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The Effects on Investment Behavior of Zero Interest Rate Policy Evidence From a Roulette Experiment

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Abstract

This paper examines the effects of interest rate cuts on investment behavior. The methodology is to simulate investment decision making under different capital costs. The experiment showed that decreasing interest rates encourage risk-taking. With the decreased interest rate as borrowing costs the risk taking increased weakly but continuously. The risk taking increased strongly when the interest rate reached zero. Thus the experiment showed excessive risk-taking when there were no capital costs. This finding supports the hypothesis that extreme expansive monetary policy with low, zero or negative interest rates encourage financial bubbles and overinvestments or wrong investments in the real economy.

Keywords: quantitative easing, anticyclical monetary policy, monetary business cycles, financial crisis policy, zero interest rate policy, experimental simulation with roulette

JEL Classification: E 43, E 47, E 58

1. Introduction

The Federal Reserve implemented an extreme expansionary monetary policy (Quantitative Easing) and turned to unconventional monetary policy tools such as forward guidance and large-scale asset purchases. The ECB and the central banks of Switzerland, Sweden and Japan went one step further and set their target rates below zero (zero interest rate policy). This monetary policy is controversial and its effects barely researchable, because the influence of monetary policy on the economy cannot be isolated. There are too many additional factors (Nishad Nishad, 2018). The development of growth rates in Japan also raises doubts as to whether there will be positive effects if the zero interest rate policy is applied over a longer period of time. Rather, this policy of cheap money is made responsible for exaggerations on stock markets (Conrad & Stahl, 2002) even including the financial crisis. The allegation is that money is wasted and used for risk-taking if it costs nothing.

Historically, the question is very controversial as to how a central bank can generate real growth through monetary policy instruments. According to monetarism, real gross domestic product growth cannot be artificially generated by an expansionary monetary policy. Friedman and Schwartz used historical time sequences and economic analyses to argue that changes in the money supply had unintended adverse effects, and that sound monetary policy is necessary for economic stability. Hayek and Wicksell even blamed the central bank for boom and bust cycles (Wicksell, 1922; Wicksell, 1898; Hayek, 1935; Friedman & Schwartz, 1969).

Against such a background this paper examines the effects of interest rate cuts on investment behavior using an experiment. Human behavior is examined in this context. The methodology is to simulate investment decision making under different capital costs. How does the borrower with the borrowed money act in relation to the price of the borrowed capital? They may be bank or non-bank investors. The business banks borrow the money from the central bank and then invest it by lending it to private borrowers just as private investors borrow the money from the banks to invest it, for example, in their own companies, real estate or equities.

In section 2 the existing literature and studies are presented and compared to the experiment presented here. Section 3 explains the experimental design of the study. Finally, the results are presented (section 4) and the conclusions drawn (section 5).

2. Related Literature

"The more money there is the better it is for the economy", is the conclusion of most studies about quantitative easing (Gagnon, 2016) and "the lower the better" is their conclusion for the interest rate. For a long time it was common sense that nominal interest rates cannot fall below zero. This barrier was called the "lower boundary." Scientists have been discussing how to break the Lower Boundary to achieve more economic stimuli since the financial crisis. The arguments for and against a zero-percent policy can be found at Tymoigne (Tymoigne, 2018).

There have been numerous studies about zero interest rate policy, or negative interest rate policy. For example, Cúrdia estimates that in the US, the decline in GDP during the recession would have decreased by half a percentage point if the Fed had lowered the federal funds rate to -0.75% (Cúrdia, 2019). The question arises as to what other consequences follow from subsidizing credits by the central bank. If money is cheap it may be wasted like every other product.

So others argue that low interest rate policy could lead to a buildup of leverage, or asset bubbles by encouraging excessive risk taking by financial market participants (Conrad & Stahl, 2002; Caruana 2013; Feldstein 2013; Stiglitz 2016). Confronted with low interest rates bank and non-bank investors may switch to excessive risk in order to compensate the smaller interest income (Hannoun, 2015).

The mechanism is called "search for yield". If financial institutions have long-term commitments (such as pension funds and insurance companies) they come under pressure to earn the yield they promised on their liabilities. If they obtain only a low interest return on their assets they might be forced to go in risk (Rajan, 2005; De Nicolò, Dell'Ariccia, Laeven, & Valencia, 2010). Unilaterally constructed bonus-based compensation schemes encourage excessive risk-taking and were one reason for the financial crisis (Conrad, 2015).

