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Negative Interest Rate Policy (NIRP): Implications for Monetary Transmission and Bank Profitability in the Euro Area

by Andreas (Andy) Jobst and Huidan Lin

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Negative Interest Rate Policy (NIRP): Implications for Monetary Transmission and Bank Profitability in the Euro Area

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Abstract

More than two years ago the European Central Bank (ECB) adopted a negative interest rate policy (NIRP) to achieve its price stability objective. Negative interest rates have so far supported easier financial conditions and contributed to a modest expansion in credit, demonstrating that the zero lower bound is less binding than previously thought. However, interest rate cuts also weigh on bank profitability. Substantial rate cuts may at some point outweigh the benefits from higher asset values and stronger aggregate demand. Further monetary accommodation may need to rely more on credit easing and an expansion of the ECB's balance sheet rather than substantial additional reductions in the policy rate.

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Keywords: negative rates, NIRP, unconventional monetary policy, monetary transmission

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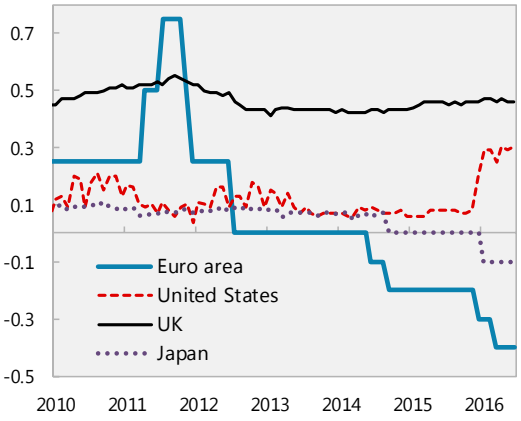
I. Introduction

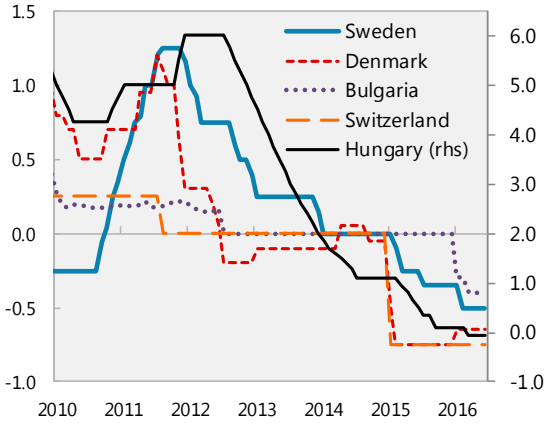
Since the 1990s interest rates have been declining and remain low across all major advanced economies. In particular, low long-term interest rates reflect the diminishing return on safe assets due to demographic changes, a slowdown in the rate of technological progress, and a high demand for safe assets relative to their supply (Bean and others, 2015). Given the secular decline of inflation and inflation expectations and short-term policy rates approaching zero percent, this has made it more difficult for accommodative monetary policies to reduce real interest rates to a level consistent with stable inflation and output at its potential level (technically, the "natural" rate of interest). For a long time, central bankers believed that the policy rate could not drop below zero, because households and corporates might start converting deposits into cash to avoid devaluation−thus, conflating the nominal lower bound with the "physical lower bound". However, not going below zero percent meant that with inflation remaining low, real rates could not fall further to help reduce high debt burdens and support aggregate demand.

Major Reserve Currencies: Effective Marginal Policy Rates, 2010-2016
(Percent)



Source: Bloomberg, L.P.; and Haver Analytics.
Note: Policy rates used for each country are the following: EA: deposit rate; US: Fed funds rate; UK: O/N interbank rate; Japan: deposit rate.

Other Currencies: Effective Marginal Policy Rates, 2010-2016
(Percent)



Source: Bloomberg, L.P.; and Haver Analytics.
Note: Policy rates used for each country are the following: SWE: reverse repo rate; DEN: certificates of deposit rate; HUN: deposit rate; BGR: deposit rate; CHE: deposit rate.

More than two years ago, following the example of the Danmarks Nationalbank (DN), the European Central Bank (ECB) became the first major central bank to effectively move its marginal policy rate into negative territory in response to these macroeconomic challenges. The move in June 2014 strengthened its forward guidance about the expected future path of interest rates and complemented a series of further easing measures aimed at bringing inflation back to

the ECB's price stability objective of below, but close to, two percent over the medium term. Also other central banks−the Sveriges Riksbank (SR) and the Swiss National Bank (SNB)−cut their marginal policy rates to below zero percent over the period from mid-2014 to early 2015 (see text figures).[2] Central banks in Norway (September 2015), Japan[3] (February 2016), and Hungary (March 2016) lowered only their deposit rate for excess bank reserves while keeping the main policy rate in positive territory.[4] While some central banks have adopted a negative interest rate policy (NIRP) to counter low inflation (ECB, BoJ, SR),[5] others have focused on mitigating spillover effects from unconventional monetary policy (UMP) measures (Mircheva and others, 2016) and to address currency appreciation pressures (DN, SNB) (Table 1 and Appendix I, Table A1). Most central banks have also introduced a tiered deposit rate to reduce banks' cost of holding excess reserves while still allowing for a strong pass-through to money markets (Appendix II).

[2] DN cut its policy rate to below zero in July 2012 and the rate stayed negative until April 2014. It turned negative for a second time in September 2014.

[3] The interest rate on excess reserves is technically not the key policy rate in Japan. The complementary deposit facility was introduced at the end of October 2008 to ensure stability in financial markets.

[4] Both Hungary and Norway are not true cases of NIRP and are included for completeness only. While the Magyar Nemzeti Bank (MNB) used negative rates to promote new lending and reduce vulnerabilities, in particular regarding public debt, no liquidity is effectively priced at the negative deposit rate in Hungary, and the MNB offers fixed rate full allotment at three-month deposit auctions each week at the (positive) policy rate. In the case of Norway, the negative reserve rate is not a policy measure but part of normal liquidity operations to motivate banks to lend reserves to other banks rather than deposit them with Norges Bank (NB). Like in Hungary, the key policy rate remains positive, and the negative deposit has had little or no influence on the money market (NOWA) rate. In absence of excess reserves above a certain quota ("reserve rate"), the cost of holding reserves rather than lending them to other banks is the same as when the reserve rate was positive.

[5] In Sweden, policymakers undertook domestic UMP including negative policy interest rates in order to address low inflation and a sharp decline in inflation expectations; this also help avoid deflationary pressures from the exchange rate pass-through in an inflation-targeting regime. The effect of this package was to keep the Swedish bond yields broadly aligned with those on German Bunds even as the latter yields fell owing to the ECB's UMP. The Swedish krona remained broadly stable against the euro, avoiding an appreciation that could have significantly hindered the SR's efforts to return inflation to its target.

Table 1. Overview of Central Banks with Negative Policy Rates

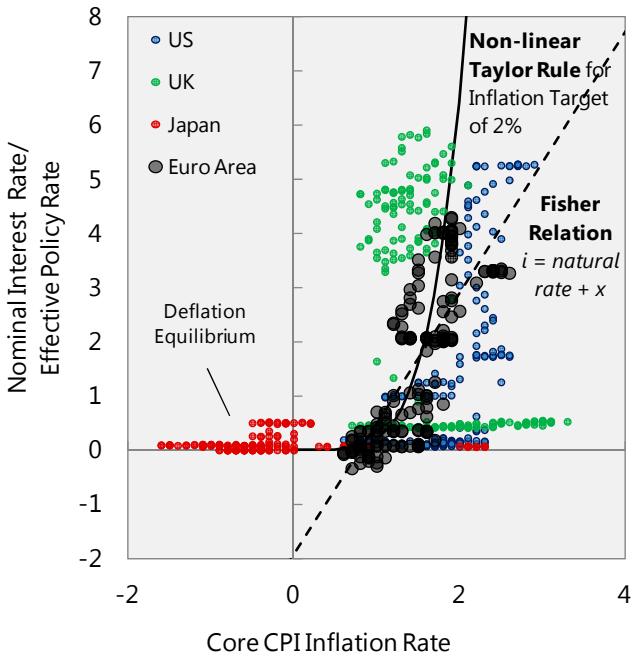
	FX regime	Objective	Policy Rates *(in basis points)* 1/			Date of Introduction
			Overnight Lending 2/	Open Market Operations	Deposit Facility	
Denmark	Conventional peg (to euro)	Countering safe-haven inflows and exchange rate pressures	5	0	-65	July 2012-April 2014, Sept. 2014
Euro Area	Free floating, inflation-targeting framework	Price stability and anchoring inflation expectations	25	0	-40	June 11, 2014
Hungary	Floating, inflation-targeting framework	Price stability and countering exchange rate pressures	115	90	-5	March 23, 2014
Japan	Free floating, inflation-targeting framework	Price stability and anchoring inflation expectations	10	0	-10	Feb. 16, 2016
Norway	Free floating, inflation-targeting framework	Price stability 3/	150	50	-50	Sept. 24, 2015
Sweden	Free floating, inflation-targeting framework	Price stability and anchoring inflation expectations	25	-50	-125	Feb. 12, 2015
Switzerland	Free floating 4/	Reducing appreciation and deflationary pressures 5/	50	n.a.	-75	Jan. 15, 2015

Source: National central banks and authors. Note: 1/ effective policy rate are highlighted with a red background, as of end-July 2016; 2/ refers to special rate (liquidity-shortage financing facility) in the case of Switzerland; 3/ Norway has not adopted NIRP, and the negative interest rate on bank deposits at the central bank ("reserve rate") has had little or no influence on market rates. The reserve rate is one percentage point below the sight deposit rate (key policy rate). On average, NB has kept reserves in the banking system at around NOK 35 billion (and below the aggregate quota of NOK 45 billion). Thus, a bank with reserves in excess of the quota will always be able to deposit reserves with a bank with room on its quota.; 4/ conventional peg (to euro) before January 15, 2015); 5/ in conjunction with the exit from the exchange rate ceiling.

II. Arguments Surrounding NIRP

In an environment of low inflation and a declining equilibrium real rate of interest, negative rates restore the signaling capacity of the central bank by effectively removing the zero lower bound (ZLB). Moving the marginal policy rate into negative territory can help the real rate adjust downward, compensating for inflation below the inflation target (text figure) and contributing to a significant flattening of the yield curve.[6] In other words, a decline in the nominal rate could lower its real rate component, allowing inflation expectations to rise and boosting aggregate demand; however, if both nominal and real interest rates are shifted down, a widening gap leads to deflation pressure.[7] Thus, if banks hold excess reserves, cuts to the central bank deposit rate (as the marginal policy rate) can effectively lower the interbank and other interest rates, encouraging banks to take greater risks and facilitating portfolio rebalancing.

Inflation and Interest Rates, Jan. 2002-April 2016
(In percent, monthly)



Source: Bloomberg, Haver Analytics, and IMF staff calculations.

Assessing the effect of NIRP on exchange rates is difficult since many other factors influence external demand. Negative rates cause exchange rates to depreciate by providing incentives for moving capital to higher-yield jurisdictions. Thus, a widening real term spread differential would put downward pressure on the currency. Higher inflation and inflation expectations in other countries might counter this effect. In addition, the stimulative effect of negative rates on aggregate demand (which is discussed below) and rising asset prices in real terms might offset depreciation pressures on the exchange rate.

[6] Already subdued interest rate expectations limit any additional support provided by forward guidance on policy rates, with slowing growth challenging the credibility of commitments to anchor inflation expectations.

[7] The nominal interest rates can be decomposed into two components, the real rate and expected inflation.

The economic lower bound of NIRP is largely determined by the impact of negative rates on financial intermediation. While there is some *direct* cost pressure from charging interest for excess liquidity that banks hold at the central bank (suggesting limits to negative rates based on the tendency of banks to raise cash balances), some central banks have implemented mitigating policy to limit the incentive to move into cash—such as tiered reserve regimes and penalties for banks making large transfers of reserves into cash. As rates become more negative, the lower nominal bound is increasingly determined by the broader *indirect* pressure coming from diminishing bank profitability as most lending rates are assumed to fall more than deposit rates.

The downward stickiness of deposit rates could result in a difficult trade-off between effective monetary transmission and bank profitability. If negative policy rates are transmitted to lower lending rates (and term premia),[8] banks are likely to see their interest earnings decline unless they either impose negative rates (or commensurate fees) on deposits or substitute more wholesale funding (at lower money market rates) for deposits.[9] But retail deposit rates tend to be downward sticky since (i) households and small businesses do not face the same set-up cost as banks and corporations in storing cash,[10] and (ii) a zero percent interest rate could be a psychological threshold (Alsterlind, 2015).[11] The stickiness of deposit rates reflects the avoidance of being penalized to save and is determined by the actual costs of holding cash rather than deposits; under these conditions, demand for cash is likely to be greatest for economic agents with high excess liquidity and increases if negative interest rates are expected to persist for some time.[12] As a result, banks' net interest margins (NIMs), defined as net interest income

[8] In addition, in countries with a high share of variable rate lending (and/or indirect pressure on bank lending rates from corporate bond markets), the impact of negative rates on the re-pricing of existing loans is likely to outweigh the profits from new lending.

[9] While deposits tend to represent the major source of funding for most banks, some also rely on funding via unsecured bonds, covered bonds, and securitization, which are likely to be more responsive to changes in interest rates than deposits. Banks could substitute wholesale funding for more expensive retail deposits (also to meet stable funding requirements under the Basel liquidity risk framework); however, longer-term funding contains some term premium, and market access might be limited for smaller banks, especially in countries where banks rely heavily on deposit funding.

[10] The costs of holding cash rather than deposits can be calculated by adding up the costs for secure storage and transport, as well as for settling payments in cash, which is likely to be small for households and small businesses.

[11] For example, compared to more sophisticated agents, households may simply react more instinctively to negative rates viewing negative rates as "abnormal" or "theft."

[12] If banks eventually decide to lower retail deposit rates below zero as done on large deposits in several countries, this would increase the chances of "leakages" to cash. This can be gauged from consumers' cash preference in retail transactions. Despite the higher social cost of settling cash payments (i.e., costs incurred by the financial sector, retailers and households), empirical evidence suggests that consumers have a strong cash preference to avoid potential fees on electronic payments. For example, in early 2005, Danish banks and retailers were allowed to pass on part of the costs of electronic transactions to consumers, which is—for each marginal unit of money spent—economically equivalent to imposing negative rates on savings; this move caused

relative to average interest-earning assets, compress as lending rates for new loans decline and existing (variable-rate) loans re-price while deposit rates remain sticky. This could reduce bank profitability and impair the pass-through to lending rates.[13] Thus, banks might also consider increasing lending rates if they face (i) a considerable opportunity cost of accepting deposits at non-negative rates as wholesale funding costs decline in lock-step with the marginal policy rate and/or (ii) corporate deposit rates cannot be cut to potentially subsidize sticky retail deposit rates.

A prolonged period of negative rates could also raise financial stability concerns. In particular, the downward stickiness of deposit rates encourages banks to substitute less stable wholesale funding for deposits. For example, German, Italian, Portuguese, and Spanish banks, whose deposit base is wider than the euro area average, would have stronger incentives to trade off market-based sources of funding against more stable (term) deposit funding (Figure 3). This calls for greater emphasis on the appropriate supervision of bank liquidity, including the transition to the liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) requirements.

