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SPECIAL

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A Comparative Study of Bitcoin Prices and Financial Asset Classes

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FOCUS

Negative Interest Rates

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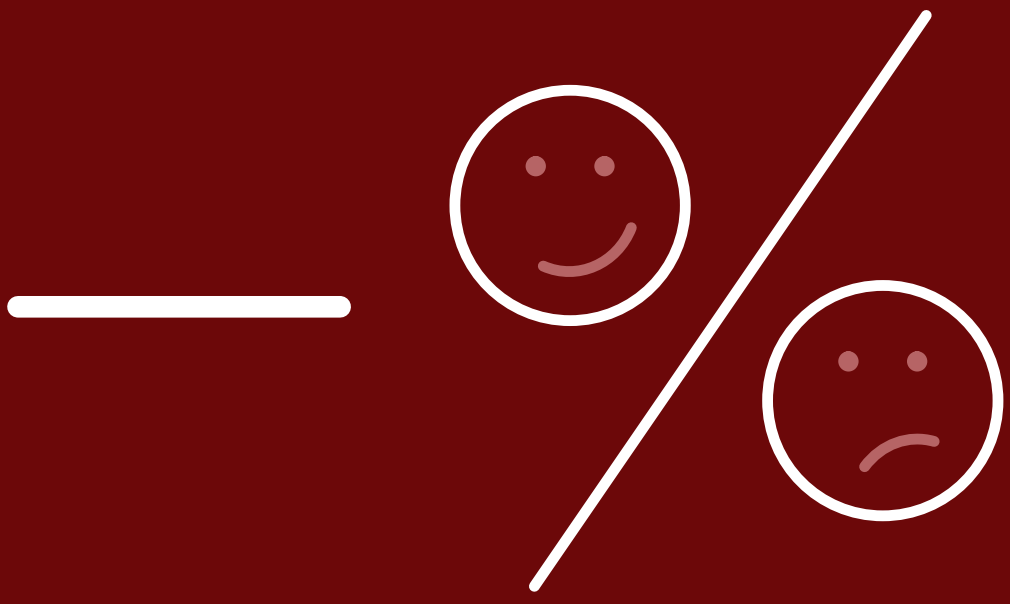

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FOCUS

Negative Interest Rates

SPECIAL

The sudden and rapid spread of the Corona crisis has created serious economic challenges worldwide. Yet, it is hardly possible today to collect the relevant data and estimate the extent to which the global economy will be damaged. This persistent uncertainty forces us to omit the ‘Spotlight’ and ‘Trends’ chapters in this issue of the CESifo Forum, which regularly inform the readers about the world economic outlook and the development of key economic indicators and expectations in the EU.

Negative Interest Rates

Clemens Fuest and Timo Wollmershäuser

Low Interest Rates: Global Causes and Policy Implications for Germany

Clemens Fuest
ifo Institute and
University of Munich

Timo Wollmershäuser
ifo Institute

In Germany, low interest rates and the role of monetary policy in this development are currently the subject of intense discussion. Critics of the European Central Bank (ECB) claim that expansionary monetary policy is a major cause of low interest rates. According to them, the aim of this policy is to relieve the highly indebted economies in southern Europe. The result is a redistribution at the expense of savers with small and medium incomes in particular. Moreover, this expansionary monetary policy leads to a 'zombification' of the European economy, i.e., weak economic growth, as a result of companies without a sustainable business model and therefore with low productivity growth being kept alive by cheap loans. These accusations triggered defenders of the ECB, who in turn claim that low interest rates are primarily caused by the real economy, in particular through high savings and weak demand for capital. They argue that the ECB's expansionary monetary policy is a prerequisite for ensuring that the economy does not become even weaker. This group often demands that the German government should take on more debt, so that interest rates would rise.

In order to understand the current situation on the capital markets, it is useful to take a longer perspective. Real and nominal interest rates have been following a downward trend for decades. This trend began long before the establishment of the common European currency. According to analysis by Del Negro et al. (2019), the average global real interest rate for 'safe' and liquid assets has historically been around 2 percent for long periods of time, rising temporarily to around 2.5 percent after World War II and starting to fall steadily around 1980 (Del Negro et al. 2019). Today, it stands at about 0.5 percent (Figure 1). While in the decades before 1980 average real interest rates still varied widely across countries, the opening up of global capital markets contributed to the fact that most countries have since been equally affected by the fall in interest rates, so that today the differences between average real interest rates are only very small.

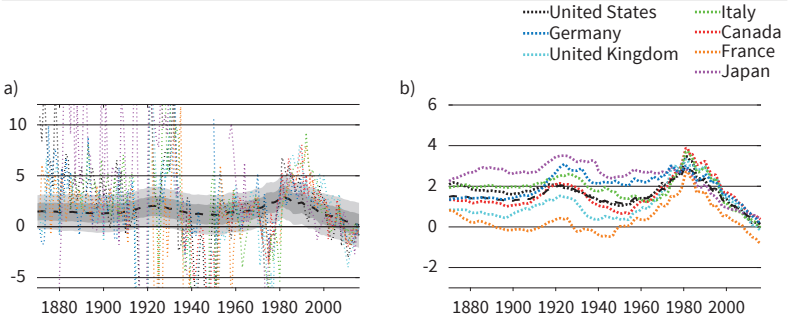
The decline in nominal interest rates was even more pronounced than in real interest rates because inflation rates have fallen significantly. In Germany, for example, average inflation was 4 percent at the beginning of the 1980s, whereas today it is only 1.5 percent. If this decline of the average inflation rate of 2.5 percentage points is added to the decline of the average real interest rate of 2.0 percentage points, the average nominal interest rate in Germany has fallen by 4.5 percentage points since 1980.

REAL DRIVERS OF LOW INTEREST RATES

The decline of the trend in real interest rates can be explained by a simple capital market diagram where the interest rate is the price determined by the intersection of the supply of capital and the demand for capital. Various changes in these two behavioral

Figure 1

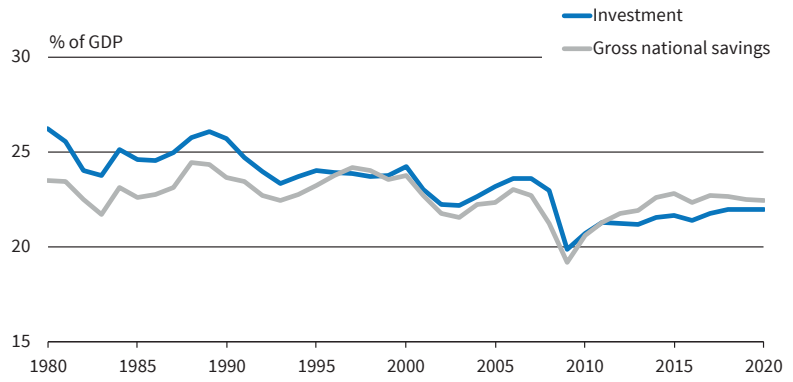
Global Real Interest Rates



Note: Panel a) shows the actual short-term real interest rates for major economies. The black dashed line is the estimated global trend, and the shaded areas are the 68 and 95% confidence intervals.
Panel b) shows the estimated national trends in short-term real interest rates.
Source: Del Negro et al. (2019).

relationships can account for the trend towards ever lower real interest rates. On the supply side, factors such as demographics, income distribution, and exceptionally high savings in emerging markets can be cited here. In recent decades, demographic change has led to a growing proportion of the world's population at the age between 30 and 60 with medium or high incomes wishing to build up savings for their retirement. In addition, pay-as-you-go social security systems will make a shrinking contribution to pension schemes with ever fewer contributors and ever more recipients. As other forms of old-age provision become more important, this increases the propensity to save.

Figure 3
Investment and Gross National Savings in Advaced Economies



Source: International Monetary Fund. © ifo Institute

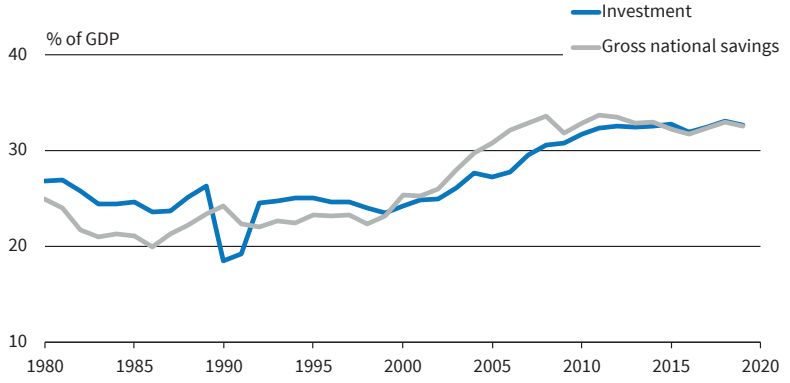
The distribution of global income has also changed significantly since the 1980s. While the rise of emerging market economies such as China and India has lowered global income inequality, in many advanced economies, and above in all the United States, top income earners' share of total income has increased. Since the savings ratio of households increases with income, this may be one of the reasons for a growing supply of savings.

In addition, developing and emerging market economies have played a special role in the global capital market. Economic theory predicts that countries that are trying to catch up with advanced economies should attract international capital inflows in order to finance the investments associated with the catch-up process. However, while developing and emerging market economies have indeed experienced an investment boom, especially in the first decade of the 21st century, they have financed these investments entirely from their own savings, and in some cases their savings have even exceeded domestic investments (Figure 2). This has helped to increase global capital supply and to lower global interest rates.

On the capital demand side, the main factors are declining trend growth in GDP and a corresponding weakening of investment demand, especially in the advanced economies. However, the fall in the investment-to-GDP ratio since the 1980s, which is shown in Figure 3, implies that the slowdown in investment growth has even been stronger than the decline in trend growth of GDP. According to IMF estimates, weak public investment in advanced economies has contributed to this decline.[1] Since 1980 the public-investment-to-GDP ratio in advanced economies has fallen from roughly 5 percent of GDP in 1980 to 3.5 percent in 2015. In addition, a price effect may have contributed to the decline of the investment-to-GDP ratio, as capital goods have become considerably cheaper relative to consumer goods in recent decades. The consequences for investment expenditure depend on the elasticity of demand for capital goods to price changes. Rachel and Smith (2017) argue that the price reduction has been stronger than the increase in the quantity of capital goods, which means that overall demand for capital has fallen.

Another important factor in the decline of the safe real interest rate is a shift in demand away from risky and towards safe investments. As a result, the spread between the returns on risky and safe investments has increased significantly. One reason for this has been the growth in demand for government bonds from central banks in the aftermath of the global financial crisis. According to Caballero et al. (2017), this development may have been reinforced by a significant decline in the supply of safe assets, as many issuers of

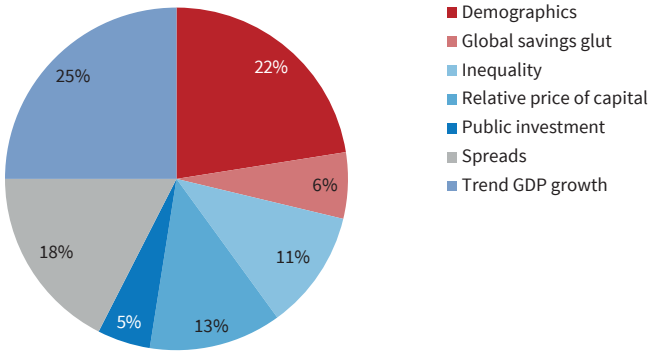
Figure 2
Investment and Gross National Savings in Developing and Emerging Market Economies



Source: International Monetary Fund. © ifo Institute

[1] International Monetary Fund, Fiscal Affairs Department, *Investment and Capital Stock Dataset.*

Figure 4
Factors behind the Decline of the Trend in Global Real Interest Rates since 1980



Source: Rachel and Smith (2017). © ifo Institute

assets suddenly lost their safe status between 2007 and 2011.

Rachel and Smith (2017) provided a quantitative estimate of the importance of the various factors on the supply and demand side of the capital market for the decline of the trend in the global real interest rate since 1980. Figure 4 gives an overview of their result. According to their analysis, an increase in the propensity to save due to demographic changes and declining growth expectations are the two main drivers of the decline of the trend in the global real interest rate. It should be emphasized that this quantification is based on a number of methodological premises that need not be shared. In particular, both the trend in the global real interest rate and its determinants are not observable, which increases the uncertainty surrounding their estimates. However, the analysis of Rachel and Smith (2017) also underlines that simple and monocausal explanations for the phenomenon of low interest rates are misleading.

MONETARY POLICY ALSO CONTRIBUTES TO THE FALL IN INTEREST RATES

In addition to these long-term real economic factors, the ECB's zero interest-rate policy and its large-scale asset purchases have also contributed to the fall in nominal interest rates over the past ten years. Given the current estimates for the trend in the real interest rate of around 0.5 percent and the trend in the German inflation rate of around 1.5 percent, it can be assumed that if monetary policy were to normalize, nominal interest rates in Germany would rise from currently zero to around 2.0 percent. However, if one believes the ECB's current announcements, there is still a long way to go before this normalization of monetary policy takes place. In its economic analyses, the ifo Institute has pointed out that even after taking into account the declining trend in real interest rates the stance of ECB policy has been significantly more expansionary since 2017 than in comparable situations in the first ten years of the common European currency (Wollmershäuser et al. 2018). Accordingly, the ECB would have had to abandon its zero interest-rate policy and raise key interest rates already in the course of 2017.

However, the ECB's policy, which was too expansionary from this perspective, did not significantly accelerate inflation in the euro area. Even at the peak of the economic cycle at the beginning of 2018, inflation was well below the ECB's price stability target. This means there are good reasons to believe that the channels of monetary policy transmission have changed and that the same monetary stimulus is now producing different effects than before. Given the low rate of inflation, one can argue that the ECB's present stance should be to risk raising interest rates too late rather than too early. However, it should be borne in mind that there is currently little scope for monetary policy to react to a possible downturn with an interest-rate cut.

This poses major challenges for the ECB. The longer its zero interest-rate policy lasts, the more negative side effects it will have and the greater the risk that the abundant liquidity provided will be unloaded elsewhere and contribute to the formation of price bubbles in the financial markets. As mentioned at the beginning, criticism is repeatedly voiced – especially in Germany – that the ECB's expansionary monetary policy not only lowers actual interest rates, but also causes a decline of the trend in real interest rates because it slows down productivity growth ('zombification'). It cannot be ruled out that low interest rates will lead to the survival of companies that would be forced out of the market if interest rates were higher. Nor can it be ruled out that production factors could be channeled more quickly into more productive uses if interest rates were higher. So far, however, compelling empirical evidence for this zombification thesis is lacking. Using interest rate hikes as a kind of 'productivity whip' – an argument also familiar from the debate on minimum wages – seems risky in any case. It does not seem plausible that the current weakness in growth could be overcome in this way.

HOW GERMANY MAY BENEFIT FROM LOW INTEREST RATES

In view of the persistent global trend towards lower interest rates in internationally integrated financial markets, it is not convincing to identify national policies and national economic developments as the main determinants of interest rate developments. One of the consequences of this is that the claim that

the abandonment of the 'black zero' in German fiscal policy would allow interest rates to rise again is misleading. The influence of German fiscal policy on global interest rates is too small.

However, one must certainly ask whether, in view of the low interest rates on German government bonds, it makes sense from the point of view of the optimal structuring of public assets to further reduce the supply of German government bonds, which from a global perspective are perceived as safe assets. There are various ways of exploiting the currently very good borrowing conditions without impairing the sustainability of German public finances. This certainly applies to public investment. However, public investment in Germany currently fails less because of fiscal space than because of approval processes or the resistance of the local population to infrastructure projects.

One could, however, also use the German government's good borrowing conditions to build up a sovereign wealth fund, as envisaged by the concept of the Citizens' Fund (Fuest et al. 2019). The concept is simple. The German government would set up an entity that is endowed with funds generated by issuing German government debt. The fund would be used to acquire an internationally diversified portfolio of riskier but also higher-yielding assets. The investment policy would be similar to that of other sovereign wealth funds like, for instance, the Norwegian oil fund. Of course, in contrast to Norway, Germany does not have oil revenues that can be invested through the wealth fund. While the German government can borrow at unusually low interest rates, returns on assets are generally also low, so why should a wealth fund financed with German government debt generate any profits? Here, the particular situation of Germany as the largest eurozone economy and as an anchor for economic stability plays an important role. Due to this unique position, global investors pay a premium for holding German Bunds, which means that the interest rate the German government has to pay is systematically lower that that paid by other EU member states. The wealth fund concept exploits this premium. The income generated by such a sovereign wealth fund could be used to supplement the old-age provision of low-income population groups in particular.

Fuest et al. (2019) consider a scenario where the German government would increase its debt issuance by 0.5 percent of GDP per year and transfer the proceeds to the wealth fund for investment. The analysis shows that, if the difference between the cost of public debt and the return on the fund is equal to 2 percent, and after a buildup phase (of admittedly several decades,) every German citizen would receive a lump sum payment on their 67th birthday amounting to over EUR 16,000. The investment volume of the fund would be equal to roughly 11 percent of German GDP.

REFERENCES

Caballero, R. J., E. Farhi and P. O. Gourinchas (2017), "The Safe Assets Shortage Conundrum", *Journal of Economic Perspectives* 31(3), 29–46.

Del Negro, M., D. Giannone, M. P. Giannoni and A. Tambalotti (2019), "Global Trends in Interest Rates", *Journal of International Economics* 118(C), 248–262.

Fuest, C., C. Hainz, V. Meier and M. Werding (2019), *Das Konzept eines deutschen Bürgerfonds,* https://www.ifo.de/DocDL/ifo-studie-2019-fuest-etal-buergerfonds.pdf.

Rachel, L. and T. D. Smith (2017), "Are Low Real Interest Rates Here to Stay?", *International Journal of Central Banking* 13, 1–42.

Wollmershäuser, T., S. Delrio, M. Göttert, C. Grimme, J. Güntner, C. Krolage, S. Lautenbacher, R. Lehmann, S. Link, W. Nierhaus, M. Reif, R. Šauer, T. Schuler, M. Stöckli, K. Wohlrabe and A. Wolf (2018), "ifo Konjunkturprognose Sommer 2018: Gewitterwolken am deutschen Konjunkturhimmel", *ifo Schnelldienst* 71(12), 33–87.

Oliver de Groot and Alexander Haas

The Negative Interest Rate Policy Experiment[1]

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University of
Liverpool and CEPR

Alexander Haas
University of Oxford
and DIW Berlin

Nominal interest rates cannot go negative, or so say the textbooks gathering dust on my bookshelves. Tell that to the European Central Bank (ECB, see Figure 1) and other central banks across Europe that have implemented negative interest rates on banks' excess reserve holdings.[2] This paper surveys the theoretical underpinnings of a Negative Interest Rate Policy (NIRP); the trade-off central banks face in implementing it; and the tentative empirical evidence that assesses its efficacy.

THEORETICAL UNDERSPINNINGS OF NIRP

What exactly is the textbook explanation for the existence of a *zero lower bound* (ZLB) on nominal interest rates? In normal times, a central bank adjusts its policy rate – a short-term risk-free nominal interest rate – in order to stabilize aggregate demand in the economy. When the economy slows, the central bank cuts its policy rate. When the economy really tanks, the central bank can cut its policy rate to zero and no further. This ZLB derives from the existence of a risk-free perfectly liquid asset that carries a zero nominal interest rate – currency. Currency should dominate any asset that pays a negative nominal interest rate.[3]

In practice, several central banks did not even venture to the ZLB during the financial crisis despite a clear need for additional monetary policy stimulus. The ECB, for example, only lowered its deposit facility rate (DFR) – the interest rate paid on reserves – to 0.25 percent during 2009–2011, whereas the Bank of England cut its Bank Rate to 0.5 percent and remained there until 2016 when it briefly cut the rate to 0.25 percent and no further. As a result, economists often refer to the effective lower bound (ELB) rather than the ZLB on nominal interest rates. In short, low positive interest rates appear to raise concerns, not just negative interest rates.

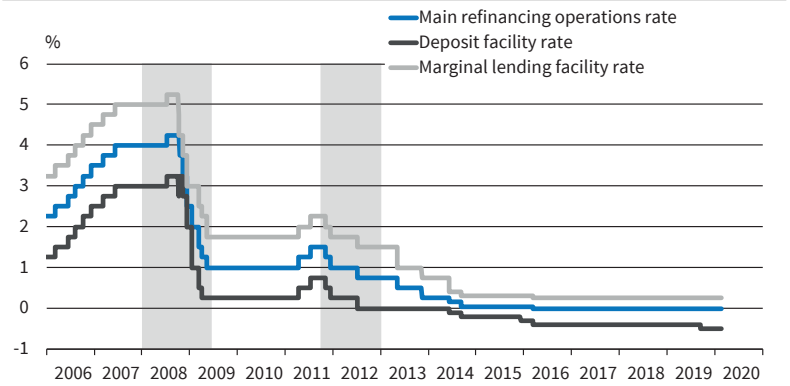
A low interest rate environment generates outcries from the public just as a high interest rate environment does – central banks are rarely popular. That is because changes in interest rates have differential effects on segments of the population. When interest rates are high, borrowers (homeowners with mortgages, for example) are outraged. When interest rates are low, savers (retirees living on the interest from their pensions, for example) are outraged. However, monetary policy is concerned primarily with stabilizing aggregate demand and not these distributional consequences.

An interest rate measures the relative price of consuming today versus consuming in the future. When interest rates are low, consuming today becomes relatively cheaper. This is the basic logic of a central banker. If aggregate demand (households' willingness to consume) is low, unemployment rises. Lowering interest rates can induce households (in aggregate) to increase consumption today and this will prop up aggregate demand and employment. So, if a positive ELB is not to protect savers' income, then what is the rationale?

Rather, central banks are concerned about the banks. To understand why, we need to build a more nuanced picture of how monetary policy works. So far, in this narrative, there has been a single short-term nominal interest rate in the economy set by the central bank. In reality, neither households nor firms save and borrow at this interest rate. In reality, the banking system plays a major role in intermediating funds between savers and borrowers. Suppose, for simplicity, that households save via bank deposits and firms borrow via bank loans. Banks, in this environment, are in the business of 'maturity transformation', taking households' short-term liquid savings and using them to finance long-term illiquid investment projects. A bank earns profits from the spread between the interest rate on its assets

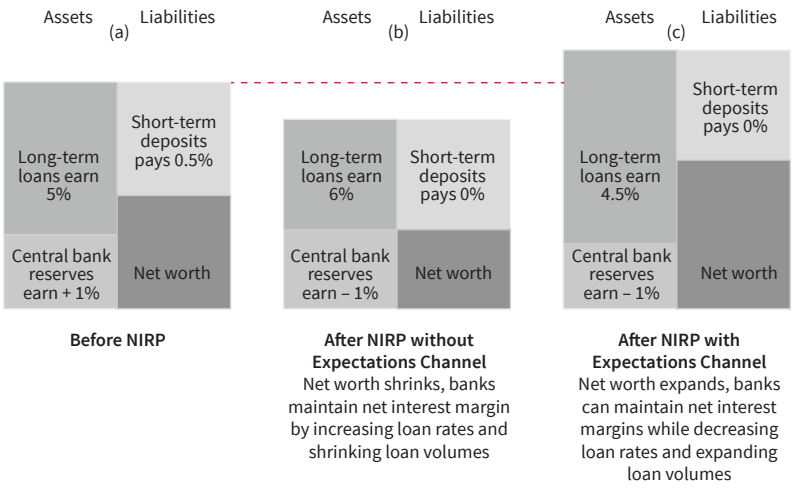
[1] The authors are grateful for excellent research assistance from Yaxin Zheng. Disclaimer: de Groot was a consultant to the ECB in 2019. Haas was an intern at the ECB in 2018. The views expressed in this article are the authors' views alone.
[2] The other economies include Denmark, Sweden, Switzerland, and Japan. Bech and Malkhozov (2016) provide an excellent overview of the technical aspects of how the different central banks have implemented negative interest rate policies.
[3] Buiter (2009) has suggested overcoming the ZLB by abolishing cash or taxing cash holdings.

