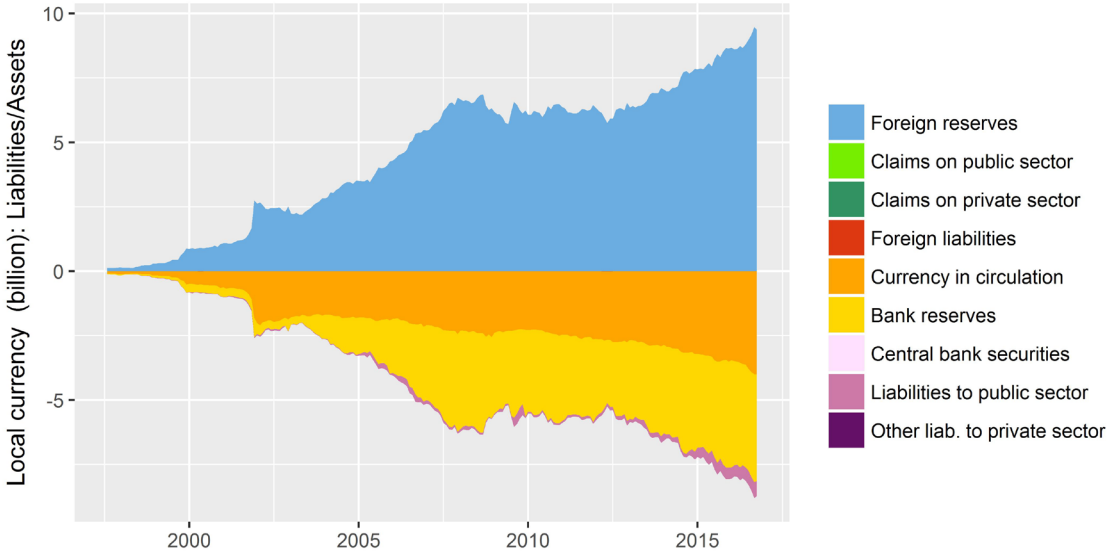
Similarly to Bulgaria, Bosnia and Herzegovina is also pegging its currency, the convertible mark, to the euro within a currency board arrangement. As a consequence, the Central Bank of Bosnia and Herzegovina (CBBH) introduced a negative deposit rate equivalent to 50% of the rate on the ECB's deposit facility in July 2016. Similarly to other countries analyzed here, this is not an explicit application of a NIRP, but simply a way to mirror the ECB's monetary policy stance.

Figure 20: Bosnia and Herzegovina's Deposit Rate



Source: Central Bank of Bosnia and Herzegovina.

Figure 21: Bosnia and Herzegovina's Central Bank Balance Sheet



Source: IMF International Financial Statistics.

Aside from the deposit rate, the CBBH does not maintain other independent policy rates. The interbank market is extremely limited, with no repo transactions and only a limited number of interbank overnight transactions taking place. The only tool at the disposal of the CBBH to influence interbank liquidity is thus the reserve requirement ratio, which currently stands at 10% (Mortlock and Rutman, 2015). The negative deposit rate only applies to commercial bank reserves exceeding the mandatory reserve requirement ratio (CBBH, 2016).

The balance sheet of the CBBH is structurally similar to that of other currency boards, as the asset side is almost exclusively made up of foreign reserves ("foreign exchange holder" pattern) and the liability side is almost entirely made up of base money ("banker's banker" pattern). The maintenance of the exchange rate peg will make continued foreign exchange market intervention necessary and, depending on the direction of cross-border financial flows, might necessitate further expansion or shrinking of the CBBH's balance sheet.