As much as negative rates ease financial constraints on borrowers in the short run, they could distort the long-term debt affordability for borrowers if lending rates become negative in *real* terms.[14] The reduced debt service burden under NIRP could delay the exit of nonviable firms, hurting demand prospects of healthy firms by adding to excess capacity and delaying the efficient allocation of capital and labor (Caballero and others, 2008; Kwon and others, 2015).[15] By effectively removing the profitability constraint of investments as real borrowing rates drop to or even fall below the ZLB, NIRP might also delay corporate restructuring in countries with debt overhangs, especially if inflation does not pick up. In these instances, more assertive supervision and regulatory pressures would be needed to address large amounts of non-performing loans and debt overhang problems (Syed and others, 2009).

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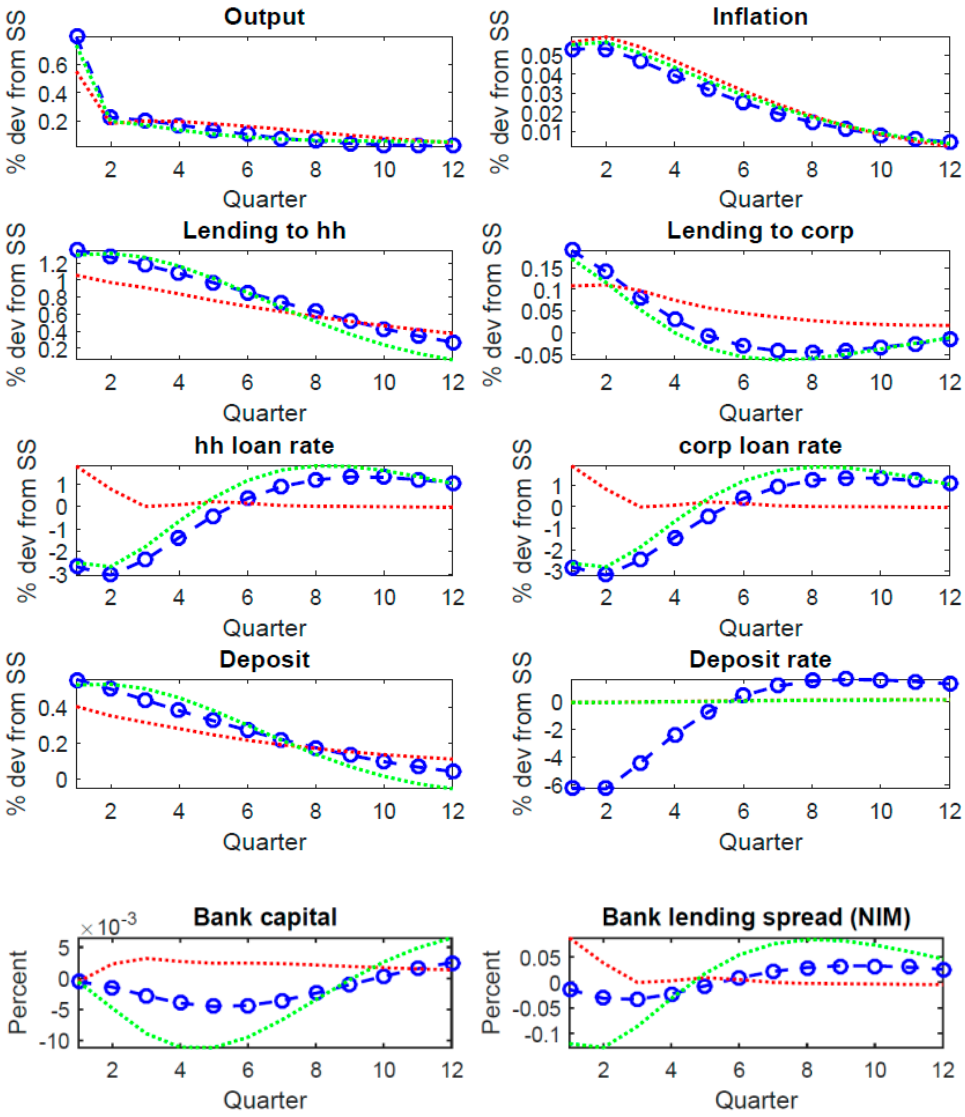
the number of transactions to drop sharply (Abildgren and others, 2010), suggesting that the lowest socially acceptable deposit rate might not be far below the ZLB.

[13] For a comprehensive analysis of how cash hoarding can be prevented under NIRP, see Agarwal and Kimball (2015).

[14] This would necessitate a tightening of lending standards if greater risk-taking due to NIRP undermines the usefulness of asset impairment levels in detecting financial distress.

Box 1. Monetary Transmission under NIRP[1]

We assess the impact of negative rates on bank profitability and its implications for monetary transmission when deposit rates become sticky using a general equilibrium specification. We adapt the DSGE model by Gerali and others (2010), which was estimated using euro area data. In the model, banks enjoy monopoly powers in intermediating funds between savers and borrowers and setting rates on loans and deposits. The modeled banking sector comprises two retail branches, which are responsible for lending and deposit-taking, while the wholesale unit manages the capital position of the banking group subject to a simple solvency constraint, and, in addition, provides wholesale loans and raises wholesale funding. Banks face different adjustment costs when changing rates. A higher cost implies lower adjustment for a given shock, and, thus, the rates are more "sticky."



Source: authors. Note: blue line=unchanged pass-through scenario (first scenario, base case); green dotted line=sticky deposit scenario but non-binding solvency constraint for banks (second scenario); red line= sticky deposit scenario and binding solvency constraint for banks (third scenario).

Box 1. Monetary Transmission under NIRP (Concluded)

Sticky deposits under NIRP seem to either weaken bank profitability or diminish monetary transmission. We examine three different scenarios reflecting banks' response to a policy rate cut assuming that deposit rates are bounded at zero percent (text chart below). Banks can substitute some cheaper wholesale funding for deposit funding but potentially offsetting components of banks' net operating income are ignored (e.g., capital gains from higher asset prices and lower provisioning cost from higher debt service capacity of borrowers). While higher asset prices boost the investment income, lower funding costs, and decrease provisioning expenses of euro area banks, these benefits weaken over time relative to the adverse effect of compressed interest margins where the pass-through of policy rates is high and credit demand is low.

In the *first case* (blue line), we assume that the pass-through from the policy rate to deposit rate remains unchanged. Banks reduce the both deposit and lending rates, and their profitability increases over time as output and inflation outturns improve. In the *second case* (green dotted line), price-setting banks face (artificially) higher adjustment costs in setting deposit rates (i.e., deposits are "sticky"). Banks optimally choose to lower lending rates to increase lending volume at the cost of deviating temporarily from the minimum capital requirement (Angelini and others, 2014). Bank profitability declines significantly as lending volumes are initially insufficient to offset the compression of lending margins due to sticky deposit rates. In the *third case* (red line), banks' solvency constraint is strictly enforced for the second scenario of sticky deposits. Here, monetary transmission breaks down as banks (initially) increase lending rates and curtail credit growth given the limited substitution of wholesale funding (due to a large deposit base). However, the impact on output is still positive, although smaller over the short term, as the wealth and substitution effects (from lower discount rates) pushes up loan demand, supporting consumption and investment. In general, the simulation results suggest a positive aggregate impact of NIRP under all three scenarios but rising pressures on bank profitability over the short and medium terms if deposit rates have reached a lower bound and banks are capital-constrained.

[1] Prepared by Jiaqian (Jack) Chen and Andreas (Andy) Jobst.

Negative rates also have distributional implications that are beyond the scope of this paper. For instance, negative rates could increase the re-distributional impact of monetary policy on wealth and income. Any reduction in interest rates makes savers worse off while borrowers benefit and could have important intergenerational implications. Elderly people tend to have accumulated savings, so moving from positive to negative interest rates could increase intergenerational inequality as retirement income declines. However, higher asset prices increase the net worth in present value terms. Lower borrowing rates also support consumption and investment of liquidity constrained households and firms, raising aggregate demand over time and outweighing any adverse impact on savings.

However, several important factors could compensate for the adverse impact of NIRP:

- *Stronger credit growth and/or higher non-interest income*. The credit supply effects of reduced profitability from lower lending rates can be offset by the credit demand effects if banks increase lending (Box 1)—but this becomes more difficult if credit demand is low,

assets re-price quickly, and competition among banks is high. Banks could also supplement declining interest margins with alternative sources of income, such as fees and commissions.[16]

- *Higher asset prices and lower funding costs.* Portfolio rebalancing with negative rates reduces term and credit risk premia, eases financial conditions and ultimately supports credit creation and economic activity. The resulting decline in risk aversion increases asset prices and generates capital gains for banks. Furthermore, higher asset prices (especially in tandem with higher inflation) are likely to raise future income and strengthen borrowers' repayment capacity, lowering banks' expected provisioning costs and write-off charges for non-performing loans (NPLs).[17]

- *Stronger aggregate demand through portfolio rebalancing.* Negative rates also increase household consumption and steer portfolio rebalancing towards other investment opportunities, with beneficial effects on aggregate demand.[18] Portfolio rebalancing helps lower firms' general cost of capital via lower term premia on corporate bond yields.[19] At a lower cost, more investment projects would become profitable, raising investment and credit demand. Higher asset prices and lower interest expenses for indebted households (who tend to have higher marginal propensity to consume) also boost household consumption through wealth effects.[20]

[16] For instance, charging retail clients fees to maintain checking accounts as it is done commonly in the United States.

[17] Bolt and others (2012) find a strong impact of output growth on bank profitability, with loan losses as the main driver.

[18] Thus, the "true" limit on negative deposit rates would be the level at which households would find it preferable to hoard large amounts of cash. Given the costs of moving and storing cash, this rate can be well below zero.

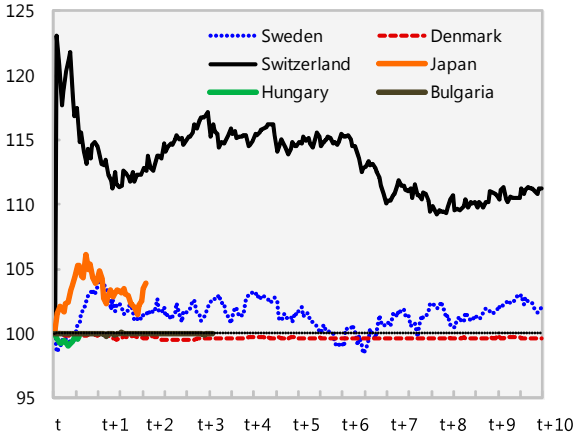
[19] Even though the portfolio rebalancing channel would apply to any reduction of policy rates, its effectiveness might change in an environment of negative interest rates depending on how lower risk aversion affects investment behavior. Greater risk taking via the portfolio rebalancing under NIRP also implies that some safe assets, such as government bonds, will yield negative returns (depending on the maturity term), and, thus, represent a guaranteed loss of purchasing power if held to maturity. As safe assets are being removed from the financial system and replaced with riskier assets, some investors will take more risk to compensate for loss of income while others might be forced to reduce their risk exposure in response. In addition, regulatory requirements, including capital adequacy considerations, can affect the portfolio rebalancing channel (Berkmen and Jobst, 2015).

[20] For example, Genay and Podjasek (2014) find that the estimated negative effect on bank profits of low interest rate environment is small and outweighed by the likely positive effects on profits of low interest rates boosting economic activity.

III. The Impact of Negative Interest Rates

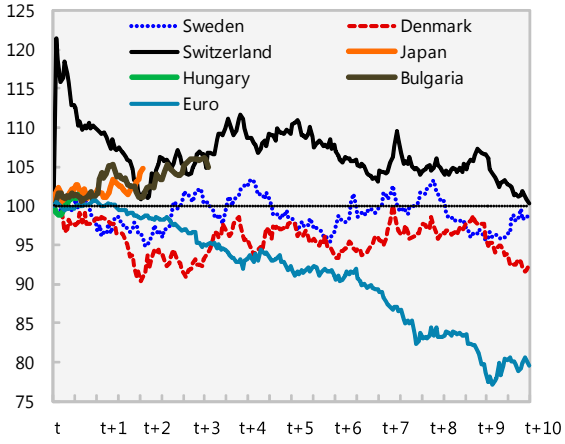
Overall financial conditions have improved as central banks in many advanced economies set policy rates at record low levels, without causing significant swings in exchange rates. Negative rates have been fairly effective thus far in reducing money market rates and have been transmitted to the wider economy through lower lending rates for both corporates and households as lending standards have eased (Elliott and others, 2016; Viñals and others, 2016). At the same time, retail and corporate deposit rates also have declined, allowing most banks to maintain their lending margins and supporting credit growth.[21] In cases where sticky deposits have compressed lending margins, banks have shifted some of their activities to fee-based services and/or increased their lending volumes to offset declining interest revenues. Negative rates have so far had a muted impact on exchange rates as current disinflationary dynamics in many countries with negative rates prevent real rates from declining further (see text figures).

Exchange Rates relative to Euro
(Index, time t = 100, day before introduction of negative deposit rates)



Source: Haver Analytics. Note: the x-axis shows monthly intervals.

Exchange Rates relative to U.S. Dollar
(Index, time t=100, day before introduction of negative deposit rates)



Source: Haver Analytics. Note: the x-axis shows monthly intervals.

Money market rates have closely followed an increasingly negative marginal policy rate without disruptions to market functioning (Appendix III, Figures A1 and A2). In the environment of excess liquidity, the observed money market rate will be at or just above the marginal policy rate at which excess reserves are remunerated (or penalized under NIRP).[22] In several countries, a tiered central bank deposit rate has facilitated the smooth transmission of the marginal policy rate to money markets, reducing the cost of interbank lending and restoring the signaling capacity of the central bank and strengthened its commitment to keep rates low for an extended

[21] See McAndrews (2015) for a critical review of issues concerning negative interest rates.

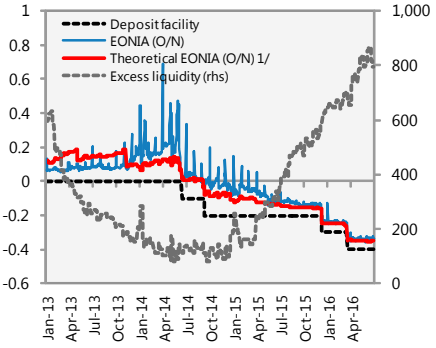
[22] Banks would be willing to lend at rates above the negative deposit rate but there are no (or very few) borrowers given excess reserves in the system, and, thus, the overnight money market rate converges to the deposit rate.

period of time (Box 2). However, several factors, in particular related to the design of a tiered reserve system, could keep the money market rate away from the deposit rate as the technical floor of the policy rate corridor (Appendix I, Box A1). These include: (i) the amount of excess liquidity and the fraction that is exempted from the marginal policy rate, (ii) the spread between the marginal and average policy rate for excess reserves, and (iii) banks' willingness/ability to lend excess liquidity to each other (fragmentation).

