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**Negative Interest Rates May be More Psychologically Acceptable than Assumed:
Implications for Savings**

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Abstract (157 words)

The recent implementation of negative interest rates (NIR) by central and commercial banks invites empirical scrutiny of how people would react to this atypical financial policy where one has to pay to let money in the bank. Economic thinking on this issue posits that people would not tolerate NIR on their deposits, and would instead be motivated to spend or invest their money. In two experiments, we find that people, when the alternative is to take one's savings out of the bank, show a large tolerance to NIR. This tolerance fluctuates as a function of the size of one's savings (less tolerance for higher amounts), size of NIR (less tolerance for more negative rates), age (older people are less tolerant of NIR) and risk-taking inclinations (those that are more risk-seeking show less tolerance of NIR). The findings are discussed with regards to economic assumptions associated with NIR policy implementation and the psychological implications of this decision-making context.

Keywords: saving; negative interest rates; financial decision making; loss-aversion

Negative Interest Rates May be More Psychologically Acceptable than Assumed: Implications for Savings

Central (e.g., in the Eurozone and Japan; Altavilla, Burlon, Giannetti, & Holton, 2019; Brown, 2018) and commercial banks (Blackstone, 2017; Martin, 2019) have recently started implementing negative interest rates policies (Rogoff, 2017). Negative interest rates (NIR) depart from classic economic policies and have been proposed as a tool to spur economic activity (Agarwal & Kimball, 2015; Kimball, 2015). A central assumption motivating NIR policies is that people would show low tolerance of rates that essentially imply ending up with less money in the future. This assumption, however, invites empirical scrutiny. More specifically, it is presently unclear how people would react to NIR and which factors may *modulate* their tolerance for NIR. The present research contributes to this real-world question by focusing on people's tolerance for NIR when they apply to their savings. To start with, we briefly discuss the background literature relevant for our current research. We then report and discuss results from two experiments that provide preliminary insights into individual and contextual factors moderating people's tolerance for NIR.

What do we know about people's tolerance for NIR?

At present, because of the novelty of the NIR policies, there is little to no theoretical propositions offering predictions or formalizing how people would react to NIR. As this quote by Altavilla, Burlon, Giannetti, and Holton (2019) points out: "Yet, there is no agreement in the economic profession on the effectiveness of negative interest rate policies." A starting assumption is that in saving money, people require a certain premium (a positive interest rate) for the "sacrifice" they are making in delaying immediate opportunities. The implementation of NIR flips this standard practice on its head, leading to a situation where

people would effectively be *paying* banks for letting money on their savings accounts¹. This practice is certainly atypical (for a long time it was thought that zero is the lower bound for interest rates, Fischer, 2016), but increasingly, it is becoming commonplace. For example, in Switzerland, the “Alternative Bank Schweiz AG” maintains a -0.75% (Blackstone, 2017) while the Danish “Jyske Bank” maintains a -0.6% (Martin, 2019) deposit rate, effectively meaning that they are charging depositors to leave money with them. NIR are being applied to large deposits (e.g., over €5 million in a Belgian bank), but also for smaller ones (e.g., above €2,500 for a Dutch online broker) (“DEGIRO will no longer compensate for negative MMF returns,” 2019; “Local Belgian bank applies negative interest rates,” 2019).

It is generally assumed that people would not tolerate NIR (Block, 2011; Lilley & Rogoff, 2019; McKinnon, 2010). Such assumptions have motivated suggestions that NIR can boost economic growth as people (just as financial institutions) would be penalized for hoarding money when they could spend it, lend it, or invest it. For example, Agarwal and Kimball (2019) propose that NIR could be used during recessions or economic slowdowns as a tool for stimulating the economy. The argument is that: “Rate cuts work in every corner of the economy to encourage investment and consumption spending... In the case of negative rates, the carrot for those who spend is coupled with a stick for those sitting on pile of cash they resist putting to good use.” (Kimball, 2019). Indeed, there is some macro-economic evidence that NIR may actually promote risk-taking and spending. In Japan, money funds have started taking riskier positions as a result of NIR (Di Maggio & Kacperczyk, 2017).

¹ Note that interest rates differ from bank fees. For standard savings accounts, bank fees refer to nominal fees for account set-up, maintenance, or transactional services. Such fees can be one-time, ongoing, or related to specific operations. Interest rates, on the other hand, relative to standard savings accounts are risk-free rates, i.e. they do not include any risk premium (since there is no risk-taking by the saver). Such interest rates aim at capturing the time value of money, which allows any comparison of different risk-free amounts of money at various points in time.