4. TRANSMISSION AND EFFECTS OF NEGATIVE INTEREST RATES

4.1 Transmission to the Real Economy

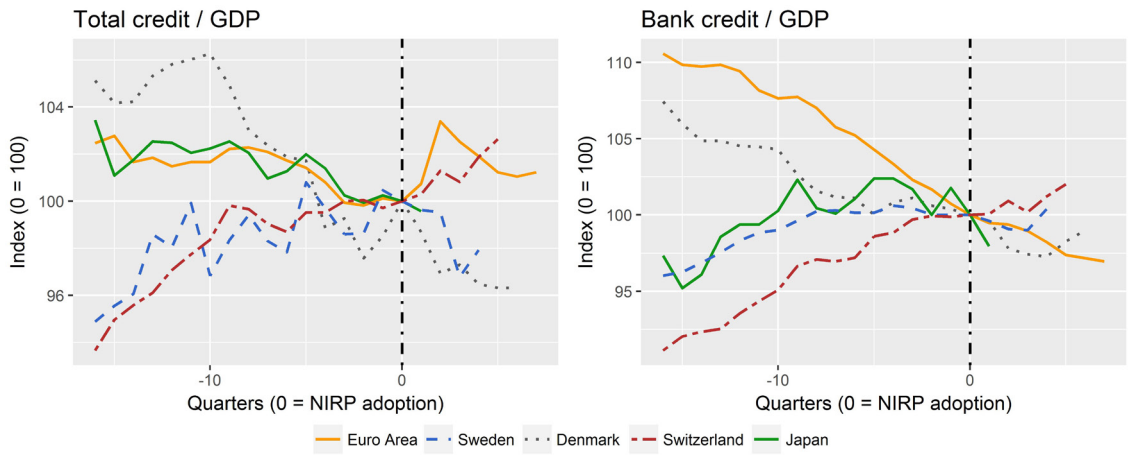
The transmission of NIRPs to the real economy is conceptualized differently in the literature, depending on authors' views of monetary policy transmission channels in general (Arteta et al., 2016; Hannoun, 2015). The following is a summarized, stylized overview to lay out general ideas against which the effects of NIRPs can then be discussed.

4.1.1 Interest Rate and Credit Channel

A reduction of policy rates is generally expected to lead to a reduction of private market rates, specifically retail loan and deposit rates and the yield on short-term securities, which is in turn expected to stimulate credit growth. Most research thus far has

found that negative policy rates have been transmitted to private market rates in the expected way, although the reduction of private market rates is a bit less pronounced than the reduction observed when policy rates are lowered within positive territory (Arteta et al., 2016). Specifically, there appears to be an asymmetry between lending rate adjustments and loan rate adjustments. Whereas lending rates have generally declined, only some banks in Switzerland, Denmark, and Germany have been found to apply negative deposit rates to large deposits (Jobst and Lin, 2016; Shotter, 2016). As a declining spread between lending rates and deposit rates implies a decline in profit margins, the effect of NIRPs on bank profitability has become a central point of contention in the debate regarding the benefits and drawbacks of NIRPs (Bech and Malkhozov, 2016).

Figure 22: Credit-to-GDP Ratios Before and After NIRP

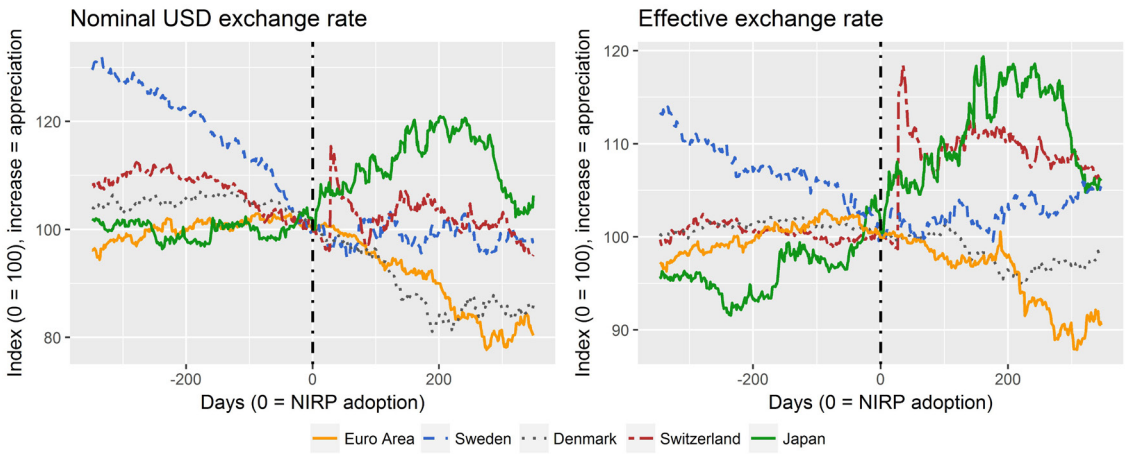


Source: Bank for International Settlements.