Figure 1
ECB Policy Rates



Source: European Central Bank. © ifo Institute

Figure 2
Bank Balance Sheets before and after NIRP



Before NIRP

After NIRP without Expectations Channel
Net worth shrinks, banks maintain net interest margin by increasing loan rates and shrinking loan volumes

After NIRP with Expectations Channel
Net worth expands, banks can maintain net interest margins while decreasing loan rates and expanding loan volumes

Note: Balance sheets not drawn to scale. Before NIRP: Suppose the following quantity of loans, L=7, reserves, R=3, deposits, D=5. The net interest margin (NIM) is 3.55%. After NIRP w/o Exp. Channel: NIM is maintained if L=5.6. NIRP w/ Exp. Channel: NIM is maintained if L=14.4.
Source: Authors' own compilation.

(loans to firms) and the interest rate it pays on its liabilities (household deposits).[4]

In this setting, the central bank interacts with banks in the banking system and the banks interact with households and firms. Figure 2 provides a stylized view of a bank's balance sheet. Some of the bank's assets are reserves held at the central bank. These reserves earn the central bank policy rate (or short-term nominal risk-free interest rate). In this example, the bank earns a 5 percent return on loans, a 1 percent return on central bank reserves, and pays a 0.5 percent return on deposits.

Since bank reserves earn a lower return than loans, why do banks hold reserves? Banks face liquidity risk – the risk that there is an unexpected outflow in deposits – and a bank needs to insure itself against this risk since it is costly to liquidate long-term loans. Banks can hold reserves, which are liquid assets, for this purpose. However, banks need not hold reserves in excess of regulatory requirements. A bank with liquidity needs could also borrow funds from another bank so long as the interbank market is working well. The 2007/08 panic saw a freezing up of interbank markets. Demand for excess reserves increased rapidly during that period since it was a means of ensuring liquidity without facing counterparty risk – reserves provide insurance against the insolvency of other financial institutions. Banks in the euro area continue to hold a large quantity of excess reserves amounting to around 20 percent of total deposits in the banking system (de Groot and Haas 2019).

In a frictionless financial system, we can expect all short-term risk-free interest rates to move one-for-one with a change in the policy rate. However, consider the example in Figure 2 in which the central bank cuts the policy rate on reserves from + 1 percent to − 1 percent. As argued above, banks find it difficult to reduce deposit rates below zero because of the existence of cash.[5,6] All else equal, the inability to fully pass on a cut in the policy rate to depositors would result in a fall in banks' net interest margins (NIM, see Figure 2 (b)).[7]

In a frictionless financial system, the profitability of the banking system would be irrelevant for outcomes in credit markets and the spread between the interest rate on risk-free loans (5 percent in the example) and on deposits (0.5 percent) would disappear. Any such spread would represent an arbitrage opportunity. Banks could exploit this arbitrage opportunity by leveraging up, drawing in more deposits (by increasing the deposit rate), and issuing more long-term loans (by decreasing the loan rate). In reality, banks face financial constraints, which explains the existence of such a spread. Concerns such as moral hazard limit banks' ability to leverage. Bank equity (net worth) protects depositors from loan losses and as such, depositors will be unwilling to lend to a bank that is highly leveraged.

If net worth in the banking system falls, depositors become reluctant to supply deposits and banks have to curtail lending activities, driving up the spread between saving and lending rates. As a result, profitability of the banking system is important for the process of credit creation in the economy. When banks struggle, as evidenced during the financial panic of 2007/08, the broader economy also suffers.

Thus, even before we discuss the relationship between negative rates and bank profitability, there is an argument that low rates can hurt bank profitability. The argument goes as follows: during 2008/09, the ECB sharply cut its (short-term) policy

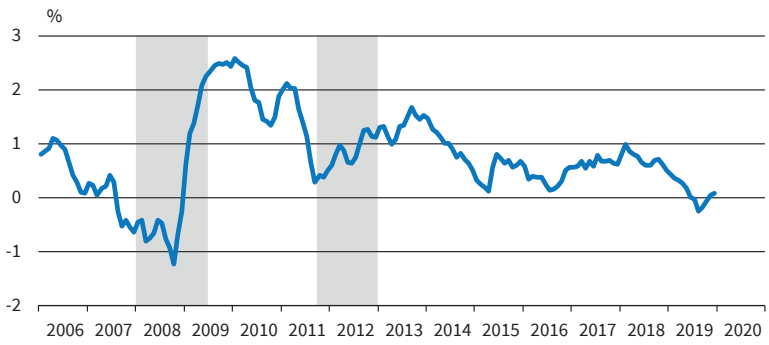
[4] For simplicity in this example, we are assuming that loans are risk-free.

[5] For simplicity in this example, we are assuming that banks' demand for reserves is sufficiently price-inelastic such that the change in the quantity of reserves demanded as a share of total deposits remains broadly unchanged.

[6] Holding cash involves storage costs. Thus, households may be willing to accept a marginally negative interest rate on deposits. Moreover, corporations may be willing to accept a more negative deposit rate since the storage cost for large cash holdings is likely to be higher. This is confirmed empirically by Altavilla et al. (2019). However, the evidence from Heider et al. (2019), among others, suggests that the pass-through of negative policy rates to deposit rates has been particularly slow. See Rognlie (2016) for a theoretical model that incorporates storage costs.

[7] The net interest margin is a measure of the difference in interest earned on assets and interest paid on liabilities, relative to assets. In the example of Figure 2 (a), NIM = (7x5% + 3x1% − 5x0.5%)/10 = 3.55%. Without a change in balance sheet composition, if the interest rate on reserves falls to − 1% and the interest rate on deposits falls to 0%, then the bank's NIM falls to 3.20%.

Figure 3
The German Yield Curve Has Flattened[a]



[a] German ten year government bond yield minus three month interbank rate.
Source: OECD.

rate, while longer-term rates remained relatively stable. This created a steepening of the yield curve (Figure 3). Since banks engage in maturity transformation, this proxies a rise in bank profitability. However, over time, as short-term rates remained near zero, long-term rates also began to slide downwards, flattening the yield curve and potentially reducing banks' profits. Notice that this argument is not about low interest rates per se but rather the difference between short- and long-term rates.

Nevertheless, putting this concern aside for now, estimates from Taylor-type rules, which make the policy rate an increasing function of inflation (relative to target) and the output gap, suggest that policy rates should have been well into negative territory after 2009, if not for the ELB. In that sense, had short-term rates been able to fall into negative territory, this would have allowed a further steepening of the yield curve and provided additional support for banks.

THE BANK BALANCE SHEET CHANNEL AND NIRP

Several papers, including Brunnermeier and Koby (2018); de Groot and Haas (2019); Eggertsson et al. (2019); and Sims and Wu (2019), study the bank balance sheet channel in the context of negative interest rates.[8] When the policy rate turns negative, banks cannot pass this rate on to depositors and the deposit rate becomes stuck at zero. Banks are now earning a negative interest rate on a portion of their assets funded by deposits. Effectively, the central bank is taxing banks for holding reserves. This causes a fall in banks' net interest margin, so profits fall and net worth falls. A fall in net worth forces banks to curtail lending. In equilibrium, lending rates rise, credit shrinks, lowering consumption demand and investment. This is the fear: that negative interest rates are counterproductive – they don't lower deposit rates, they raise lending rates and economic activity contracts.

[8] See also Glover (2019) and Porcellacchia (2019) for related theoretical work.

What might be missing from this narrative? First, we need to inspect our assumption about reserves. Are reserves fixed? Could banks hold less reserves if they wanted to? On the one hand, yes, reserves are simply unproductive deposits. However, we have argued that banks are already financially constrained and up against their leverage constraint. While the central bank has control over the aggregate quantity of reserves in the banking system in euro terms, the reserve-to-asset ratio is determined within the banking system. Thus, the observed increase in excess reserves as a fraction of deposits within the banking sector reflects a demand for liquidity on the side of the banking system. The extent to which banks wish to hold a smaller fraction of reserves because of negative interest rates depends on the price elasticity of that demand. Empirically at least, it is not clear that this demand for liquidity is particularly elastic. Thus, banks experience negative interest rates as a downward force on net interest margins and not as a spur for further loan creation.

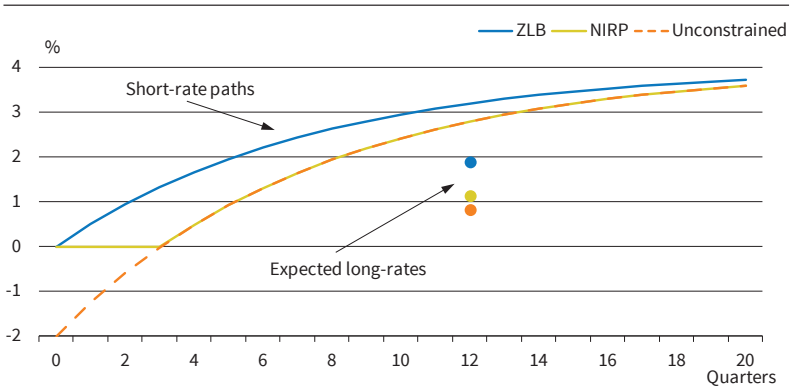
THE EXPECTATIONS CHANNEL AND NIRP

However, the prediction that NIRPs are contractionary runs contrary to most of the empirical evidence. A second important channel of monetary policy exists – the expectations (or signaling) channel, which we study in de Groot and Haas (2019). Much of the theoretical literature has overlooked this channel, but it is potentially very potent and reconciles the existing empirical evidence.

Even though in the environment described above, households save via short-term interest rates, future interest rates determine their consumption decisions as well. Suppose policy rates evolve as follows: i) In normal times, the policy rate is 4 percent. ii) If the central bank lowers the policy rate today, households expect that the central bank will increase the policy rate only slowly back to its normal level. This behavior is termed central bank *inertia* or *smoothing* in the monetary policy literature and is empirically well documented.

For concreteness, suppose that central bank policy-rate changes have a half-life of around five quarters and that the central bank lowers the interest rate to 0 percent. Then households expect the interest rate to revert along the blue path in the Figure 4. Using the expectations hypothesis, the average of these short-term interest rates over the next 12 quarters equals 1.9 percent (blue dot). Thus, changes in

Figure 4
Expectations Channel



Source: Authors' calculation.

policy change expectations about the future and are factored into households' and firms' decisions.

Suppose instead, the central bank calculates that it needs to lower the three-year interest rate today to 0.8 percent in order to meet its inflation target. Lowering interest rates to 0 percent, in this scenario, would not be sufficient. If, instead, the central bank was unconstrained by the ZLB, it could simply set today's short rate at − 2 percent in order to achieve this long-term interest rate objective (orange dotted line).

Alternatively, the central bank might like to promise to maintain interest rates at 0 percent for an extended period. However, households may not deem this credible. Instead, the central bank can signal its intention by setting the policy (reserve) rate to − 2 percent while banks maintain deposit rates at 0 percent. This has the same effect as keeping deposit rates at 0 percent for the next three quarters (yellow line). This lowers the long rate (yellow dot) to 1.1 percent, close to its objective. In this way, the central bank is using negative interest rates to *signal* lower-for-longer deposit rates in an environment in which it cannot commit to maintaining both policy and deposits rates at zero. This is the rationale for negative interest rates explored in de Groot and Haas (2019).

Okay, but what of the banks? Will the banks not suffer via the balance sheet channel identified before? The theory and evidence suggest not. Banks' balance sheet health (and net worth) is not determined solely by net interest margins. In fact, net interest margins can shrink and balance sheet health can simultaneously improve. Consider what happens when consumption demand increases via the signaling channel identified above. The economy gets stronger, unemployment prospects increase, and thus the default probability on banks' assets falls. As this risk recedes, banks' assets become more valuable. This is the scenario pictured in Figure 2 (c). As a result, bank net worth rises and leverage falls, allowing for an expansion in lending and a fall in lending rates.

Since the bank lending and signaling channels work in opposite directions, the effectiveness of NIRPs is ultimately a quantitative question. In de Groot and Haas (2019), using a carefully calibrated quantitative model, we find that the signaling channel dominates and NIRPs are effective. However, the strength depends on the quantity of reserves in the banking system, the expected duration of the ZLB period, and central bank inertia. The theory predicts that NIRPs are more effective when the ratio of excess reserves is low, the expected duration of the ZLB is short, and the central bank adjust policy more gradually.

EMPIRICAL EVIDENCE

Our explanation of the channels through which negative interest rates work raises several hypotheses that need to be tested. The empirical evidence, however, remains in its infancy. In part, this is because standard methods of identifying monetary policy shocks do not work. First, there is not yet a sufficient time-series of data points. Second, negative interest rates were often introduced alongside a range of other monetary policy measures, making even high-frequency identification methods problematic. Instead, the majority of the empirical literature has sought to exploit cross-sectional variation by analyzing bank profitability making use of, for example, difference-in-difference estimation techniques. While this micro-level evidence helps to highlight the transmission channels, it does not provide an accurate gauge of the macroeconomic effectiveness of NIRPs.

Nevertheless, Ampudia and Van den Heuvel (2018) find that a 25 basis point surprise rate cut will lower bank equity values by 2 percent in the period of NIRPs. However, consistent with the signaling channel, the effect of a long-term rate surprise operates in the conventional direction. A 25 basis point policy-induced reduction in the long-term rate increases bank stock prices by about 3 percent. Heider et al. (2019) study bank risk taking and find that banks with more deposits finance riskier firms when rates become negative. Moreover, they find that banks that are highly reliant on deposit financing are more likely to reduce loan volumes. Boungou (2019), in contrast, finds that a 25 basis point decrease in the policy rate leads to a 10 basis point reduction in net interest margins, a reduction in risk-taking, but an improvement in banks' creditworthiness.

Lopez et al. (2018) study both Europe and Japan and find that bank profitability has, thus far, been

unaffected by NIRPs. In particular, consistent with the signaling theory, they find that losses in terms of net interest income are compensated for by non-interest income such as capital gains on securities. As a result, banks that rely less on deposits perform better under NIRPs than banks heavily reliant on deposit funding. Scheiber et al. (2016) study Denmark, Sweden, and Switzerland and conclude that NIRPs have not resulted in a significant reduction of bank profitability and particularly of net interest income. Madaschi et al. (2017) also study Denmark and Sweden. They conclude that net interest income margins have remained broadly stable in Sweden and have declined only marginally in Denmark. Basten and Mariathasan (2018) study Switzerland and also document evidence of increased risk-taking.[9]

What can we conclude from this mixed evidence? Have banks actually been reluctant to pass on negative interest rates to its customers? Initial evidence suggested the answer to this question was yes. However, more recent evidence from Altavilla et al. (2019), for example, suggests that, over time, it appears that banks are increasingly setting negative interest rates on deposits. This suggests that the effectiveness of negative interest rates is likely to be time-varying and that as deposit rates fall, NIRPs act more like conventional monetary policy.

Have bank profits fallen as a result of negative interest rates? The empirical evidence summarized above is mixed. On balance, the evidence suggests that net interest margins have been compressed but along other non-interest dimensions, like capital gains, bank profitability has risen. Overall, the effects on bank profitability appear to have been modest. Have there been side-effects of negative interest rate policies? The literature provides suggestive empirical evidence that risk-taking by banks has increased. However, the evidence remains limited and not all the studies agree.

CONCLUSION

The effectiveness of negative interest rates remains open for debate. In fact, the effectiveness of standard monetary policy actions continues to be keenly debated amongst economists and, in this area we have a wealth of data stretching back decades and across many countries. Like with all policy actions, we do not have a clean laboratory in which to study monetary policy. Thus, identifying exogenous changes in monetary policy is difficult. Identifying exogenous changes in policy during recent negative interest rate episodes is even more difficult. This issue confronts all the empirical papers surveyed in this study. The ECB entered into its NIRP at the same time as introducing multiple other unconventional policy measures. Disentangling these effects is problematic.

Nevertheless, theory tells us the upper bound of the effectiveness of NIRPs is the effectiveness of standard policy rate changes. At the other extreme, it is hard to conclude from the evidence that NIRPs have had catastrophic economic consequences. They do not appear to have created clear financial stability issues, nor contributed to a marked slowdown in economic activity. Nor has there been a sharp move into currency holding.

In clinical trial research, experiments are halted when early results show no justification for exposing human subjects to additional potential risk by continuing the trial. The NIRP experiment has thus far been conducted in gradual steps. On balance, the benefits of each step down into negative territory have been modest but the risks also seem manageable. Finally, with aggregate demand in the euro area remaining weak and global demand slowing, we would conclude that it is beneficial for the euro area that the ECB continues to explore the depths to which policy rates can be lowered in negative territory in order to generate additional monetary stimulus.

[9] For evidence from Japan, see Yoshino and Miyamoto (2017); Yoshino et al. (2017); and Inoue et al. (2019).

REFERENCES

Altavilla, C., L. Burlon, M. Giannetti and S. Holton (2019), "Is There a Zero Lower Bound? The Effects of Negative Policy Rates on Banks and Firms", *Swedish House of Finance Research Paper* 19–11.

Ampudia, M. and S. Van den Heuvel (2018), "Monetary Policy and Bank Equity Values in a Time of Low Interest Rates", *FEDS Working Paper* 2019-064.

Basten, C. and M. Mariathasan (2018), *The Transmission of Negative Interest Rates: Evidence from Swiss Banks,* mimeo.

Bech, M. L. and A. Malkhozov (2016), "How Have Central Banks Implemented Negative Policy Rates?'', *BIS Quarterly Review*, March, https://www.bis.org/publ/qtrpdf/r_qt1603e.htm.

Boungou, W. (2019), *Negative Interest Rates, Bank Profitability and Risk-Taking,* mimeo.

Brunnermeier, M. K. and Y. Koby (2018), "The Reversal Interest Rate", *NBER Working Paper* 25406.

Buiter, W. H. (2009), "Negative Nominal Interest Rates: Three Ways to Overcome the Zero Lower Bound", *The North American Journal of Economics and Finance* 20, 213–238.

de Groot, O. and A. Haas (2019), "The Signalling Channel of Negative Interest Rates", *CEPR Discussion Paper* 14268.

Eggertsson, G. B., R. E. Juelsrud, L. H. Summers and E. G. Wold (2019), "Negative Nominal Interest Rates and the Bank Lending Channel", *NBER Working Paper* 25416.

Glover, A. (2019), "Negative Nominal Interest Rates Can Worsen Liquidity Traps", *Federal Reserve Bank of Kansas City Working Paper* 19-07.

Heider, F., F. Saidi and G. Schepens (2019), "Life below Zero: Bank Lending under Negative Policy Rates", *The Review of Financial Studies* 32, 3728–3761.

Inoue, H., K. Nakashima and K. Takahashi (2019), *Credit Allocation and Real Effects of Negative Interest Rates: Micro-Evidence from Japan*, mimeo.

Lopez, J. A., A. K. Rose and M. M. Spiegel (2018), "Why Have Negative Nominal Interest Rates Had Such a Small Effect on Bank Performance? Cross-Country Evidence", *NBER Working Paper* 25004.

Madaschi, C. and I. Pablos Nuevo (2017), "The Profitability of Banks in a Context of Negative Monetary Policy Rates: The Cases of Sweden and Denmark", *ECB Occasional Paper* 195.

Porcellacchia, D. (2019), *Maturity Transformation and Negative Interest Rate Policies*, mimeo.

Rognlie, M. (2016), *What Lower Bound? Monetary Policy with Negative Interest Rates,* mimeo.

Scheiber, T., M. A. Silgoner and C. Stern (2016), "The Development of Bank Profitability in Denmark, Sweden, and Switzerland during a Period of Ultra-low and Negative Interest Rates", *Focus European Economic Integration* 3, Austrian Central Bank, Vienna, 8–28.

Sims, E. R. and J. C. Wu (2019), "Evaluating Central Banks' Tool Kit: Past, Present, and Future", *NBER Working Paper* 26040.

Yoshino, N. and H. Miyamoto (2017), "Decreased Effectiveness of Fiscal and Monetary Policies in Japan's Aging Society", *ADB Working Paper* 691.

Yoshino, N., F. Taghizadeh-Hesary and H. Miyamoto (2017), "The Effectiveness of the Negative Interest Rate Policy in Japan", *Credit and Capital Markets* 50, 189–212.

Carlo Altavilla, Miguel Boucinha and Lorenzo Burlon

The Economic Consequences of Negative Interest Rates[1]

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In normal times, central banks react to a subdued economic outlook or recessions by providing accommodation through substantial policy interest rate cuts. During the last 40 years, central banks in industrialized countries – such as the Fed, the ECB, and the Bank of Japan – have usually cut rates by around 4 percent in response to recessions. The long-lasting downward trend in real equilibrium interest rates (visible since the 1980s) together with the central banks' attempt to provide monetary accommodation to recoup the ample output losses associated with the last global financial crisis have pushed policy rates close to zero in many advanced economies. This has stimulated a lively debate on whether monetary authorities should, if necessary, provide further stimulus by lowering policy rates into negative territory (Rogoff 2016 and 2017; Rostagno et al. 2019; Altavilla et al. 2019; Demiralp et al. 2019; Bottero et al. 2019; Heider et al. 2019; Eggertsson et al. 2019). Starting from 2012, central banks in Switzerland, Sweden, Denmark, Japan, and the euro area have moved their key policy rates below zero. Yet, there is no agreement in the economic profession on the effectiveness of negative interest rate policies.

This article provides an assessment of the impact of negative interest rate policy (NIRP) on banks and on its transmission to the real economy. We start by discussing the channels of transmission and describing some meaningful stylized facts. These include the impact of the policy on the yield curve, on market participants' assessment of bank valuations and risk, as well as on the remuneration of corporate deposits. We then assess the impact of negative interest rates on bank lending conditions and, finally, on firms' investment.

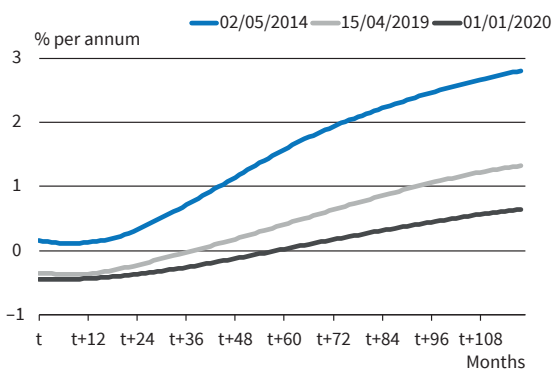
CHANNELS OF TRANSMISSION AND STYLIZED FACTS

Negative policy rates are a relatively new tool for central banks and it is therefore important to understand their implications for the transmission of monetary policy to the real economy.[2] Negative rates have been recently adopted by a number of central banks, e.g., Switzerland, Japan, Denmark, and Sweden, to exert (additional) monetary policy accommodation in situations where policy rates reach zero. In the euro area, the five equally sized rate cuts – on 5 June and 4 September 2014, 3 December 2015, 10 March 2016, 12 September 2019 – have taken the DFR to – 50 bps.