Empirical studies show (e.g., for Spain, Maddaloni & Peydró, 2010; Ongena et al., 2009) that credit standards tend to loosen when policy rates decline. Maddaloni, Peydró-Alcalde and Scope (2009) show that if overnight rates are lowered credit standards are loosened.

De Nicolò and others (2010) found a negative relationship between the monetary policy rate and ex ante risk taking in a study about US banking policy. The average internal risk rating by banks and the spread over the federal funds rate decline as monetary policy rate increases. They also test the relation between interest rate to the ratio of the bank's risk-weighted assets to total assets of U.S. commercial banks and bank holding companies using their quarterly financial statements (Call Report filings). They find a strong negative relationship between real interest rates and the riskiness of banks' assets. The relationship is weaker when bank capital is low.

Expansive monetary policies and low interest rates, especially long lasting ones, have been made responsible for credit booms and excessive risk taking. The context is as follows. Lower interest rates lead to higher asset prices and borrower's fortune, in turn allow higher and cheaper lending. Analytical models (Stiglitz & Weiss, 1981), show more risk-taking when interest rates decline and vice versa a reallocation to more quality and safe investments when interest rates rise. The withdrawal leads to less availability of external financing.

Easy and cheap money access encourages greater risk-taking, which leads to asset bubbles. Later crashes of such bubbles could be damaging for the real economy. If they take place in the housing market they may affect balances of credit institutes and thus lead to credit crunches, which affect the real economy severely (Conrad & Stahl, 2002; Claessens, Kose & Terrones 2012; Mian, Sufi & Verner 2015). The cheap central bank money is seen as a reason for the US housing market bubble. The relatively low interest rates in the U.S. during 2001-04 resulted in a rapid increases in house prices and household leverage (Lansing, 2008; Hirata et. al, 2012).

Accommodative monetary policy is blamed as one reason for the global financial crisis. Persistently low real interest rates and excess liquidity fueled a bubble as a boom in asset prices and securitized credit and seduced financial institutions into take on increased risk and leverage. Had central banks raised the interest rates earlier and more aggressively and preempted this buildup of risk, the consequences of the burst would have been much less severe (Borio & Zhu, 2008; De Nicolò, Dell'Ariccia, Laeven, & Valencia, 2010). Claessens and Kose state that whether and how monetary policy affects risk taking, and thereby asset prices and leverage, remains a subject for further research (Claessens & Kose, 2013).

This paper details a simple incentive-based experiment regarding investment behavior in relation to borrowing cost based on roulette. There have been several experiments with roulette but with the objective to scrutinize the gambling behavior (Rubio, Hernández & Santacreu) and guessing tendencies (Rubio, Hernández, Zaldvíar, Márquez & Santacreu, 2010). In 2015 there was a roulette experiment, that simulated most common short-term bonus compensation schemes without accountability (Conrad, 2015).

3. Roulette Experimental Design

The purpose of this paper is to test the hypothesis that decreasing the interest rate to zero encourages excessive risk-taking in the financial system. The methodology is to simulate investment decision making under different capital costs. Therefore an experimental environment similar to the investment conditions had to be constructed. Roulette has the advantage of clearly demonstrating the probabilities for gains and losses. In the original game (apart from zero) the probability of losses is compensated with higher payouts. A higher risk has an equivalent higher payout.

The experiment was conducted with 107 students from different Business Bachelor courses at the University of Applied Science HTW at Saarbrücken. The students played 3 rounds of Roulette (A, B and C), each with three games. They could bet on red or black, on one of the three thirds of the 36 numbers or on one number. The winning number and color was determined by the roulette wheel. If it was zero, the game was repeated and not registered. The payouts were distributed according to the probability of winning (x2, x3, x36).

The task was to invest borrowed capital like a manager of a company. The participants were asked to maximize the profit as it is the obligation of a manager as agent for a principal (company owner resp. shareholder). Maximal profit in the group resulted in 10€ real money as variable compensation. In order to reduce change in behavior due to learning effects the game consisted of three rounds each with three games. Learning effects should therefore arise early with small influence.