4.1.2 Exchange Rate Channel

NIRPs are expected to operate through the exchange rate, as a lower domestic interest rate should reduce financial inflows and lessen exchange rate appreciation (Viñals et al., 2016). Empirical evidence has demonstrated that the exchange rate may move in either direction, however (Hameed and Rose, 2016). With the normalization of interest rates in the United States, the case for NIRPs may furthermore weaken somewhat in those economies that have adopted negative rates to stabilize their exchange rate.

Figure 23: Exchange Rates Before and After NIRP

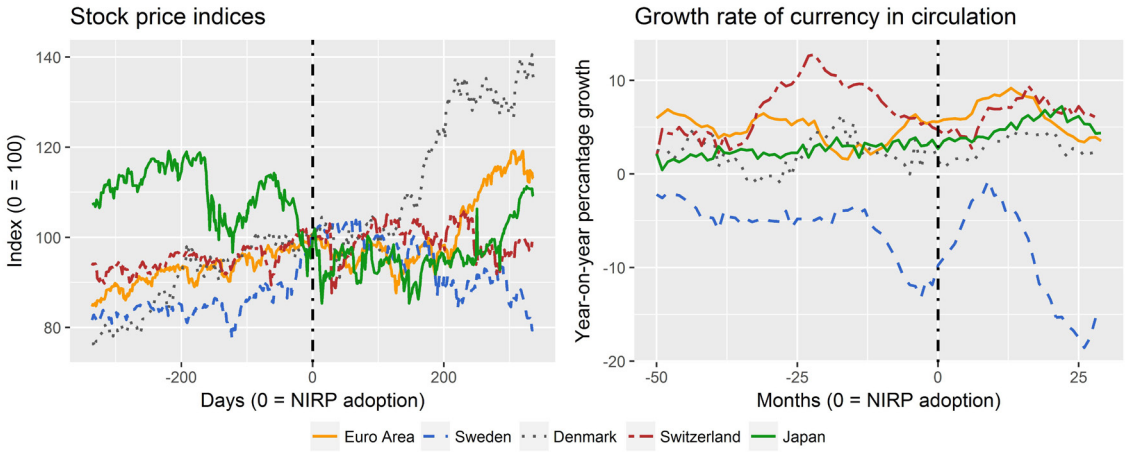


Source: Bank for International Settlements, St. Louis Fed.

4.1.3 Asset Valuation and Portfolio Channel

NIRPs also affect financial assets through the asset valuation channel and the portfolio channel. Asset prices increase as the yield on assets decreases, while lower yields simultaneously encourage investors to switch towards assets with higher duration or higher risk, flattening the yield curve and potentially improving market access (Hannoun, 2015; Sheard, 2016; Arteta et al., 2016).

Figure 24: Stock Prices and Currency in Circulation Before and After NIRP



Source: CEIC, IMF, monetary authorities, stock markets.

4.1.4 Other Channels

NIRPs are also assumed to affect markets in a variety of other ways not explored here, e.g. by affecting consumer expectations (Sheard, 2016), producer and consumer confidence, and saving decisions (Cliffe, 2015; Aizenman, Cheung, and Ito, 2016). Related to the effectiveness of the transmission of NIRPs is the debate on the role of cash in the modern economy, as substitution into physical currency presents one way

to avoid negative deposit rates (see Rogoff, 2016, and McAndrews, 2016, for the corresponding debate). While some empirical evidence points towards increases in cash holdings in some economies (Shirai, 2017, pp. 90–91), long-term evidence is not yet available.

4.2 Effectiveness, Benefits, and Risk

The effectiveness of NIRPs has been discussed widely since the policy's introduction. Authors supporting the policy argue that NIRPs will exhibit an overall positive impact through a combination of stronger credit growth, higher noninterest income, higher asset prices, lower funding costs, and ultimately stronger aggregate demand (Viñals et al., 2016; Blanke and Krogstrup, 2016; Jobst and Lin, 2016). While proponents do generally acknowledge potential negative effects on bank profitability, they argue that the positive effects of NIRPs will outweigh these negative effects (e.g. Cœuré, 2014).