There are multiple channels through which negative rate policy transmits to financial and economic conditions. First, negative interest rates remove the non-negativity restriction on future expected short rates. NIRP not only shifts down short rates to negative territory, but also keeps open expectations of possible further rate cuts. As a result, the forward curve becomes flatter than it would be if short rates were expected to be constrained by a zero lower bound, and monetary accommodation propagates over the entire term structure (Figure 1). Second, the incentive for investors to move to longer dated assets increases the demand for these securities relative to their supply. This ultimately exerts an extra downward pressure on the term premium, which compensates investors for the risk of holding bonds with longer duration. The lower yields also translate into higher asset valuations with associated capital gains in the bank security book. Third, commercial banks are encouraged to expand lending to escape the excess liquidity charge (credit channel). More specifically, the charge on excess liquidity shifts the risk-adjusted return assessment of banks' portfolio allocation and makes loans more attractive. The attempt by individual banks to escape the charge results in balance sheet adjustments, whereby banks react to the mechanical absorption of their excess liquidity by creating new (riskier) loans or by purchasing securities. This portfolio rebalancing therefore reinforces the risk-taking channel.

The typical footprint that NIRP leaves on the yield curve is concentrated on rates with short- and medium-term maturities. The impact of NIRP on the yield curve has a different footprint compared to the APP, which exerts the strongest impact on longer

Figure 1
Eonia Forward Curve

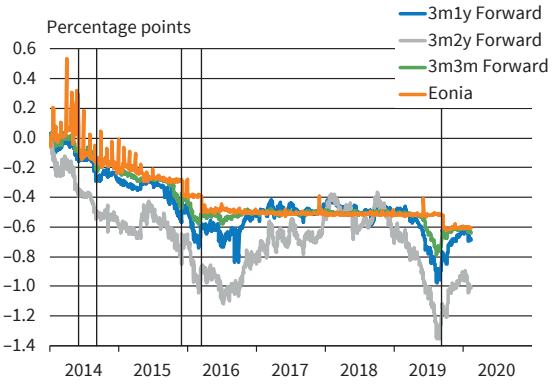


Source: Thomson Reuters; Bloomberg; authors' calculations. © ifo Institute

[1] The opinions in this paper are those of the authors and do not necessarily reflect the views of the European Central Bank or the Eurosystem.

[2] A comprehensive discussion on the role, the effectiveness, and the various channels through which non-standard measures, including NIRP, transmit to financial conditions and ultimately affect the real economy is available in Rostagno et al. (2019).

Figure 2
Cumulated Change in Eonia and Forward Curve since the NIRP Announcement



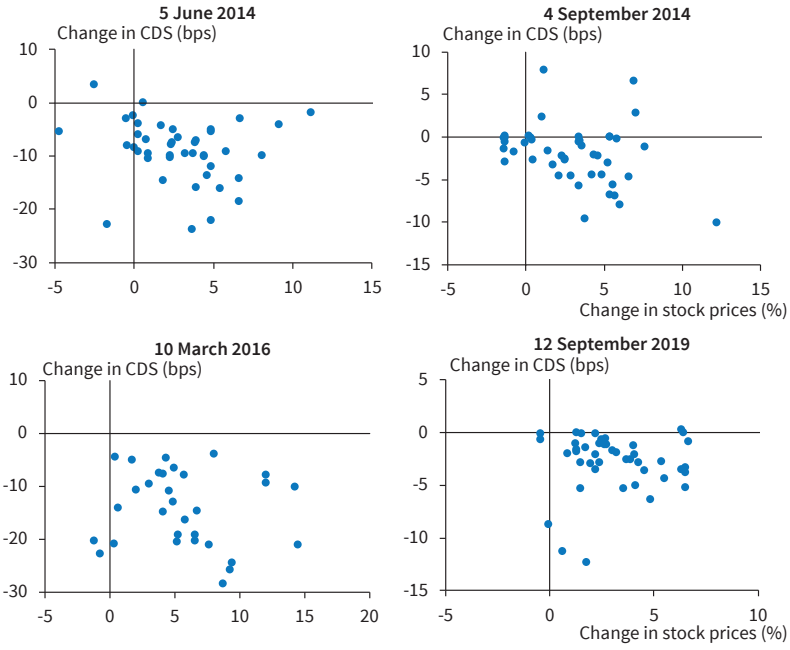
Note: The vertical grid lines represent the five dates of negative interest rate cuts, i.e., 5 June and 4 September 2014; 3 December 2015; 10 March 2016; and 12 September 2019.
Source: European Central Bank. © ifo Institute

maturities and compared to standard interest rate policy, which affects primarily the short- to mid-maturity range of the risk-free yield curve (mainly on account of the expectations component of future rates). This is clearly visible in Figure 2.

Banks' equity valuations and their perceived credit quality improved following NIRP announcements (Figure 3). The reaction of bank stock returns and CDS to the announcements of NIRP is obtained by using high-frequency information available at the individual bank level. Bank equity valuations reflect all the information currently available to stock market participants thereby representing an important summary indicator of future profitability. The results indicate that financial market participants reacted positively to the announcement of the NIRP: stock prices increased and CDS spreads narrowed following all policy announcements. The only exception is the announcement of the recalibration of the APP scheme in December 2015, which is associated with a fall in stock prices (not reported in the figure). This is, however, easy to understand, as financial market participants interpreted the December policy decision as delivering lower-than-expected accommodation compared with what they had anticipated and factored into stock prices. The policy decision therefore elicited an opposite reaction in financial markets when announced. Importantly, the event of September 2014 is the more prominent, as it is the only one where there were no other concomitant policy announcements during the same GovC meeting.

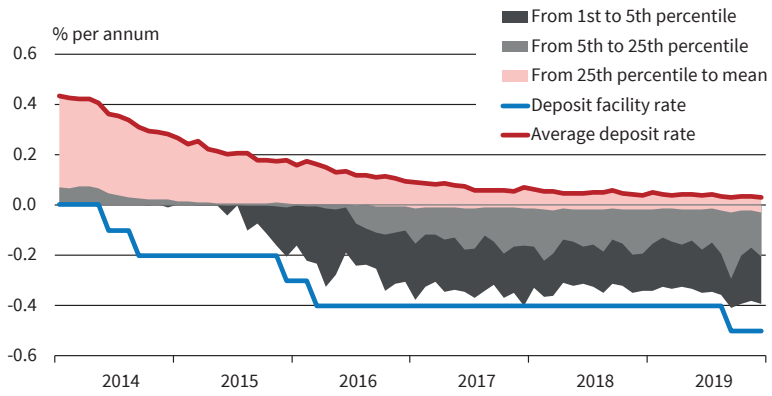
The pass-through of negative policy rates to deposit rates becomes stronger as policy rates move deeper into negative territory (Figure 4). The conventional wisdom that interest rates on deposits do not fall below zero appears to hold for the median bank in the euro area. Nevertheless, there is evidence that interest rates do to turn negative on an economically significant fraction of deposits of banks in the euro area. The figure shows the evolution of the ECB's deposit facility rate (DFR) and the interest rates offered by banks on nonfinancial corporations' deposits. We show the evolution of different percentiles of the interest rates on corporate deposits. Figure 4 reports the deposit rates on the outstanding amounts averaged across all deposit segments for vulnerable countries and other countries, respectively. Even though the pass-through of negative rates has increased in the case of large customers (such as institutions and corporate customers), households remain largely shielded from negative rates. Figure 5 shows that the share of banks charging negative rates has been increasing during the NIRP period and is primarily driven by highly rated banks. Initially, negative deposit rates were charged mostly by banks with market power, which is intuitive given that higher market power is normally associated with larger mark-downs on deposit rates. In terms of volumes, the share of deposits with negative interest rates is around 25 percent as of December 2019.

Figure 3
Change in Stock Price and CDS Following NIRP Announcements



Note: The charts report the reaction of bank CDS and stock prices to major policy announcements over a 2-day window.
Source: Updated version of Altavilla et al. (2018). © ifo Institute

Figure 4
Evolution of Non-financial Corporations (NFC) Deposit Rates



Notes: The composite indicator is computed by taking the weighted average of deposit rates on new overnight and agreed maturity deposits, where weights are outstanding amounts of these two categories. Rates on new deposits with agreed maturity are a weighted average of rates on new deposits for each maturity (below 1 year, between 1 and 2, above 2), where weights are the 24-month average of the new business volumes.
Source: Altavilla et al. (2019).
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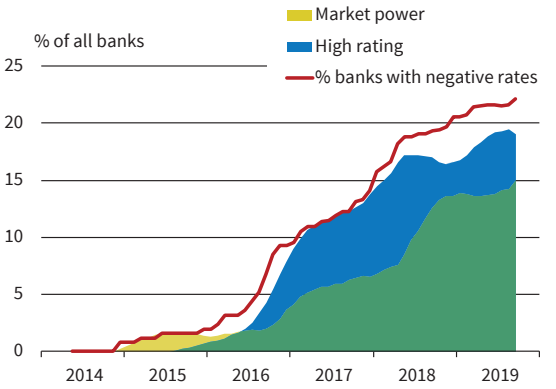
Figure 5
Determinants of Negative Deposit Rates



Note: The red line indicates the percentage of banks that until that month have charged negative deposit rates. We run month-by-month regressions where the dependent variable is the probability to charge negative rates and the regressors are a dummy for having an investment grade rating (high rating) and a dummy for having a share of the domestic market of deposits above the country median (market power). The blue area indicates the coefficient associated with high rating. The yellow area indicates the coefficient associated with market power.
Source: ECB; Moody's; S&P; Fitch.
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deposits have up to now not experienced deposit outflows compared to other banks. At the same time, these banks extended more loans to the nonfinancial private sector. While this difference in the lending behavior observed in the data can also reflect demand factors, the bulk of the relevant literature concludes that NIRP had a positive impact on credit supply (see, e.g., Bottero et al. 2019; Demialp et al. 2019; Grandi and Guillé 2020). At the same time, there is also some evidence that NIRP can stimulate banks' risk-taking. This is not necessarily an unintended consequence of the policy as, if not excessive, risk-taking can support the transmission of the monetary policy stimulus to the real economy. Moreover, it is important to note that, at least so far, this increase in risk-taking has not materialized in higher ex post defaults. Crucially, an active banking supervision helps to avoid excessive risk-taking (Altavilla et al. 2020).

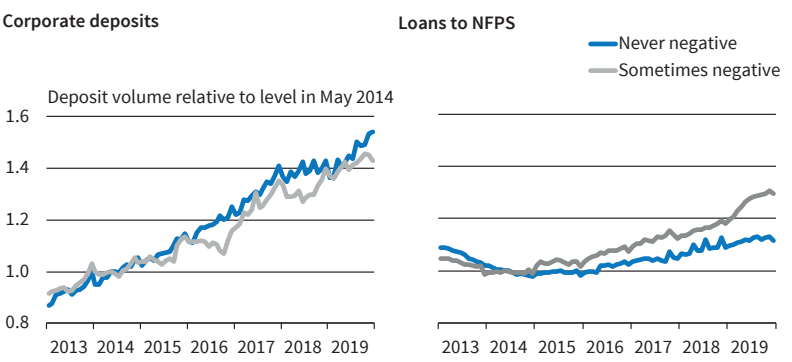
The expansion of loan supply has also translated into lower borrowing costs for firms (Figure 7). The recovery brought forth by the unconventional monetary policy measures adopted since 2014 has stirred an expansion of loan demand. Nonetheless, the rightward shift of banks' supply schedules has resulted into a compression of lending rates by around 1.5 percentage points for the median bank. The decrease was more marked for banks operating in countries more affected by the financial and sovereign crisis, where risk premia were still more elevated. Overall, the full interquartile range of responses was below the decline in the policy rate,

IMPACT OF NEGATIVE INTEREST RATE ON BANK AND FIRMS

Impact on Banks' Lending Conditions

Banks offering negative rates provide more credit than other banks, suggesting that the transmission mechanism of monetary policy is not hampered. Using confidential information at bank-level data on more than 300 MFIs from the IBSI dataset, Figure 6 shows that banks that charge negative rates on corporate

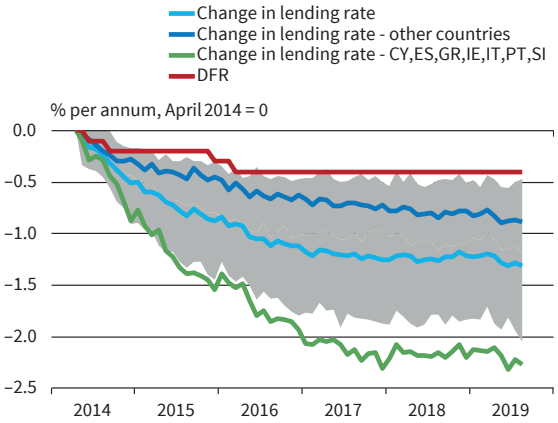
Figure 6
Corporate Deposits and Loans to Households and Firms for Banks That Never Charged Negative Deposit Rates and Other Banks



Note: Information on deposit rates charged at the individual bank level is based on iMIR data, while data on loan and deposit volumes are based on iBSI data. Total volumes for loans and deposits are normalised to the level in May 2014.
Source: Update of Altavilla et al. (2019).
© ifo Institute

Figure 7

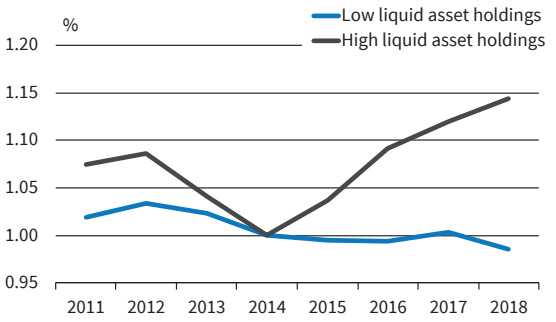
Pass-through to NFC Lending Rates



Note: The figure shows interest rates on new loans excluding overdrafts as deviations from the level observed in April 2014. The mean is the weighted average of lending rates across banks, where weights are the 24-month moving average of new business volumes. Floating (fixed) rate banks are those with a share of loans with duration below 1 year above (below) 50% as of April 2014.
Source: ECB; authors' calculations. © ifo Institute

Figure 8

Corporate Investment before and after the NIRP for Exposed Firms with Low and High Liquidity



Notes: Average investment for corporate clients of banks whose average NFC deposit rate has been negative at least once, distinguishing between firms with a ratio of current assets over total assets in the top decile (high liquidity, black line) and in the bottom decile (low liquidity, blue line) of the distribution. Investment orthogonal to firm and year fixed effects, normalised to 1 in 2013.
Source: Altavilla et al. (2019). © ifo Institute

indicating a strong and widespread pass-through of the policy to borrowing conditions.

Impact on Firm's Investment

The negative interest rate policy (NIRP) provides further stimulus to the economy through firms' asset rebalancing. Using confidential information on more than 300 banks from the IBSI dataset matched with information obtained from Bureau Van Dijk's ORBIS database on more than 3 million firms operating in 19 euro area countries, Figure 8 shows a different pattern in the investment of firms exposed to negative deposit rates depending on their cash-holdings. Firms with large holdings of liquid assets subject to negative deposit rates have an incentive to reduce these liquid assets by increasing investment. Therefore, firms that have high liquid asset holdings and have faced negative deposit rates have accelerated their investment growth considerably after the introduction of negative rates, even after we account for their normal level of investment growth (black line). By contrast, firms that have low liquid asset holdings and are therefore not particularly affected by negative deposit rates did not show such acceleration (blue line). These effects are economically significant, and it has been estimated that this effect has boosted corporate investment by about 1 percent point.

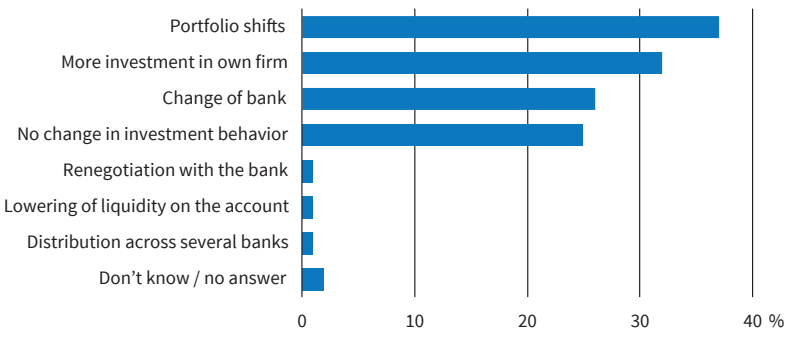
These findings are corroborated by the evidence emerging from a recent market study conducted by Commerzbank in cooperation with Forsa. The study surveys 500 German companies with an annual turnover starting at EUR 15 million over the period 8 July to 9 August 2019. The main results of the survey are depicted in Figure 9, showing that a large share of the firms reported that they reacted to negative interest rates by rebalancing their portfolio or increasing investment.

CONCLUSIONS

This article provides an assessment of the impact of negative interest rate policy (NIRP) on banks and on its transmission to the real economy. We start by discussing the channels of transmission and describing some meaningful stylized facts, including the pass-through of the policy on the yield curve. We then show that market participants' assessment of bank valuations and risk reacted positively to NIRP announcements. Moreover, banks are increasingly able to pass on negative interest rates to corporate deposits. Overall, the policy resulted in an easing of funding conditions for firms, both through higher lending volumes and lower lending rates. Finally,

Figure 9

Reaction to Negative Interest Rates



Note: Multiple answers possible, basis: n = 145 respondents who have paid credit or negative interest, Question 4b: "How did you react to this with your investment behavior?"
Source: Commerzbank/Forsa. © ifo Institute

firms' own exposure to negative deposit rates creates incentives to increase investment.

The policy by definition implies a direct cost on the banking system, through the negative remuneration of their holdings of excess reserves. This cost is overall contained in terms of its contribution to overall profitability (close to 30 bps of ROE). Looking ahead, the adoption of the two-tier system for the remuneration of excess reserve holdings will contribute to mitigating this cost. Moreover, against the background of the downward rigidity in retail deposit rates, negative interest rates lead to a compression of banks' net interest margins. However, the policy also supports bank profitability through other factors. Lower interest rates mechanically translate into an increase in financial asset valuations leading to capital gains for banks. More importantly, the policy supports the economic outlook, translating into larger intermediation volumes and into lower credit risk, which feeds into lower loan loss provisions.

REFERENCES

Altavilla, C., M. Boucinha, S. Holton and S. Ongena (2018), "Credit Supply and Demand in Unconventional Times", *ECB Working Paper* 2202.

Altavilla, C., M. Boucinha and J. L. Peydró (2018), "Monetary Policy and Bank Profitability in a Low Interest Rate Environment", *Economic Policy,* October, 533–583.

Altavilla, C., M. Boucinha, J. L. Peydró and F. Smets (2020), "Banking Supervision, Monetary policy, and Risk-Taking: Big Data Evidence from 15 Credit Registers", *ECB Working Paper* 2349.

Altavilla, C., L. Burlon, M. Giannetti and S. Holton (2019), "Is There a Zero Lower Bound? The Effects of Negative Policy Rates on Banks and Firms", *ECB Working Paper* 2289.

Bottero, M., C. Minoiu, J. L. Peydro, A. Polo, A. Presbitero and E. Sette (2019), "Negative Policy Rates and Bank Asset Allocation: Evidence from the Italian Credit and Security Registers", *IMF Working Paper* 19/44.

Demiralp, S., J. Eisenschmidt and T. Vlassopoulos (2019), "Negative Interest Rates, Excess Liquidity and Bank Business Models: Banks' Reaction to Unconventional Monetary Policy in the Euro Area", *ECB Working Paper* 2283.

Eggertsson, G. B. and M. Woodford (2003), "The Zero Bound on Interest Rates and Optimal Monetary Policy", *Brookings Papers on Economic Activity* 2003(1), 139–211.

Eggertsson, G. B., R. E. Juelsrud and E. G. Wold (2017), "Are Negative Nominal Interest Rates Expansionary?", *NBER Working Paper* 24039.

Eggertsson, G. B., R. E. Juelsrud, L. H. Summers and E. G. Wold (2019), "Negative Nominal Interest Rates and the Bank Lending Channel", *NBER Working Paper* 25416.

Grandi, P. and M. Guillé (2020), *The Upside Down: French Banks, Deposits and Negative Policy Rates,* mimeo.

Heider, F., F. Saidi and G. Schepens (2019), "Life below Zero: Bank Lending under Negative Policy Rates", *Review of Financial Studies* 32, 3728–3761.

Rogoff, K. (2016), *The Curse of Cash*, Princeton University Press, Princeton.

Rogoff, K. (2017), "Dealing with Monetary Paralysis at the Zero Bound", *Journal of Economic Perspectives* 31, 47–66.

Rostagno, M., C. Altavilla, C. Carboni, W. Lemke, R. Motto, A. Saint-Guilhem and J. Yiangou (2019), "A Tale of Two Decades: The ECB's Monetary Policy at 20", *ECB Working Paper* 2346.

Summers, L. H. (2014), "U.S. Economic Prospects: Secular Stagnation, Hysteresis, and the Zero Lower Bound", *Business Economics* 49, 65–73.

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Negative Interest Rates and Bank Lending

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

NEGATIVE RATES AS AN UNCONVENTIONAL POLICY TOOL IN EUROPE

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

In June 2014, the ECB set its interest rate on (excess) reserves deposited by commercial banks below zero for the first time. Since then, the Deposit Facility Rate has been gradually lowered from − 0.1 percent to − 0.5 percent. For the ECB, the negative deposit facility rate is only one instrument of unconventional monetary policy aimed at strengthening aggregate demand in order to meet its inflation target of close to, but below, 2 percent. The ECB's toolkit of unconventional measures also includes asset-purchase programs aimed at easing credit conditions through a direct impact on long-term borrowing rates. In addition, targeted long-term refinance operations are aimed at providing banks with sufficient loanable funds to expand lending.[1] The role of negative rates in this toolkit can be seen as one of increasing banks' incentives to expand lending, rather than hoarding loanable funds in the form of central bank reserves.

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

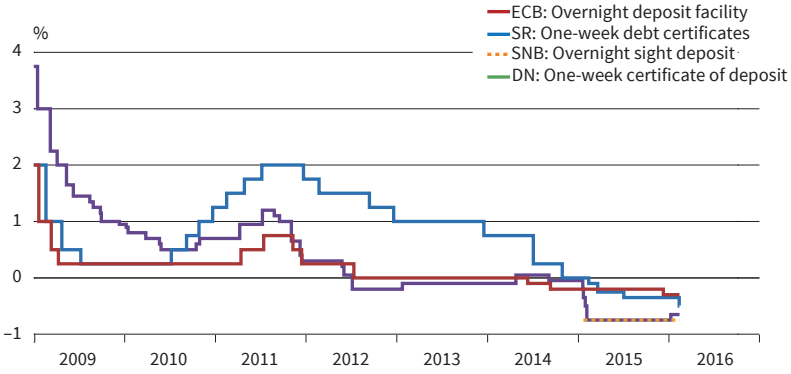
NEGATIVE RATES AND BANK LENDING: THE CREDIT CHANNEL OF MONETARY POLICY

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

[1] For an overview of current ECB policy measures, see: https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html and https://www.ecb.europa.eu/mopo/implement/omo/tltro/html/index.en.html.
[2] For an up-to-date analysis of business cycle conditions for Switzerland, see https://kof.ethz.ch/en/publications/kof-analysen.html.
[3] For a textbook presentation of the transmission channels of monetary policy, see Mishkin (2018).