Box 2. Reducing the Direct Cost of NIRP and the Role of Tiering in Monetary Transmission

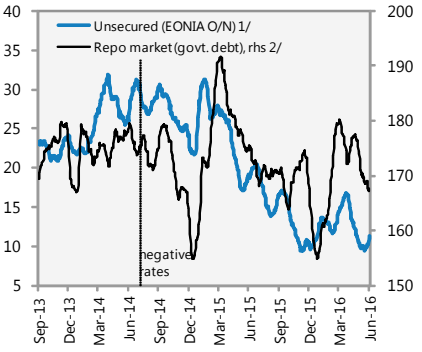
The implementation of a second effective deposit rate for excess reserves (such as through tiering) would increase the central bank's general capacity to pursue NIRP while mitigating the direct cost to banks. More specifically, excess reserves can be held in both the current account and the deposit facility of central banks. In a tiered regime, the exemption typically applies to the current account (which satisfies the minimum reserve requirement); thus, banks would have an incentive to shift excess reserves from the deposit facility to the current account to reduce the cost of negative rates up to a certain limit. Currently, euro area banks' overnight deposits (€297 billion) and current account balances (€613 billion) amount to about €910 billion. The minimum reserve requirement of €116 billion is remunerated at the MRO rate of 0 percent, which leaves excess reserves of €794 billion subject to the negative deposit rate of -0.4 percent as the marginal policy rate—setting the lowest rate at which banks would be prepared to lend to each other (which is reflected in the theoretical EONIA rate in the chart below). Thus, the direct (annual) cost of negative rates (without implementation of a tiered reserve regime) is about €3.2 billion for all euro area banks in aggregate (and 0.1 percent of total consolidated assets). In other words, a 10 basis point reduction in the deposit rate results in a direct cost of about €0.8 billion per year. Given the recent experience in Switzerland, where the direct cost of NIRP did not exceed 0.03 percent of total assets (Barr and others, 2016),[1] the current deposit rate may have already reached its limit (without considering any mitigating effects). However, for a tiered reserve regime excluding 75 percent[2] of excess reserves from the negative deposit rate (in line with reserve system in Switzerland), the Eurosystem could theoretically tolerate further cuts to the deposit rate based on the direct cost of NIRP only.

Euro Area: Actual and Theoretical EONIA Rate (percent/EUR billion)



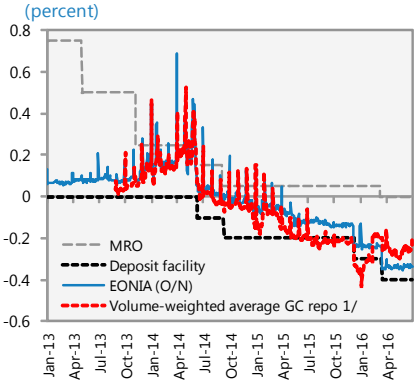
Source: Bloomberg L.P., ECB, and IMF staff calculations. Note: 1/ The theoretical EONIA rate is calculated as the average of the MRO and deposit rate, weighted by the relative proportion of the ECB's current account balance and excess reserves.

Euro Area: Secured and Unsecured Lending Volumes (EUR billion)



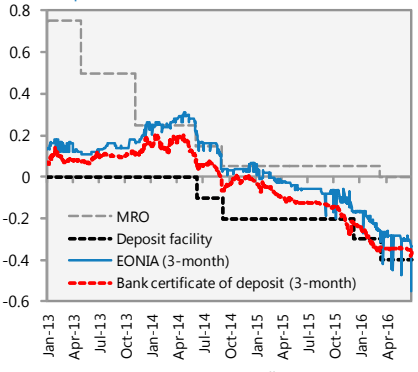
Source: Bloomberg L.P., ECB, and IMF staff calculations. Note: 1/ trading volume of overnight contracts; 2/ composite outstanding volume of general collateral (GC) repo on German, French, and Italian government debt.

Euro Area: EONIA and Repo Rates (percent)



Source: Bloomberg L.P., ECB, and IMF staff calculations. Note: 1/ Composite of German, French and Italian GC repo.

Euro Area: EONIA and Certificate of Deposit Rate (percent)



Source: Bloomberg L.P., ECB, and IMF staff calculations.

Box 2. Reducing the Direct Cost of NIRP and the Role of Tiering in Monetary Transmission (Concluded)

The direct cost of a negative deposit rate on excess reserves is relatively small, even without tiering, but affects banks disproportionately due to significant differences in excess reserve holdings. Since the ECB charges interest only on excess liquidity, the charge is greater in those countries where banks hold large excess reserves. These are generally countries with substantial current account surpluses vis-à-vis other members of the monetary union. Banks in other economies hold much lower excess reserves and thus are much less affected.

In comparison, the indirect effect of NIRP via (potentially) lower bank profitability from lending can be large. Given a total outstanding amount of loans of about €17.6 trillion (end-May 2016) at an average interest spread of 0.8 percent, euro area banks would record aggregate net interest income of about €141 billion (gross of operating expenses, provisioning, and taxes). Based on a (historically conservative) pass-through of 50 percent, a 10 basis point rate cut would reduce lending margins by 5 basis points and result in an indirect cost of about €8.8 billion (or 11 times the estimated direct cost of NIRP above). Valuation gains from investments and trading income might, to some extent, mitigate these costs. However, the aggregate balance sheet of euro area banks suggests that lending is about 6-7 times more important than investments for profitability.

Fine-tuning the exempted portion of excess reserves can alter the effective monetary transmission of negative rates to money markets. In its current reserve regime, the ECB achieves negative short-term money market rates by setting a positive policy rate (MRO at 0 percent) and a negative interest rate on the deposit facility (-0.4 percent) while maintaining excess reserves in the banking system. The money market rate is pushed down towards the lowest marginal policy rate because banks will try to lend their surplus liquidity to other banks in the interbank market to avoid using the central bank's deposit facility—but only as long as the lending rate exceeds the deposit rate.[3] Given the prevailing excess liquidity in the system, the overnight money market rate (EONIA) has converged to the volume-weighted average of (i) the deposit rate (at -0.4 percent) for excess reserves and (ii) the marginal refinancing operations (MRO) rate (of 0 percent), which applies to banks' minimum reserve requirement held in the ECB's current account (see text chart above). Thus, the transmission of the marginal policy rate is also affected by the dispersion of the excess liquidity among banks and banks' willingness/ability to lend excess liquidity to other banks.[4] This also holds true for secured funding markets (repo), where rates have similarly adjusted downward as the ECB lowered the deposit rate (see text chart). The experience in countries with tiered deposit rates shows that the average rate has a large impact on the fixing; thus, a volume-weighted average of potentially two deposit rates—by excluding a certain share of reserves from the deposit rate and removing some excess liquidity from interbank market—below the marginal policy rate could marginally push up the money market rate.

The effective transmission of the policy rate can also be assessed based on the sensitivity of unsecured term funding of banks via certificates of deposits (CDs). The CD rate reflects the willingness of money market funds to lend to issuing banks over a pre-defined maturity term (see text chart). Since the CD rate continues to track the marginal policy rate very closely even under NIRP (without a change in volumes), this suggests that banks are able to impose lower and negative rates on investors despite counterparty risk given the unsecured nature of CDs.

---

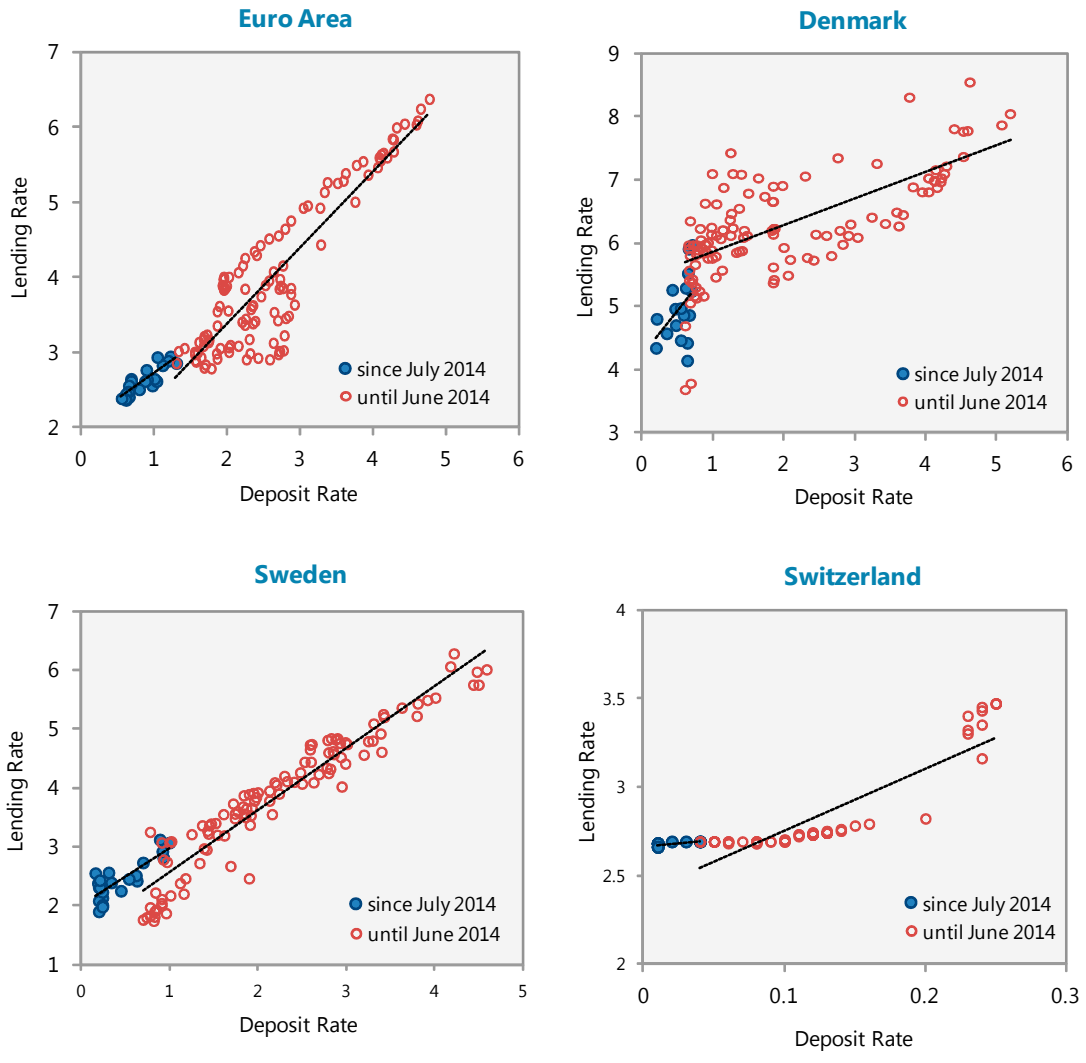
[1] The assumption of exempting 75 percent of reserves from a negative deposit rate was based on the experience in Switzerland where the share of the overall reserve stock subject to negative deposit rates averaged 23 percent until end-2015. In practice, given the significant heterogeneity of bank business models, banks' tolerance threshold for the direct cost of negative rates might be different in the euro area than in Switzerland.

[2] The exemption of a certain amount of reserves can vary over time (and would need to decrease as excess liquidity declines). The opportunity cost of lending can be increased (on average) by calibrating the tiering such that the price of depositing cash with the ECB would be the same (or higher) than the expected net interest margin from lending multiplied by the share of the deposit base funding loans (i.e., the inverse of the aggregate loan-to-deposit ratio of the banking sector).

[3] The money market rate could be higher than the lowest marginal policy rate if the exempted portion of excess reserves is too large, leaving banks little incentive to engage in interbank lending; thus, lower supply of liquidity could create potential scarcity in some parts of the system, pushing up money market rates above the technical floor of the ECB deposit rate.

[4] Given that the average daily quoted turnover underpinning EONIA fixings has only been about €12.6 billion (or 1.5 percent of excess liquidity) since January 2016, the impact of the marginal policy rate on money market rates is quite sensitive to changes in bank behavior and rate setting.

Figure 1. Deposit and Lending Rates (New Lending) for Households
(January 2005–June 2016, percent)

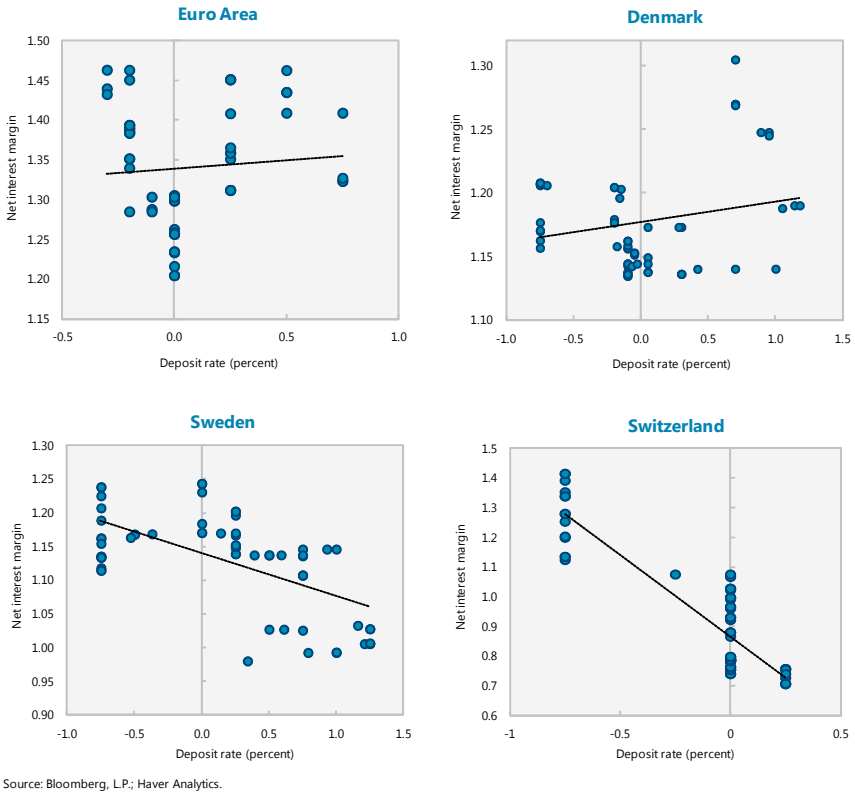


Source: Bloomberg L.P., Haver and IMF staff calculations.

Negative policy rates also have been transmitted to the wider economy through lower lending rates for both corporates and households as lending standards have eased. In most countries, banks lowered their lending rates to both households and firms (which continued to decline even as deposit rates had reached the ZLB) while offsetting the negative impact on lending margins (when deposit rates adjusted less) by some small increase in fees and commissions and cost cutting. However, this has occurred, in most cases, as long as deposit rates still had some room to drop to the ZLB (see text figures and Figure 1), allowing banks to transmit lower policy rates

without impeding their profitability (Box 1).[23] In some countries (e.g., Denmark and Sweden), banks also passed negative rates to deposits of some large corporations and institutional investors but maintained positive rates for retail depositors. In Switzerland, lending rates adjusted only slowly when policy rates moved into negative territory, helping to raise bank profitability (Appendix III, Figure A3).

Figure 2. Marginal Policy Rate (Central Bank Deposit Rate) and Bank Net Interest Margin (January 2010–May 2016, percent)

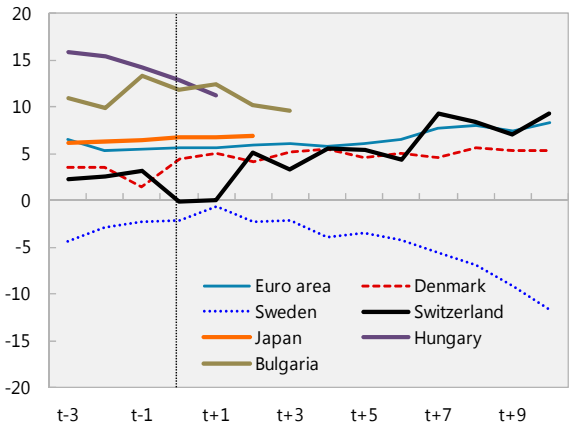


Source: Bloomberg, L.P.; Haver Analytics.