On the other side of the debate, authors view NIRPs much more skeptically, particularly due to their impact on bank profitability (Borio et al., 2015; Caruana, 2016; ESRB, 2016). Although some banks in jurisdictions subject to NIRPs have been successful at reducing their operational costs by speeding up the adoption of information technology (Nemoto, 2016), observations of declining bank profitability in the euro area (ECB, 2016b), Japan (Fukase, 2016), and Switzerland (Danthine, 2016) have given rise to increased concerns over the effectiveness and sustainability of NIRPs. In particular, the case of Switzerland, where banks have raised mortgage rates to counteract declining profit margins, has frequently been raised as an example of unintended side effects of NIRPs (Arteta et al., 2016; Bech and Malkhozov, 2016). Recent work has thus argued that policymaking needs to pay greater attention to the actual operations of commercial banks, credit creation, and broad money growth (Goodhart, Bartsch, and Ashworth, 2016).

Low and negative interest rates have led all financial market participants to shift into longer maturities, which furthermore affects the profitability and soundness of institutions traditionally operating in these markets. It has been argued that financial institutions with long-term guarantees, such as life insurers and pension funds, may see their business model fundamentally challenged (ESRB, 2016), as the accumulation of interest rate risk exposure (Hannoun, 2015) and increases in duration gaps between assets and liabilities (Domanski, Shin, and Sushko, 2015) may entail negative consequences for financial stability.

On international levels, the relationship between NIRPs and exchange rates has been a major point of contention. Following the adoption of a NIRP by the BOJ, the US Treasury published its regular report on "Foreign Exchange Policies of Major Trading Partners of the United States" , stressing that the US government will closely monitor the foreign exchange policy of Japan and the BOJ's policy (US Treasury, 2016). The announcement came on the back of a strong US dollar, which has been appreciating against currencies of US trading partners since mid-2014.

Other criticism of NIRPs mirrors criticism of low interest rates in general. For example, Cette, Fernald, and Mojon (2016) argue that low interest rates encourage consumption booms, impede resource allocation, and reduce productivity growth, while Juselius, Borio, Disyatat, and Drehmann (2016) argue that the easing bias of monetary policy will negatively affect financial stability. Interestingly, both proponents and critics of NIRPs argue for a more active fiscal policy to accompany negative rates and to counteract potential adverse effects of NIRPs (Jobst and Lin, 2016; Sheard, 2016).

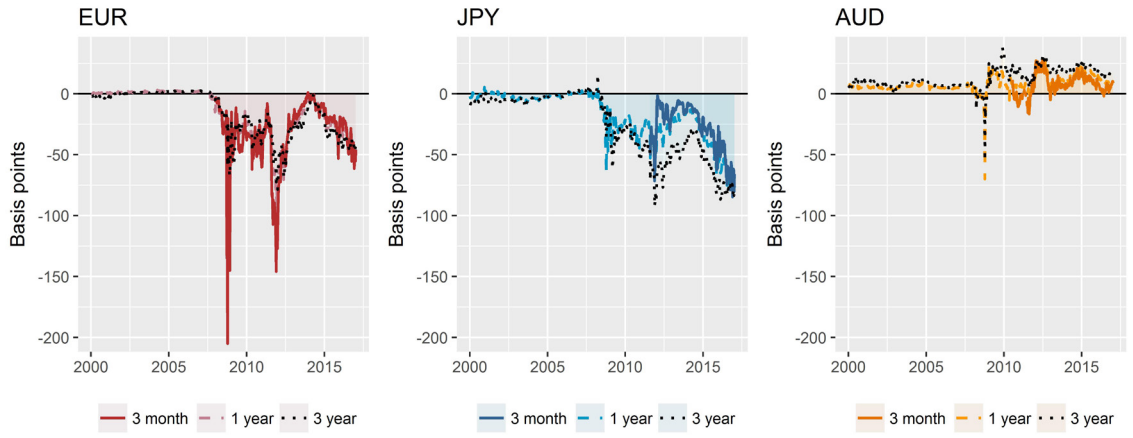
One final argument that is often made in regard to the effectiveness of NIRPs is that NIRPs merely represent one type of unconventional monetary policy measure. As Shirai (2017, p. 103) points out, however, the simultaneous application of interest rate policy and quantity-based asset purchase programs presents nontrivial operational challenges and may adversely affect the interpretation and effectiveness of monetary policy overall.