Likewise, Hong and Kandrac (2018) pointed out that Japanese banks responded to NIR by: “...broadening their appetite for risk, which included an increase in credit supply.”

However, individuals may not behave in similar fashion to funds or banks. As a matter of fact, in several countries that are experiencing all-time low rates or NIR, aggregate household savings are still increasing (cf., European Commission & Directorate-General for Economic and Financial Affairs, 2019). This begs the question: what can we expect from *individuals* when NIR is applied to their savings deposits?

A first possibility is that people regard NIR as they actually are: a sure loss. Many field and lab demonstrations indicate that people are loss averse (i.e., that losses loom larger than gains). This finding is a cornerstone of prospect theory and is widely observed in people’s decision-making (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). It has been used to explain various decision-making biases such as the endowment effect, the status quo bias, and the disposition effect (Odean, 1998; Samuelson & Zeckhauser, 1988; Thaler, 1980; Tversky & Kahneman, 1981). Therefore, in line with loss aversion, when facing a choice between experiencing a NIR on their savings vs. withdrawing their money from the bank, people may generally opt for the latter. A NIR on a deposit also implies that, at some later time horizon, say one year, a person has less money than what they had a year before. It is known that people are highly present biased, i.e., they put more weight on the value of a present amount of money than on a future one (Doyle, 2013). As a result, people should generally reject NIR.

On the other hand, akin to the value functions assumption in prospect theory (Kahneman & Tversky, 1979), the reference point from which individuals evaluate the effect of NIR on, say, their saving account, may imply a commitment to the future. In this case, people may consider a NIR as a cost to bear for ensuring their future. One may think here of

at least three reasons why people may show some tolerance for NIR. First is a desire to match future needs, e.g., expected and/or unplanned expenditures. Specifically, people may be willing to pay for ensuring the security of future payments (Wärneryd, 1989). Even the earliest discussions on saving reflect this *precautionary motive* that explains why people save money. Alfred Marshall argued that an individual would save: "...not only if he thought that his savings would increase in his hands, but even if he thought they would diminish." (Marshall, 1890; 2009, p. 192). The next two reasons relate to how people prefer saving money. *Safekeeping* is an added value provided by banks. Saving money at the bank is safer than holding cash at home, where the risk of robbery or destruction is higher. In addition, bank accounts are associated with *practicality*. In a world that is becoming cash-less, it is often advantageous (or even necessary) to have access to bank deposits (e.g., for online payments, access, transfer, etc.). Furthermore, money kept in bank deposits is, oftentimes, insured by governments (up to certain amounts). As a result, when facing a choice between experiencing a NIR on their savings vs. withdrawing their money from their bank accounts, people may sometimes opt for the first option.

Psychologically speaking, people might also tolerate NIR on their savings to be consistent with their savings commitment. People are generally motivated to maintain a consistent and positive self-image (Cialdini, 2009). Initial commitments (e.g., to save money) signal to a person that they care about their future which could increase the likelihood that they behave consistently (Ariely & Norton, 2008). Likewise, some economists (Modigliani, 1986) have suggested that the discount rate for money corresponds to the actual rate of interest and that most people try to spread out their income over their lives so as to achieve a constant income (adjusted for inflation). The fact that many people try to save money is consistent with this view as failure to save is an example of underweighting the future. By this view, people care as much about their future as about their present. Therefore, they might

be motivated to tolerate some NIR on their savings even if this implies having less in the future.

To summarize, while many economic proposals of NIR implementation rest upon the assumption that people would be intolerant to NIR being applied to their savings (Block, 2011; Lilley and Rogoff, 2019; McKinnon, 2010), because of pre-commitment and future orientation, people may be willing to tolerate at least some NIR on their savings. A critical research endeavor, therefore, is to identify the factors that modulate people's tolerance for NIR. We considered several of those factors in the current research. The rationale for their selection is explained in the next section.

Factors to consider for NIR tolerance

Amount of money: The first factor that could impact NIR tolerance is the amount of money individuals have at their disposal. Larger amounts of money are at higher risk of being lost, stolen, or destroyed, if withdrawn from the bank. They are also less practical to keep in cash form and previous research suggests that loss aversion is observed under high (i.e., more money), but not under low (i.e., less money) stakes (Ert & Erev, 2013).