[23] Whether this effect is stronger or weaker at negative rates remains unclear. Claessens and others (2016) suggest that interest rate cuts reduce banks' NIMs, and this effect increases the lower the policy rate.

The *direct* cost imposed on excess bank reserves is modest relative to the size of the overall balance sheet. Negative rates have important implications for banks' cost of holding central bank liabilities depending on the structure of reserves and their remuneration (Appendix I, Box A1) and the transmission of the marginal policy rate to money markets. However, bank profitability is far less sensitive to negative rates on excess reserves (even under a tiered system) since cash balances of banks represent only a fraction of their asset base (although there are significant differences in the distribution of reserves around the euro area). That said, many banks earn negative returns on many liquid assets, which are required for liquidity risk management and represent a significant portion of their balance sheet. At the same time, rolling over these short-term holdings tends to offset any benefits from valuation gains.

Currency in Circulation at Time of Negative Deposit Rates
(Percent, year-on-year)



Source: Haver Analytics. Note: the x-axis shows monthly intervals.

In the euro area and countries with an even more negative deposit rate (Denmark, Sweden and Switzerland), there have been no clear signs of cash hoarding (see text figure).[24] Current levels of negative rates seem to provide insufficient incentives to build alternative storage capacity for excess reserves. However, banks have been hesitant to pass on negative rates to depositors—with the exception of large corporates (e.g., Denmark and Switzerland)—limiting the incentives for hoarding cash. In fact, most of the recent increase in cash holding in some countries (Denmark and Switzerland) can be explained by the normal relation between currency in circulation and movements in the short-term interest rate, reflecting the reduced opportunity cost of holding cash rather than deposits (Figure 3). Irrespective of whether interest rates are positive or negative, the amount of currency in circulation increases when interest rates decline.[25]

Despite lower lending rates, there is limited evidence so far of negative rates having directly damaged bank profitability; however, they have contributed to the flattening of the yield curve.

[24] In the case of Switzerland, the annual growth of currency in circulation is now higher than the pre-NIRP period (especially high-denomination banknotes). However, currency growth rates are still below those observed in earlier years (e.g. 2009 and 2012).

[25] The avoidance of negative deposit rates by corporates can also affect other parts of the economy. For instance, Danish tax authorities had to restrict the amount of taxes firms could prepay in order to receive modest interest on the deposits, which are credited against what they owe or are refunded, and, thus, limiting the use of tax collection as a quasi-bank account to avoid negative interest rates on taxable income (Campbell and Levring, 2016).

While there is some direct cost pressure coming from the charge on excess reserves, it is dominated by the indirect cost of negative rates coming from the possible decline of net interest income in cases where sticky deposits compress lending margins. However, bank profitability has not worsened because positive effects have so far outweighed these adverse effects. Many euro area banks have been able to more than offset declining interest revenues with higher lending volumes, lower interest expenses, lower risk provisioning and capital gains (Cœuré, 2016a).[26] While bank profitability has been a longstanding structural challenge for many euro area countries (Albertazzi and Gambacorta, 2009), the aggregate NIM has even improved slightly towards the end of 2015, after almost 1.5 years of negative rates.[27] Moreover, reduced lending margins have also put pressure on banks to consolidate and strengthen operational efficiency.[28] Some banks—such as those in Sweden, Denmark and Switzerland[29]—have been able to maintain overall profitability and benefitted from historically low impairment charges and greater wholesale funding at negative rates (Appendix I, Box A2 and Figure 2).

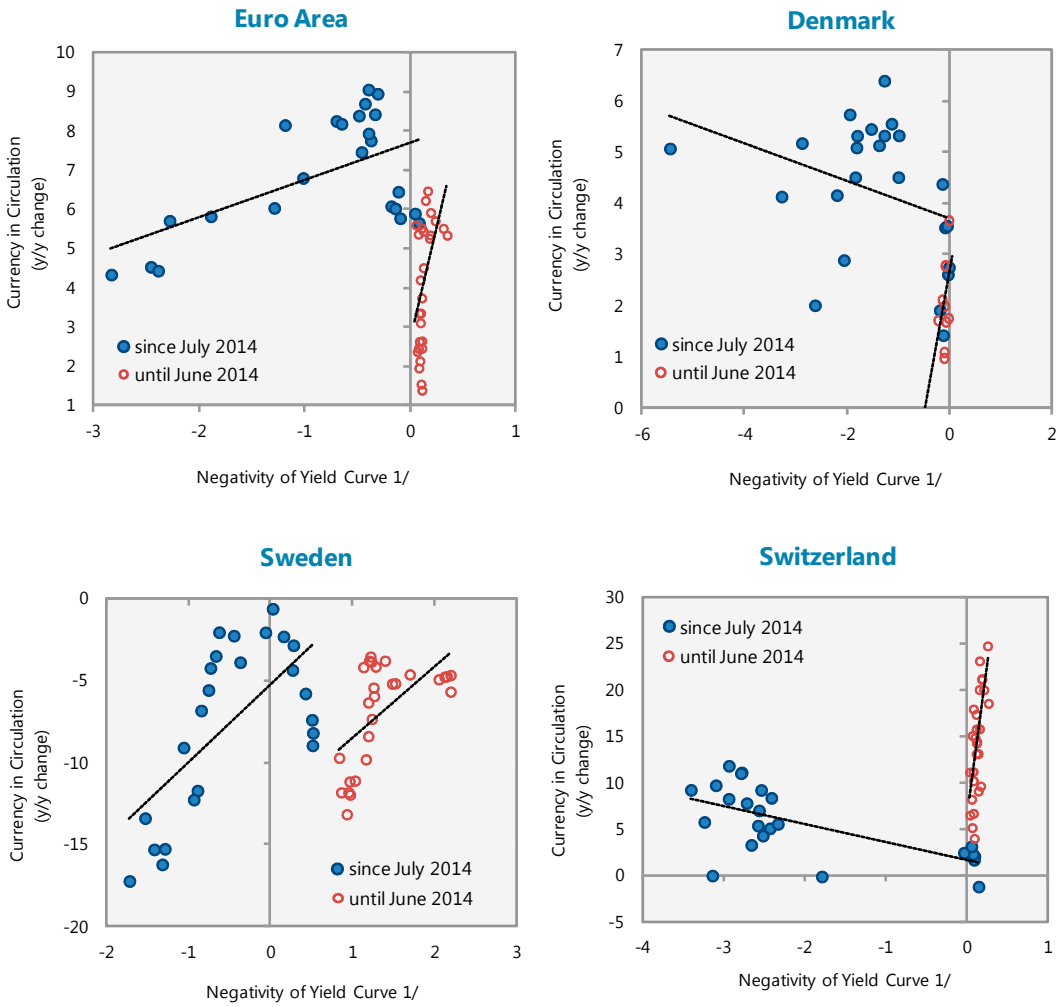
[26] ECB staff estimate that negative rates have contributed about one percentage point to corporate lending growth since July 2014 (Rostagno and others, 2016).

[27] See Demirguc-Kunt and Huizinga (1999) for early evidence on determinants of bank interest margin and profitability from international experience.

[28] For instance, the pressure on profitability in Italy and Spain may explain why some banks have already announced significant cuts in operating costs (closing of branches and reduction in staffing). See also Jobst and Weber (2016).

[29] Also house prices have risen significantly since interest rates turned negative as the demand for mortgage loans has increased; in this context, banks also generate more fee income from higher re-financing of mortgages.

Figure 3. Currency in Circulation and Pervasiveness of Negative Interest Rates
(2012-2016, percent)



Source: Bloomberg L.P. and IMF staff calculations. Note: 1/ denotes the extent to which the 1-month interbank offer rate forward curve is in negative territory, calculated as the product of the maturity term and the interest rate.

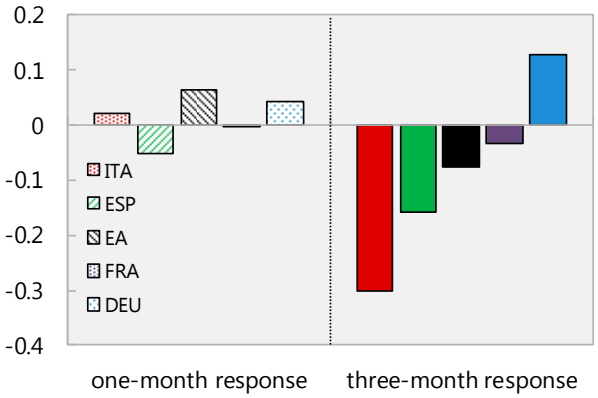
IV. Assessment for the Euro Area

So far, negative interest rates have contributed to an improvement in overall financial conditions and a modest expansion of credit. The negative deposit facility rate has been effectively transmitted through the domestic credit channel. According to the ECB's *Bank Lending Survey* (ECB, 2016a) negative rates seem to have led to an increase in household lending in the euro area (Figure 4 and Appendix III, Figure A4), and the impact is expected to continue going

forward.[30] With money market rates tracking the deposit rate in an environment of excess liquidity, the negative rate has also enhanced the ECB's forward guidance while inflation and inflation expectations have remained subdued. Negative rates have also strengthened portfolio rebalancing (Heider and others, 2016)—an important transmission channel of the ECB's asset purchase program.

The impact of NIRP on bank profitability so far has been limited but monetary transmission might become less effective as interest rates become more negative. Given that the volume of outstanding loans in the euro area matches the amount of deposits, the pass-through of policy rates to lending and deposit rates matters greatly for the earnings capacity of most banks. Estimates of the impact of the recent decline in policy rates on banks' NIMs suggest a small effect (7 basis points for a 50-basis point reduction in the policy rate).[31] Since the adoption of NIRP, however, monetary transmission has become more heterogeneous across the euro area, especially for household lending, with a higher pass-through in countries with a higher share of variable rate loans. While the extent to which deposit rates are sticky at the ZLB remains to be seen, lending rates would likely decline more than deposit rates in the near term if cash demand is highly elastic (see text figure and Rognlie, 2015). This would leave little room for further substantial adjustments to the deposit rate without compromising banks' net interest earnings. On the other hand, banks might also be reluctant to reduce lending rates unless they can offset lower interest margins by substituting wholesale funding for more expensive deposit funding, which represents a large part

Euro Area: Estimated Change of the Lending Spread to a Reduction in Effective Policy Rate, 2006-2016
(multiple) 1/



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Note: estimates based on the cumulative response of the lending spread (lending rate minus deposit rate) to a one-percent reduction in the overnight money market rate (EONIA) using a VAR specification with a simple lag structure between July 2006 and May 2016; the lending rate is the volume-weighted average lending rate to both non-financial corporates and households.

[30] Negative interest rates have had little impact on corporate lending volumes over the past six months, but some positive impact is expected for the coming months.

[31] NIMs have been estimated for all large euro area banks that are directly supervised by the ECB using publicly reported data on consolidated bank balance sheets. For some banks with sizeable and, in most cases, more profitable, foreign operations, the reported NIMs might overstate the profitability of lending within the euro area.

of euro area bank liabilities. If lending rates become stickier, monetary transmission could become impaired, reducing the effectiveness of negative rates as a policy measure.

Early evidence suggests that the adverse impact of negative rates on bank profitability may increase non-linearly as the policy rate declines further.[32] Indeed, the ECB's *Bank Lending Survey* (ECB, 2016a) shows that banks' profitability has recently declined and is expected to remain depressed (Figure 4). Admittedly, higher aggregate demand and asset quality help raise investment income, lower funding costs and provision expenses, which has mitigated so far the adverse impact on bank profitability in the euro area and support the notion that the economic lower bound to NIRP might be much lower than the ZLB (Cœuré, 2016b). However, these benefits have weakened over time, especially in countries where the pass-through of policy rates is high and low credit demand limit the extent to which banks (can) increase lending to offset the impact of lower lending rates.

Deteriorating investor confidence and declining risk-taking behavior could intensify the potentially adverse impact of negative rates. The prospect of low policy rates for a longer time—amplified by structural challenges to banks especially in countries where the cost of risk remains high due to a (still) large stock of impaired assets—has already worsened the outlook for bank earnings.[33] Further substantial reductions to the deposit rate could further weigh on banks' equity prices as investors will be likely to revise down their expectations of banks' future earnings (Figure 5).[34] While monetary easing has reduced borrowing costs,[35] equity risk premia have risen, and price-to-book ratios have declined during the second half of 2015, with the average cost of equity now exceeding the return on equity.[36] As sustainable profitability becomes more difficult to achieve, capital-constrained banks become more likely to reduce lending despite declining rates.

[32] Although it is unclear whether banks still have room to cut deposit rates, banks may be reluctant to do so due to competition.

[33] Both level and slope of the yield curve are found to contribute positively to bank profitability in the long run (Alessandri and Nelson, 2012; Borio and others, 2015). Busch and Memmel (2015) also find that banks' net interest income benefits over the medium- to long-term horizon if the interest rate level increases.

[34] The return on assets for European banks is low at 0.24 percent (compared to 1.0 percent of U.S. banks).

[35] For some banks the cost of borrowing might not necessarily decrease as their funding opportunities via money markets remain limited (such as smaller banks) and/or they lengthen the maturity of their term funding.

[36] This holds particularly true in countries where banks face greater earnings pressure and credit growth has been low.

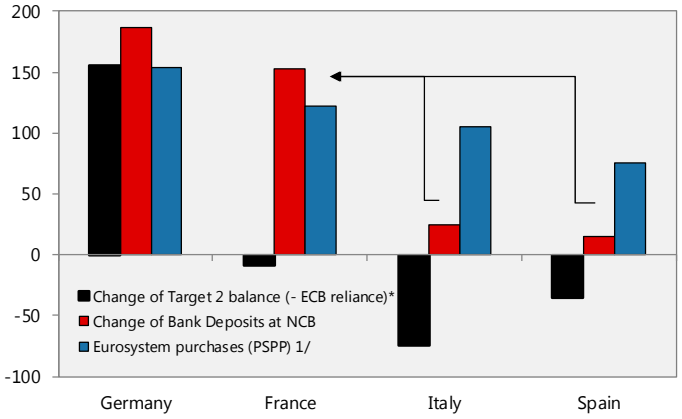
For the euro area, three important adverse implications need to be considered in the way negative rates could diminish the transmission of monetary policy to the real economy:

- *NIRP may become less effective in economies most in need of stimulus.* Given the wide deposit base in most euro area countries, the extent to which deposit rates are sticky has a direct impact on bank profitability and the effectiveness of NIRP on monetary transmission. Even if banks were to fund themselves increasingly via money markets, the benefit from wholesale funding at negative rates will be limited by the existing deposit base and cannot offset the negative impact of lower rates on existing loans if credit growth is insufficient (Figure 3). Hence, lower profitability from financial intermediation might override possible mitigating benefits from higher asset prices and pricing frictions due to an insufficient reduction in funding costs. In particular, bank profits are likely to decline in countries with large outstanding loan amounts at variable rates if lending growth cannot offset diminishing interest margins as existing loans re-price. In this regard, the ECB's TLTRO II program could facilitate the transmission to lending rates by mitigating the potentially adverse impact of negative rates on banks' lending margins (ECB, 2016b). Higher credit demand can offset declining margins, and, in turn, reinforce the impact of TLTRO II on bank profitability (Appendix I, Box A3). Among countries with a high share of variable rate loans, such as Italy, Portugal, and Spain, also high asset impairments amplify concerns about banks' earnings capacity, and restrict their ability to supply credit to the real economy. For instance, in the case of Italy, NIMs have declined, and credit growth is far below the NIM-preserving threshold (in contrast to high credit growth in Germany and France).

