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On equilibria in the model of deposit markets with exogenous switching costs of depositors

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Abstract

We model the deposit market, where commercial banks compete using deposit interest rates, and depositors initially distributed among banks, when switching to another bank, bear the exogenous switching costs associated with a lack of information and money transfer fee. We consider both discrete and continuous distribution of depositors over switching costs and find equilibria in pure strategies.

The theoretical model in hand allows us to explain the empirically observed negative relation between the size of a bank and its weighted average deposit rate. We show that this dependence may be the result of the history of the banking market formation. Initially, established banks could manage to obtain a majority of depositors with high switching costs, while depositors with low costs could be lost to newly emerging banks. Because of this, previously established banks can set lower deposit rates without fear that their depositors will switch to competitors, and maintain a large share of all depositors in the market. It follows from the analysis that the division of large banks into smaller ones will not lead to an increase in their deposit interest rates, but on the contrary, may even increase discrimination against depositors with high transition costs. It is the reduction of depositors' switching costs that makes banks to raise deposit rates and thus increase public welfare.

Key words: banks, deposits, switching costs, Nash equilibrium, equilibrium in secure strategies, welfare.

JEL-codes: D42, D43, D60, E58, G21, L13.

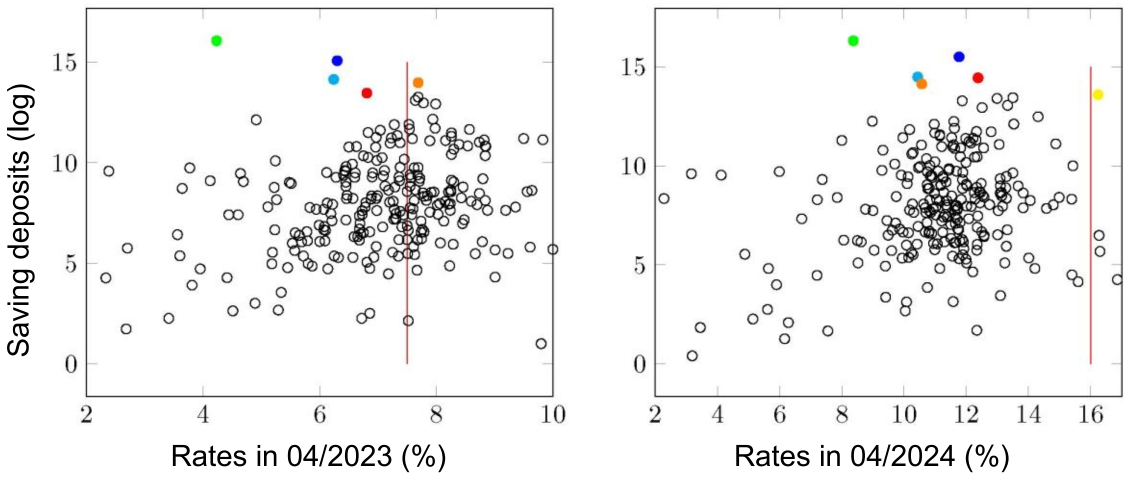
1 Introduction

In theory, in a competitive market, a homogeneous product should have one price. It can be seen in Fig. 1 that there is no law of one price in the deposit market. It is empirically confirmed that larger banks offer lower deposit rates, Penikas (2021); Schoors et al. (2019). Amounts of deposits in banks seem to be persistent from year to year, see Fig. 2, that suggests a so called lock-in effect of consumers.

One can argue that persistent deposit interest rate heterogeneity, see Fig. 3, can be addressed to the fact that large banks are more reliable than others and provide more convenient online banking, while smaller banks compete via higher deposit interest rates, see, e.g. d'Avernas et al. (2023). But in Russia, where deposit insurance system is in place, and the risks of depositors losing their savings are practically levelled, such a high difference in interest rates looks puzzling.

Even with a formally free choice among banks, depositors continue to keep money in banks with low interest rates. This may indicate that there are various costs for depositors when switching banks. However, the availability of convenient ecosystems of large banks can also lead to costs due to loss of access to services when switching to another bank. In our study, we formally model this lock-in effect and show how it can lead to heterogeneity of interest rates in the deposit market.

Figure 1: Saving deposits of individuals in Russian banks in April 2023 (left) and in April 2024 (right) corresponding to their weighted average deposit interest rates. Vertical red line depicts the interest rate of the central bank. The coloured dots show the positions of the largest banks in terms of deposits. Sources: Bank of Russia, forms 0409101 and 0409102.



The literature on price competition with endogenous switching costs resulting in lock-in of consumer effects is vast. To mention a few on the deposit market, in Zephirin (1994), endogenous switching costs are considered as a trade-off between service quality and the interest rate faced by a depositor who values the services provided by banks. In Sharpe (1997) there is a generalization of the theory in Klemperer (1987) to a world with an arbitrary market structure and an empirical test with panel data on bank retail deposit interest rates. The economics of switching costs and network effects became popular in the last three decades; see e.g. Farrell and Klemperer (2007) and references therein.

We believe that a deposit market can be studied with rather simple model with exogenous switching costs of depositors, who do not behave strategically being initially distributed among banks and switching to another bank only when its deposit interest rate is so high that it compensates money transfer fee and other associated costs (including non-monetary costs of losing time and habitual environment). We do not assume free entry of new banks, although some of our results could fit for this assumption too.