NIR size: The second factor is the size of the penalty, i.e., the size of the NIR. This factor is highly correlated with the amount of money as even higher NIR (i.e., less negative) could lead to a substantial loss if applied to a large sum of money. Nevertheless, this factor could impact tolerance independently. Lower (i.e., more negative) NIR imply larger losses, which might prompt people to withdraw their money from their savings. Higher (i.e., less negative) NIR might imply the reverse. Previous research has demonstrated that gains loom larger than losses (a loss aversion reversal) when people are dealing with small losses of money (Harinck, Van Dijk, Van Beest, & Mersmann, 2007). That is, people are not as taken aback by small losses as they are by small gains.

NIR implementation: The third factor relates to the reasons behind NIR implementation. People may think of NIR as an unfair policy imposed upon them by greedy financial institutions, one that they can avoid by withdrawing their money. Conversely, tolerance for NIR may increase when people see it as a public policy instituted to help national economies bounce back from downturns.

Individual differences: Finally, certain individual differences may also modulate NIR tolerance. Research suggests that younger, compared to similar middle aged households, are more likely to save (Heckman & Hanna, 2015). However, middle aged people tend to save little while older people save more than they should (Furnham & Argyle, 1998). Hence, tolerance for NIR may vary as a function of an individuals' age. In addition, psychological research has cast doubt on the fact that people are able to successfully manage their long-term finances. It is often difficult for consumers to make informed economic decisions and it has been shown that people often undertake little or no retirement planning at all (Campbell, 2006; Lusardi & Mitchell, 2007). Individual differences in risk-propensity and numeracy might therefore be another correlate of NIR tolerance (Cokely, Galesic, Schulz, Ghazal, & Garcia-Retamero, 2012). People who might be more risk-seeking could be less tolerant of NIR as they are more willing to invest their money in risky assets or risk it being stolen. Finally, people's ability to delay gratification could also play a significant role. Levels of delay-discounting (i.e., preferring a smaller immediate than a larger but delayed reward) are seen as an important consideration in retirement planning models (Bidewell, Griffin, & Hesketh, 2006) and intertemporal preferences have been shown to be a stronger predictor of the importance of saving for retirement than a host of other variables such as age, race, parental income, or gender (Finke & Huston, 2013). Therefore, one might expect people who are more likely to delay immediate gratification to be more tolerant towards NIR.

The present research

The present research aimed to provide behavioral insights into the empirical question of how tolerant people are towards NIR on their savings and the effect of the above-mentioned factors on their tolerance to NIR. In the first experiment, we set out to probe a general tolerance towards penalties that apply to savings deposits without specifying when the payment would be taken out. In the second experiment, we look at people's tolerance for NIR as they would usually be applied, i.e., when the payments are taken out at the end of a future time horizon.

Because we were interested in individuals' perspective, both experiments were conducted on a sample of the general population. As no current theorization addresses the impact of NIR on financial decision-making behavior, the experiments were not pre-registered. Data, materials, and analysis codes for the experiments are available at the following link: https://osf.io/7ftak/?view_only=11332155730b49309f5ec605e9b73c9b. In all experiments, we report how we determined our sample size, all data exclusions, all manipulations, and all measures.

Experiment 1

If NIR are to be employed as an effective tool to spur economic growth, people have to be highly intolerant to payments for letting one's savings at the bank. The first experiment gauges people's tolerance towards such payment. For those that express a willingness to accept such payments, we also provided the opportunity to state when they would prefer to proceed to the payment: immediately or at the end of one year. Note that having the payment occur at a later time horizon corresponds to NIR as usually applied (the effective annual interest rate is equal to the nominal interest rate). We used two amounts of money people would be dealing with and we varied the size of the payment. In addition, we also varied the motivation for this policy.

Method

The experiment had a 3 (*NIR implementation*: policy implemented across all banks vs. policy implemented across all financial institutions, to help the US economy recover vs. policy implemented across all financial institutions, to help the US economy recover through increased spending) x 2 (*Amount*: \$1,000 vs. \$35,000) x 3 (*Payment*: 0.3% vs. 0.6% vs. 1% of the saved amount) mixed design. The NIR implementation factor was the only between-subject factor. Participants completed six decisions as a result of the within-subject factors. We aimed to recruit at least a 150² participants per between-subject cell on Prolific. The participants were from the US and were paid £0.5. After excluding those who failed an attention check presented at the start of the study, our final sample was: $N = 457$ (47% female; $Med_{Age} = 32$, $IQR_{Age} = 15$).