In order to simulate investment behavior with different interest rates thus capital costs, decision-makers were be exposed to three different investment situations. In round A they were allowed to borrow up to 10,000€ (maximum) at 10% interest, in round B at 5% and in round C at 0%. Losses and gains were credited at 100%. The payouts could be reinvested and were accumulated in each round and afterwards the borrowed capital deducted. The results of the rounds A, B and C were added and the player with the highest result was rewarded with €10 real money. The rules were explained to the students before starting the experiment. The students were asked to check each other's calculations after each game. This simple experiment shows clear results.

4. Results

The sum of the average borrowed capital rose from €5,439.93 in round A to €9,931.78 in round C, thus by 81.03%. The sum of the average capital set rose from €7,211.05 in round A to €14,244.15 in round C, thus by 97.53% (see figure 1 and 2).

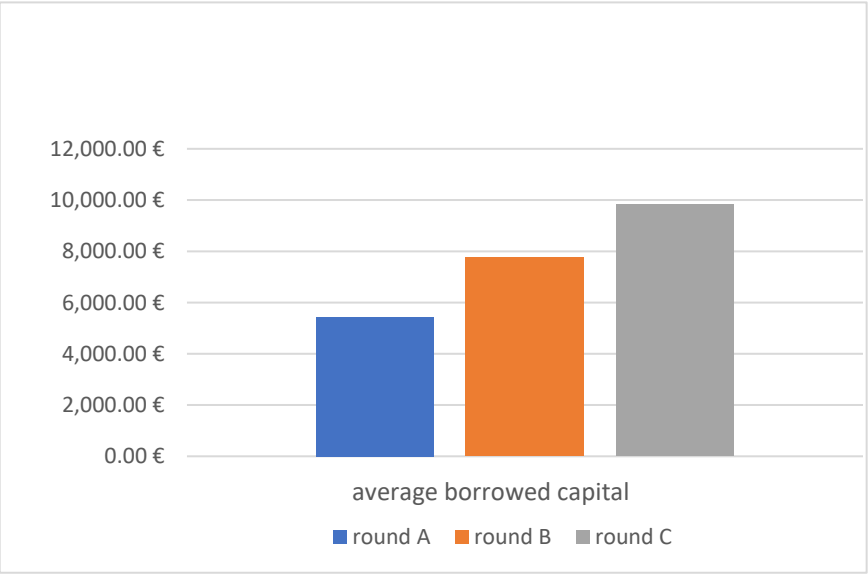

Figure 1. Average borrowed capital

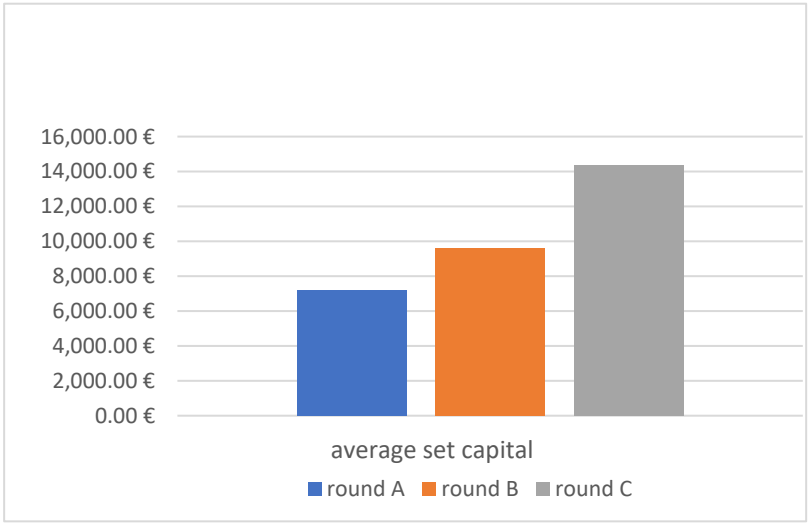

Figure 2. Average set capital

How was the risk behavior? The highest possible profit (calculated as the product of the set capital and the possible payout multiple) in all three games rose continuously from €37,483.12 in round A to €98,754.77 in round C, by 163.46% (see figure 3). The significantly higher standard deviation in round C shows that some players were more willing to take risks than the average (see figure 4).