- *The direct cost of negative deposit rates is likely to be greater for banks in surplus countries.* Since the ECB charges interest only on excess liquidity the charge is greater in those countries where banks hold large excess reserves. Given the imbalances within the euro area, the Target 2 settlement of capital flows generates large amounts of excess liquidity in the banking sectors of those countries with substantial current account

surpluses (such as Germany and the Netherlands) vis-à-vis other members of the currency area.[37] In addition, the implementation of the Eurosystem's asset purchase program has generated additional liquidity in other core economies in excess of their national share of asset purchases, such as France (see text figure). Both developments have led to a very uneven distribution of excess liquidity, affecting banks differently across the euro area.[38] In principle, tiering of the deposit rate could mitigate the direct cost of NIRP and ensure effective transmission of the marginal policy rate (to short-term rates) even if rates became more negative and excess liquidity increases. However, the heterogeneity of national banking systems within the euro area might complicate the effective implementation of a tiered reserve regime (Appendix I, Box A1).

Euro Area: Rising Financial Fragmentation, January 2015-March 2016
(absolute change, EUR billion)



Sources: Bloomberg L.P., ECB, Haver, NCBs, and IMF staff calculations. Note: */The use of ECB liquidity reduces the Target 2 balance and is subtracted; 1/ public sector purchase program (PSPP).

- *Negative interest rates might not necessarily increase the scope of eligible assets for purchases under the current program.* Since purchases are limited to eligible government and public agency debt securities trading at yields that are above the ECB's deposit facility rate, moving interest rates into deeper negative territory would make this price-based exclusion less restrictive as more securities trading at negative yields would become eligible for purchase. However, lowering the deposit rate will also cause yields to fall—albeit at different degrees across the euro area depending on the yield curve flattening—leaving some proportion of the securities trading above the lower (new) deposit rate unchanged.

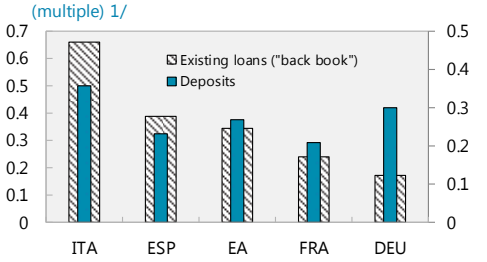
[37] Note that the extent to which TLTRO II boosts the usage of ECB liquidity (and not just facilitates a rolling over of existing liquidity), existing Target 2 imbalances are bound to increase. This would be consistent with a more positive credit impulse and hence stronger domestic demand growth.

[38] Several countries (Bulgaria, Denmark, Japan, Norway, and Switzerland) have tiered reserve systems. In the case of Japan and Switzerland they were only introduced in conjunction with NIRP in order to reduce banks' direct cost of holding excess reserves (Annex, Box A1).

Figure 4. The Impact of NIRP on Bank Profitability and Implications for Credit Growth

Within the euro area, banks in the selected economies will likely re-price lending quicker than deposits, reducing lending margins ...

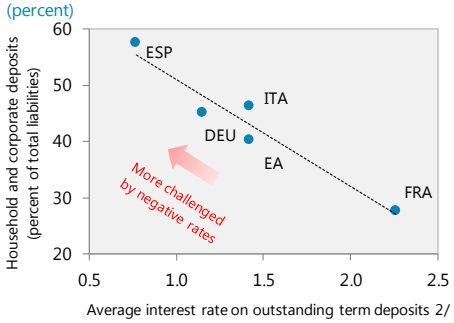
1. Estimated Sensitivity of the Average Rate of the Loan Book and Deposit Rates to a Change in Effective Policy Rate, 2006-2016
(multiple) 1/



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Notes: based on the cumulative response over three months to a one-percent reduction in the overnight money market rate (EONIA) using a VAR specification with a simple lag structure between July 2006 and May 2016; 1/ volume-weighted average based on lending to both non-financial corporates and households.

... given the high reliance on a wide deposit base amid rising pressure to rollover expiring term deposits.

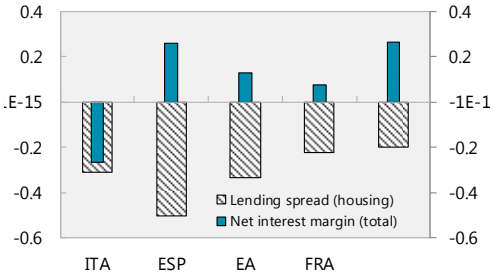
2. Non-MFI Deposits as a Share of Total Liabilities and Interest Rates on Deposits, January 2016 1/
(percent)



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Note: 1/ MFI=monetary financial institutions; 2/ oth household and non-financial corporates.

As a result, lending margins have compressed most in countries with high asset re-pricing and stickier deposits ...

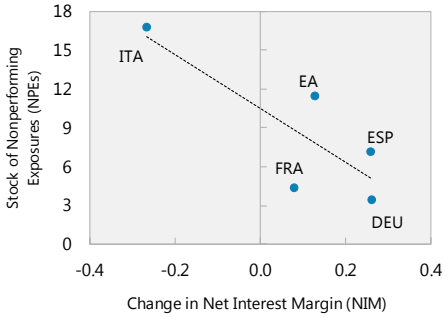
3. Change in Lending Spread and Net Interest Margin (NIM)
(percentage points) 1/



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Notes: calculated for new agreements between June 2014 and Jan. 2016 (lending spread) and June 2014 and March 2016 (NIM); 1/ lending spread is calculated as the difference between the lending rate for new business less the three-month money market rate.

... with higher levels of underprovisioned impaired assets weighing on the capacity of banks to maintain their NIMs.

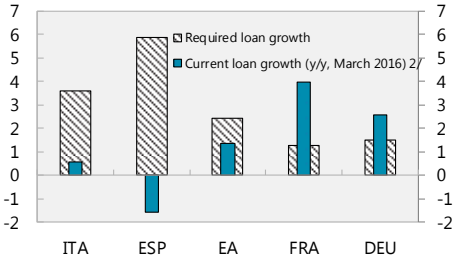
4. Change in Net Interest Margin and Nonperforming Exposures 1/
(percent change/percent of total exposure)



Sources: Bloomberg LP, EBA Transparency Exercise (2015) and IMF staff calculations. Note: NPEs as of end-June 2015; change of NIM between June 2014 and March 2016.

Current loan growth in selected economies is insufficient to offset the impact of declining margins ...

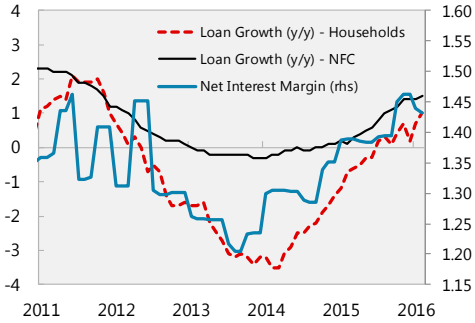
5. Annual Loan Growth Required to Maintain Net Interest Margin, end-2015
(y/y percent change) 1/



Sources: Bloomberg L.P., EBA Transparency Exercise (2015), ECB, SNL, and IMF staff calculations. Note: 1/ based on the historical pass-through of policy rates and the elasticity of net interest margins to changes in term premia between Jan. 2010 and Feb. 2016; total mortgage and corporate loans at end-2015 to EA residents.; scenario assumes an increase of monthly asset purchases (until Sept. 2017) by the ECB and a reduction of the deposit rate by 10bps (as per ECB decision on March 10).

... and recent history suggests that it is unlikely that credit will pick up under these conditions.

6. Euro Area: Average Net Interest Margin and Credit Growth
(weighted by bank assets)

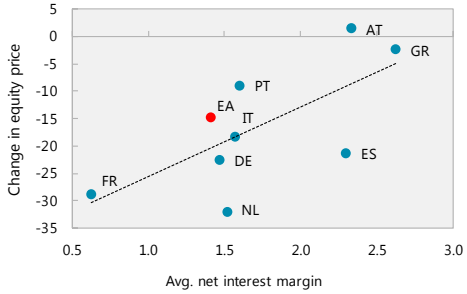


Sources: Bloomberg, L.P.; ECB; and IMF staff calculations.

Figure 5. Bank Equity Valuation and Credit Growth

Banks with weaker profitability experienced a larger decline in equity prices since 2015 ...

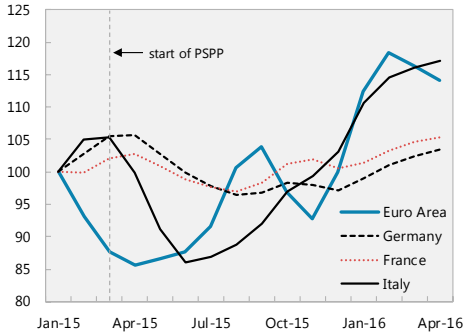
Banking Sector: Change in Equity Price and Net Interest Margin, since 2015
(percent) 1/



Sources: Bloomberg, L.P.; and IMF staff calculations. Note: 1/ Change in equity price and average net interest margin (NIM) between April 2015 and March 2016.

... with low equity valuations raising the cost of equity.

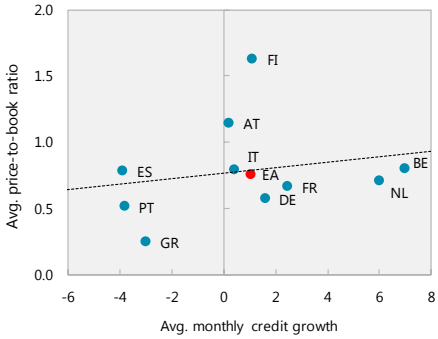
Equity Risk Premium
(index, Jan. 2015 = 100)



Sources: Bloomberg, L.P.; and IMF staff calculations.

The impact of lower returns on valuations has made banks less willing to lend ...

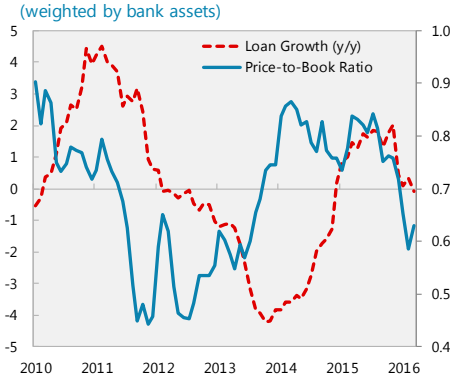
Banking Sector: Price-to-Book Ratio and Credit Growth, since 2015
(percent) 1/



Sources: Bloomberg, L.P.; and IMF staff calculations. Note: 1/ Change in price-to-book value and credit growth between April 2015 and March 2016.

... with credit supply lagging a recovery in bank equity.

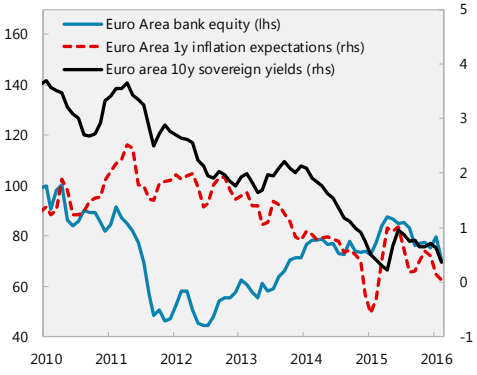
Euro Area Banks: Price-to-Book Ratio and Credit Growth
(weighted by bank assets)



Sources: Bloomberg, L.P.; and IMF staff calculations.

The combined effect of low inflation and low expected profitability has depressed equity valuations of euro area banks ...

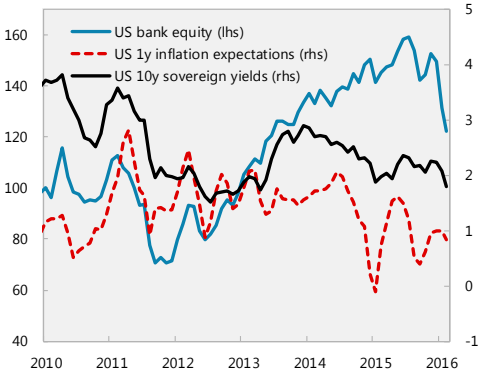
Euro Area: Bank Equity Prices, Inflation Expectations, and Sovereign Yields
(Index 2010 = Jan. 2010/Percent)



Source: Bloomberg, LP.

... while U.S. banks have benefitted strongly from monetary easing, falling only recently as a result a broader market deterioration.

United States: Bank Equity Prices, Inflation Expectations, and Sovereign Yields
(Index 2010 = Jan. 2010/Percent)

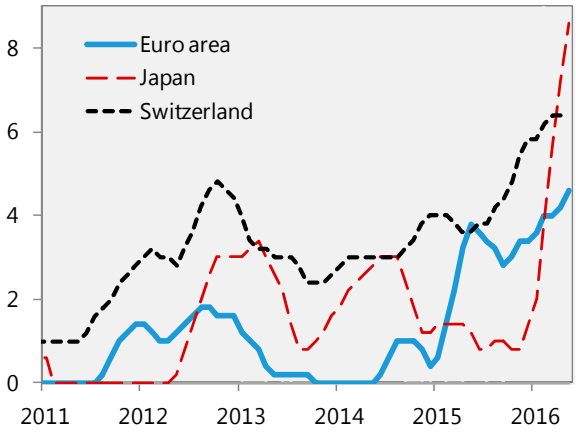


Source: Bloomberg, LP.

V. Conclusion

Negative interest rates so far have had a positive effect on the economy, helping to lower bank funding costs and boost asset prices. In addition, negative rates have significantly enhanced the signaling effect of the ECB's monetary stance strengthening its forward guidance. Lowering the deposit rate has also supported the portfolio rebalancing channel of the ECB's asset purchase program by encouraging banks to substitute investment in riskier assets for excess reserves. With money market rates tracking the deposit rate in an environment of excess liquidity, this has enhanced the ECB's signaling capacity and strengthened its commitment to keep rates low for an extended period of time until the price stability objective is achieved. In some countries, rate cuts have been passed through to corporate and household borrowers thereby contributing to a modest credit expansion and bolstering the economic recovery. Lower lending rates have encouraged higher credit demand as lending standards continue to ease. Concerns about their negative effect on bank profitability have for the most part not yet materialized.

Equivalency of Government Bond Yield and Marginal Policy Rate
(Years) 1/



Source: Bloomberg LP and IMF staff calculations. Note: Euro area covers the core economies only; 1/ the "equivalency line" shows the maturity term at which the prevailing government debt yield is no higher than the marginal policy rate in the respective jurisdiction.

However, further substantial reductions of the deposit rate will likely entail diminishing returns, since the lending channel is crucially influenced by banks' expected profitability. While most banks have been able to mitigate the squeeze on profitability with higher lending volumes and benefitted from higher asset prices, lower funding costs, and possible cost savings from greater operational efficiency and consolidation, there are clearly limits to such mitigation measures.

The outlook for bank profitability has worsened recently. This is particularly relevant in euro area countries with a high share of variable rate loans (and a high dependence on deposit funding), where concerns about sustainable bank profitability are amplified by low credit growth. Additional rate cuts could weaken monetary transmission if lending rates fail to adjust

or customers withdraw cash from banks. Declining bank profitability could then constrain credit expansion and undermine the aim of monetary easing.