Procedure

Participants started by filling in a consent form. If they completed the first attention check correctly, they were presented with the instructions (see full instructions here: https://osf.io/7ftak/?view_only=bf579396c3b741f8aaaf5b47025aa43b). Participants were asked to imagine that all banks have introduced a new policy where one is required to pay to keep savings in the bank. The instructions changed as a function of the NIR implementation factor: (i) in the control condition, participants were informed that a new policy was introduced and applied across all banks, ii) in the public policy condition participants were told “The public policy aims to ease recovery from economic crises and to stimulate manufacturing and industry growth in the US. All financial institutions are obligated to follow it.”, and iii) in the public policy spending condition, participants were told “The public policy aims to ease recovery from economic crises and to stimulate manufacturing and

² With this sample size, we had > 80% power to obtain an effect size of $d = .20$, with an alpha of .05 for all main effects and interactions as calculated by Pangea (Westfall, Kenny, & Judd, 2014). We chose to power the study for a $d = .20$ effect size as this is typically identified as a conventionally small effect size.

industry growth in the US by encouraging spending instead of saving. All financial institutions are obligated to follow it". People were then told that they would be asked six questions (two randomly presented blocks for the two amounts) in the following format: "You saved \$X on your account. To have access to it on your bank account for the next 1 year, would you be willing to pay X% of that amount?"

Participants were told that the safety of their deposit is guaranteed. Our main dependent variable was whether participants accepted or refused the payment. The instructions specified that refusing implied taking the money out of the bank. Those who chose to accept the payment were asked whether they would prefer to pay "immediately" or "at the end of the time period (1 year)". After that, they were asked to imagine that the preference they just made had a cost and whether they would be willing to pay to secure that option? Participants were told that they could say zero indicating that they would not be willing to pay to secure the option. Note that, one can refer to NIR as it is usually applied only if the payment is taken out at the end of the time period so that the effective annual interest rate is just equal to the nominal interest rate.

Participants were reminded that, for the purposes of this experiment, the policy is wide-ranging and that they would not be able to take their money to a different institution if they decide to withdraw their money. Because it was important to us that participants carefully read the instructions pertaining to the NIR implementation, we introduced a manipulation check at the end of the study that asked them to identify why the new policy was implemented. At the end, participants were asked to report their age, gender, highest completed level of education (ranging from *no degree* to *doctoral degree*), and annual household income (ranging from *less than \$14,999* to *greater than \$100,000*).

Results

Ninety-nine participants failed the manipulation check (21.66% of the sample). This might be due to subtle differences between some instruction conditions, which may not have been apparent to all participants. This seems mostly driven by the condition where the instructions added that the policy was implemented to *encourage spending* instead of saving. A full 46.46% of participants that failed the manipulation check were in this condition ($\chi^2 = 11.09, p = .004$). We excluded individuals who failed the manipulation check, resulting in a data set of $N = 358$ participants (50% female; $Med_{Age} = 32, IQR_{Age} = 14.75$)³.

Overall, only 15.54% of participants chose to accept the payment across *all* six choices. For the lower amount, across *all* three choices, 25.16% of participants chose to accept, while 27.57% chose to accept for the higher amount. Looking across all 2148 choices made, 39.85% were to accept a payment. Among those participants who chose to accept, the majority (73.48%) expressed a preference to pay immediately, rather than later. This behavior is indicative of negative discounting, i.e., that people would rather expedite losses, rather than delay them (Loewenstein, 1987). Note that this preference is consistent with participants being more future oriented.

Looking more closely at how many participants would be willing to pay to secure their preferred time of payment (i.e., immediately vs. later), 79.17% would pay some money to secure an immediate payment, while 80.62% would pay to secure a later payment. There was, however, no difference in the amounts paid to secure the immediate or the later preference (Wilcoxon test $p = .90$). For both preferences, participants would pay a median of an extra \$20.