Figure 1

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



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

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

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

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

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

To what extent could the bank-lending channel be disrupted when policy rates go negative? A widespread conjecture is that there is a discontinuity in the impact of policy rates on customer deposit supply when policy rates hit negative territory. In particular, the pass-through of policy rates to deposit rates may be muted as deposit rates reach the nominal zero rate. In the extreme case, where all consumers and firms can frictionlessly store cash as a liquid safe asset, the supply of bank deposits would be bound at zero.

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

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

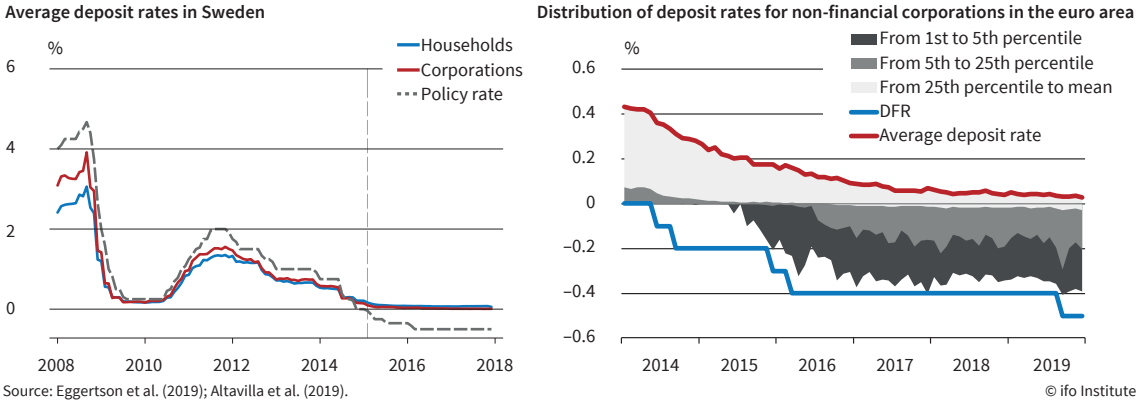
The Bank-Balance-Sheet Channel: Interest Rate Risk and Bank Valuation

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

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

Figure 2

Negative Policy Rates and Interest Rates on Deposits



Source: Eggertson et al. (2019); Altavilla et al. (2019).

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

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

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

The Deposits Channel: Market Power in the Deposit Market

Novel evidence by Drechsler et al. (2020) suggest that changes in monetary policy conditions have little effect on the strength of bank balance sheets. They confirm a significant contractual maturity mismatch for US banks. However, they document that due to market power in the deposit market, this mismatch does not lead to effective interest-rate-risk exposure for banks. Rather, their analysis shows that banks' net interest margins and equity valuations are largely insensitive to monetary policy shocks.[6] In a related paper (Drechsler et al. 2017), the authors argue that bank market power – rather than interest rate risk – is the mechanism through which monetary policy is transmitted through bank balance sheets. In the spirit of oligopolistic models of financial intermediation,[7] they argue that banks face an inelastic supply of deposits from households and firms. Due to their market power banks adjust their deposit rates only partially to changes in policy rates. As a consequence, a decline in policy rates leads to lower intermediation spreads, which lead to an increase in the supply of customer deposits to banks.

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

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

NEGATIVE INTEREST RATES AND BANK LENDING: THE EVIDENCE

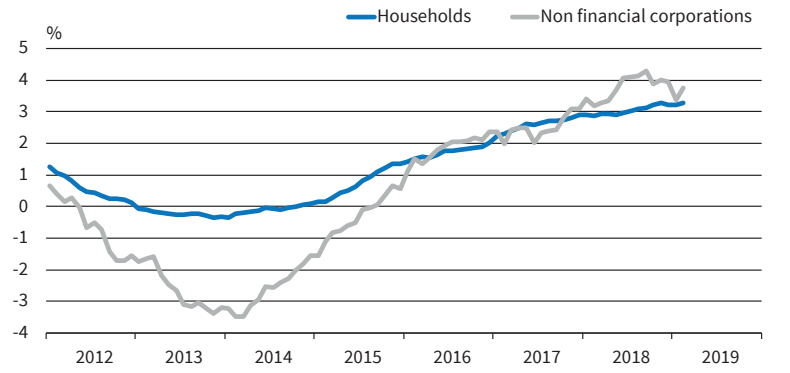
Aggregate data suggests an acceleration of bank lending in the eurozone between 2014 and 2019 (Figure 3). However, it is far from clear if the negative interest rate policy contributed to this expansion of credit. As discussed above, over this period the ECB pursued significant further unconventional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

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

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

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

Figure 3
Credit Growth in the Eurozone



Source: Euro Area Statistics. © ifo Institute

Funding Structure and Bank Lending

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

Heider et al. (2019) study contract-level data from the syndicated loan market over the period 2013–2015 to examine how negative interest rates impact on the lending activity of (large) European banks. The authors compare the volume and risk structure of new syndicated lending by banks during 18 months before and after the introduction of negative rates (in June 2014). In their sample of 69 banks, the ratio of deposit funding varies from on average of 61 percent (high-deposit banks) to 22 percent (low-deposit banks). Their results show that following the introduction of negative rates in 2014 syndicated lending develops significantly more weakly for high-deposit banks than for low-deposit banks. Indeed, their main estimates suggest that negative interest rates reduced lending of high deposit banks by 35 percent relative to that of low deposit banks. In addition, the authors show that following the introduction of negative rates high-deposit banks are more likely to increase their syndicated lending to riskier firms. Heider et al. (2019) conjecture that their findings are driven by a weakening of profitability and net worth of banks that face a zero-lower bound on deposit rates. On the one hand, lower net worth and profitability constrains credit growth (bank-balance-sheet channel). On the other hand, lower net worth and profitability increases risk taking as banks have less skin in the game or search for yield (Dell'Ariccia et al. 2017).[8] Note, however, that this inter-pretation presumes a significant correlation between lower policy rates, bank profitability, and net worth, which has been questioned by recent evidence (Drechsler et al. 2020; Altavilla et al. 2018).

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

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

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

[8] See Dell'Arricia et al. (2017) or Jimenez et al. (2014) for evidence on risk-taking channel of monetary policy. Both studies document that lower policy rates are associated with an increase in risk taking.
[9] Further studies also document an expansion of lending in response to negative rates: Nucera et al. (2017); Demiralp et al. (2017).

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

Asset Structure and Bank Lending

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

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

Basten and Mariathasan (2018) examine the asset and liability management of Swiss banks in reaction to the introduction of negative rates in January 2015. In Switzerland, each bank was allocated a quota of excess reserves below which the negative rates would not imply. This quota was set on a bank-by-bank level and equal to 20 times a bank's regulatory reserves at the end of 2014. This implies that banks with high ratios of central bank reserves to deposits were more exposed to the negative interest rate policy. Basten and Mariathasan (2018) employ confidential regulatory data at the bank level to examine how the balance sheet and revenue structure of banks changed, depending on the extent to which they exceeded their quota for 'free' excess reserves. Their results confirm a more significant rebalancing of assets by those banks most exposed to the negative rates. In the Swiss case, banks with high levels of reserves display a stronger reallocation of assets from central bank reserves to mortgage loans and marketable securities. The exposed banks also adjust their funding structure by reducing capital market funding (mortgage backed bonds). The authors thus demonstrate that structural shifts in asset and liability holdings induced by negative interest rates may not only trigger changes in the credit risk exposure, but impact on interest-rate risk and liquidity risk within the banking sector.

CONCLUSION

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

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

REFERENCES

Altavilla, C., L. Burlon, M. Giannetti and S. Holton (2019), "Is There a Zero Lower Bound? The Effects of Negative Policy Rates on Banks and Firms", *ECB Working Paper* 2289.

Altavilla, C., M. Boucinha and J. L. Peydro (2018), "Monetary Policy and Bank Profitability in a Low Interest Rate Environment", *Economic Policy*, October, 533–583.

Auer, R. (2015), *A Safe Haven: International Demand for Swiss Francs during the Euro Area Debt Crisis,* Swiss National Bank Quarterly Bulletin 2015/2.

Basten, C. and M. Mariathasan (2018), "How Banks Respond to Negative Interest Rates: Evidence from the Swiss Exemption Threshold", *CESifo Working Paper* 6901.

Bech, M. and A. Malkhozov (2016), *How Have Central Banks Implemented Negative Policy Rates?*, BIS Quarterly Review, March, https://www.bis.org/publ/qtrpdf/r_qt1603e.htm.

Borio, C, L. Gambacorta and B. Hofmann (2017), "The Influence of Monetary Policy on Bank Profitability", *International Finance* 20, 48–63.

Bottero M., C. Minoiu, J. L. Pedro, A. Polo, A. F. Presbitero and E. Sette (2019), "Negative Monetary Policy Rates and Portfolio Rebalancing: Evidence from Credit Register Data", *IMF Working Paper* 2019/44.

Claessens, S., N. Coleman and M. Donnelly (2018), "Low-for-Long Interest Rates and Banks' Interest Margins and Profitability: Cross-Country Evidence", *Journal of Financial Intermediation* 35, 1–16.

Dell'Ariccia, G., L. Laeven and G. A. Suarez (2017), "Bank Leverage and Monetary Policy's Risk-Taking Channel: Evidence from the United States", *The Journal of Finance* 72, 613– 654.

Demiralp, S., J. Eisenschmidt and T. Vlassopoulos (2017), *Negative Interest Rates, Excess Liquidity, and Bank Business Models: Banks' Reaction to Unconventional Monetary Policy in the Euro Area,* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2941377.

Drechsler, I., A. Savov and P. Schnabl (2017), "The Deposits Channel of Monetary Policy", *Quarterly Journal of Economics* 132, 1819–1876.

Drechsler, I., A. Savov and P. Schnabl (2020), "Banking on Deposits: Maturity Transformations Without Interest Rate Risk", *NBER Working Paper* 24582.

Eggertsson, G. B., R. E. Juelsrud, L. H. Summers and E. G. Wold (2019), "Negative Nominal Interest Rates and the Bank Lending Channel", *NBER Working Paper* 25416.

English, W. B., S. J. Van den Heuvel and E. Zakrajšek (2018), "Interest Rate Risk and Bank Equity Valuations", *Journal of Monetary Economics* 98, 80–97.

Freixas, X. and J. C. Rochet (2008), *Microeconomics of Banking,* MIT Press, Cambridge MA.

Gomez, M., A. Landier, D. Sraer and D. Thesmar (2016), *Banks' Exposure to Interest Rate Risk and the Transmission of Monetary Policy,* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2220360.

Heider, F., F. Saidi and G, Schepens (2019), "Life below Zero: Bank Lending under Negative Policy Rates", *Review of Financial Studies* 32, 3728–3761.

Jiménez, G., J. L. Peydró, J. Saurina and S. Ongena (2012), "Credit Supply and Monetary Policy: Identifying the Bank-Balance-Sheet Channel with Loan Applications", *American Economic Review* 102, 2301–2326.

Jiménez, G., S. Ongena, J. L. Peydró and J. Saurina (2014), "Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say about the Effects of Monetary Policy on Credit Risk-Taking?", *Econometrica* 82, 463–505.

Kashyap, A. K. and J. C. Stein (2000), "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?", *American Economic Review* 90, 407–428.

Knell, M. and H. Stix (2005), "The Income Elasticity of Money Demand: A Metaanalysis of Empirical Results", *Journal of Economic Surveys* 19, 513–533.

Nucera, F., A. Lucas, J. Schaumburg and B. Schwaab (2017), "Do Negative Interest Rates Make Banks Less Safe?", *Economics Letters* 159, 112–115.

Schelling, T. and P. Towbin (2018), *Negative Interest Rates, Deposit Funding, and Bank Lending,* www.snb.ch › reference › source › sem_2018_09_21_towbin.n.pdf.

Tan, G. (2019), "Beyond the Zero Bound: Negative Policy Rates and Bank Lending", *DNB Working Paper* 649.

Tobin, J. (1958), "Liquidity Preference as Behavior Towards Risk", *The Review of Economic Studies* 25, 65–86.

Nicolas Reigl and Karsten Staehr

Negative Interest Rates in the Five Eurozone Countries from Central and Eastern Europe[1]

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The European Central Bank (ECB) lowered the interest rate on its deposit facility to − 0.1 percent on 11 June 2014 and has subsequently pushed it further into negative territory. The policy of negative interest rates is one of the unconventional monetary policy measures introduced in the aftermath of the global financial crisis and the European debt crisis (Dell'Ariccia et al. 2018).[2]

Five small countries from Central and Eastern Europe are members of the euro area. The group is here abbreviated as the CEEA (Central and Eastern Euro Area) and it is comprised of Slovenia which joined in 2007, Slovakia (2009), Estonia (2011), Latvia (2014), and Lithuania (2015). After the accession of these countries to the euro area, the monetary policy decisions of the ECB apply fully to these countries. This article discusses how the ECB's measures of negative interest rates may have affected financial and economic developments in the CEEA countries.

The pros and cons of the negative interest rates in the euro area have been debated keenly (Siegel and Sexauer 2017; Eisenschmidt and Smets 2017; Dell'Ariccia et al. 2018; Financial Times 2019). It has been argued that the measure was necessary to improve financial conditions and bring inflation back to its target, but also that it may lead to financial instability, spark high inflation, and unfairly disadvantage savers.[3]

Academic studies have considered the possible ways that negative interest rates can impact a number of variables. A key question is the extent and speed with which lower policy rates have been passed through to the deposit and lending rates of banks. It is generally found that the pass-through has been relatively muted, although the results depend on the specific interest rates considered (Eggertsson et al. 2017; Dell'Ariccia et al. 2018; Eisenschmidt and Smets 2018; Altavilla 2019). Studies have found that the negative rates have been passed through to bank rates in the core of the euro area to a larger extent than elsewhere in the area, probably reflecting the extent of excess liquidity in the banking sector in various parts of the euro area (Eisenschmidt and Smets 2018).

Other studies have considered a wider set of developments in the financial sector. Studies have shown that lending volumes have not been adversely affected by the negative interest rates and may indeed have expanded (Jobst and Lin 2016; Altavilla et al. 2019). Financial stability concerns may arise if banks are unable to reduce their deposit rates to below zero and interest margins end up being compressed. Heider et al. (2019) find that lending volumes held up in Sweden, but the banks took larger risks in their lending and this could over time jeopardize financial stability. However, Boungou (2020) does not find that negative interest rates have led to more risk-taking by the banks. Nucera et al. (2017) and Demiralp et al. (2019) contend that the effect on lending volumes depends on the business model of the bank. Lopez et al. (2018) conclude that negative interest rates have had little effect on the profitability of banks.

Academic studies have also considered the macroeconomic effects of negative interest rates. Christensen (2019) finds that the introduction of negative interest rates has generally lowered interest rates of all maturities and so has led to a downward shift of the yield curve. Perhaps surprisingly, Hameed and Rose (2018) find that there has been no discernible effect on exchange rates in the countries that introduced negative interest rates. The impact on economic growth is uncertain though. Eggertsson et al. (2017 and 2019) posit that a scenario where bank lending margins are compressed and lending volumes reduced is realistic and that the result may be lower economic growth. Ulate (2019) finds that cuts in the interest rate are always expansionary, though less so when the rate turns negative.

The studies of the effects of negative interest rates have typically focused on developments in the countries in the core euro area, or those in Southern Europe that were most affected by the global financial crisis (Dell'Ariccia 2018; Eisenschmidt and Smets 2018). Studies have largely overlooked the consequences for the new members of the euro area from Central and Eastern Europe, with the key exception of Damjanovic (2019). This is unfortunate, since the CEEA countries exhibit a number of particularities. First, the financial sectors in these countries are at quite an early stage of development with most banks foreign-owned and thus tied to events abroad. Second, the process of economic convergence implies that the countries are generally experiencing relatively fast trend growth in GDP per capita and this may result in inflationary pressures, a phenomenon sometimes labeled the dynamic Penn effect.[4] Third,

[1] The authors would like to thank Dmitry Kulikov, Helen Ljadov, Martti Randveer, and Reet Reedik for discussions and useful comments to earlier versions of the article. The views expressed are those of the authors and not necessarily those of the Bank of Estonia or other parts of the Eurosystem.

[2] Denmark was the first country to introduce negative interest rates in 2012 after the global financial crisis (Christensen 2019). Switzerland introduced negative interest rates in 2015, Sweden in 2015, Bulgaria in 2016, Hungary in 2016, and Japan in 2016.

[3] The debate on negative interest rates and their consequences for pensioners and other savers has been particularly active in Germany (Bloomberg 2019).

[4] Degler and Staehr (2019) find evidence of the dynamic Penn effect in the sample of EU countries from Central and Eastern Europe.

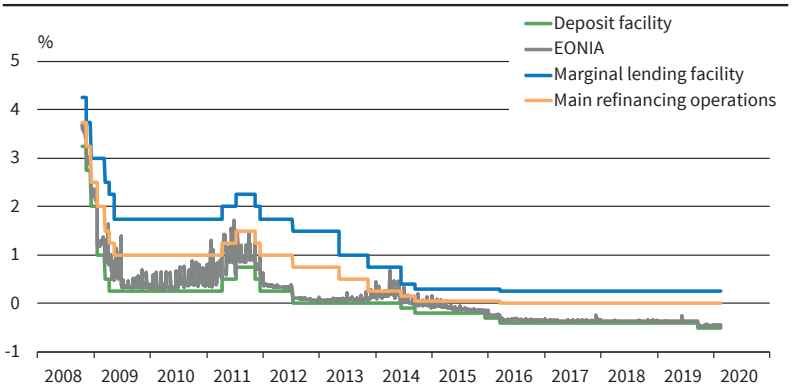
the CEEA countries often have cyclical positions that differ markedly from those of the large countries in the core euro area. Finally, the public finances in these countries are typically on a sounder footing than those in many other euro-area countries.

This paper discusses some of the financial and economic effects in the five CEEA countries that may be associated with the negative interest rates in the euro area. We focus our discussion on developments in lending and deposit rates, lending volumes, and house prices, but we also touch on broader economic developments such as the dynamics of economic growth and inflation. The study is exploratory and narrative along the lines of Dell'Ariccia et al. (2018), who consider the effects of negative interest rates on a number of large economies.

We find that economic developments in the CEEA countries after the introduction of negative interest rates have generally been benign and there have been no uniform signs of overheating. However, risks in the form of rapid lending growth and rising housing prices cast some doubt on the longer-term impact on financial and economic stability.

Figure 1

Interest Rates in the Euro Area



Source: European Central Bank. © ifo Institute

NEGATIVE INTEREST RATES IN THE EURO AREA

The ECB sets three interest rates. The deposit rate is the interest paid to banks for overnight deposits at the ECB, the main refinancing rate is used for regular provisions of liquidity to the market, and the marginal lending rate is used for overnight credit to banks. The three interest rates basically provide a floor, a midpoint, and a ceiling for EONIA, the overnight unsecured interest rate in the interbank market of the euro area.[5] Figure 1 shows the three interest rates set by the ECB together with EONIA.[6] After the global financial crisis erupted, the ECB lowered its interest rates markedly. The deposit rate entered negative territory on June 11, 2014 and reached − 0.5 percent on 18 September 2019.

Whether it is feasible to keep interest rates negative has been questioned on the grounds that households and corporations may choose instead to hold cash, which carries an interest rate of zero. Handling, storing, and insuring large amounts of cash is impractical and costly, so in practice this does not prevent interest rates from being negative. There is evidently a minimum level somewhere under which a large fraction of households and corporations will resort to hoarding cash.[7]

It is important to underscore that EONIA is negative not only because the ECB's deposit rate is negative, but also because there is excess liquidity in the banking system in the euro area. The ECB has used a large number of unconventional monetary policy measures since the end of 2012 (Jäger and Grigoriadis 2017). Some of these entail purchasing assets such as government bonds or other safe assets that normally appear on the balance sheets of banks and other financial institutions. The unconventional monetary policy measures have in this way funneled liquidity into the banking sector and this has helped drive down the EONIA rate.

Scholars have sought to compute *shadow interest rates*, which are synthetic interest rates that combine conventional interest rates with the implicit or induced effects of unconventional monetary policy measures (Krippner 2013; Wu and Xia 2016). Estimates of the shadow interest rate for the euro area vary substantially over time and across various studies, but since 2015 they have mainly centered around an interval of − 3 to − 5 percent (Reserve Bank of New Zealand 2020). It may thus be argued that the negative interest rates comprise only a small component of the overall loosening of monetary policy in the euro area since the start of the global financial crisis.[8]

Most intertemporal decision-making, such as consumption and investment choices, is based on the expected *real* interest rate. The nominal interest rate enters this calculation, but so does the expected inflation rate. This means the expected real interest rate can be negative even when the nominal interest

[5] In October 2019, the ECB introduced a new data series for the overnight interbank rate for the euro area called the €STR. The new series will coexist with EONIA until the beginning of 2022.

[6] The starting point of the sample, 15 October 2008, was chosen to coincide with the ECB's introduction of new procedures for the main refinancing operations. It is shortly after the bankruptcy of Lehman Brothers.

[7] There is some evidence that cash holdings of euros have increased since the introduction of negative interest rates. Financial Times (2020) reports the emergence of large-scale storage arrangements that include insurance of the cash stored and at a lower cost than that implied by the negative interest rate.

[8] This of course overlooks the intricate interactions between the conventional and unconventional policies of the ECB.

rate is positive, so the monetary policy stance cannot be assessed using solely the nominal rate or the shadow rate.

Moreover, the ECB sets the short-term interest rate in the euro area, but lending, deposits, and other financial transactions often use longer-term interest rates that are not directly under the control of the ECB. The relationship between the short-term rates and the longer-term rates, customarily captured by the yield curve, is of key importance for how effective monetary policy, including the use of negative interest rates, is. It is, however, very difficult to isolate the effect of the negative interest rate policy on longer-term interest rates from the effects of other ECB policies such as asset purchases and forward guidance.

Finally, it should be kept in mind that how appropriate the monetary stance is depends on the cyclical position of the economy and the prevailing inflation outlook. Negative real interest rates may be appropriate in some circumstances but not in others. It is noticeable in this context that the cyclical stance often varies across countries and regions in the euro area.

DIRECT AND INDIRECT EFFECTS

The economies in the CEEA countries are affected by the eurozone monetary policy, but are too small to have any discernible influence on euro aggregates. This makes it reasonable to assume that economic developments in the CEEA countries will have a negligible impact on ECB policy rates. There are nevertheless several channels through which negative interest rates may affect developments in the CEEA economies. It is convenient to distinguish between direct and indirect effects.

The direct effect stems from the interest rates and other monetary policy measures of the ECB that apply to all the euro-area members. Negative interest rates affect the cost of funding directly and so affect the operations of the banks in the CEEA countries.