NIRP involves a difficult trade-off between implementing unconventional policy measures to support aggregate demand and mitigating adverse effects of declining net interest margins on the bank lending channel. The micro-level risks associated with negative interest rates warrant a balanced use of non-standard policy measures, to help mitigate risks to banks' profitability and its impact on monetary transmission. Looking ahead, further monetary accommodation could rely more on credit easing measures and a further expansion of the ECB's balance sheet. Focusing on asset purchases would raise asset valuations and aggregate demand, while also supporting the bank lending channel. More generally, further easing would also benefit from more centralized fiscal policy support and structural reforms to support aggregate demand going forward.

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Appendix I. Implementation Issues under NIRP

Table A1. Overview of Central Banks with Negative Policy Rates

	Objective	Instrument	Rate
Bosnia and Herzegovina (two tiers) 1/	Transmission of the ECB's monetary policy stance; also aimed at avoiding potential losses to the central bank	Deposit rate	-0.20% (July 1, 2016) *Note: 50% of the ECB's deposit facility*
Bulgaria (two tiers) 1/	Transmission of the ECB's monetary policy stance; also aimed at avoiding potential losses to the central bank	Deposit rate	-0.30% (January 4, 2016) -0.40% (March 16, 2016) *Note: the same interest rate as the ECB's deposit facility*
Denmark (two tiers)	Countering safe-haven inflows and exchange rate pressures *(continued FX interventions)*	Certificates of deposit (CD)	-0.20% (July 2012) -0.10% (January 2013) +0.05% (April 2014) -0.05% (September 2014) -0.20% (January 19, 2015) -0.35% (January 22, 2015) -0.50% (January 29, 2015 -0.75 % (February 5, 2015) -0.65 % (January 8, 2016)
Euro Area (no tiers) 2/	Price stability and anchoring inflation expectations *(together with asset purchase program)*	Deposit rate	-0.10% (June 11, 2014) -0.20% (September 10, 2014) -0.30% (December 9, 2015) -0.40% (March 16, 2016)
Hungary (no tiers)	Price stability and countering exchange rate pressures *(together with a small asset purchase program)*	Deposit rate	-0.05% (March 23, 2016)
Japan (three tiers)	Price stability and anchoring inflation expectations *(together with asset purchase program)*	Deposit rate	-0.10% (February 16, 2016)
Norway (two tiers) 1/ 3/	Price stability	Reserve rate	-0.25% (September 24, 2015) -0.50% (March 17, 2016)
Switzerland (two tiers)	Reducing appreciation and deflationary pressures 4/	Sight deposits at SNB (with an exemption threshold)	-0.75% (January 15, 2015)
Sweden (no tiers)	Price stability and anchoring inflation expectations *(together with asset purchase program)* 5/	Reverse repo rate	-0.10% (February 12, 2015) -0.25% (March 18, 2015) -0.35% (July 2, 2015) -0.50% (February 11, 2016)

Source: National central banks. Note: 1/ The Bulgarian National Bank (Българската народна банка) and Norges Bank (NB) imposed a negative interest rate on banks' excess reserves held in the central bank on January 4, 2016 and September 24, 2015, respectively. The central bank of Bosnia and Herzegovina (Centralna Banka Bosnei Hercegovine) introduced a fee for the banks' surplus reserves (exceeding the obligatory reserve rate of 10 percent) equal to 50 percent of the ECB's deposit rate on July 1, 2016. In the case of Bosnia and Bulgaria, given their currency board arrangements with the euro as exchange rate anchor, it was not intended as an active monetary policy measure but to transmit the ECB's monetary policy stance while avoiding potential losses to the central bank from inaction.

2/ A loosely defined tiered reserve system also applies to the ECB, which remunerates overnight deposits in the current account at the MRO rate of 0 percent (as of March 16, 2016), effectively exempting about one-seventh of current reserves from the marginal policy rate.

3/ Norway has not adopted NIRP, and the negative interest rate on bank deposits at the central bank ("reserve rate") has had little or no influence on market rates

4/ In conjunction with the exit from the exchange rate ceiling (to the euro).

5/ The asset purchase program started with the purchase of SEK10 billion and was gradually increased to a cumulative total of SEK245 billion by end 2016 or about 37 percent of government bonds.

Box A1. The Mechanics of Tiered Reserve Systems

Banks' cost of holding central bank liabilities varies with the structure of reserves and their remuneration (Bech and Malkhozov, 2016). Central banks have historically used tiering regimes to ensure that excess reserves are distributed widely within the banking sector; they also help protect the interests of domestic retail depositors while attempting to push as much of the costs onto wholesale (and especially foreign) investors whose deposits contribute mostly to excess reserves. Thus, the ideal size of the exemption threshold is determined by the amount of domestic retail funding banks have at the time of the introduction of the system (i.e., the level of deposits central banks want to protect).

Excess reserves at the ECB, the Swiss National Bank (SNB), and Norges Bank (NB) are held as overnight deposits whereas the Danmarks Nationalbank (DN) and the Sveriges Riksbank (SR) use a combination of overnight fine-tuning operations and one-week term deposits to attract reserves and other central bank liabilities above required amounts ("liquidity surplus"). While the ECB was the first central bank to move its deposit rate significantly into negative territory, it continues to maintain a single (negative) rate for excess reserves. In contrast, other central banks (BoJ and SNB)1 have put in place tiered reserve regimes for excess reserves2 to mitigate burdens on bank earnings, facilitate market transactions (by exploiting the uneven distribution of excess reserves among financial institutions), and discourage higher holdings of physical currency.3 Excess reserves are partially exempted from the marginal policy rate for overnight deposits (Denmark and Japan), sight deposit account (Switzerland) or reserve rate balances (Norway) at the central bank. The two-tier reserve systems in Denmark and Norway were already part of the monetary policy framework prior to the introduction of negative deposit rates. In the case of Norway, the tiering remains part of the central bank's standard liquidity management and was not aimed at shielding excess reserves from negative rates.4

A tiered reserve regime enhances central banks' capacity to lower the effective policy rate by reducing the direct cost of negative rates on excess reserves. Exempting a certain amount of excess reserves from the marginal policy rate avoids imposing the full impact of negative deposit rates on banks. Thus, at the same direct costs to banks, the marginal policy rate can be lower in a tiered reserve regime. The cost of holding depends on excess reserve holdings in the tier with the lowest marginal policy rate (i.e., deposit rate). The tiering (and the difference of policy rates in each tier) determines the extent to which the interest rate of an additional unit of (excess) reserves differs from the average interest rate for all reserves.

Existing tiered regimes can be broadly categorized based on the number of tiers and the allocation of excess reserves across these tiers: (i) constant allocation (e.g., Norway and Switzerland), where the exemption threshold for deposits is specific to each bank (as a fixed multiple of a bank's required reserves); and (ii) dynamic allocation, where fine-tuning operations determine the share of excess reserves to be placed with the central bank as more costly overnight deposits (Sweden), excess deposits (above the aggregate and individual limits for the current account deposits are converted into certificates of deposit (Denmark),5 or the portion subject to negative rates is designed to increase over time in line with the monetary base target (Japan). 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 (and increase the opportunity cost of lending rather than depositing cash as reserves with the central bank). Central banks tend to adjust the tiering over time so that the amount of excess reserves below the exemption threshold is sufficient to keep money market rates aligned with the marginal policy rate.

[1] In Sweden, the SR administers a de facto tiered reserve regime. The marginal policy rate is determined by the central bank's reserve repo operations ("market-maintaining repo facility") while accepting excess reserves as overnight deposits at the repo rate minus 10 bps or as certificates of deposits, which are issued at the repo rate minus 75 bps for a maturity term of one week. In the case of Norway, the total exemption amount is set to NOK 45 billion ("total quota"), while the NB has aimed towards keeping the reserves in the banking system at NOK 35 billion (with an interval of plus/minus NOK 5 billion). As long as excess reserves in the banking system are below this exemption threshold, the overnight rate (NOWA) remains close to the key policy rate, which is still positive (Bernhardsen and Lund, 2015).

[2] A loosely defined tiered reserve system also applies to the ECB, which remunerates overnight deposits in the current account at the MRO rate of 0 percent, effectively exempting about one-seventh of current reserves from the marginal policy rate.

[3] Negative interest rates create incentives for banks to hold cash rather than reserves, and for households and non-financial corporates to hold cash rather than bank deposits. In countries with an even more negative deposit rate than that of the euro area (Denmark, Sweden and Switzerland), cash in circulation has increased, but growth rates remain within the range seen over the last decade.

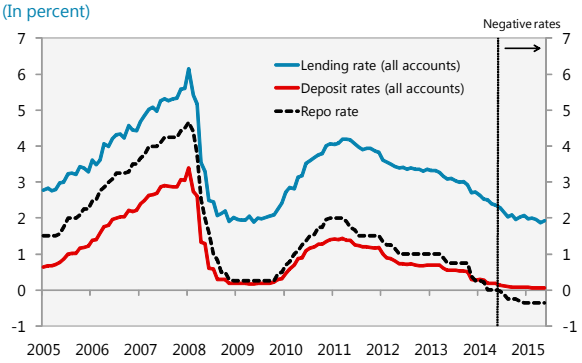
[4] The NB kept the level of reserves at the normal level and cutting the reserve rate to a negative level just to maintain banks incentive to redistribute reserves. The short-term money market rate remains positive and close to the key policy rate (sight deposits) in absence of excess reserves in the system. Only the reserve rate is negative, and with normal liquidity management this rate does not influence the overnight rate.

[5] The DN offers one-week certificates of deposit at currently -65 bps and overnight deposits in a current account at currently 0 bps. There are aggregate limit and individual limits for the current account deposits, which are actively managed by the DN. If the aggregate limit is exceeded by the end of the day, the excess deposits are converted into certificates of deposit (with a shorter maturity than the usual one-week certificates). Most recently, it was increased in March 2015 and subsequently lowered in August 2015 and January 2016.

Box A2. Low and Negative Interest Rates in Denmark and Sweden[1]

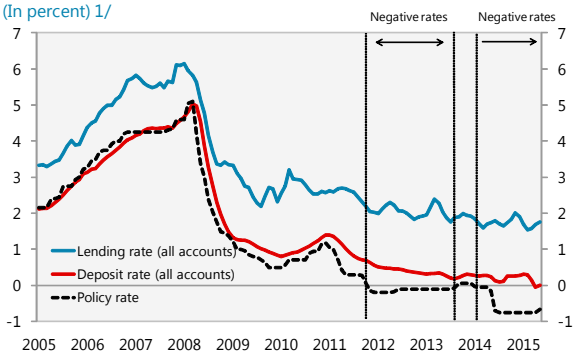
Negative interest rates were introduced in Denmark and Sweden for different reasons. In Denmark— which pegs to the euro—they were introduced in July 2012, in conjunction with other measures, to deter speculative pressures on the peg at a time when the country faced sizeable capital inflows in response to strains in the euro area. Inflows surged once more in 2015, after the Swiss National Bank (SNB) abandoned the currency ceiling to the euro, and the ECB announced the expansion of its asset purchase program, triggering the Danmarks Nationalbank (DN) to further cut the deposit rate by 70 bps over the course of four weeks. In contrast, the Swedish Riksbank adopted NIRP as part of a package of measures aimed at raising inflation to the two percent target and preventing a de-anchoring of inflation expectations.

Sweden: Bank Interest Rates, New Agreements
(In percent)



Sources: Statistics Sweden and Fund staff calculations.

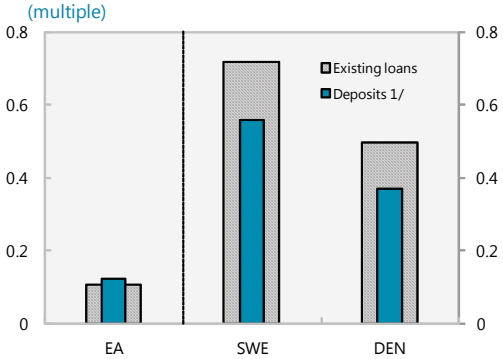
Denmark: Bank Interest Rates, New Agreements
(In percent) 1/



Sources: Statistics Denmark and Fund staff calculations. Note: 1/ 3-month moving average.

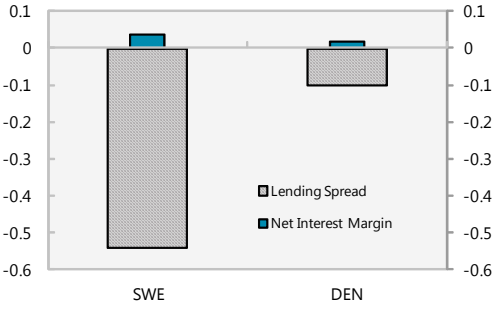
The decline in bank interest margins under NIRP was contained by the high share of wholesale funding. Money market rates turned negative and banks' assets re-priced downwards quickly in response to policy rate changes given the high share of variable rate loans (with a greater importance for household loans in Sweden) (see text figure). While lending rates declined, albeit to a lesser extent in Denmark (Jensen and Spange, 2015),[2] retail deposit rates did not drop below the ZLB (see text figure). As a result, the interest spread between lending and deposit rates narrowed—a development that began in Sweden as interest rates reached low levels in 2014, before turning negative in 2015. However, a relative narrow deposit base (with a high reliance on non-deposit funding at 52 percent of total funding at end-2015) allowed banks to benefit from lower money market rates (below their cost of deposit funding), mitigating the overall impact of NIRP on banks' net interest margins (NIMs), which remained positive in aggregate.[3]

Estimated Sensitivity of the Average Household Lending and Deposit Rates to a Change in the Interbank Rate, 2008-2015
(multiple)



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Notes: 1/ deposit rate less 3-month money market rate.

Change in Lending Spread and Net Interest Margin (NIM)
(percentage points)



Sources: Bloomberg L.P., Danmarks Nationalbank, Sverige Riksbank, and IMF staff calculations. Note: lending spread is calculated for all new loan agreements (non-financial institutions and households) between June 2014 and Jan. 2016; NIMs have been calculated on a bank-by-bank data using publicly reported data up to March 2016.

Box A2. Low and Negative Interest Rates in Denmark and Sweden (Concluded)

Also others factors have so far limited the effects of NIRP on bank profitability, despite the high degree of asset re-pricing. In Denmark, fee income rose as the volume of mortgage refinancing increased with falling interest rates and provisions declined with improved loan portfolio quality (DN, 2015). In Sweden, fee income also increased with rising inflows to banks' investment funds and an expansion of their corporate advisory services (Asterlind and others, 2015). Whereas lending growth remains subdued in Denmark, higher loan volumes in Sweden have also helped compensate for lower rates. However, the compensatory effect of credit growth in an environment of NIRP weighing on banks' net interest income also raises the importance of prudent lending, especially to households.

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[1] Prepared by Rima A. Turk and Andreas (Andy) Jobst. For a more detailed analysis of the performance of banks in Denmark and Sweden, see Turk *(forthcoming)*.

[2] Negative interest rates have not been fully passed through to bank deposit and lending rates to households. However, large deposits from firms and institutional investors are paying negative interest rates.

[3] During the first quarter of 2016, however, NIMs for Swedish banks have declined (Kuelpmann and others, 2016).