Next, we regressed the factors of NIR implementation, amount, payment and their interactions on the main DV. All factors were sum contrast-coded. The results show that

³ We ran the same analyses on the full data set (i.e., including those participants who failed the manipulation check) and the results were the same.

there was an effect of amount; participants were more willing to accept the payment for larger amounts of saving, $z = -3.24$, $SE = 0.06$, 95% CI $[-0.33, -0.08]$, $p = .001$, $OR = 0.81$. Of all the choices made, while 42.36% were to accept the payment for the higher amount, 37.34% were for the smaller amount. Both contrast codes for the payment factor were significant, $z = 12.05$, $SE = 0.10$, 95% CI $[-1.38, -0.99]$, $p < .001$, $OR = 0.31$ and $z = 3.25$, $SE = 0.09$, 95% CI $[0.12, 0.47]$, $p < .001$, $OR = 1.34$. People were less willing to accept the payment as it increased with 54.19% of the choices for the 0.3% payment being to accept, 36.03% for the 0.6%, and 29.33% for the 1% payment. No other effects were significant. Adding demographic variables to the model did not change the results.

The same regression analysis on *when* participants would prefer to pay found that there was a significant effect of amount, $z = 2.98$, $SE = 0.19$, 95% CI $[0.19, 0.94]$, $p = .003$, $OR = 1.76$. There were slightly more immediate payment preferences for the smaller (74.81%), rather than the larger (72.31%) amount. No other effects were significant.

Finally, we looked at the correlations between acceptance rates and the demographic information. Older people were less likely to accept the payments ($\tau = .09$, $p < .001$), but there were no correlations with education, income, or gender.

Discussion

The results of Experiment 1 hint at relatively high tolerances for payments as around 40% of the choices indicated acceptance of some payment (i.e., 0.3%, 0.6%, or 1% of the saved amount) for letting one's savings on the bank account. We also find that people are more tolerant to such payments for larger amounts of money and for smaller (e.g., paying 0.3% of one's savings) than larger (e.g., paying 1% of one's savings) payments. Indeed, more than half (54.9%) of the choices for the 0.3% payment were to accept. Interestingly, the majority of people who chose to accept the payment, also said they would prefer to pay it immediately. This was even more the case for smaller amounts of money. This is an

interesting, and rare, occurrence of negative discounting (Benhabib, Bisin, & Schotter, 2010; Hardisty & Weber, 2009) where people would prefer to expedite, rather than delay losses. This could be seen as an indication of people's future orientation as they prefer to experience the loss sooner rather than later. Our policy factor did not seem to have any impact, hinting that people might not be as sensitive to various justification of why such payments are implemented.

Experiment 2

The results of Experiment 1 indicate that, when it comes to payments being applied to their saved money, people show a tolerance, and in cases of smaller payments even a preference, to incur the payment rather than take their money out of the bank. Additionally, people seem to prefer for the payment to occur sooner, rather than later. This suggests that NIR on savings may elicit an orientation to the future as people wish to remain consistent with their savings behavior. Technically, however, a NIR would usually occur at the end of a certain time period (say after one year)⁴. Therefore, in Experiment 2, we highlighted that the payment would be made at the end of the time horizon to all participants. In addition, we specified how much money they would end up with and we measured individual differences in risk-taking, delay-gratification, and numeracy. We also asked participants to report their estimated savings, and their overall trust in banks.

Method

The experiment had a 2 (*Amount*: \$1,000 vs. \$35,000) x 3 (*NIR*: -0.3% vs. -0.6% vs. -1% of the saved amount) within-subject design. Participants again completed six decisions as a result of the two factors. As we had only within-subject factors, we planned on a participation of 150 individuals. The participants were from the US, recruited on Prolific and

⁴ Paying interests up-front (i.e. at the beginning of the period under consideration) is sometimes possible in reality. However, such a practice is somewhat harder to implement since it requires to mention the *effective* rate that can differ from the *nominal* interest rate.

paid £1. After excluding participants who failed an attention check presented at the start of the study our final sample was: $N = 156$ (53% female; $Med_{Age} = 33$, $IQR_{Age} = 15.25$).