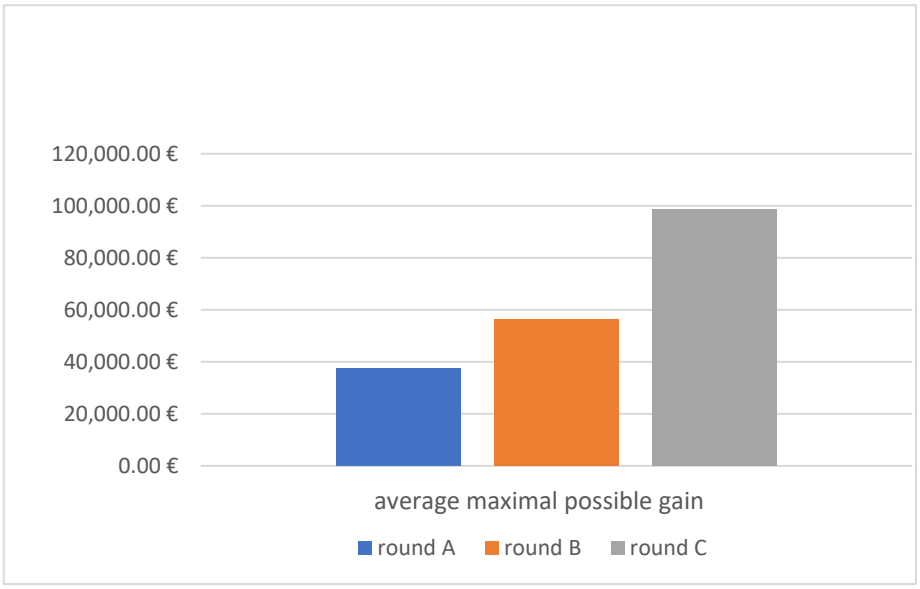

Figure 3. Average maximal possible gain

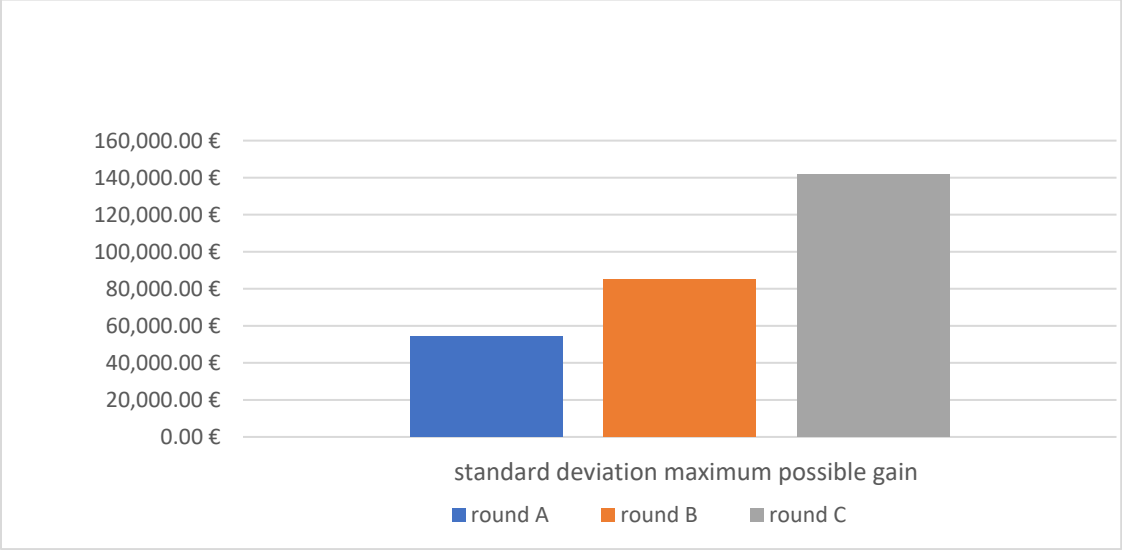

Figure 4. Standard deviation maximum possible gain

If you set the maximum possible gain in relation to set capital as a risk measurement indicator, the willingness to take risks increased by 33.27% from 5.20 in round A to 6.89 in round C (see table 5). The same development shows the risk measurement indicator maximal possible gain in relation to the borrowed capital as a risk measurement indicator. The willingness to take risks increased by 46.67% from 6.90 in round A to 10.04 in round C (see figure 6).