There are numerous indirect effects. Monetary policy is immediately transmitted to euro-area aggregates such as exchange rates and international capital flows. In the longer term there may also be other economic developments in the euro area, such as changes to inflation, foreign trade, and economic growth. The CEEA countries have close economic links to the rest of the euro area, so overall developments in the euro area will affect the CEEA countries. Developments in the euro area may also affect neighboring non-euro countries like Sweden, Denmark, and the UK – countries with which the Baltic states in particular have close economic ties (Kucharcukova 2016). It is likely that the complex web of indirect effects is as important as the direct effects for the CEEA economies.

It should also be kept in mind that negative interest rates or other expansionary monetary policy measures may be followed by policy reactions in the individual CEEA countries. The countries may for instance change their fiscal stance or adjust supervision and regulation of their financial sector, including how they set countercyclical capital buffers. However, it is difficult to ascertain which policy measures are reactions to negative interest rates, and which measures would have been implemented anyway.

The discussion above underscores the numerous problems in disentangling the effects that different monetary policy measures, including negative interest rates, have on financial and economic developments in the CEEA countries. Empirical studies have used VAR models, estimated or parametrized DSGE models, and difference-in-differences methods to address some of these knotty identification issues (Errit and Uusküla 2014; Stakenas and Stasiukynaite 2017; Damjanovic 2017).

This paper adopts a broad perspective and discusses key features of the CEEA economies in the aftermath of the global financial crisis and the introduction of negative interest rates in the euro area, along the lines followed by Dell'Ariccia et al. (2018). An important issue is whether domestic developments suggest that economic and financial stability may be jeopardized by negative interest rates and other expansionary monetary policy measures.

DEVELOPMENTS IN THE CEEA COUNTRIES

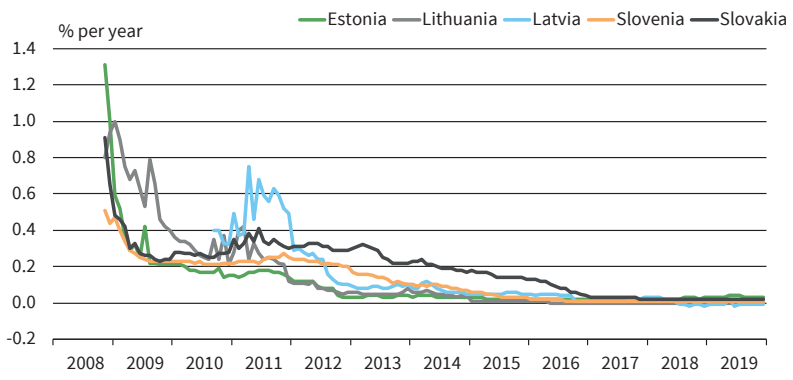
Bank Interest Rates

We start by looking at the average interest rates in the banking sectors in the CEEA countries. Figure 2 shows the deposit rates on sight deposits held by households. The interest rates have declined markedly since the onset of the global financial crisis, and this process continued after negative interest rates were introduced in June 2014. The reaction in Slovakia was somewhat slower, which may be due to lending in the country mainly being on fixedrate terms, so that the Slovak banks were less exposed as interest rates declined after the global financial crisis (see below). It is noticeable that although the average deposit rates have been low and at or marginally above zero since June 2014, the rates for households have not fallen below zero.

The introduction of negative interest rates has arguably affected lending rates more than deposit rates. Figure 3 shows the average interest rate on outstanding loans to nonfinancial corporations from banks in the CEEA countries. Lending rates were relatively stable in 2013 and the first half of 2014 and then started to decline gradually. The pattern is particularly pronounced for Slovenia after the country

Figure 2

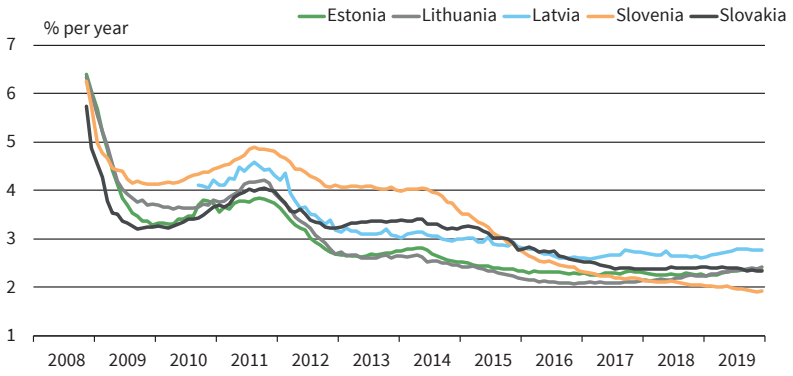
Bank Interest Rate for Sight Deposits Held by Households



Source: European Central Bank. © ifo Institute

Figure 3

Bank Interest Rates on Outstanding Loans to Non-financial Corporations



Source: European Central Bank. © ifo Institute

exited the economic crisis that hit it in 2011–2013. Precisely how the policy of negative interest rates affected lending rates is difficult to ascertain, but it is clear that the expansionary monetary policy lowered lending rates not only in the core euro area but also in the five CEEA countries.

Lending rates for various types of loans to households were also declining. Figure 4 shows the interest rate on outstanding housing loans, which are loans given to households to buy residential properties. Two features stand out. First, the interest rates in the Baltic states and Slovenia fell somewhat from mid-2014 to 2016, but have since remained broadly constant; the negative interest rates have had at most a modest impact on the interest rates for house purchases. Second, the interest rate on housing loans in Slovakia fell only gradually after the global financial crisis, in part because a large share of the outstanding loans were long-term loans with fixed interest rates. Starting in 2018, the interest rate on outstanding housing loans was below 2.5 percent in all five CEEA countries.

Financial Conditions

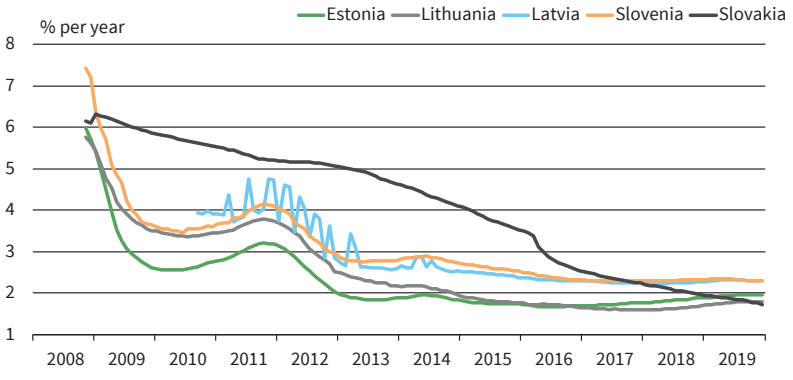
Bank interest rates have been low and relatively stable in the years since 2014, when negative interest rates were introduced in the euro area. The negative rates may however have had wider effects on financial conditions in the CEEA countries, and some of these could jeopardize financial stability.

Figure 5 shows the annual growth in the nominal value of outstanding bank loans to households and nonfinancial corporations. The large variability of the data over time arises mainly because lending to nonfinancial corporations is very volatile throughout the period considered. A clear picture emerges even though the growth rates vary substantially across the countries. The growth rates of the stocks of loans to households and nonfinancial corporations have risen markedly since 2014 for all five CEEA countries. The change is particularly pronounced for Slovenia, which did not emerge from the recession until 2014. The dynamics for Slovenia stem from the corporate deleveraging that followed the recession in the early 2010s, and also from a switch from debt to equity financing.

The average growth rates for loans vary over the years 2017–2019 across the CEEA countries. The

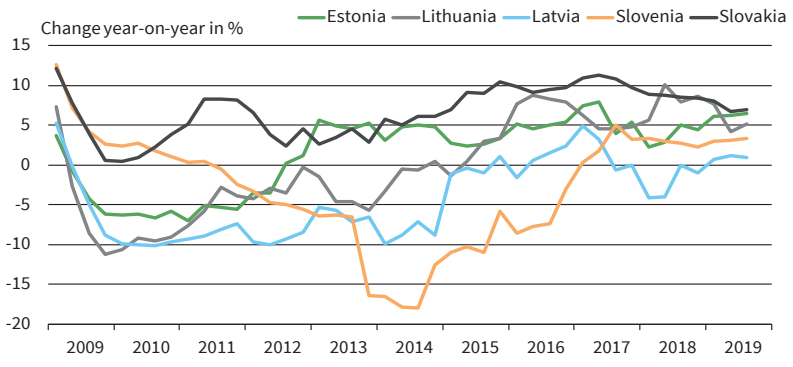
Figure 4

Bank Interest Rates on Outstanding Housing Loans



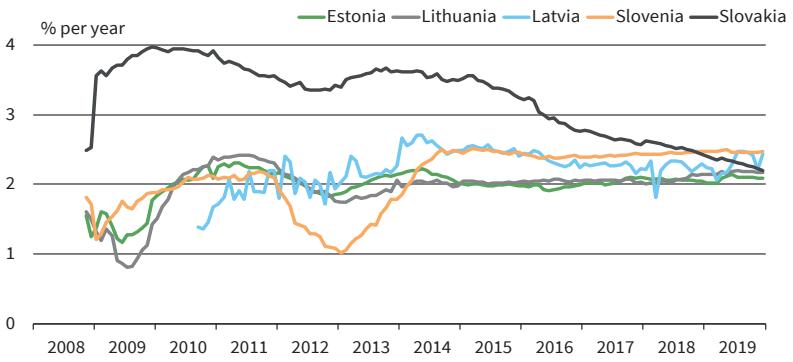
Source: European Central Bank. © ifo Institute

Figure 5
Bank Loans to Households and Non-financial Corporations



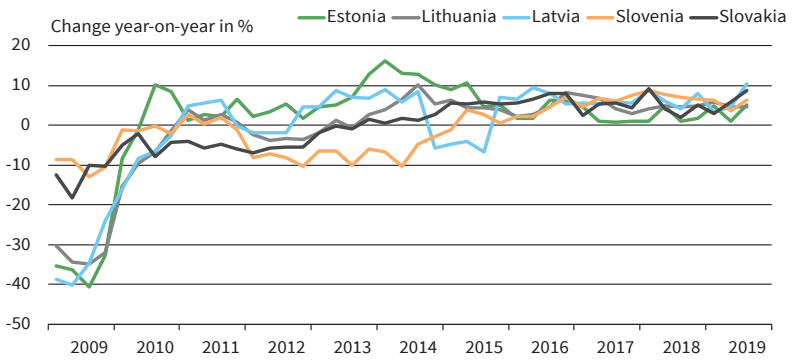
Source: European Central Bank; authors' calculations © ifo Institute

Figure 6
Margin on Outstanding Loans to Households and Non-financial Corporations



Source: European Central Bank. © ifo Institute

Figure 7
Real Housing Price Index



Source: Eurostat. © ifo Institute

average annual growth rate hovered around zero for Latvia, but was 8–10 percent for Slovakia and Lithuania and around 5 percent for Estonia and Slovenia. The debt dynamics should be ascribed not only to the ECB's monetary policy, but also to national policy interventions (ESRB 2019). After a period of high rates of lending growth, Slovakia has taken measures since 2016 to address potential cyclical risks in the real estate sector, including tighter limits on housing loans. Slovenia tightened several macroprudential instruments in 2018 while the Baltic states have taken only a few measures.[9]

Figure 6 shows an aggregate measure of the margin on the outstanding stock of loans to households and nonfinancial corporations. The dynamics for the Baltic states and for Slovenia are relatively similar. Margins were compressed in the aftermath of the global financial crisis, but they stabilized in 2015 and have since remained relatively constant. Slovakia is again an exception here because the share of fixed-rate loans was large, which meant that the average lending rates on outstanding loans declined only gradually. Overall, the fear of narrower bank lending margins does not appear to have materialized in the CEEA countries.

Movements of housing prices are often used to gauge challenges to financial stability. High or rapidly increasing housing prices may lead to imprudent borrowing by the household sector and leave the sector exposed to adverse economic or financial shocks. Figure 7 shows the dynamics of real housing prices in the five CEEA countries, and there is substantial variation across the countries. The Baltic states experienced very large declines in real prices during the global financial crisis, followed by a rebound starting around 2011. Slovakia saw a smaller decline during the crisis, but real price growth remained subdued until 2015. Finally, Slovenia also saw a moderate decline in real housing prices during the global financial crisis, but then substantial declines in real prices during the subsequent downturn.

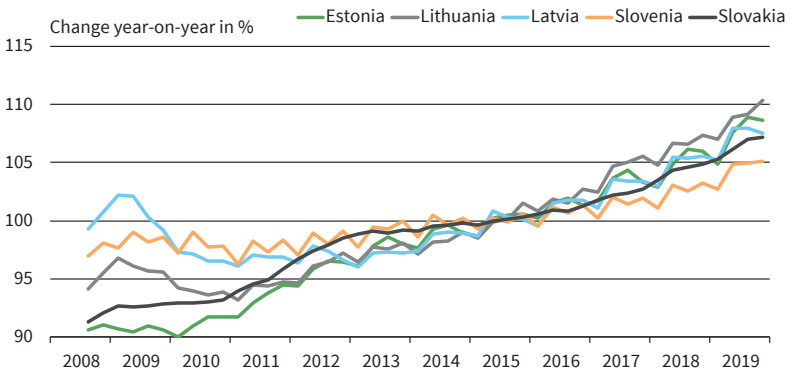
Since mid-2016, the rate of growth in real housing prices has been relatively similar, and on average

[9] Countercyclical capital buffers are part of the set of macroprudential instruments and require banks to set aside additional reserves when lending. They may thus help to dampen credit growth during an upswing in the financial cycle. Estonia, Latvia, and Slovenia have not applied countercyclical capital buffers after negative rates were introduced, whereas Lithuania has had a buffer of 1 percent since June 2019 and Slovakia is set to increase its buffer from 1.5 percent to 2 percent in August 2020.

quite high, in the five countries. Lower interest rates and easier credit conditions have favored housing markets in the CEEA countries and have been followed by an upward drift in real housing prices. As discussed above, several CEEA countries have taken measures to tighten credit conditions for housing loans, and these may have helped stabilize price developments. At the time of writing in February 2020, it is unclear whether these price rises may be excessive and may constitute a threat to financial and economic stability in the future.

Figure 9

HICP Inflation Excluding Energy, Food, Alcohol and Tobacco



Source: Eurostat. © ifo Institute

Macroeconomic Dynamics

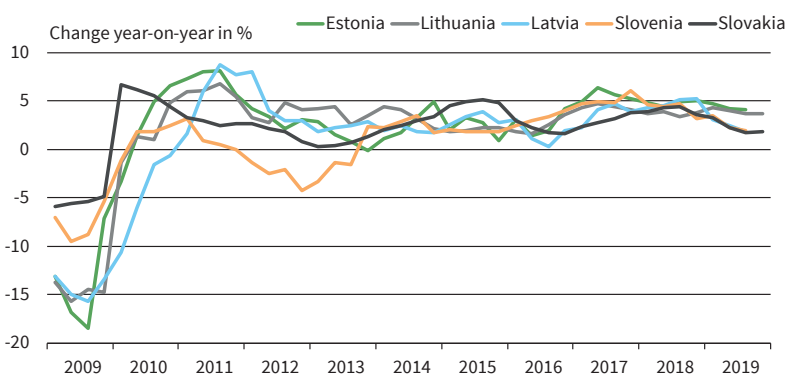
The macroeconomic trends in the CEEA countries have been relatively benign over the 2014–2019 period. Figure 8 shows annual GDP growth for the five countries. The deep recessions in the wake of the global financial crisis affected the countries deeply, but GDP growth was positive in all five in the fourth quarter of 2011. Slovenia, however, slid into another recession shortly afterwards, and year-on-year growth did not turn positive in the country until the fourth quarter of 2013. Growth has been positive in all five countries since 2014, and year-on-year growth rates have at times hovered around 5 percent. Economic growth slipped, however, in several of the CEEA countries in 2019, reducing the risk of overheating.

Although rates of economic growth have been relatively high in the CEEA countries since negative interest rates were introduced, inflation has generally been contained. Figure 9 shows HICP core inflation, i.e., HICP inflation excluding energy, food, alcohol, and tobacco from the price index. Core inflation rose visibly in 2014–2019. Annual core inflation was 2.0–2.5 percent in all of the CEEA countries in 2019, and as such was clearly higher than in most of the euro-area countries in Western Europe. This might partly be ascribed to convergence effects, since trend growth in the CEEA countries is higher than that in Western Europe. It cannot be ruled out, however, that the upward inflationary pressure has arisen because of relatively high rates of economic growth and accommodating financial conditions in the five countries.

The impression that macroeconomic conditions have been relatively stable during the years when interest rates have been negative is also confirmed by other indicators. The current account balance can be defined as saving minus investment in an economy. The current accounts in the CEEA countries have generally been in balance or slightly in surplus since the global financial crisis, although Slovakia has had moderate deficits since 2015 (Ameco 2020, code: *UBCABOP*). The financing costs of government debt have eased as yield curves have shifted downwards. This is arguably of less importance in the CEEA countries than it is in many Western European countries, since government debts are relatively low. It is noticeable, however, that the cyclically adjusted budget balances have been negative in all five CEEA countries for extended periods of time, suggesting that fiscal stances have been relatively expansionary (Ameco 2020, code: *UBLGAPS*).

Figure 8

Gross Domestic Product



Source: Eurostat. © ifo Institute

FINAL COMMENTS

The monetary policy of the ECB focuses on the inflation rate and other aggregates for the entire euro area. The policy cannot take account of conditions in the individual countries, so developments in small economies will generally have a negligible impact

on the monetary policy decisions of the ECB. This makes it pertinent to consider how euro-area policies have affected financial and economic developments in individual euro-area countries.

The introduction of negative interest rates challenged long-held perceptions about the transmission and macroeconomic effects of monetary policy. The deposit interest rate of the ECB and the overnight interest rates in the euro area have been negative since June 2014. The negative interest rates may have affected the economies of the five CEEA countries directly, but may also have done so indirectly through developments in the euro area and countries outside the euro area.

At the time of writing in February 2020, the economic climate in the five CEEA countries is relatively benign and with few signs of financial instability or overheating. Interest rates on bank deposits in the CEEA countries have remained close to zero since 2014, but have not dipped below zero. Lending rates have not fallen substantially and the margins on outstanding loans have not been narrowed unduly since 2014. On the other hand, lending volumes have increased, real house prices have risen markedly, and core inflation is on an upward path, which are mild signs of imbalances gradually accumulating. The muted effects are on the whole consistent with the empirical literature discussed in the beginning of this paper. It is also of note that the ECB deposit interest rate has come down modestly and gradually.

The introduction of negative interest rates in the euro area as of June 2014 was not the result of developments in the five CEEA countries. The negative interest rates and other measures of monetary stimulus may, however, have helped the recovery in the euro area, and thus provided a backdrop against which financial markets and the real economy in the CEEA countries could stabilize. In this situation, the challenge for policymakers in the euro-area countries in Central and Eastern Europe is to ensure that the accommodating monetary policies do not lead to imbalances that jeopardize financial and economic stability in this part of the euro area.

REFERENCES

Altavilla, C., L. Burlon, M. Giannetti and S. Holton (2019), "Is There a Zero Lower Bound? The Effects of Negative Policy Rates on Banks and Firms", *ECB Working Paper* 2289.

Ameco (2020), *Ameco Database*, European Commission, https://ec.europa.eu/economy_finance/ameco/user/serie/SelectSerie.cfm.

Bloomberg (2019), *Negative Interest Rates Are Destroying Our Pensions*, 17 December, https://www.bloomberg.com/opinion/articles/2019-12-17/negative-interest-rates-are-destroying-our-pensions.

Boungou, W. (2020), "Negative Interest Rates Policy and Banks' Risk-Taking: Empirical Evidence", *Economics Letters* 186, forthcoming.

Christensen, J. H. E. (2019), "Yield Curve Responses to Introducing Negative Policy Rates", *FRBSF Economic Letter* 2019–27.

Damjanovic, M. (2019), "A Country Perspective on the Monetary Policy Transmission in the Euro Area: The Case of Slovenia", *Bank of Slovenia Working Papers* 1/2019.

Degler, M. and K. Staehr (2019), "Price and Income Convergence and the Dynamic Penn Effect in Central and Eastern Europe", *Economic Change and Restructuring*, forthcoming.

Dell'Ariccia, G., P. Rabanal and D. Sandri (2018), "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom", *Journal of Economic Perspectives* 32, 147–172.

Demiralp, S., J. Eisenschmidt and T. Vlassopoulos (2019), "Negative Interest Rates, Excess Liquidity and Bank Business Models: Banks' Reaction to Unconventional Monetary Policy in the Euro Area", *ECB Working Paper* 2283.

Eggertsson, G. B., R. E. Juelsrud and E. G. Wold (2017), "Are Negative Nominal Interest Rates Expansionary?", *NBER Working Papers* 24039.

Eggertsson, G. B., R. E. Juelsrud, L. H. Summers and E. G. Wold (2019), "Negative Nominal Interest Rates and the Bank Lending Channel", *NBER Working Papers* 25416.

Eisenschmidt, J. and F. Smets (2018), "Negative Interest Rates: Lessons from the Euro Area", in Á. Aguirre, M. Brunnermeier and D. Saravia, eds., *Monetary Policy and Financial Stability: Transmission Mechanisms and Policy Implications,* Central Bank of Chile, Santiago, 13–42.

Errit, G. and L. Uusküla (2014), "Euro-Area Monetary Policy Transmission in Estonia", *Baltic Journal of Economics* 14, 55-77.

ESRB (2019), *A Review of Macroprudential Policy in the EU in 2018*, European Systemic Risk Board.

Eurostat (2020), *Database*, European Commission, https://ec.europa.eu/eurostat/data/database.

Financial Times (2019), *ECB Set to Consider Damage Done by Negative Rates,* 5 September, https://www.ft.com/content/21aae97e-cb3d-11e9-af46-b09e8bfe60c0.

Hameed, A. and A. K. Rose (2018): "Exchange Rate Behaviour with Negative Interest Rates: Some Early Negative Observations", *Pacific Economic Review* 23, 27–42.

Heider, F., F. Saidi and G. Schepens (2019), "Life Below Zero: Bank Lending under Negative Policy Rates", *Review of Financial Studies* 32, 3727–3761.

Jäger, J. and T. Grigoriadis (2017), "The Effectiveness of the ECB's Unconventional Monetary Policy: Comparative Evidence from Crisis and Non-crisis Euro-Area Countries", *Journal of International Money and Finance* 78, 21–43.

Jobst, A. and H. Lin (2016), "Negative Interest Rate Policy (NIRP): Implications for Monetary Transmission and Bank Profitability in the Euro Area", *IMF Working Paper* WP/16/172.

Krippner, L. (2013), "Measuring the Stance of Monetary Policy in Zero Lower Bound Environments", *Economics Letters* 118, 135–138.

Kucharcukova, O. B., P. Claeys and B. Vasicek (2016), "Spillover of the ECB's Monetary Policy outside the Euro Area: How Different Is Conventional from Unconventional Policy?", *Journal of Policy Modeling* 38, 199–225.