Procedure

The procedure was similar to Experiment 1 except for five changes. First, the instructions (full instructions can be accessed here: https://osf.io/7ftak/?view_only=806070cf8f5e46d89fe76d6ac30496fa) now specifically stated that the payment would be taken out at the end of one year. Second, participants were told the exact amount that would be taken out. Third, because we fixed when the payment would be taken out, participants who accepted the NIR were not asked to provide their preference for time of payment. Fourth, at the end of the study, participants were asked to respond to a measure of *delay gratification*, using the “money” subscale from the “Delayed Gratification Inventory (DGI, $\alpha = .64$)” (Hoerger, Quirk, & Weed, 2011), and a measure of *risk-taking*, using the “financial” risk-taking measure from the DOSPERT ($\alpha = .76$) scale (Blais & Weber, 2006). This scale has two further subscales relating to risk-taking in the domain of gambling ($\alpha = .82$) and investing ($\alpha = .87$), both of which were used to ascertain participants’ risk tolerance. In addition, people’s numeracy skills were measured with a single-item (Cokely et al., 2012) along with their estimated actual savings (over the last three years), and perceived trustworthiness towards banks (ranging from 1 - *not trustworthy at all*, to 7 - *completely trustworthy*). Fifth, after participants provided responses for all six choices, we also asked what they would do if NIR was actually applied to their savings account and they *rejected it* (i.e., as if they already decided that they would not tolerate the NIR). They were given four options to choose from: save money elsewhere, spend it on goods or services, invest it, or pay off your debts.

Results

We found similar acceptance rates as in Experiment 1. Overall, 15.38% of participants chose to accept the NIR across *all* six choices. For the lower amount, across *all* three choices, 34.62% of participants chose to accept, while 21.15% chose to accept for the higher amount. Looking across all 936 choices made, 40.17% were to accept the NIR.

Similar to Experiment 1, we regressed the factors and their interactions on the main DV. The results show that there was again an effect of amount but, opposite to Experiment 1, participants were less willing to accept NIR for larger amounts of saving, $z = 0.62$, $SE = 0.11$, 95% CI [0.41, 0.83], $p < .001$, $OR = 1.86$. Of all the choices made, while 33.76% were to accept the NIR for the higher amount, 46.58% were to accept for the smaller amount. The contrast comparing the -0.3% to the -1% NIR was significant, $z = -1.20$, $SE = 0.16$, 95% CI [-1.51, -0.89], $p < .001$, $OR = 0.30$, however, the contrast comparing -0.6% and -1% was not significant ($p = .24$). Of all the choices, 52.88% were to accept the -0.3% NIR, 38.14% the -0.6%, and 29.49% the -1% payment signaling similar tolerance rates as in Experiment 1. The interaction was not significant. Adding demographic variables to the model did not change the results. Interestingly, 41.06% of participants said that removing their money from the bank by rejecting a NIR they would invest it while 35.90% said that they would continue to save it in some other way, and 22.45% said they would use the money to pay off their debt. Almost no one (0.64%) said they would spend the money.

Finally, we looked at the correlations between acceptance rates and the demographic information as well as the individual difference measures. Older people were again less likely to accept NIR ($\tau = .13$, $p < .001$). Women were also more likely to accept NIR ($\tau = -.12$, $p < .001$). People who also scored higher on the investment risk-taking measure were more likely to reject NIR ($\tau = .06$, $p = .02$). However, there were no significant correlations with education, income, savings, bank trust, delay gratification, financial risk or gambling risk, or numeracy.

Discussion

The results of Experiment 2 indicate the same tolerance levels for payments to let one's saved money in the bank as in Experiment 1. Again, around 40% of the choices indicated acceptance of some NIR for letting one's savings on the bank account. This is even more important as, in Experiment 2, the payment was set at the end of one year, making it faithful to NIR environments as they would usually be applied. Similar to Experiment 1, people were more tolerant (even preferring as more than half, 52.88% accepted) for larger (e.g., paying a -0.3% NIR on one's savings) than smaller (e.g., paying -1% NIR on one's savings) NIR. The effect of amount, however, was reversed in Experiment 2. Now, people were less tolerant towards NIR for larger amounts of money. Of importance too, asked what they would prefer to do if a NIR was applied to their savings after they had rejected it, almost no participant said that they would spend the money. The majority preferred investing the money or paying off debts.