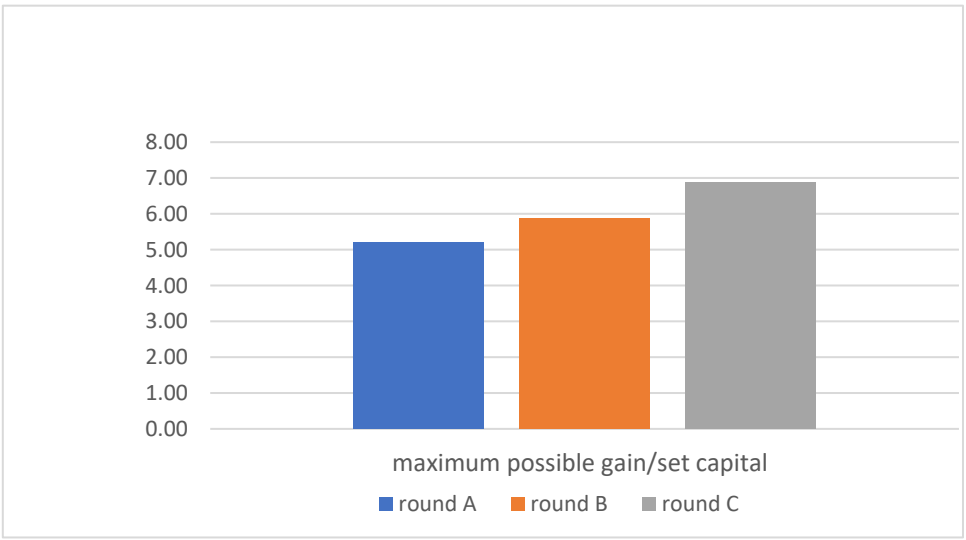

Figure 5. Maximum possible gain in relation to set capital

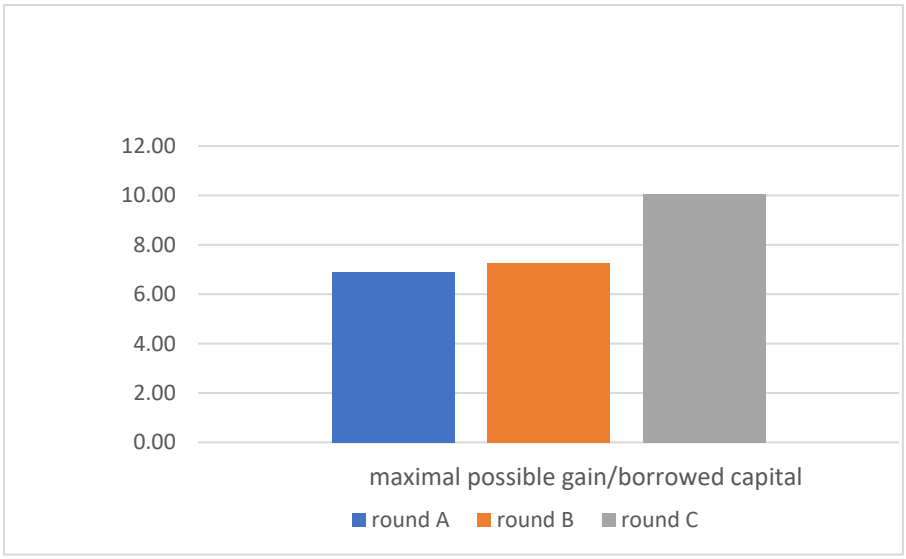

Figure 6. Maximum possible gain in relation to borrowed capital

How were the results? How successfully did the investors set their capital? The average gains of round A and B with 10% and 5% interest rate stayed pretty much the same (A: €51.68 and B: €63.60€) whereas in round C the students realized an average loss of €297.66 (see figure 7).