Lopez, J. A., A. K. Rose and M. M. Spiegel (2018), "Why Have Negative Nominal Interest Rates Had Such a Small Effect on Bank Performance? Cross Country Evidence", *NBER Working Papers* 25004.

Nucera, F., A. Lucas, J. Schaumburg and B. Schwaab (2017), "Do Negative Interest Rates Make Banks Less Safe?", *Economics Letters* 159, 112–115.

Reserve Bank of New Zealand (2020), *Comparison of International Monetary Policy Measures,* https://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures.

SDW (2020), *Statistical Data Warehouse,* European Central Bank, https://sdw.ecb.europa.eu/.

Siegel, L. B. and S. C. Sexauer (2017), "Five Mysteries Surrounding Low and Negative Interest Rates", *Journal of Portfolio Management* 43, 77–86.

Stakenas, J. and R. Stasiukynaite (2017), "Monetary Policy Transmission: The Case of Lithuania", *Baltic Journal of Economics* 17, 1–24.

Ulate, M. (2019), "Going Negative at the Zero Lower Bound: The Effects of Negative Nominal Interest Rates", *Federal Reserve Bank of San Francisco Working Paper* 2019–21.

Wu, J. C. and F. D. Xia (2016), "Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound", *Journal of Money, Credit and Banking* 48, 253–291.

Torben M. Andersen

Fiscal Sustainability and Low Government Borrowing Rates[1]

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Alongside the general downward trend in rates of return, government bond rates have declined, being even negative at short maturities for some countries. At the same time, large country differences persist, reflecting dissimilarities in economic fundamentals. The low government borrowing rate, and especially the fact that it is below the growth rates, has fueled a debate on public debt. Blanchard (2019, 1198) goes as far as stating that "from a theory viewpoint, one of the pillars of macroeconomics is the assumption that people, firms, and governments are subject to intertemporal budget constraints. If the interest rate paid by the government is less than the growth rate, then the intertemporal budget constraint facing the government no longer holds".

This is a strong statement with wide-ranging policy implications and therefore worth discussing.[2] Blanchard's argument is essentially saying that a stable debt-to-GDP ratio is consistent with a permanent primary budget deficit when the growth-corrected rate of return is negative.[3] If so, debt servicing is not an issue, and debt levels pose no problem calling for fiscal consolidation. Importantly, this reasoning relies on several debatable assumptions. Two are particularly critical: a stationary environment and rates of return unaffected by the debt level.

The debate on low rates of return-cum-public debt has raised several issues, including the scope to pursue more aggressive stabilization policies not constrained by deficit/debt rules, and the scope to debt finance public investments in infrastructure or climate policies. Not least, these issues are important in relation to medium- to long-run sustainability of public finances in the wake of demographic changes. The following discusses this aspect.

DEMOGRAPHIC CHANGES AND PUBLIC FINANCES

The question of fiscal sustainability has become important due to strong trends in demographics, implying significant changes in the age composition of the population. The demographic trends are well known and widely described – see e.g., Bloom and Lee (2016). The flipside is that an increasing dependency ratio affects public finances, tending to make expenditures outpace revenues for unchanged policies. The drivers are primarily expenditures on pensions, health, and care. Figure 1 shows an assessment of the increases between now and 2070 in public ageing-related spending (pensions, health care, long-term care). On average, age-related expenditures increase by 1.7 percentage points of GDP, but with much larger increases in a number of countries.

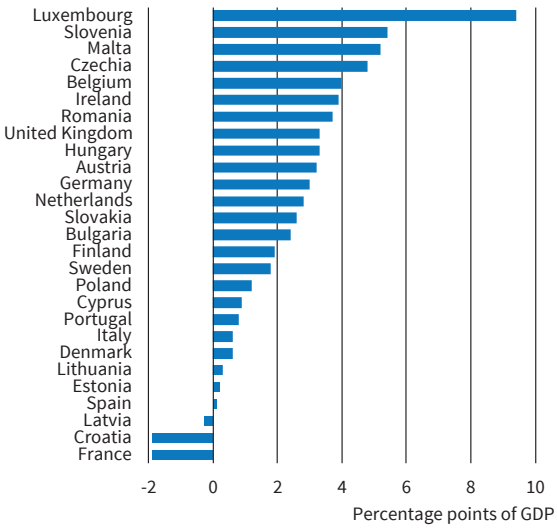
These developments raise fundamental questions on the viability of current welfare arrangements and the need for reform. In short, the environment is not stationary, and a trend deterioration in public finances is predicted for a large number of countries. Neglecting this issue creates uncertainty about future policies, a need for larger policy changes in the future, and has important implications for intergenerational distribution. Therefore, discussions of public debt issues need to take explicit outset in the fact that the environment is nonstationary.

FISCAL SUSTAINABILITY

Fiscal sustainability analyses pose a basic question: are current policies financially viable given predicted changes in demographics or other trends? This is a feasibility test, not a test of policy optimality. If the criterion for fiscal sustainability is met, current policies can be maintained, if this is wanted. Not meeting the requirement points to a need for a policy change

Figure 1

Increases in Public Expenditures[a] due to Ageing by 2070



[a] Includes expenditures on pensions, health care and long-term care.
Source: European Commission. © ifo Institute

[1] I thank Seppo Orjasniemi for providing data.
[2] See also e.g., Auerbach et al. (2019); Eichengreen et al. (2019); and Wyplosz (2019).
[3] Debt (D) evolves according to $D_t = (1 + r_t)D_{t-1} - B_t$, where r is the rate of return, and B is the primary budget balance (revenues less expenditures). Hence, the debt-to-GDP (Y) ratio is $d_t = \frac{D_t}{Y_t} = \frac{1+r_t}{1+g_t} d_{t-1} - b_t$, where g is the growth rate for GDP, $Y_t = (1 + g_t)Y_{t-1}$. Assuming a stationary environment, the steady state relation between the debt and primary budget balance is $b^* = \frac{1}{\hat{r}} d^*$, where the growth-corrected gross rate of return is defined as $1 + \hat{r} \equiv \frac{1+r}{1+g} \cong 1 + r - g$. Hence, a given debt-to-GDP ratio ($d^* > 0$) is consistent with a budget deficit ($b^* < 0$) if $\hat{r} < 0$, while it requires a budget surplus ($b^* < 0$) to sustain a given debt level if $\hat{r} > 0$.

at some point in time. The analysis is silent on the precise content and timing of such a policy change. The sustainability metric is an indicator for policymakers, clarifying the opportunity set and providing guidance on the need for policy reforms.

To define the sustainability indicator – denoted by b_t the primary budget balance (revenues less expenditures) measured relative to GDP, and by $\hat{r}$ the growth-corrected real rate of return (r–g), which for simplicity is assumed constant – the debt level (measured relative to GDP) at the end of period t is denoted d_t, and hence $d_t = (1+\hat{r})d_{t-1} - b_t$. The indicator for sustainability of fiscal policy (S)[4] is defined as the permanent improvement in the budget balance relative to GDP, which, given the initial debt level ($d_t - 1$), the projected primary budget balances ($E_t b_{t+j}, j \geq 0$) and the growth-corrected real rate of interest ($\hat{r}$)ensures that the intertemporal budget constraint is exactly fulfilled. The sustainability indicator S is defined as the solution to

$$(1)\quad E_t\left[\sum_{j=0}^{\infty}\left(\frac{1}{1+\hat{r}}\right)^j b_{t+j}\right] + \sum_{j=0}^{\infty}\left(\frac{1}{1+\hat{r}}\right)^j S_t = (1+\hat{r})d_{t-1}$$

where E_t denotes the expectations (projection) operator conditional on period t information (hence the time subscript on the S variable). The sustainability indicator measures the permanent primary budget changes (relative to GDP) required to ensure that the present value of all primary balances (left-hand side of equation (1)) can exactly cover initial debt (right-hand side of equation (1)).

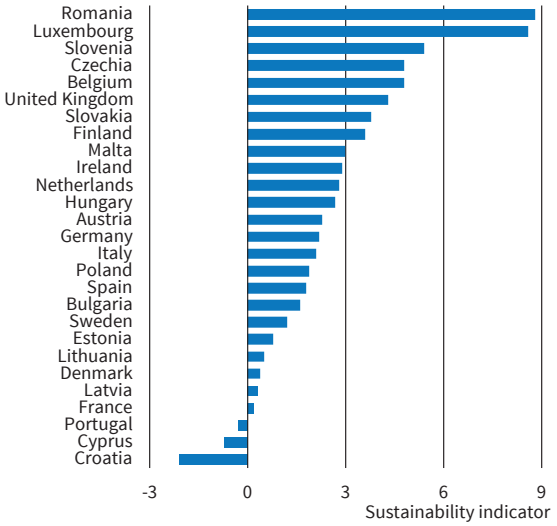
In short, the sustainability indicator is an annuity – the permanent improvement in the primary budget balance needed to meet the intertemporal budget constraint. If $S_t > 0$, there is a sustainability problem, since the primary budget balance must be permanently improved to ensure that the intertemporal budget constraint is met, and if $S_t < 0$, there is no sustainability problem but room for expenditure increases or tax decreases.

Figure 2 shows the outcome from a recent assessment of fiscal sustainability for EU countries. Clearly, such assessments rely on a number of assumptions, not discussed here for space reasons, but the conclusion is that most EU countries face substantial financing problems requiring large permanent improvements in the primary balance (compared to the initial situation). Across the EU, the needed improvement of the primary budget balance (relative to GDP) is 2.4 percentage points. Clearly, there are substantial country differences, with some countries facing large problems, while others, including countries like Denmark and Sweden, do not face major problems due to already implemented reforms.

[4] Often termed the S2 indicator in EU publications to distinguish it from other sustainability indicators – see e.g., European Commission (2020).

Figure 2

Sustainability Indicator – EU Countries



S2 indicator, computed for a horizon running until 2070.
Source: European Commission. © ifo Institute

THE ROLE OF THE RATE OF RETURN

An important variable entering the sustainability analysis is the rate of return (the growth-corrected real rate of return) and, given the development in government borrowing rates, it is important to look closer at the role of the discount factor. The sustainability indicator depends in a rather complicated way on the discount factor, since the future primary balances are discounted and then translated into an annuity value ensuring that the intertemporal budget constraint is met. This is seen more clearly by noting that the sustainability indicator can be written as a weighted average of all future primary budget balances, and the initial debt level can be transformed into an infinite annuity, i.e.,

$$(2)\quad S_t = -\sum_{j=0}^{\infty} v_j E_t b_{t+j} + \frac{\hat{r}}{1+\hat{r}} d_{t-1}$$

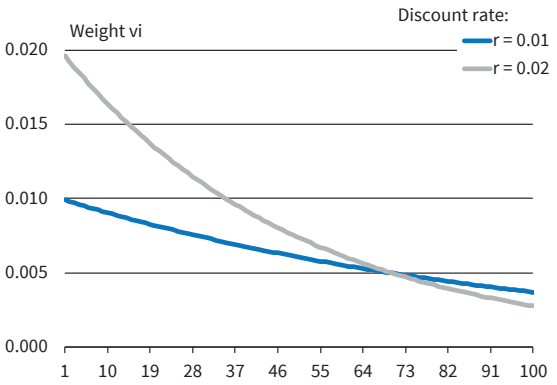
where $v_j = \frac{\hat{r}}{1+\hat{r}}\left(\frac{1}{1+\hat{r}}\right)^j$, and $\sum_{j=0}^{\infty} v_j = 1$ for $\hat{r} > 0$. A change in the discount rate $\hat{r}$ thus 'twists' the weights, since

$$\frac{\partial v_j}{\partial r}\begin{cases} < 0 \; for \; j > j^* \equiv \dfrac{1+\hat{r}}{\hat{r}} \\ > 0 \; for \; j < j^* \equiv \dfrac{1+\hat{r}}{\hat{r}} \end{cases}$$

A higher discount rate decreases the importance of the budget balance in the far future and increases the importance of the budget balance in the near future. The intuition is that a higher discount rate decreases the present value of the primary budget balance in the far future, but at the same time, it increases the annuity factor, and therefore the underlying budget profile is weighted differently when the interest rate changes (see below).

Figure 3

Period Weights in the Sustainability Indicator



Source: Author's calculations © ifo Institute

Figure 3 shows how different periods are weighted for two different discount rates. The lower the discount rate, the larger the weight to the budget position far into the future.[5] In short, the decline in the discount rate effectively makes the sustainability analysis more forward-looking by weighting the far future more heavily relative to the near future. The importance of this clearly depends on the profile for the primary budget balance. Since ageing tends to cause a deteriorating profile for the primary budget position, a lower interest rate goes in the direction of worsening the sustainability problem.

To consider the importance of the discount rate for the sustainability indicator, consider the case of Finland, whose sustainability is in the upper half of EU countries (Figure 2). The project development in public expenditures and revenues for Finland are shown in Figure 4. There is a widening gap between expenditures and revenues; that is, the budget profile deteriorates over time due to an ageing population. For unchanged policy public gross debt would increase from currently about 60 percent of GDP to about 250 percent in 2070. The sustainability indicator is 4.7 percent of GDP, pointing to a significant sustainability issue.

[5] It is an implication that the assumptions made on the far future get a higher weight and thus become more important.

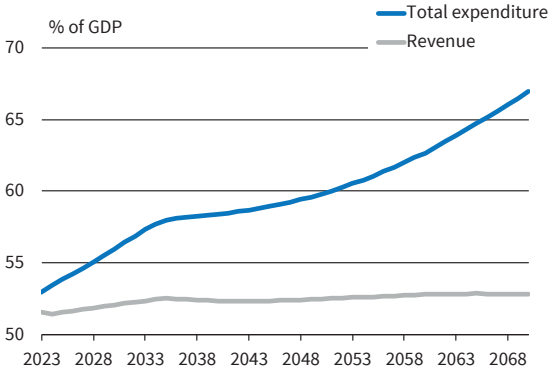
For the policy discussion, it is important how sensitive the sustainability assessment is to the discount factor. Figure 5 shows how the sustainability indicator depends on the discount rate. The nonlinear effect arises because the gap between expenditures and revenues is not monotonously increasing over time. Overall, the sustainability indicator for Finland is not significantly affected (note the scale) by changes in the discount rate. This is reassuring for the use of the fiscal sustainability indicator given the current discussion on the level of the discount factor. The bottom line is that the discussion of the government borrowing rate and its declining trend is not important; what matters is the clear deteriorating trend, which translates into an increasing trajectory for the public debt level. A development which clearly calls for policy action in many countries (Figure 2).

The preceding discussion takes outset in a positive growth correct rate of return, which is also the empirical relevant case for most countries facing serious sustainability problems. There are several other arguments to take into account in setting the discount rate for sustainability analyses. First, while current rates of returns are low, this cannot be taken to be a good predictor of future (global) rate of returns over the horizon relevant for the sustainability analysis. Hence, on current low rates of return cannot uncritically be assumed in analyses of fiscal sustainability.

Second, in the illustration of the sustainability analysis above, the rate of return was assumed independent of the primary budget and thus debt, that is, the credit risk premium was disregarded. However, a sustainability problem implies that in the absence of policy initiative there will be systematic budget deficit and thus increasing debt, which calls the constant rate of return assumption into question. Basing sustainability analyses on currently observed low rates of return is thus misleading. Experience has shown that countries with high debt levels face a vicious circle with increasing rates of return triggering a debt spiral, as seen during the sovereign debt crisis following in the aftermath of the financial crisis. Empir-

Figure 4

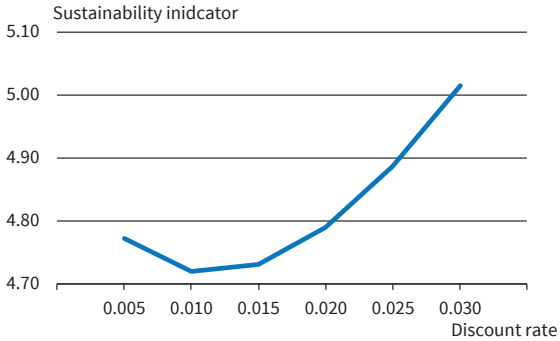
Projected Public Expenditures and Revenues, Finland



Source: Finish Economic Policy Council; Finish Ministry of Finance. © ifo Institute

Figure 5

The Sustainability Indicator and the Discount Rate



Source: Finish Economic Policy Council; Finish Ministry of Finance; author's calculations. © ifo Institute

ical evidence points to such nonlinear responses, see Alcidi and Gros (2019) and the survey on empirical evidence in Rachel and Summers (2019). Analyses of the determinants of fiscal (debt) limits have clarified the precise mechanisms including the underlying taxation capacity (Bi and Leeper 2010). Such responses can be included in assessments of fiscal sustainability. The important point in the present context is that it points out that government borrowing rates would be affected if debt levels pass critical levels.

Third, the approach taken above implicitly assumes certainty equivalence by focusing only on the expected trajectory for public finances, neglecting the uncertainty. The presence of uncertainty is an argument against using a risk-free rate of return as the discount rate.

Finally, running high debt level increases risk exposure in relation to adverse business cycle events that may bring debt levels above critical levels, releasing financial market responses, which in turn may constrain the room for countercyclical fiscal policies in such situations, as also seen during the financial crisis.

CONCLUSION

Ongoing demographic changes imply that budget deficits are on a deteriorating trajectory for most EU countries. This calls for policy initiatives to ensure the financial viability of welfare arrangements. The intertemporal budget constraint is alive and important for government, despite current low levels of government borrowing rates.

Defining away budget constraints is often leading to shortism in economic policy, accumulating into large problems in the medium to long run. The current low levels of government bond rates surely provide relief to public budgets. Debt servicing becomes easier, and for an unchanged primary budget position, some debt consolidation is thus possible without the need for policy initiatives. But in a medium- to long-run perspective, this effect is overrun by the budgetary consequences of ageing. These changes have significant negative public finance implications, and the need to address this problem cannot be escaped.

REFERENCES

Alcidi, C. and D. Gros (2019), "Public Debt and the Risk Premium: A Dangerous Doom Loop", *VoxEU.org*, 22 May.

Auerbach, A. J., W. G. Gale and A. Krupkin (2019), *If Not Now, When? New Estimates of the Federal Budget Outlook*, Brookings Report, 11 February, Brookings Institution, Washington DC.

Bi, H. and E. M. Leeper (2010), *Sovereign Debt Risk Premia and Fiscal Policy in Sweden*, Studier i Finanspolitik, http://www.finanspolitiskaradet.se/download/18.6c09f59d1287ef288f9800077951/100527_3_Bi_Leeper.pdf.

Blanchard, O. J. (2019), "Public Debt and Low Interest Rates", *American Economic Review* 109, 1197–1229.

Bloom, D. E. and D. L. Luca (2016), "The Global Demography of Aging: Facts, Explanations, Future", in J. Piggott and A. Woodland, eds., *Handbook of the Economics of Population Ageing*, Vol. 1, Elsevier, Amsterdam, 3–56.

Eichengreen, B. (2019), *The Return of Fiscal Policy, Project Syndicate*, 13 May, https://www.project-syndicate.org/commentary/return-of-fiscal-policy-by-barryeichengreen-2019-05.

Eichengreen, B., A. El-Ganainy, R. Esteves and K. J. Mitchener (2019), "Public Debt through the Ages", *NBER Working Paper* 25494.

European Commission (2020), *Debt Sustainability Monitor*, Brussels.

Finish Ministry of Finance (2019), *Economic Survey Autumn 2019*, Publication Ministry of Finance 2019-49, Helsinki.

Finish Economic Policy Council (2020), *Economic Policy Council Report 2019*, Helsinki.

Rachel, L. and L. H. Summers (2019), *On Falling Neutral Real Rates, Fiscal Policy, and the Risk of Secular Stagnation*, BPEA Conference Draft, 7–8 March, Brookings Institution, Washington DC.

Wyplosz, C. (2019), "Olivier in Wonderland", *Vox CEPR Policy Portal*, 17 June, https://voxeu.org/content/olivier-wonderland.

Christoph M. Schmidt

The German Debt Brake on Trial: Not Guilty[1]

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THE CURRENT CONTROVERSY IN A NUTSHELL

While periods of a negative interest rate-growth rate differential are nothing unusual in historical perspective, the discussion about its implications for fiscal policy has gained new momentum: in some developed economies nominal short- and long-term interest rates have even reached the negative range, and nominal GDP growth rates have remained relatively high. This holds in particular for Germany. Unsurprisingly, after Blanchard's (2019) elucidation that a sustained negative interest-growth differential might facilitate accumulating additional public debt without endangering fiscal sustainability, this discussion has reached the German discourse on fiscal policy. Most importantly, advocates of higher public debt argue that this could be a panacea for overcoming Germany's large unfulfilled investment needs.

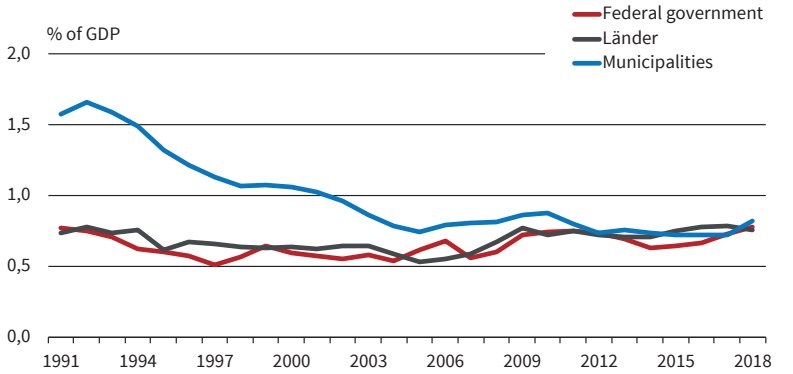
Yet, engaging in such a change of fiscal strategy is hardly risk-free. After all, the risk of a reversal of the interest-growth differential is substantial (Mehrotra 2017). The German Council of Economic Experts (GCEE) estimates the reversal risk based on data for the period 1946 to 2016 to be around 41 percent in five years and over 54 percent in six to ten years (GCEE 2019b). Moreover, systematically incurring more debt would mean altering, circumventing, or even abolishing the debt brake as the principal fiscal rule governing fiscal policy at the federal and the state levels (albeit not the municipal level). Thus, the discussion should clarify whether the potential benefits are worth the risks associated with higher public debt: (i) would softening the debt brake have negative repercussions, especially regarding the German debt brake as an element of the European fiscal framework; and (ii) would more debt indeed be the avenue towards increased public investment?

It is undisputed that Germany, like many other industrialized economies, needs more public investment. Yet, to make matters even more intricate, the precise magnitude of the current needs for public investment remains unknown. The reasons for this uncertainty are manifold. National income accounting is an imperfect tool for assessing the quality of public expenditure, and projections spanning a period of several years are fraught with difficulties. Furthermore, after a protracted decline in the investment activity of municipalities (vis-à-vis overall economic output), the investment share of municipalities is currently approximately one-third (Figure 1). Its recent development is difficult to assess, since it partially reflects the delegation of public tasks to seemingly private companies held by a public majority: their investments are not counted as public. Thus, accurate comparisons of public investment activity across municipalities and over time is difficult (GCEE 2019b).