General discussion

NIR represent an economic policy tool that, when applied to people's savings, imply one would have to *pay* to let saved money in the bank (Rogoff, 2017). While this policy bulks the standard economic approach, many central (in Europe and Japan) and commercial banks have, in fact, started implementing it (Carla Altavilla et al., 2019; Blackstone, 2017; "Local Belgian bank applies negative interest rates," 2019; Martin, 2019). Furthermore, given the current economic climate, some economists foresee NIR policies being implemented in more and more countries (Lilley & Rogoff, 2019). It is argued that NIR would be an effective tool to spur economic activity and fight recession (Agarwal & Kimball, 2019; Kimball, 2015) as people would be penalized for hoarding money. People thus ought to be more motivated to increase investment, take more risks, and increase their spending. The main assumption is that people would show very low tolerance for NIR. However, there is still very little

theorization and formalization in ways of what an effect NIR would have on individual depositors and decision-makers. It remains an empirical question and, in this paper, we test these assumptions and we look at how tolerant are people towards NIR on their savings and which factors may *modulate* their tolerance.

We looked at people's tolerance for payments to letting one's savings at the bank (Experiment 1) and when payments were set to occur at a later time horizon (Experiment 2), with the alternative, in both experiments, being to take one's money out of the bank. There were striking consistencies across the two experiments. In both, around 40% of the overall choices made were to tolerate some form of payment or NIR. Similarly, as the payment increased (i.e., NIR become more negative), people showed less tolerance, although remaining at around 30% even for the -1% payment/NIR. Importantly, for higher NIR (e.g., 0.3%) more than half of choices were to tolerate it, staying around 52%. Participants in Experiment 1 who chose to accept the payment were also given an opportunity to state when they would prefer to enact the payment. In contrast to findings in the discounting of losses literature, people showed signs of negative discounting (Hardisty & Weber, 2009; Loewenstein, 1987). The majority preferred to pay immediately rather than later, thus expediting their losses. More commonly, people show preference to delay losses (Doyle, 2013; Urminsky & Zauberman, 2015). Given that a later payment corresponds to NIR as they would be usually applied, this tendency is telling as the overall preference seems to be to get the loss over with as soon as possible. In Experiment 2, the payment was actually constrained to a later time horizon, but we did not observe any difference in the overall tolerance levels of NIR. If given the option, it seems people would prefer to get payments on their savings over with as soon as possible. Overall, it seems that NIR are, at least when it comes to people's savings, quite acceptable.

While these findings are not exemplary of a 100% level of tolerance, it is still beyond any universal *intolerance*. Given this, one is left to conclude that NIR policies might not be as effective (or at least that it might not have the desired impact) if applied to individuals and their savings. Further, it is important to note that in our experiments, as in the real world, the alternative to not letting one's money in the bank was set as simply taking it out. Individuals are left to decide what to do with one's money and in a system where cash is still a viable option, many might simply decide to continue saving it out of the bank. When prompted on this, most of the people (around 58%) said that they would continue saving the money or use it to pay off their debts. Nevertheless, around 41% did say that they would invest the money. Curiously, almost no one (0.6%) said that they would spend the money. It appears that, since the money in question was ostensibly their savings, people might not be ready to spend it. This would further imply that an application of a NIR policy to people's savings would not lead to a proposed encouragement of consumption spending (Kimball, 2019).

A potential reason for this tolerance might be that unlike NIR being applied to money by large funds or central banks, for individuals, NIR would most likely be applied to their deposits and savings. In this case, people might be tolerant towards NIR to be consistent with their savings commitment. The savings were set aside for the future and NIR cannot compromise that future (Ariely & Norton, 2008; Cialdini, 2009). Furthermore, the implementation of NIR might be a signal of high uncertainty in the economic system, which might spur people to gravitate towards safe assets and tolerate a slight loss to ensure their future. Recent evidence is concurrent with this suggesting that, on average, deposits increase during a NIR period (as long as people do not lose confidence in the banking system) (Carla Altavilla et al., 2019). We also looked at several moderators of NIR tolerance. In the following paragraphs, we discuss our findings in relation to each.

Amount of money. The results of the two experiments point to an interesting inversion in NIR tolerance when it comes to amount of money. In Experiment 1, when we were talking about payments for letting one's savings in the bank, not specifying when the payment would need to be taken out, people tolerated the payments more for larger amounts. Furthermore, they were more likely to prefer paying immediately, rather than later, when it came to smaller amounts. However, in Experiment 2, when we constrained the payment to a later time horizon, people tolerated the NIR less for larger amounts. It could be that later payments might have spurred people to discount the future as they would be accessing less funds later, than now (Benhabib et al., 2010). Similarly, people might have been more comfortable with making a smaller payment now, rather than later, for the smaller amount. For the larger amount, people might have thought there might be a change in interest rates or that they could recuperate the money in some other way. Overall however, it appears that NIR would lead people with access to more savings to take this money out of the bank, independent of the size of the NIR. NIR might thus be more effective against the practice of hoarding money, for those individuals who have higher savings, presumably because they would also stand to lose more money than individuals with smaller savings. In this sense, loss aversion would be a powerful motivator (Kahneman & Tversky, 1979), but most likely only for the wealthiest savers. Ironically, ensuring future spending opportunities might be more of a cautionary motive for people with smaller savings.