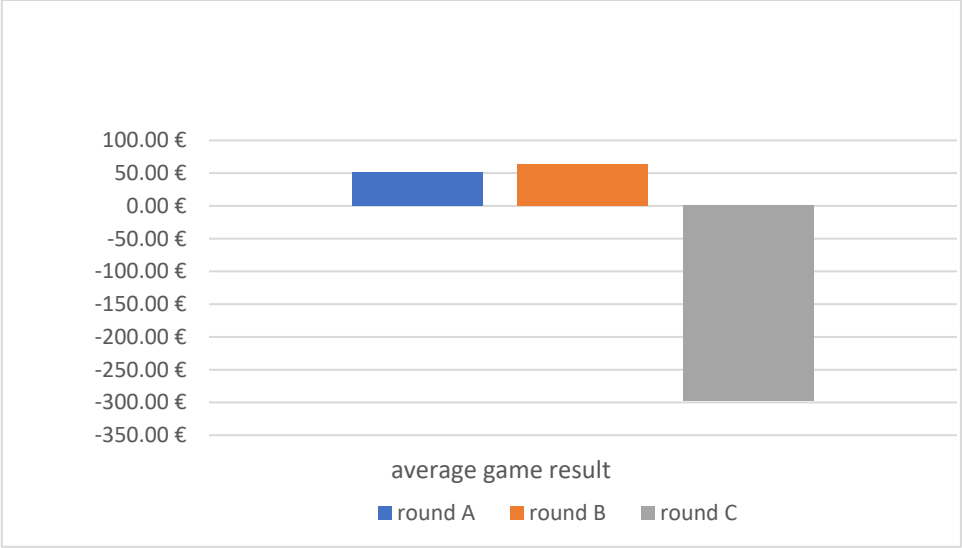

Figure 7. Average game result

Table 1. Statistical data

	Round A	Round B	Round C
Average borrowed capital	€5,430.93	€7,759.81	€9,831.78
Average set capital	€7,211.05	€9,617.37	€14,244.15
Average maximum possible gain	€37,483.12	€56,466.74	€98,754.77
Standard deviation average maximum possible gain	€54,490.10	€85,157.77	€141,764.15
Risk as max. possible gain/set capital	5.2	5.87	6.93
Risk as max. possible gain/borrowed capital	6.90	7.28	10.04
Average game result, +gain, -loss	€51.68	€63.60	-€297.66

Interestingly, with the decreased interest rate as borrowing costs, the risk taking increases continuously, which means that there are proportional effects of the borrowing costs to the risk behavior. But the strongest reaction was detected at zero interest rate, where there were no capital costs.

5. Conclusion

The experiment showed that decreasing interest rates encourage risk-taking. With the decreased interest rate as borrowing costs the risk taking increased weakly but continuously. The risk taking increased strongly when the interest rate reached zero. The experiment showed excessive risk-taking when there were no capital costs. With no capital costs the average result of the game was a net loss, whereas before there was a small profit. It seems that if money is free, human beings react less rationally. This finding supports the hypothesis that extreme expansive monetary policy with low, zero or negative interest rates encourage financial bubbles and overinvestments or wrong investments in the real economy. Bank and non-bank investors are less prudent and rational the less the capital costs are and extremely irrational and incautious if there are no costs at all.

Decreasing the interest rate to zero encourages excess risk-taking in the financial system. Low interest rate policy could lead to a buildup of leverage, or asset bubbles by encouraging excessive risk taking by financial market participants. Bank and non-bank investors may be encouraged by low interest rates to take excessive risk in their search for profit, which can create asset bubbles on the stock market and housing market. If they are financed by credit, credit crunches and strong economic downturns may follow, which caused the 1929 financial crisis (stock market crash), followed by the great depression and the financial crisis of 2008 (housing credit crisis).

Moreover, it has been demonstrated (Conrad, 2015) that unilaterally constructed incentive schemes encourage excess risk-taking. This would indicate that common bonus-based compensation schemes enhance risk because of the asymmetries in the treatment of gains and losses. Unilaterally constructed compensation schemes were one reason for the financial crisis.

After the financial crisis many central banks turned to quantitative easing (QE) to support economic growth. In order to reduce long-term borrowing costs they purchased massive and unprecedented amounts of long-term bonds, which created liquidity and decreased the long term borrowing costs. Some central banks even pushed short-term interest rates slightly below zero to stimulate the economy. But the slow recovery, especially in Europe, has raised questions about the benefits of QE bond purchases versus their detriments and whether their effectiveness has reached a limit.