Nevertheless, a sober assessment of overall investment figures reveals that public investment activity has increased markedly over the course of the last couple of years. At the federal level, public investment has even reached the highest value since 1991 (GCEE 2019b), relative to overall economic output (Figure 2). And yet, this is less than what was intended by policymakers, due to a range of important obstacles that are unrelated to the magnitude of funds being earmarked for public investment:

- overstretched capacity of the construction industry, which increasingly complains about skilled-worker shortages (BBSR 2019); it would be difficult to incentivize the industry to increase its capacity substantially by simply publishing more ambitious plans for future public investment (which on average comprises only 13 percent of construction investments anyhow);
- protracted administrative processes due to a heavy dose of regulation, which requires cumbersome planning and complex approval proce-

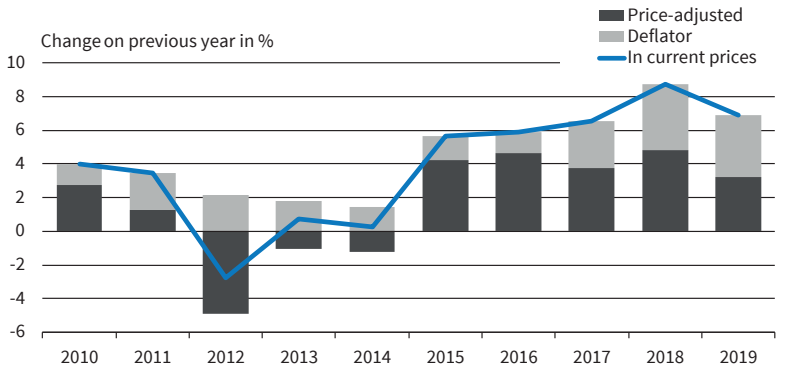
Figure 1
Public Gross Fixed Capital Formation



Source: Federal and Länder Statistics Offices; author's calculations. © ifo Institute

[1] This article rests heavily on GCEE (2019b), Chapter 5: "The Debt Brake: Sustainable, Stabilizing, Flexible". A preliminary version of this article in German served as a contribution to a public hearing of the Budget Committee of the German Bundestag. I am grateful for numerous constructive discussions to my colleagues in the GCEE and the whole GCEE team, in particular to Wolf Reuter.

Figure 2
Development of General Government Gross Fixed Capital Formation



Source: Federal Statistical Office; author's calculations

dures, and due to numerous objections by local initiatives (the 'NIMBY' problem); and
– over-indebtedness of some individual municipalities concentrated in four western German states, which might prevent them, inter alia, from quickly increasing their planning capacity for the administration of large infrastructure projects.

In consequence, the available financial means are not put to effective use to their full extent; a large share of them is still awaiting their disbursement. This impasse also implies that additional earmarked funds would have failed to deliver the realization of more public investment. Moreover, as the German economy, and in particular its construction industry, have been running at full capacity for some years, more than half of the observed increase in public investment figures merely reflects increasing prices. Lower prices would require capacity in the construction industry to be enhanced or construction to be made less cumbersome and costly, or both.

For the near future, substantial public revenues are expected to be collected at the federal, state, and municipal levels. Moreover, the additional public debt that would be acceptable under the rules of the debt brake also amounts to a substantial figure. Together, these financial resources would provide ample means for a steady increase of public investment, at least as long as this is not prevented by non-financial obstacles. Admittedly, their precise amount is difficult to forecast, since calculations depend, inter alia, on the assumed medium-term growth rate. With this caveat in mind, the forecast of approximately EUR 300 billion over the next ten years derived by Feld et al. (2020) unquestionably provides substantial fiscal leeway for increasing public investment.

And the medium-term plans published by, for instance, the federal government in its projections for investments in traffic infrastructure correspondingly document the intentions to realize such a steady increase. It would be the prerogative of governments at the various federal levels to obtain even more leeway for public investment by challenging the case for other public expenditures. And this would certainly be advisable: during the last decade, the ample fiscal space provided by low interest rate payments on outstanding public debt was mainly used for expenditures that on closer scrutiny might have been considered less worthwhile than investment expenditures.

In politically less contentious times, this brief assessment of the state of public investment would suffice to suggest concentrating on the alleviation of the practical obstacles retarding more public investment from being realized, not on a discussion of the financial means available for financing these investments. Obviously, the following options would be desirable for public policymakers:

– arranging for increased capacity in the construction sector, by enhancing productivity and especially by more immigration of skilled (blue-collar) workers;
– reducing regulatory red tape and streamlining both planning procedures and the mechanisms for obtaining sufficient civil society participation; and
– bailing out highly-indebted municipalities – which would predominantly be the responsibility of the states, not the federal level.

That is, underneath the ceiling set by the debt brake, policymakers would need to set priorities and decide between expenditures for public investment and public consumption given their limited, albeit quite respectable budget. This, after all, is exactly what voters could expect, as they handed over their sovereignty to their elected officials. And yet, the current discussion is taking a dramatically different route. This might be unsurprising from an economic policy perspective, since the suggested options appeal to the individual responsibility of policymakers at all levels of government. Setting priorities with a limited budget is certainly more difficult than finding an avenue to smother the problem by simply amassing even more financial means.

Unfortunately, the political debate in Germany has homed in on another narrative, supported by advocates in international institutions and by some other participants in the international macroeconomic debate. In essence, this narrative states that the current generation could confidently push more of the burden of financing current public investment onto future generations. Eliminate the debt brake

and all problems will vanish, we are told. Given the low interest rate environment, the narrative's proponents argue, it would even be a cost-free alteration of the fiscal strategy. Most importantly, as future generations will enjoy a substantial share of the fruits of this investment, so the narrative goes, they should also participate in its financing.

On the surface this is an attractive thought, but its merit has of course to be assessed both in the context of already pre-determined intergenerational burden sharing and with respect to its macroeconomic implications. Implicating the debt brake as an obstacle to public investment requires strong assumptions that reach far beyond ignoring the practical issues of implementation identified as the real obstacles above. It is telling that these typically remain implicit in the eliminate-the-debt-brake narrative: the narrative's accusation relies on assessing all previously arranged expenditure items in the public budgets as fundamentally unalterable, and on earmarking all leeway arising from future revenue increases for expenditures other than public investments. These implicit assumptions are highly questionable, though.

Consequently, blindly following the popular eliminate-the-debt-brake narrative would be a deplorable fiscal strategy: identifying the wrong culprit for the unsatisfactory development of public investment will not provide the basis for finding a reliable path towards increased investment. After all, getting the diagnosis wrong never serves to pave the avenue to good therapy. It rather seems advisable to address the real obstacles, even if that means engaging in an unpopular debate about the failure of public officials to set the right priorities in their budgets, and comprehensive – and therefore challenging – reforms of administration and civil participation procedures.

The eliminate-the-debt-brake narrative apparently receives support from numerous political voices outside Germany, which, by and large, advocate a less stringent German approach to public debt. Apart from the fact that the economic discourse is far more diverse on these matters than the proponents of the narrative frequently suggest, two key aspects have to be kept in mind in the assessment of the weight that should be given to these voices. First, the available evidence suggests that the possible spillover effects of German fiscal policy measures on adjacent economies will be quite meager, relative to their cost for German taxpayers. Second, and even more important, as the German debt brake is part of the European fiscal framework, which intends to prevent debt crises and to ascertain the independence of the European Central Bank, setting a precedent for disregarding fiscal discipline by tampering with it could be a detrimental signal for the euro area.

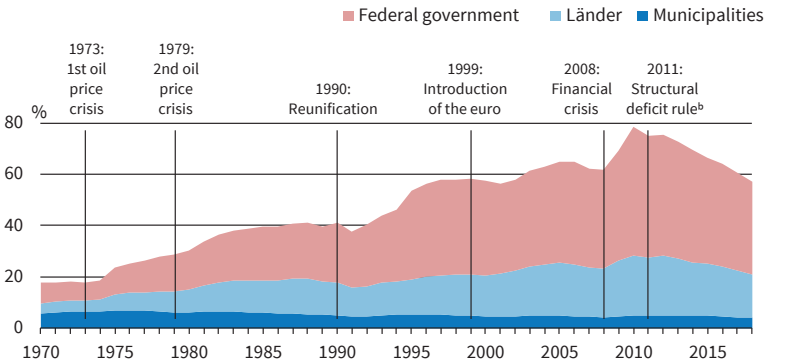
THE GERMAN DEBT BRAKE AS AN INTELLIGENT FISCAL RULE

Within limits, public debt is perfectly acceptable; the extent to which it is palatable has to be determined carefully in the context of macroeconomic circumstances, though. In theory, one particularly convincing guideline is the so-called 'golden rule' stipulating that a deficit corresponding to the amount of net investment would be sensible. Such a balance between net investment and the structural deficit will, however, typically not emerge as the automatic outcome of economic policymaking. Instead, empirical evidence suggests that fiscal policy tends to display a deficit bias (Alesina and Passalaqua 2016). Several motives generate such a bias, such as problems of governance involving a common pool of resources, self-serving signals being sent to potential voters during electoral campaigns, or the attempt to provide a particularly bad start for the successors in public office. Instead of hoping that this deficit bias remains small, the general consensus is that fiscal rules are needed (Eyraud et al. 2018).

One such rule would indeed be the 'golden rule', and exactly this rule was the guideline for German fiscal policy until the time of the Great Recession. But the experience with this rule was disappointing. As Figure 3 documents for the years since 1970,

Figure 3

Development of the General Government Debt-to-GDP Ratio[a]



[a] General government gross debt-to-GDP ratio according to the definition of finance statistics excluding social security. Deviation from figures according to the definition of national accounts due to methodological differences (Heil and Leidel 2018). Comparabiltity over time prior to 2010 is limited due to methodological changes. From 1955 including Berlin (West) and from 1960 including Saarland. Since 1991 all-German results. Only until 1992 were hospitals with commercial ccounting included in the federal debts. Special federal funds taken into account: from 1999, Federal Railway Property Fund, the Redemption Fund for Inherited Liabilities and the Coal Compensation Fund; from 2007, ERP Special Fund. From 2006 including selected public fund, institutions and enterprises in the public sector.

[b] Converted into a structural deficit rule in 2009 with effect from 2011.

Source: Federal Statistical Office; author's calculations

the German debt ratio increased relentlessly until 2009, with – from the perspective of 2009 – no alleviation in sight. German states frequently used the low threshold for claiming the existence of a 'serious disturbance of economic equilibrium' to motivate a higher deficit, and some states even declared a fiscal emergency. These developments partially reflected the poor incentives characterizing the system for distributing tax revenues between the federal and the state level, which will hardly be reformed fundamentally any time soon, but also the opportunity for circumventing the fiscal rule via the implementation of special funds.

This disenchantment with the 'golden rule' formed the basis for reforming the fiscal rules stipulated in the German constitution. It seemed all the more sensible, as a severe demographic change is well underway in consequence of the German baby boom of the 1950s and 1960s. This will challenge the sustainability of public finances in earnest in the next decades. Moreover, fiscal solidity in Germany had become increasingly important as a signal for the euro area and for financial markets. In the wake of the crisis in the euro area, its member states pledged in the Fiscal Compact to implement effective fiscal rules in their national laws, thereby strengthening the existing set of fiscal rules. These fiscal rules are viewed as an important instrument for supporting individual member states in their quest to fulfill their national responsibilities for conducting a solid fiscal policy and, thus, for obtaining the independence of the European Central Bank.

The German debt brake introduced in 2009 is an intelligent compromise between the objective of embedding fiscal decisions into a rule-based framework and the provision of sufficient discretionary leeway. It is a fiscal rule of the '2nd generation' comprising three central elements (GCEE 2019b):

- Cyclical adjustment: the debt brake restricts the cyclically adjusted structural budget balance, by contrast to a balanced-budget rule.
- Exceptions: in case of factual emergencies such as natural disasters, the debt brake offers extraordinary fiscal leeway.
- Banking: to account for surprises arising in the practical implementation of the debt brake in real time, banking via a separate account will be allowed.

Most importantly, the debt brake is part of the fiscal framework in the euro area. As a signatory, Germany had to choose, one way or another, to implement the fiscal compact; if it did not stipulate the debt brake as it stands, Germany would have to devise a similarly strict rule instead. Arguably, European agreements under the fiscal compact would allow for adjustment of the deficit threshold upward, once a low debt ratio has been achieved; this is not yet the time for discussing this adjustment, though. Moreover, one should not forget that the Maastricht threshold for the debt ratio of 60 percent of GDP has always been meant to be a ceiling, not a target rate.

The German debt brake works intelligently against the potential weaknesses of any fiscal rule. Perhaps most importantly, cyclical adjustment serves to preserve – by contrast to a balanced-budget rule – the necessary fiscal leeway for automatic stabilizers to work without restraint. Due to the mechanics of banking via the separate account, estimation problems that simply cannot be avoided in real time will not lead to a systematic underestimation of acceptable fiscal leeway (GCEE 2019b). The alternative, choosing a fiscal rule that would not attempt to adjust the estimated output gap cyclically, would hardly be preferable. And there is hope that economic research might even produce more reliable forecasts.

Furthermore, the systematic cyclical adjustment under the debt brake ascertains a provision of funds for public investment that is unrelated to the state of the economic cycle. Indeed, there is no evidence that in Germany public investments are reduced more strongly than consumptive expenditures in a downswing (Feld et al. 2020). Since lacking financial means are obviously not the decisive obstacle for more public investment, the debt brake can hardly be made responsible for an unsatisfactory state of affairs regarding public investment. There is only one possible conclusion: there is no evidence for the concern that the debt brake fails to deliver. To be fair, as the economic cycle since 2009 has not been completed yet, it would be advisable to go through a downturn as well, before finally calling the jury in. Meanwhile, we might rely in our assessment on previous experiences with fiscal rules, especially those being scrutinized by internationally comparative studies (Feld and Reuter 2017; Eyraud et al. 2018; Heinemann et al. 2018).

WEAKNESSES OF CURRENT SUGGESTIONS FOR REFORM

Despite the high surplus currently being accumulated in public coffers and despite the fact that a large share of the budget being earmarked for public investment has not been retrieved to finance actual investments, especially by local governments, Germany is currently discussing intensely the circumvention or softening of the debt brake. Frequently, proponents of such reforms refer to the claim that during the next ten years there will be an additional need for public investment at the order of some 450 billion euros (Bardt et al. 2019). This figure apparently exceeds the current budgetary plans for investment by a veritable amount.

It seems to be advisable, though, to assess this figure critically. At its core is a survey of a very small sample of municipalities, which are asked to state estimates of their own investment requirements. By contrast to a normal budgeting procedure, respondents in this survey are in their answers free of any consideration regarding alternative uses of their financial resources. In addition, one might be somewhat wary regarding the representativeness of the survey and, even more importantly, regarding the obvious incentives for responding strategically. To be fair, the precise amount of investment requirements at the municipal level is quite uncertain, with a degree of uncertainty that rivals the imponderability regarding the future fiscal leeway under the rules of the debt brake.

A prudent strategy for fiscal policymakers should therefore be to utilize the quite sizeable fiscal leeway offered under the rules of the debt brake for increasing public investment step by step. It seems more than heroic to instead devise a plan for public investment, let alone for concrete investment projects, over a ten-year time frame. Rather than engaging in such a futile exercise, it would make sense to address the factual obstacles to more public investment, as indicated above. That is to say, faster administrative procedures, less regulation, and a leaner public administration should be on the political agenda, not more public debt.

Moreover, there are good reasons to shy away from revitalizing the 'golden rule' as a fiscal rule or from circumventing the debt brake via the implementation of an investment fund. While revitalizing the 'golden rule' might, at first glance, appear to be an innocuous suggestion, it has not passed the test before and probably will not pass it now: after all, German fiscal history provides ample evidence against its effectiveness in disciplining fiscal policy – only with a systematic deficit bias could German public debt increase so relentlessly in comparison to GDP over several decades up to 2009.

At the heart of the problem lies the definition of public investment as contrasted to consumptive expenditures. At the level of individual expenditure items, it proves difficult to delineate more and less sensible investment and consumption expenditures. While not every public investment project might be factually sensible, expenditures for maintenance or for paying the salaries of judges and teachers are counted as public consumption. This definitional problem plagues proponents of a reform of the debt brake as well: should, for instance, expenditures for preventing social imbalances or incentivizing sustainable behavior be counted as investments or not? Instead of hunting for the unachievable ideal definition, policymakers are called upon to set the right priorities and to take 'ownership' of their decisions.

By the same token, it would not be advisable to implement an 'investment fund' that could spend its resources outside of the otherwise required parliamentary budgeting procedures and thereby allow circumvention of the debt brake. First and foremost, if Germany were to introduce such a device, this would send a clear and detrimental signal to the rest of Europe, mocking all pledges to henceforth be adamantly committed to preserving solid public finances. Moreover, from an economic policy perspective, it is hardly certain that the additional fiscal leeway offered by such a fund will not simply enhance consumptive expenditures, marking them as politically important projects of a more or less comprehensible investment character.

Finally, climate policy is a tremendously important topic, but it also does not provide a good motivation for implementing such a special fund. The quality of a concrete policy strategy addressing the urgent transition from an energy system based on fossil fuels to an energy system based on renewables can ultimately not be assessed with a view to the amount of funds disbursed for public investment. Most of the – arguably tremendous – investment needed to accomplish the energy transition will arise for private investors. This clearly implies that any expenditures for public investment in this area need to be chosen intelligently, with the aim of crowding private investment in and not out.

But the key question is a different one (GCEE 2019a): is carbon pricing the key instrument of climate policy or not? If the answer is 'yes', then climate policy not only provides the right incentives for the transition, but carbon pricing will also generate additional revenues. These additional financial resources could be used for public investments into the decarbonization of our economy – and for generating a better social balance in sharing the burden of this transition. The debt brake has nothing to do with this; it will best be left as it is, because it supports the stability of fiscal affairs during particularly challenging times.

REFERENCES

Alesina, A. and A. Passalacqua (2016), "The Political Economy of Government Debt", in J. B. Taylor and H. Uhlig, eds., *Handbook of Macroeconomics,* Vol. 2, Elsevier, Amsterdam, 2599–2651.

Bardt, H., S. Dullien, M. Hüther and K. Rietzler (2019), "Für eine solide Finanzpolitik: Investitionen ermöglichen!", *IW Policy Paper* 10/19.

Blanchard, O. (2019), "Public Debt and Low Interest Rates", *American Economic Review* 109, 1197-1229.

BBSR (2019), *Bauwirtschaft und Bauqualität – Kapazitätsauslastung im Baugewerbe zieht wieder an*, https://www.bbsr.bund.de/BBSR/DE/Bauwesen/BauwirtschaftBauqualitaet/Bauwirtschaft/kapazitaetsauslastung/ergebnisse.html.

Eyraud, L., X. Debrun, A. Hodge, V. D. Lledo and C. Pattillo (2018), "Second-Generation Fiscal Rules: Balancing Simplicity, Flexibility, and Enforceability," *IMF Staff Discussion Note* SDN/18/04.

Feld, L. P. and W. H. Reuter (2017), "Wirken Fiskalregeln? Eine Übersicht über neuere empirische Befunde", *Wirtschaftspolitische Blätter* 2/2017, 179–192.

Feld, L. P., W. H. Reuter and M. Yeter (2020), "Öffentliche Investitionen: Die Schuldenbremse ist nicht das Problem", *Arbeitspapier* 01/2020, Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung.

German Council of Economic Experts (GCEE, 2019a), *Setting Out for a New Climate Policy*, Special Report 2019, Wiesbaden.

German Council of Economic Experts (GCEE, 2019b), *Dealing with Structural Change,* Annual Report 2019/2020, Wiesbaden.

Heinemann, F., M. D. Moessinger and M. Yeter (2018), "Do Fiscal Rules Constrain Fiscal Policy? A Metaregression Analysis", *European Journal of Political Economy* 51, 69–92.

Mehrotra, N. R. (2017), "Debt Sustainability in a Low Interest Rate World", *Hutchins Center Working Paper* 32, Brookings Institution, Washington DC.

Florian Bartholomae and Pierre Rafih

What Drives Bitcoins? A Comparative Study of Bitcoin Prices and Financial Asset Classes

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Eleven years after its introduction, Bitcoin is still around. While its future remains uncertain, the digital token trades at a value of about EUR 8,000, unsecured by any asset, unbacked by any institution. In so far as there is no fundamental driver of the value of Bitcoin and after many scandals and criticisms related to technical, financial, behavioral and even ecological issues, it remains remarkably resilient in a digital age of transparency and readily available information, where tweets and rumors may have enormous effects on the financial markets. The announcement of Libra (Libra Association Members 2019), a corporate digital currency to be introduced in early 2020 by a large consortium of international companies under the leadership of Facebook, including other leading corporate global players, has been followed by a surprisingly sustainable price rally in Bitcoin, when some expectations are that Libra could eventually spell Bitcoin's end.

The discussion about the nature of Bitcoin remains open. It is currently not possible to classify Bitcoin in an existing category of instruments. While it is decidedly a cryptocurrency, this category itself encompasses a broad range of instruments who, by design and intended purposes, range from near-equity participative tokens, over so-called smart contract platforms to digital currencies and quasi-currencies. We also agree with many authors that, while being called cryptocurrency, it does not necessarily display the range of attributes and characteristics that traditional national or supranational currencies – commonly referred to as money – display (Lo and Wang 2014). A recent study conducted between July 2010 and June 2015 concludes that Bitcoin does not display characteristics of "a traditional asset class including currencies" (Baur et al. 2017, 187). Within this paper, we will not address the discussion about the nature of Bitcoin. Nevertheless, we concur with the observation of usage patterns of Baur et al. (2017)'s, which is reflected in the judgement of international monetary institutions such as the IMF or the ECB, who, at this time, do not see any necessity to regulate Bitcoin as they do not consider it to be a currency. While Bitcoin does not fit in any 'traditional asset class', it can at least be said that it is a form of financial asset.

The purpose of this paper is to address Bitcoin purely as a financial asset, not a currency, and to contribute to answering the question of what factors drive Bitcoin prices. We want to compare and correlate the historical relative price volatilities of Bitcoin with those of a small selection of representative global financial market indicators for different asset classes, to try and assert whether similarities in patterns are recognizable that can help take a step in the direction of understanding the nature of Bitcoin as a financial asset, inspired by previous work. This approach differs from other recent studies who address Bitcoin volatility using GARCH models (Katsiampa 2017) or analyze the price volatility attributable to speculative trading (Blau 2018) or trading volumes (Balcilar et al. 2017). To complement the study, we include a comparison of Bitcoin and the financial indicators with a non-financial sentiment index and a public interest indicator. Thus, the structure of the paper is as follows. After a description of the considered variables, the results of the analysis are presented. Finally, the last section concludes and refers to future research opportunities.