NIR size. In both experiments we observed less tolerance for payments/NIR as they decreased, i.e., as penalties become higher going from 0.3% to 1%. However, it is worth noting that we never observed that people were completely intolerant to NIR as even with 1%, acceptance rates remained around 30%. It would thus appear that less negative rates would not be as effective at getting people to not hoard their money, given that the majority seem to be quite tolerant to small losses (Harinck et al., 2007).

NIR implementation. Reasons that underpin NIR implementation could vary. People might be more tolerant towards them if it is set as an “economy boosting” tool rather than if it is seen as simply another profit-making policy implemented by financial institutions. However, varying these reasons in Experiment 1, we observed no significant impact on NIR acceptance rates. NIR could be seen as such an atypical policy implementation that it would not be sensitive to different types of social justifications. However, it could also be that an experimental setting cannot adequately stress the differences in reasons behind NIR implementation.

Individual Differences. Finally, we also looked at a number of individual differences that might impact NIR tolerance. Across both experiments, we find that older people were less tolerant to payments/NIR. As older people tend to save more than they should (Furnham & Argyle, 1998) NIR would seem to spur these individuals more to not hoard money. In Experiment 2, we also observed that males were less likely to accept NIR. This might be related to findings showing that males tend to generally be more risk-tolerant and that women tend to invest less (Charness & Gneezy, 2012). However, this finding invites further replication. In addition, we failed to obtain any meaningful differences in NIR tolerance with regards to education, annual income levels, or saving trends. This might indicate that NIR tolerance would be perceived similarly across a wide-range of people. However, it could also depend on the particularities of a sample. The median education level (bachelor’s degree) and annual income levels (between \$50,000 - \$99,000) of our sample were relatively high so probing NIR tolerance in a different sample would be prudent. Interestingly, we also failed to obtain evidence that NIR tolerance was related to differences in delaying gratification or numeracy. What we did observe is that those individuals who were more risk-seeking in the investment domain, were also less tolerant towards NIR. This is consistent with expectations as NIR would motivate these individuals to take their savings out of the bank and invest it.

Nevertheless, future research ought to make more pointed hypotheses about NIR tolerance and other individual differences.

NIR offers multiple challenges to economic and psychological theory. In one sense, NIR present a sure loss option. NIR thus invite examinations of people's tolerance towards sure, compared to probable or uncertain (e.g., investment) losses (Zeisberger, 2016). Similarly, prospect theory predicts that people are risk seeking in the domain of losses (Kahneman & Tversky, 1979) but higher tolerance for losses on one's savings seem to indicate that motives that aim to preserve the security of future spending opportunities (Wärneryd, 1989), rather than shielding oneself against losses, may take precedence. When it comes to risky investments, evidence is still unclear whether NIR would spur people to take more risky investments with one paper finding no difference between NIR and positive rates (Bracha, 2016) and another finding an effect (Baars, Cordes, & Mohrschladt, 2019). It is worth noting that these studies were done on people with experience in investment so it remains to be seen how ordinary decision-makers, and savers in particular, would react. Another important aspect to probe is how people's time preferences would relate to NIR. In the two experiments, we only used one single time horizon (one year), but people's NIR tolerance might fluctuate dependent on different times when the NIR payment is implemented. Finally, a challenge is to obtain better understanding into what people would do when taking out their savings from the bank.

Conclusion

In one of the first (to our knowledge) attempts to look at people's tolerance towards NIR on letting one's saved money in the bank, we find high levels of tolerance for NIR. When the alternative is to take one's savings out of the bank, people show relatively high tolerance to smaller NIR and if they have smaller, rather than larger savings. This research opens up future investigation opportunities into this economic phenomenon and provides a

basis for inferring the eventual effectiveness and implications of such policies for individual decision makers.

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