The example of Japan should give pause. Japan is a pioneer of zero interest rate policy and quantitative easing. In 2001 and 2013, the Bank of Japan implemented zero interest rates alongside quantitative easing. Neither managed to stimulate the economy sustainably or to increase inflation (Drozd, 2018). Often when pursuing an inflation target, we forget that we are in a long phase of globalization with falling import prices. In particular, the goods made in China are pushing down prices for many consumer goods.

The question remains as to why the long period of low interest rates in Japan has not led to a second bubble. For a bubble, a constant inflow of liquidity is required, which is financed by loans. After the real estate and equity crash in Japan in the 1980s, Japanese banks still had a lot of bad credit on the books after huge write-offs. They were not recapitalized, so even if they wanted to make the same mistake again, they lacked the equity to real estate and equity loans. Rather, one spoke at that time of a credit crunch, since the Japanese banks and the real economy barely forgave loans for lack of equity, which is why the economy stagnated at a low level. Dell'Ariccia, Laeven and Marquez (2013) showed that the extent of bank capitalization appears to be an important factor for recovery. They found out that facing a lower interest rate, a well-capitalized bank is willing to give more credit, it decreases its monitoring and takes more risk, while a highly levered, a low capitalized bank does the opposite (Dell'Ariccia, Laeven & Marquez, 2010; Claessens & Kose, 2013).

There are a lot of market distortions due to the market intervention of the central bank apart from the shift to investments with higher yields. If the interest rate is below the inflation rate, there are redistributive effects from creditors to debtors. Insurance companies and pension funds do not have enough earnings to meet their obligations. Money market funds might not earn enough to cover their costs of running. The pension of the population becomes a problem, as the interest income is missing. The effects of a prolonged zero interest rate phase on the financial system has not yet been handled in depth. Banks lack the float profits from loaning their deposits, as well as the margin between investment and lending rate. Negative investment rates are usually not enforceable on the market and neither is a high credit margin if the refinancing rate is zero (Arteta, Kose, Stocker & Taskin, 2016). Lowering the interest rates thus means narrowing net interest margins—the gap between commercial banks' lending and deposit rates. Several studies found a positive relationship between short-term interest rates and net interest margins. A low interest rate environment has the adverse effect on banks' profitability (Claessens, Coleman & Donnelly 2016; Borio et al. 2015).

The Bank Lending Survey of April 2016 already noted a collapse in European bank profit as a result of low interest rate policy and quantitative easing (Arteta, Kose, Stocker, Taskin, 2016). If the banks lack income, equity is also lacking to

lend and to survive new crises. The zero interest rate policy is thus counterproductive. In addition, if the central bank buys corporate and government bonds, it shuts the commercial banks out of this market, especially since it lacks the expertise to manage corporate risk. The financing of enterprises by state organizations is not market-compliant, but characteristic of centrally planned economies.

All studies assume an interest rate responsiveness to investments. As we know from the Great Depression of 1929, this does not have to be the case. If the expectations of return on investments are negative, interest rates would have to be so negative that they more than offset losses on the investment. But then it would be less risky for companies if they did not invest the money but let it go and take the central bank's negative interest rates as a safe return.

The expectations of the return on investments must not only be negative due to poor economic expectations, they can also be due to a lack of competitiveness. For example, in spite of zero interest rates, nobody would invest in Greek hotels if the comparable Mediterranean holiday in Portugal is much cheaper due to lower labor costs.

Falling interest rates, on the other hand, always affect equity and real estate prices. For one thing, they are the alternative form of investment to bonds and, on the other hand, they can be financed by loans. If the cost of credit decreases, the present value of real estate and equities increases. The demand for shares and real estate and thus also the price will rise. The profits of companies increase due to lower borrowing costs, which also increases the demand for shares and thus the price.

In conclusion, one can say that the side effects of an extremely expansionary monetary policy such as zero interest rate policy, negative interest rate policy or quantitative easing are so great that such an intervention in the markets is only justified in a Keynesian depression situation (Great Depression) as in 1929 and 2008 and only for a limited time. One can only warn against recent suggestions, such as de-bundling cash from electronic currency and making cash depreciate relative to electronic currency, to further reduce key interest rates to negative territory (Assenmacher & Krogstrup, 2018), because the negative effects of these options are not predictable.

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