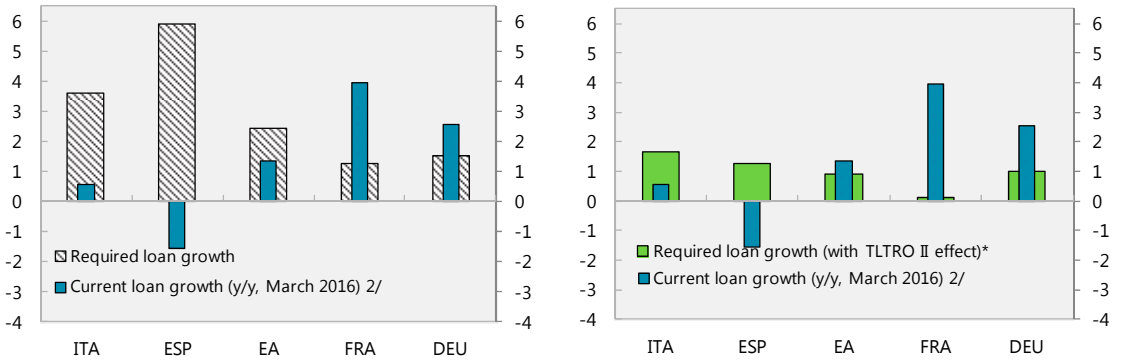
Box A3. The Impact of NIRP on Bank Profitability and the Mitigating Impact of TLTRO II

Euro area banks are under pressure to maintain current profitability from lending in an environment of continued monetary easing. A decline in term premia and a lower marginal policy rate reduce banks' net interest margin (NIM). Based on the historical pass-through of easing measures, it is possible to determine the minimum annual increase in lending (over the average maturity term of the loan book) required to offset the projected decline in net interest income as a result of the impact of the recent ECB monetary policy measures. The recently expanded asset purchase program (with monthly purchases of €80 billion, up from €60 billion, and the reduction of the deposit rate to -0.4 percent, down from -0.3 percent), are estimated to lower the NIMs of euro area banks by 11 basis points on average (Germany: 5 bps; France: 4 bps; Italy: 11 bps; Spain: 13 bps).

The decline of NIMs is greater in countries with a higher proportion of variable rate loans and a higher cost of risk (such as Italy and Spain).[1] These findings suggest that aggregate lending growth in the euro area would need to increase to 2.3 percent annually (up from 1.8 percent at end-January) for banks to maintain current profitability over the amortization period of their current loan book (see text figures).

Euro Area: Loan Growth Required to Maintain Net Interest Margins in the Banking Sector

Annual Loan Growth Required to Maintain Net Interest Margin, end-2015
(y/y percent change) 1/



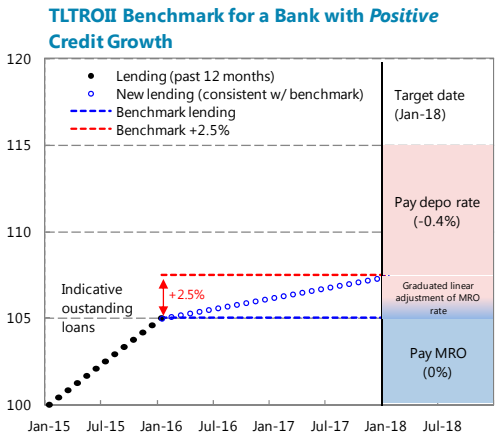
Sources: Bloomberg L.P., EBA Transparency Exercise (2015), ECB, SNL, and IMF staff calculations. Note: */ assumes that new lending is fully funded using TLTRO I funds at a weighted average borrowing rate of -20bps.1/ based on the historical pass-through of policy rates and the elasticity of net interest margins to changes in term premia between Jan. 2010 and Feb. 2016; total mortgage and corporate loans at end-2015 to EA residents.; scenario assumes an increase of monthly asset purchases (until Sept. 2017) by the ECB and a deposit rate cut of 10bps (as per ECB decision on March 10).

The launch of a second series of targeted longer-term refinancing operations (TLTRO II) will support bank lending (ECB, 2016b). Starting in June, banks will be able to borrow up to 30 percent of eligible non-mortgage private loans over a four-year period at the prevailing MRO rate. TLTRO II has two components to incentivize new lending (see text figures): (i) *conditional liquidity* (at the marginal policy rate, equivalent to the rate on the deposit facility prevailing at the time of the allotment) if banks exceed a benchmark (red line) for net new lending of at least 2.5 percent by January 2018 , and (ii) *unconditional liquidity* at either the MRO rate of currently zero percent if banks do not satisfy the lending benchmark or at a discount to the MRO rate if banks exceed the lower benchmark (blue line).[2] The size of the decrease of the interest rate for conditional liquidity is graduated linearly depending on the percentage by which the bank exceeds the lower benchmark (which is calculated similar to those under current TLTRO).[3]

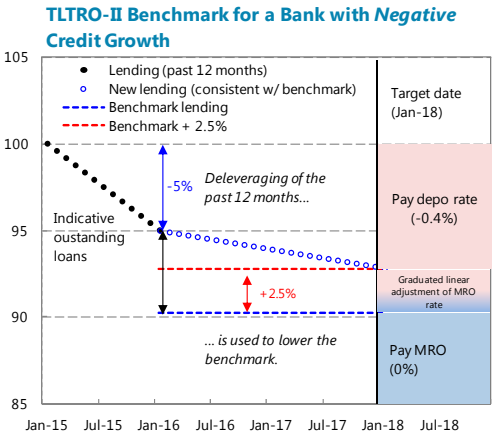
[1] We control for continued amortization, bad debt write-offs, and re-statements of asset recoveries in estimating the sensitivity of the existing loan stock to changes in interest rates; however, the calculation does not include the effects of capital gains from higher asset prices due to combined effect of negative interest rates and a flattening yield curve

Box A3. The Impact of NIRP on Bank Profitability and the Mitigating Impact of TLTRO II (Concluded)

For banks with positive lending growth over the 12 months prior to January 2016, the benchmark is zero net lending. The benchmark is lowered by the decline in eligible net lending in the same period for banks that have seen negative lending benchmark net lending.

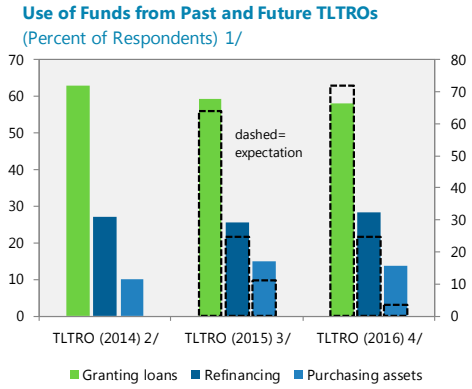


Source: Deutsche Bank; ECB; and IMF staff calculations.

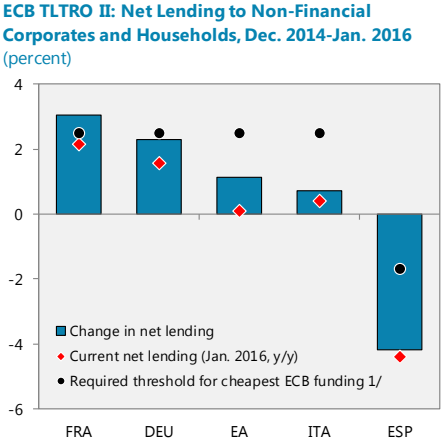


Source: Deutsche Bank;; ECB.; and IMF staff calculations.

TLTRO II could mitigate the potentially adverse impact of NIRP on bank profitability. Realigning the cost of refinancing to the marginal policy rate (if banks meet a defined minimum rate of net lending growth) facilitates the pass-through of improved bank funding conditions to the real economy by encouraging more lending. It also helps maintain bank profitability, especially in countries where banks face high cost of risk and/or would refrain from lowering lending rates to preserve profit margins without jeopardizing their deposit base (see text figures). Past evidence suggests a high effectiveness of TLTRO in stimulating new lending. Meeting the requirements for TLTRO II funding at the marginal policy rate implies at least 1.2 percent annual lending growth over a two-year period for banks with positive net lending in 2015 but a continued decline in the eligible loan book for banks that have been de-leveraging.



Source: ECB Bank Lending Survey and IMF staff calculations. Note: 1/ for survey responses in 2015, the percentage share of responses was re-scaled to unity due to multiple responses or missing responses/responses with no stated preference; 2/ first two series of TLTRO in Sept. and Dec. 2014; 3/ tender offers in Jan. and July 2015; 4/ tender offer in Jan. 2016 only.



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Note: 1/ Net lending growth required to qualify for TLTRO II borrowing at the ECB deposit rate (-0.4%).

[2] As opposed to TLTRO I, failure to meet the benchmark for net lending does not result in an early repayment of funds after two years.

[3] Banks are required to report how much they had lent during the 12 months ending January 31, 2016 to determine how much they can borrow and ascertain the lending performance against the benchmark by end of January 2018.

Appendix II. Overview of Other Countries with NIRP

Denmark

In Denmark, negative rates were adopted to counter large capital inflows speculating against the long-standing Danish peg to the euro. The Danmarks Nationalbank (DN) cut its key deposit rate four times between January and February 2015 to a record low -0.75 percent (from -0.05 percent) to defend its currency peg against the euro—and following the announcement of the ECB's asset purchase program and the Swiss National Bank abandoning its exchange rate floor in mid-January 2015. In March 2015, the DN announced an increase in the current account limit to DKK 145 billion from DKK 37 billion, thereby increasing the amount of deposit that banks could keep at the central bank without being charged the deposit rate and softening impact on banks. In January 2016, Denmark raised the deposit rate to -0.65 percent. Like in Switzerland, the ability to pass on negative interest rate to depositors was limited to large corporate customers. Denmark's experience so far also points to the importance of activity-based fees, such as mortgage application fees, and a long-term strategy of encouraging a shift from deposits into wealth management products to cope with reduced lending margins under NIRP.

Sweden

In the case of Sweden, rate cuts in 2014 and earlier were driven by persistently low inflation, with core HICP inflation at 0.5 percent in 2013-14, well below the euro area rates of 1.3 and 0.9 percent in those years. A sharp decline in inflation expectations in late 2014 and early 2015 preceded the shift to negative rates and domestic QE in February 2015. This package of measures followed the announcement of the ECB's QE program in mid-January, which increased the potential for appreciation pressures on the Swedish krona that could have impeded an increase in inflation, reinforcing the need for strong policy action by the Swedish Riksbank (SR). In February 2016, the SR reduced the reserve repo rate by another 0.25 percentage points to the current level of -0.50 percent, in combination with its own asset purchase program of government debt securities in the cumulative amount of SEK 245 billion, which amounts to more than 35 percent of the market. Note that as opposed to other countries, the current deposit rate of -1.25 percent is not the effective policy rate (and only affects a small part of bank reserves in the context of fine-tuning operations).

Japan

On January 29, 2016, the Bank of Japan introduced a three-tiered reserve deposit system (effective on February 16) with a negative interest rate on marginal excess reserves. The *first tier*, remunerated at 0.1 percent, applies to the average outstanding balance each financial institution held during benchmark reserve maintenance periods from January 2015 to December 2015 (approx. ¥210 trillion). The *second tier*, remunerated at 0 percent, is the macro add-on balance, including required reserves and the reserves equivalent to the amount of the various lending programs (¥40 trillion). An additional portion will be added to this second tier over time in line with the monetary base target. The *third tier*, remunerated at -0.1 percent, is the policy rate balance, that is, the residual reserve deposit, which is where additional reserves created by QE will initially go until the second tier is adjusted (currently ¥80 trillion/year). The amount in the third tier is expected to remain in the range of ¥10-30 trillion. To prevent financial institutions from increasing cash holding significantly, any increase in cash holding are deducted from the zero interest rate tiers of current account balance.

Switzerland

On December 18, 2014, the Swiss National Bank (SNB) announced negative interest rates on Swiss franc-denominated sight deposits above a pre-defined threshold which took effect on January 22, 2015. For domestic banks, the threshold was set to 20 times a bank's required reserves as of the reporting period ending November 19, 2014 minus (plus) any increase (decrease) in cash held. The SNB does not charge banks with negative interest rates on their cash deposits below this threshold. Thus, some Swiss banks benefitted from being able to obtain wholesale funding at negative rates and place the funds raised with the SNB at zero percent,[1] realizing additional net interest income. Switzerland exited its exchange rate floor vis-à-vis the euro at the same time as it announced a further cut of the central bank deposit rate from -0.25 to -0.75 percent (effective January 22, 2015) less than a month after it announced the cut in the policy rate from 0 to -0.25 percent, which had turned out to be insufficient to stem large safe haven flows. Following the announcement, activity in the interbank repo market increased as banks with unused exemption amounts had an incentive to trade with banks subject to negative interest on their excess reserves, distributing liquidity as efficiently as possible within the system.

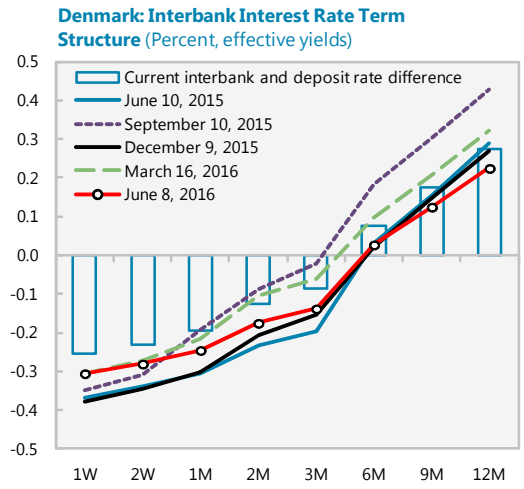
[1] However, it was not possible for all banks to realize such arbitrage gains, as the aggregate amount of excess reserves in the banking system exceeded the exemption threshold upon introduction of the negative rate.

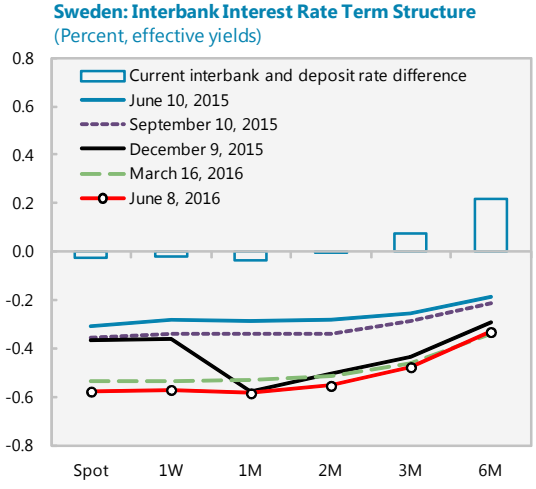
Hungary

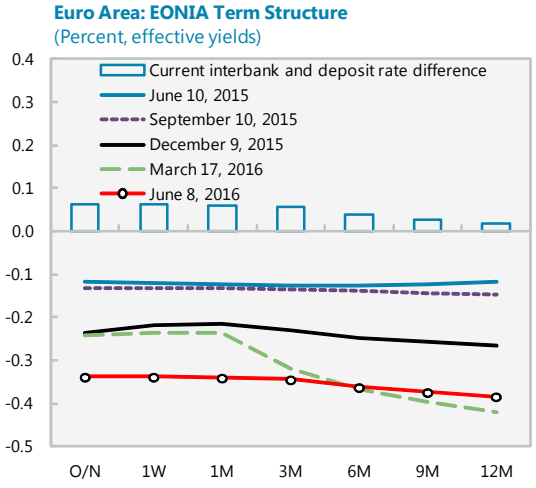
Given subdued inflation pressures and a structural liquidity surplus, the Hungarian National Bank (Magyar Nemzeti Bank, MNB) gradually eased its monetary policy stance and introduced unconventional instruments over the last two years. The objective has been to strengthen the interest, credit, and expectation channels, and lessen vulnerabilities. Conventional measures have included a gradual reduction of the policy rate, lowering and narrowing of the interest rate corridor, an effective reduction of reserve requirements, as well as changing the collateral requirements for the MNB's lending facilities. Effective March 23, 2016, the MNB reduced the policy rate and reduced the overnight deposit rate from 0.10 to -0.05 percent. Several unconventional monetary policy measures have also been introduced, including (i) supporting SME lending by providing cheap MNB funding for banks to on-lend to SMEs and offering incentives to banks (through interest rate swaps and a special deposit facility) to increase their lending to SMEs; and (ii) incentivizing banks to substitute government securities (especially long-term and local currency-denominated) for excess reserves with the MNB.