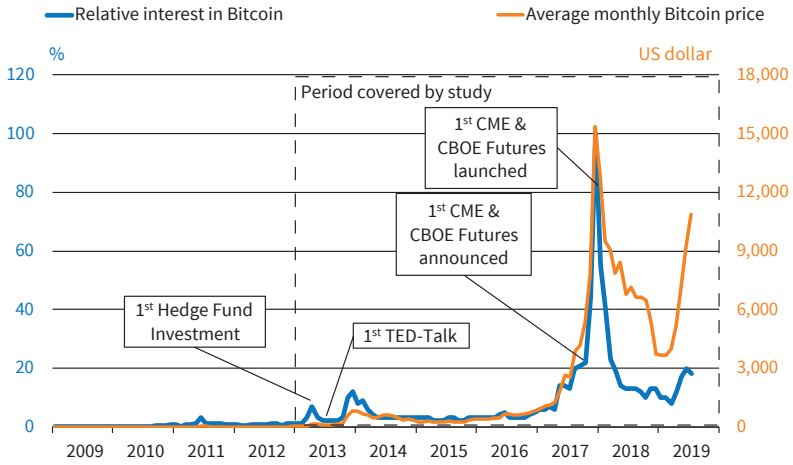
DESCRIPTION AND SELECTION OF VARIABLES

This paper focuses purely on an empirical study of 79-months long time series beginning in January 2013 and ranging to July 2019. While the last dataset was determined by the availability of information for all included variables, we chose to start no earlier than January 2013, despite information being available for all figures up to Bitcoin's introduction in January 2009, for several reasons. The first is that prior to 2013, Bitcoin was largely an unknown to the financial community and the broad public. The resulting very low trading volumes and illiquidity make a comparison with highly traded and liquid financial assets inappropriate. In 2013, Bitcoin was first introduced in popular acclaimed media such as TED.com (Kemp-Roberston 2013) and public interest, as measured by internet search queries of the term as computed by Google trends, also rises significantly by a factor of 7 to 12 over the course of that year (Google Trends 2019). That same year saw the first announcement of a hedge fund starting to invest in Bitcoin (Matonis 2019). The year 2013 also saw the biggest year-to-year price jump in percentage terms, nearly three times as high in relative terms, as the highly media-covered price rally over the course and to the end of 2017.

Figure 1 shows the study period within the dotted-line rectangle. Using a concept made popular by Gladwell (2002), it would seem that, in many respects, 2013 constitutes a tipping point for Bitcoin.

Figure 1

Average Monthly Bitcoin Price and Relative Monthly Interest in Bitcoin



Source: Google Trends; Blockchain.com; authors' calculations. © ifo Institute

We chose to use monthly averages of the Bitcoin price for several reasons. On the data side, this allows for better comparison with some of our independent variables. However, more importantly, using monthly averages rather than monthly or daily closing prices for the financial variables reduces the effect of the endemic wash trades that are characteristic in the Bitcoin market (Scheider 2019) and would create a bias in valuation through artificially driven short-term price volatility. Since the independent variables are all traded on strongly regulated and monitored markets, which essentially preclude wash trading, diffusing such effects is a legitimate foundation for comparative studies of any kind. Monthly averages also reduce the impact of known turn-of-the-month (Kunkel 2003), window-dressing and other seasonal effects (Cadsby 1992) that are common and documented occurrences in classical financial asset trading.

Besides the development of Bitcoin prices, Figure 1 also depicts the development of the relative interest in Bitcoin over time, an indicator of public interest computed by Google using search queries in the internet. The Media Buzz value is based on the interest in Bitcoin as computed by Google Trends. It represents the relative interest in Bitcoin over time, the monthly value derived from search queries of the term in the internet. This value is always between 0 and 100 for any number of observations. It is here computed on a monthly basis, where the value 0 represents months in which there are either no or only very few research queries. The value of 100 represents the month in which the term 'Bitcoin' was researched most over time. This indicator is thus a relative value.

To account for the global distribution of the Bitcoin phenomenon and limit the impact of country-specific effects, we selected three financial indices with a global scope that aim at representing a similar distribution of assets. The first independent variable is the S&P Global 1200, a global equity index that captures approximately 70 percent of global market capitalization in stocks and is a composite of several major regional indices (S&P 2019a). The index is weighted by float-adjusted market capitalization of each component. The constituents include the S&P 500 (US), S&P Europe 350, S&P TOPIX 150 (Japan), S&P/TSX 60 (Canada), S&P/ASX All Australian 50, S&P Asia 50 and S&P Latin America 40 (S&P 2019a). It thus adequately covers the markets in which Bitcoin is also most actively traded and thus represents the global regulated stock markets.

The second independent variable, representing the global bond markets, is the S&P Global Developed Aggregate Ex-Collateralized Bond Index. It measures the performance of investment grade debt issued by "sovereign, quasi-sovereign, government and corporate entities" (S&P 2019b, 2) in the native currencies of the developed countries. This index excludes collateralized bonds. We chose this index excluding collateralized bonds to exclude valuation effects induced by underlying collaterals. This exclusion makes a comparison with Bitcoin, which is not collateralized or secured by any asset or institution, more adequate.

The third independent variable is the gold price. A number of papers have drawn a comparison between Bitcoin and gold at one level or the other (Nakamoto 2008; Dyhrberg 2016; Baur et al. 2017), both in behavioral and financial analyzes. The inclusion of gold prices, as the archetypical safe haven, thus appears highly warranted. For the computation of the gold price, we use the daily closing spot prices for an ounce of gold. For spot prices, data from different sources are sufficiently close to warrant a selection of any of these sources as valid.

The sentiment variable is the OECD's Consumer Confidence Index (CCI) for 35 countries, which is published by the OECD on a monthly basis. The CCI provides an indication of future developments of households' consumption and saving, based upon answers regarding their expected financial situation, their sentiment about the general economic situation, unemployment and capability of savings (OECD 2019). For the CCI, which has a base value of 100, deviations from this base value measure the level of positive or negative sentiment at any given time. At values over 100, consumers are rather optimistic about their own future economic situation and thus more inclined to consume rather than save. Values

Table 1

Descriptive Statistics of Considered Variables, Based on Monthly Averages

Variable	N	Min	Max	Mean	Std. dev.
BTC in USD	79	15.15	14,818.23	2,535.39	3,482.71
Bitcoin Media Buzz	79	1.00	100.00	9.85	14.04
OECD CCI 35	79	98.97	100.91	100.21	0.48
Gold price	79	1,068.32	1,671.89	1273.67	103.30
S&P Global Bond Index	79	188.92	215.63	201.31	6.33
S&P Global Stock Index	79	1,375.57	1,787.50	1,588.27	117.04

Source: Authors' own calculation.

under 100 indicate a potentially higher propensity of consumers to postpone purchases and increase savings. Table 1 summarizes some descriptive statistics of the considered variables.

The observed period with monthly averages includes the all-time high of the Bitcoin price to date, which was above USD 19,000 in the middle of December 2017 (see also Figure 1). From the minimum value of just under USD 15 observed in 2013, Bitcoin's valuation has evolved significantly by a factor of a thousand, much more than any other indicator. Data from CCI indicate that instances of both rather negative (values below 100) and a positive sentiment values occurred during the period under review. Although the average mood was rather positive, the standard deviation shows that sufficient instances of negative mood were present during the period, so that the data set covers the full spectrum. The three representatives of the financial asset classes considered, the stock and bond indices and the gold spot price also show significant levels of change over the study period.

RESULTS OF ANALYSIS

In a first step, we analyze whether there is a correlation between the considered variables. Therefore, we calculate the rank correlation coefficients according to Spearman to determine general monotonous correlations without assuming a particular linear correlation. Table 2 summarizes the results. With the exception of the gold price, the Bitcoin price shows a significantly high correlation with the selected variables. The strongest positive correlation can be observed with the public interest/media buzz. Depending on the assumed causality, this means that either Bitcoin is mentioned particularly frequently when the Bitcoin price increases or the Bitcoin price is strongly influenced by public interest/media – i.e., the interest generated in the media pushes the demand for Bitcoin. A closer look at Figure 1 shows this correlation between Bitcoin price and public interest as well. Even after the December 2017 hype – which was mainly triggered by the introduction of Bitcoin futures on the two largest global commodity exchanges, CBOE and CME – it appears that public interest, while still higher than in any year prior to 2017, is correlated with Bitcoin prices.

A high correlation can also be observed with the stock index, which confirms our assumption that Bitcoin is more of a speculative investment that strives in periods of positive economic sentiment and/or growth. The next strongest positive correlation is with the OECD Consumer Confidence Index (CCI), followed by S&P Global Bond Index. The correlation with the gold price is weakly positive, but not significant. This correlation structure suggests that the price for Bitcoin is driven by emotional rather than factual motivations; i.e., Bitcoin has probably not been considered by risk diversifying investors as an additional form of investment during this period.

The only, but also highly significant, correlation for the gold price is with S&P Global Bond Index, which in turn points to an institutional correlation. This can be rationalized by the fact that both gold and bonds are conservative low-risk investments favored during weakening economic cycles. This result gives a measure of confidence on the quality and validity of the dataset. It comes as no surprise that there is a negative, but not significant, correlation between the gold price and the CCI. This confirms the well-documented assumption of gold as a classical safe haven, or refuge value, for investment purposes. Interestingly, there is also a highly significant correlation between the S&P Stock Index and the Media Buzz. A likely explanation could reside in

Table 2

Spearman Correlation Matrix

Variable	BTC$	Media	CCI	Gold	Bonds	Stocks
BTC in USD	1					
Bitcoin Media Buzz	.909**	1				
OECD CCI 35	.807**	.731**	1			
Gold price	.090	.152	– .172	1		
S&P Global Bond Index	.691**	.619**	.400**	.635**	1	
S&P Global Stock Index	.854**	.726**	.894**	– .088	.527**	1

Note: Significance levels (two-sided): **p<0.01; *p<0.05.

Source: Authors' own calculation.

Table 3

Pearson Correlation Matrix

Variable	BTC$	Media	CCI	Gold	Bonds	Stocks
BTC in USD	1					
Bitcoin Media Buzz	.818**	1				
OECD CCI 35	.671**	.494**	1			
Gold price	.100	.067	– .445**	1		
S&P Global Bond Index	.639**	.439**	.287*	.491**	1	
S&P Global Stock Index	.712**	.424**	.897**	– .278*	.471**	1

Note: Significance levels (two-sided): **p<0.01; *p<0.05.

Source: Authors' own calculation.

the fact that the introduction and rise of Bitcoin coincides completely with the sustained low interest policy supported by all major economies since the financial crisis. This resulted in substantial assets shifts in the long-term investment strategies of even conservative investors away from fixed-income securities and traditional low-yield conservative investments such as savings accounts and life insurances to stocks. Another marginal explanation could be the halo effect resulting from positive Bitcoin media coverage in conjunction with its sustained and extensive price increase of this most speculative asset, which might have drawn attention away from conservative investments as gold or bonds to more speculative investments such as equity.

In the second step, we check for a linear relationship between the variables in order to find support for an OLS regression. The results are displayed in Table 3. The direction and ranking of the correlations remain unchanged and continue to be highly significant. The highest correlation of the Bitcoin price is still with the Public Interest/Media Buzz, followed by the CCI and the stock index. However, the correlation with the Media Buzz is somewhat less strong, which suggests that there is rather a non-linear correlation. The negative correlation between the gold price and CCI is now highly significant; however, there is still no significant correlation of gold with the other variables.

Encouraged by these results, we then conduct a simple ordinary least squares (OLS) regression, assuming the Bitcoin price as the variable to be explained and gradually adding the other variables as explanatory variables. In total, we derive five model specifications, whose results are summarized in Table 4.

All model specifications have highly significant parameters and also the general explanatory content is high. As the results from Tables 2 and 3 have already suggested, there is no significant correlation between the Bitcoin price and the gold price, which also does not lead to a significant explanation in the regression analysis, which is why we do not report these results here. This low correlation differs from a previous study conducted by (Dyhrberg 2016), but could be explained by the choice of the period considered and the use of monthly averages. If we relate this to the results of previous studies (Baur et al. 2017), which find that about one third of investors buy and hold Bitcoins in a way investors would buy and hold gold as a refuge value, it would also suggest that these investors do not significantly influence the character of Bitcoin as an asset or its price.

While specification 1, in which the Media Buzz is the single explanatory variable, only has a moderate explanatory content (recognizable by R^2), the explanatory content increases by adding the other variables. The high significance remains and also the additional variables are highly significant. Specification 3 and 5 provide the highest plausible explanatory power at which each variable provides real added value (as indicated by the increase in R^2adj) and all effects are highly significant. Specification 4 yields some interesting results. The inclusion of the stock

Table 4

Regression Results of Different Model Specifications

BTC in USD	1	2	3	4	5
(Constant)	538.14 (277.823)	– 254,017.84** *(46,130.122)*	– 267,521.705** *(37,668.652)*	124,230.192 *(74,415.091)*	– 40,323.011** *(5,211.552)*
Bitcoin Media Buzz	202.806** *(16.267)*	159.465** (15.909)	128.424** (13.881)	163.274** (13.23)	140.349** *(12.212)*
OECD CCI 35		2,544.368** *(461.079)*	2,329.768** *(377.443)*	– 1,523.945 *(785.778)*	
S&P Global Bond Index			175.425** *(27.965)*		119.326** *(27.820)*
S&P Global Stock Index				18.523** *(3.124)*	10.989** *(1.493)*
R^2	.669	.763	.845	.839	.864
R^2_{adj}	.664	.757	.839	.833	.859

Note: Significance levels: **p<0.01; *p<0.05.

Source: Authors' own calculation.

index instead of the bond index leads to a reversal of the influence of the CCI into the negative, but this effect loses significance (the according p-value is given by .056). As Tables 2 and 3 show the S&P Global Stock Index and the CCI are almost perfectly related with each other, and furthermore the increase in the standard deviation of CCI points to the problem of multicollinearity in this situation. Thus, specification 5 considers all variables except for CCI and yields again plausible results. In all specifications, the effect of the Media Buzz remains positive and significant which clearly highlights the robustness of this indicator as an explanatory variable and confirms the assumptions made based on Figure 1.

CONCLUSIONS

We can conclude that the price of Bitcoin is driven by public interest/media coverage, consumer confidence, and, among the selected financial assets, stock prices, which also correlates highly with consumer confidence. These results thus make a plausible case for the price behavior of Bitcoin being similar to cyclical assets with higher risk-return relationships. The analysis shows the great importance of mood and media interest for the Bitcoin price, which is why these must be strongly considered when making potential forecasts about the future development of the price of Bitcoin. Whether such effects will be as prevalent in the long run remains to be seen. As suggested in the beginning of this paper, it would appear that the level of correlation between Bitcoin prices and public interest/media coverage might be receding since the bubble at the end of 2017. This could be interpreted as Bitcoin losing some of its glamour as a novel phenomenon. In turn, this could mean that similar studies in the future could be conducted without a public-interest bias.

Nevertheless, we want to stress that the reported results must be taken with caution as a snapshot. While Bitcoin can definitely be considered as the flagship and best representative of cryptocurrencies, this asset class still represents a very recent and heterogeneous addition to the investment markets and must be considered as still being in an 'unfinished' state. Simultaneously, this very state – which, aside from investor behavior, includes aspects such as the 'mining' mechanics and industry as well as regulations – constitutes a unique case that justifies research interest.

There is still little knowledge and much speculation about this asset class, especially how valuations will develop in the future. It remains to be seen whether the very heterogeneous cluster of currently more than 2,500 traded cryptocurrencies will be recognized in the long run as an investment class of their own, co-existing with classical ones. The heterogeneity of cryptocurrencies should, in the process of institutionalization, at the very least result in a selective 'weeding out' and segmentation within the category.

The announcement of the second generation of cryptocurrencies, so-called stable coins such as Libra (Taskinsoy 2019), which were developed incorporating the lessons learned from Bitcoin and other first-generation cryptocurrencies, may usher in a new stage, forcing the 'old' cryptocurrencies into new niches.

REFERENCES

Balcilar, M. et al. (2017), "Can Volume Predict Bitcoin Returns and Volatility? A Quantiles-Based Approach", *Economic Modelling* 64, 74–81.

Baum, K. (2018), *Wash Trading – Wie Börsen Anleger betrügen,* https://www.btc-echo.de/wash-trading-wie-boersen-anleger-betruegen/.

Baur, D., K. Hong and A. Leecet (2017), "Bitcoin: Medium of Exchange or Speculative Assets?", *Journal of International Financial Markets Institutions and Money* 54(C), 177–189.

Blau, B. M. (2018), "Price Dynamics and Speculative Trading in Bitcoin", *Research in international Business and Finance* 43, 15–21.

Cadsby, C. B. and M. Ratner (1992), "Turn-of-Month and Pre-holiday Effects on Stock Returns: Some International Evidence", *Journal of Banking & Finance* 16, 497–509.

Dyhrberg, A. H. (2016), "Hedging Capabilities of Bitcoin. Is It the Virtual Gold?", *Finance Research Letters* 16, 139–144.

Gladwell, M. (2002), *The Tipping Point: How Little Things Can Make a Big Difference*, Black Bay Books, New York.

Google Trends (2019), *Search Word: Bitcoin,* https://trends.google.com/trends/explore?date=all&q=Bitcoin.

Katsiampa, P. (2017), "Volatility Estimation for Bitcoin: A Comparison of GARCH Models", *Economics Letters* 158, 3–6.

Kemp-Robertson, P. (2013), *Bitcoin. Sweat. Tide. Meet the Future of Branded Currency,* Talk at TEDGlobal 2013, Edinburgh, https://www.ted.com/talks/paul_kemp_robertson_bitcoin_sweat_tide_meet_the_future_of_branded_currency#t-635555.

Kunkel, R. A., W. S. Comption and S. Beyer (2003), "The Turn-of-the-Month Effect Still Lives: The International Evidence", *International Review of Financial Analysis* 12, 207-221.

Libra Association Members (2019), *An Introduction to Libra – White Paper*, https://libra.org/en-US/wp-content/uploads/sites/23/2019/06/LibraWhitePaper_en_US.pdf.

Lo, S. and J. C. Wang (2014), "Bitcoin as Money?", *Federal Reserve Bank of Boston 14*(4), 1–28, https://www.bostonfed.org/economic/current-policy-perspectives/2014/cpp1404.pdf.

Matonis, J. (2013), *First Bitcoin Hedge Fund Launches from Malta,* https://www.forbes.com/sites/jonmatonis/2013/03/08/first-bitcoin-hedge-fund-launches-from-malta/#4da38cbf3e1e.

Nakamoto, S. (2008), "Bitcoin: A Peer-to-Peer Electronic Cash System", *Www.Bitcoin.Org* 9. https://doi.org/10.1007/s10838-008-9062-0.

OECD (2019), *Consumer Confidence Index (CCI),* OECD Data, https://data.oecd.org/leadind/consumer-confidence-index-cci.htm#indicator-chart.

Scheider, D. (2019), *Wash Trading: Über 90 Prozent des Krypto-Handelsvolumen ist Fake,* https://www.btc-echo.de/wash-trading-ueber-90-prozent-des-krypto-handelsvolumen-ist-fake/.

Standard & Poors (S&P, 2019a), *S&P Global 1200,* S&P Dow Jones Indices, https://us.spindices.com/indices/equity/sp-global-1200.

Standard & Poors (S&P, 2019b), *S&P Global Developed Aggregate Ex-collateralized Bond Index (USD),* S&P Dow Jones Indices, https://us.spindices.com/indices/fixed-income/sp-global-developed-aggregate-ex-collateralized-bond-index-usd.

Taskinsoy, J. (2019), *This Time Is Different: Facebook's Libra Can Improve Both Financial Inclusion and Global Financial Stability as a Viable Alternative Currency to the U.S. Dollar,* https://ssrn.com/abstract=3434493.

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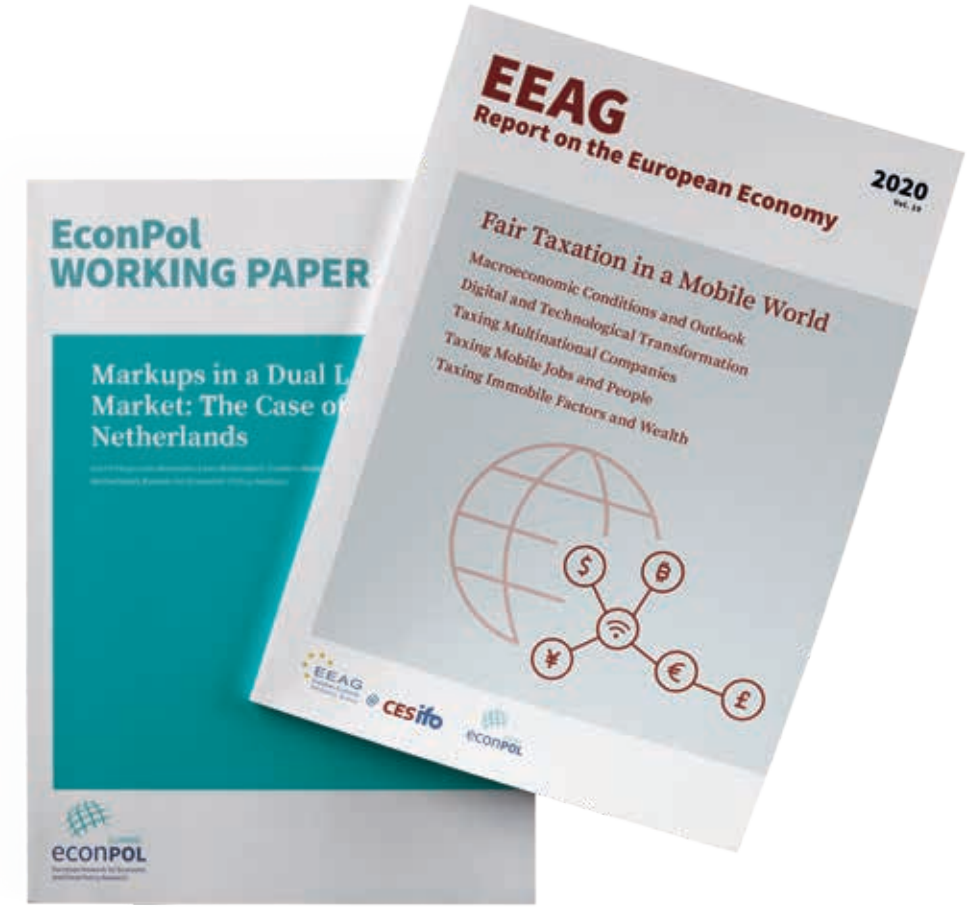

EconPol Working Paper 44

Markups in a Dual Labor Market: The Case of the Netherlands

We follow the production function approach to assess markups, which requires the estimation of the output elasticity of a free input. In the basic setup we estimate a structural value added production function, using temporary contract hours as free input. We find rather stable markups in the Netherlands in the period 2006-2016. We show that extending the free variable incorrectly with fixed contract hours results in an increasing markup. Findings are robust to an alternative setup, in which a gross output function is specified and materials are used as free input. Implications for applied work and policy are discussed.

EEAG
Report on the European Economy 2020

Fair Taxation in a Mobile World

In the 1930s, countries fought destructive trade conflicts – now we have a similar situation, but the conflicts are taking place in the tax system. These conflicts arise out of the twin impacts of globalization and digitalization. Once upon a time, there was an implicit understanding of fairness in taxation, meaning how countries tax within their borders and how the tax burden is distributed. More specifically, companies and individuals were taxed based on their residence and consumption in the destination country. Such an approach worked while these events were mostly perceived as national. However, the world has changed, and these understandings no longer appear to work smoothly, efficiently, and uncontentiously.

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EconPol Europe is a network of 14 policy-oriented university and non-university research institutes across 12 European countries. Each member contributes scientific expertise to the discussion of the future design of the European Union, providing evidence-based policy advice to inform economic and fiscal policy debate. The foundation of EconPol Europe was made possible by an initiative of the German Federal Ministry of Finance (BMF), with the intention of intensifying and deepening cross-border research and cooperation in Europe.

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