4.3 Negative Rates, Regulation, and Financial Stability

The compression of term and credit spreads in economies that adopted a NIRP (Borio et al., 2016) has forced financial market participants to shift into higher maturities and higher risk classes, and led to financial outflows seeking yield in jurisdictions with higher rates. The asset purchase programs that accompanied NIRPs further produced a decline in liquidity in domestic government bond markets (BOJ, 2016b; SR, 2016), which challenged the business model of stability-oriented investors and reinforced the trend towards financial outflows. As a result of these developments, European and Japanese investors especially have been moving funds abroad. In particular, the increasing investment in foreign currency bonds by German insurance companies (Domanski et al., 2015) and the overseas expansion of Japanese banks have attracted attention (McCauley, 2016; Pozsar and Smith, 2016).

Much of this demand has been centered on the US, where authorities began raising interest rates in late 2015, widening the interest rate differential between Europe and Japan on the one hand and US markets on the other. Growing demand for US dollar-denominated assets has led to a growth in demand for dollar hedges, especially cross-currency swaps. While such hedging was trivial in the era before the Global Financial Crisis, Basel III has imposed tighter rules on risk taking and, together with the reform of money market funds in late 2016, restricted financial market participants' balance sheet space. This in turn limits their desire and ability to engage in arbitrage across markets and asset classes (Pozsar, 2016b), giving rise to a persistent and growing divergence in several cross-currency basis pairs (Borio et al., 2016; Bräuning and Ivashina, 2016; Iida, Kimura, and Sudo, 2016).

Figure 25: Dollar Basis Swap Indices for Selected Currencies



Note: Euro, yen, and Australian dollar swaps against US dollar, mid/trade quote.
Source: Bloomberg.

Basel III has also affected the dynamics of interbank markets by changing the characteristics of reserve balances held by financial institutions. By requiring banks to hold part of their assets as high-quality liquid assets (HQLA), reserves do not affect interbank markets the same way excess reserves used to traditionally. As banks are required to hold on to a share of their reserves to satisfy Basel III liquidity requirements, these reserve balances are functionally much more similar to required reserves in that they cannot be put to alternative uses (Pozsar, 2016a). As NIRPs impose a "tax" on reserve holdings, there exists potential for adverse interaction between financial stability and NIRPs, depending on the design of the policy. Tiered reserve systems offer ways to address these potential issues by limiting the overall scope of negative rates and thus their impact on banks' reserve holdings.

5. CONCLUSION

This paper has argued that negative policy rates and negative money market rates are not entirely new, since monetary authorities have experimented with negative rates before and because money market rates have occasionally turned negative in several economies in the past. Examples include Sweden, where negative policy rates have been employed as early as 2009, and Japan, where money market rates briefly dropped below zero in 2006 already. What distinguishes NIRPs from these past policies is the combined application of different measures to push money market rates more substantially and more permanently below zero. These measures include the coordinated adjustment of different policy levers (including all components of the interest rate corridor and reserve exemption thresholds) and accompanying central bank communication. It has been argued that these features define NIRPs.

Second, the paper has demonstrated that the purpose, design and operational specificities of NIRPs and related policies differ substantially around the world. Major economies lowered rates to address deflationary trends and economic weakness, while other economies lowered rates to fend off foreign financial inflows. In countries where central bank balance sheets had grown due to asset purchase programs or foreign exchange interventions, the move below zero required operational adjustments to deal with the associated large balances of commercial bank reserves. These adjustments include tiered reserve systems, quantitative limitations on selected standing facilities, and the introduction of new facilities. These differences matter for how wholesale rates translate into retail rates, how expectations and private sector funding conditions are affected, and how a country's economy ultimately reacts. If, for example, authorities only move deposit rates slightly into negative territory without limiting access to standing facilities and without moving other policy rates, it would allow authorities to signal an elastic policy stance without actually pulling effective interbank rates much lower. If, on the other hand, authorities lower policy rates even slightly into negative territory while simultaneously removing any exemption thresholds for commercial bank reserves and depressing yields via asset purchase programs, it would put strong downward pressure on money market rates and financial institutions' profit margins.

Finally, the paper called attention to changes taking place in international finance since the Global Financial Crisis, which have substantially changed the context in which monetary policy is being applied. Basel III liquidity and capital requirements limit financial institutions' balance sheet space and their desire to engage in arbitrage across markets and currency pairs, while also making central bank liquidity a more valuable asset. The compression of profit spreads resulting from NIRPs has further challenged traditional business models, particularly for institutions with long-term guarantees. These factors impact the transmission of monetary policy across interest rates and exchange rates. Greater attention to the interaction between regulatory and monetary policies is thus warranted.

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