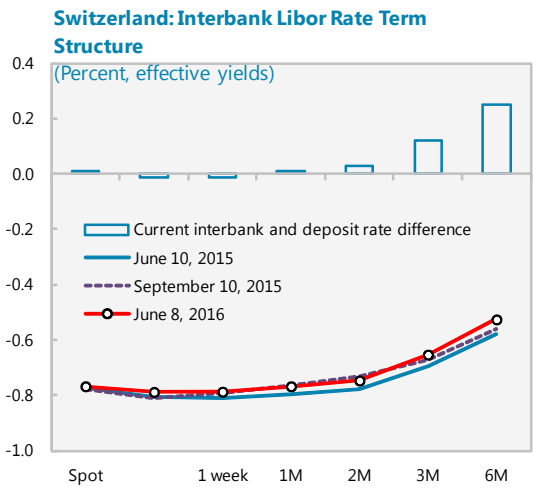
Appendix III. Monetary Conditions in Countries with NIRP

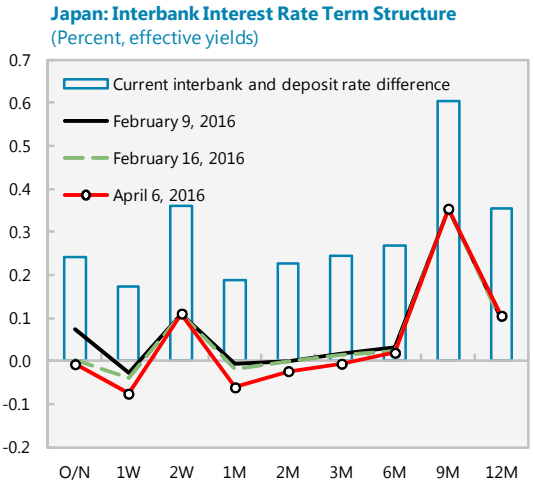
Figure A1. Marginal Policy Rate (Central Bank Deposit Rate) and Money Market Rates











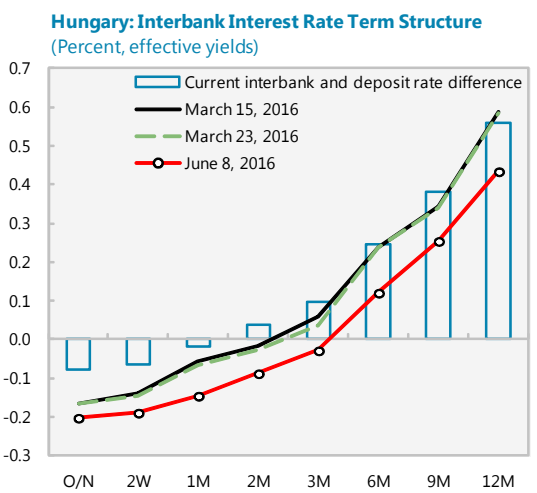


Figure A2. Marginal Policy Rate (Central Bank Deposit Rate) and Money Market Rates, January 2005–June 2016

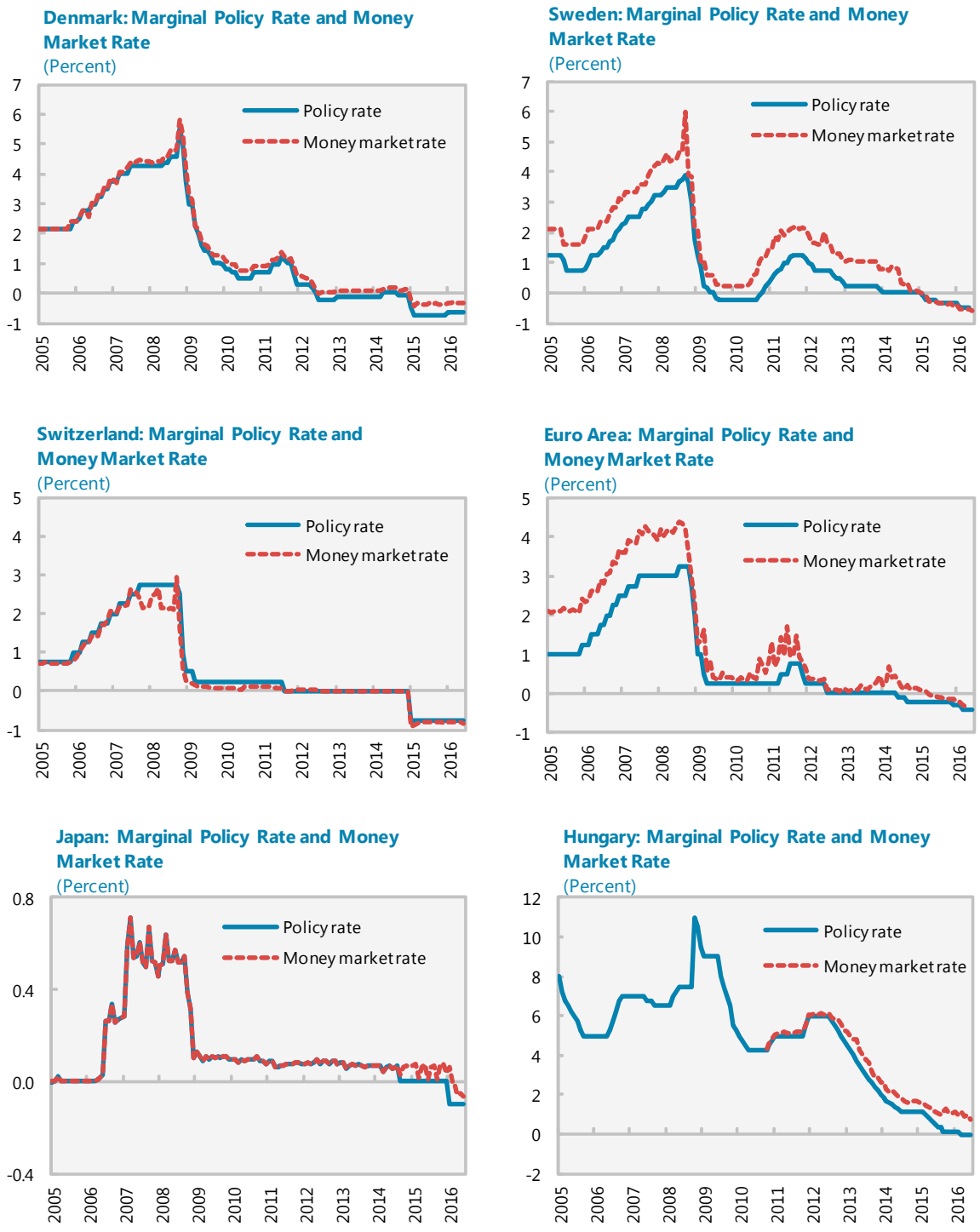


Figure A3. Marginal Policy Rate and Deposit/Lending Rates (New Lending) in NIRP Countries (without Euro Area), January 2005–June 2016

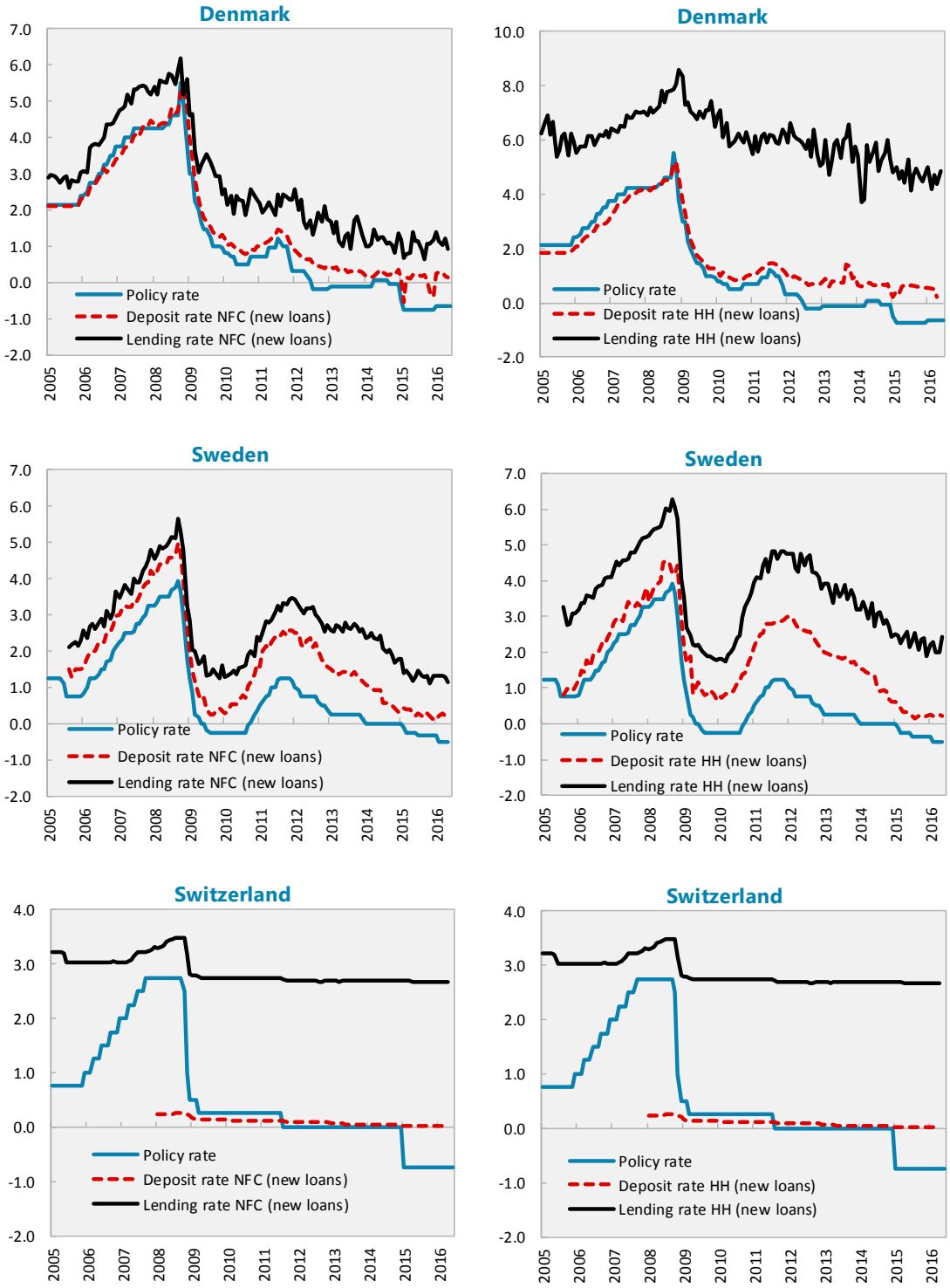


Figure A3. Marginal Policy Rate and Deposit/Lending Rates (New Lending) in NIRP Countries (without Euro Area), January 2005-June 2016 (Concluded)

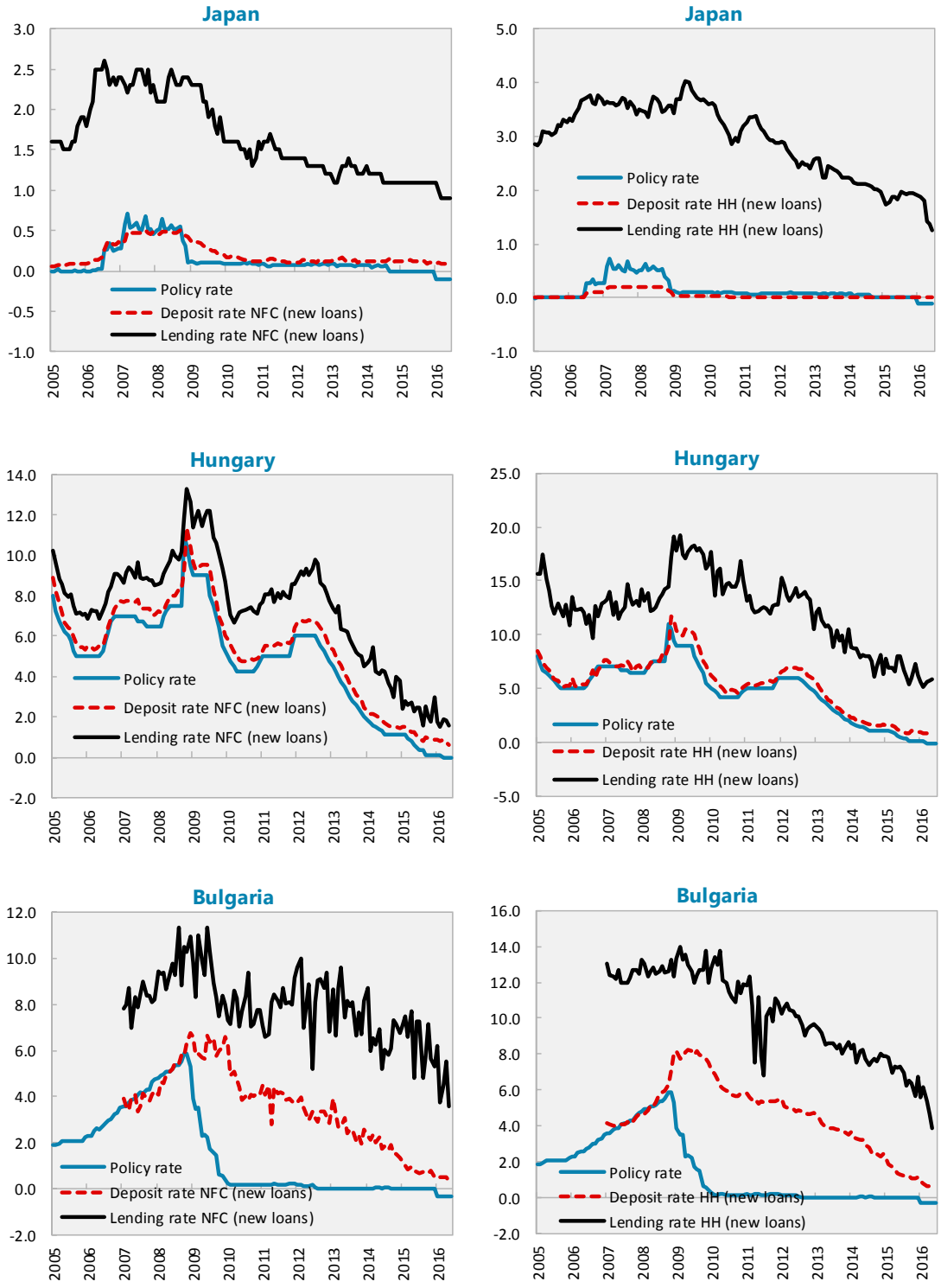


Figure A4. Marginal Policy Rate (Central Bank Deposit Rate) and Credit Growth, January 2005–June 2016