We consider a two stage game. At the first stage, banks choose deposit rates simultaneously.

Figure 2: Saving deposits of individuals in Russian banks in April 2024 versus April 2023. The coloured dots show the positions of the largest banks. We can see that most of the points lie near the diagonal: this indicates that the volume of deposits in most banks has remained at about the same level, although the volume of deposits in some banks has increased or decreased significantly (points above or below the diagonal). Sources: Bank of Russia, forms 0409101 and 0409102.

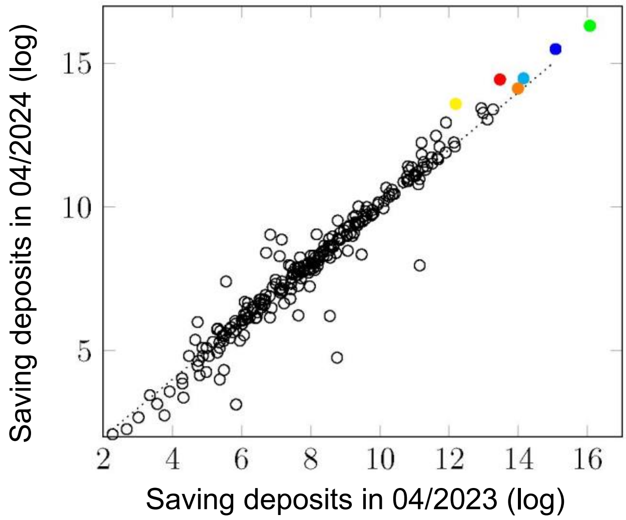
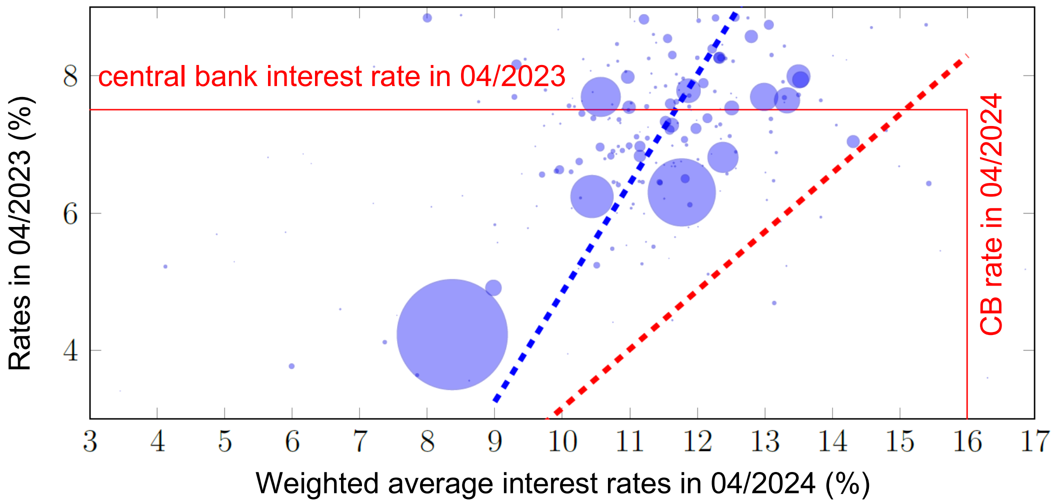


Figure 3: Saving deposits of individuals in Russian banks in April 2023 proportional to the size of corresponding circles (forms 0409101 and 0409102). Averaged saving rates in April 2024 are related to averaged rates in April 2023 (blue dashed line estimated for the 40 largest banks).
New deposit averaged saving rates in April 2024 and April 2023 are also related (red dashed line estimated for 40 largest banks, form 0409129).



At the second stage, depositors, knowing the rates, can switch bank if it is profitable for them, after which banks receive money from its depositors and put the money in the central bank, thus making profit.[1] At the first stage, each bank sets such a rate so that its profit at the end of the second stage is maximized, considering the rates of competing banks given, but knowing how depositors could redistribute themselves among banks at the second stage. We assume that depositors can keep cash without additional costs. Equilibrium is such a distribution of depositors among banks and such bank rates that no depositor will change bank and no bank will want to change its rate unilaterally.

If it is possible for depositors to freely switch from bank to bank, the deposit market can be approximated by a price competition model, where the price role is played by the difference between the central bank's rate, under which a private bank can allocate funds, and the private bank's rate on deposits. If the marginal costs of servicing depositors for banks are the same and practically zero, then the 'Bertrand paradox' takes place, when even in duopoly, the equilibrium price should be equal to the marginal costs. Therefore, the rates of banks should coincide with the rate of the central bank, so that banks practically do not have market power and receive zero profit. This is the best outcome for public welfare, as shown in the Appendix.

However, if depositors bear non-zero costs when switching to another bank, such as the commission for transferring money or the cost of finding another bank and understanding its conditions, then banks receive some market power and can lower rates without fear that depositors will switch to a competing bank. With sufficiently high switching costs, it can happen that each commercial bank assigns a rate significantly lower than the central bank's rate, as if the commercial bank had monopoly power over its depositors, allowing for a symmetric equilibrium.

It is important for the existence of pure strategy Nash equilibrium that there are at least two banks on the market with zero switching costs of depositors. In equilibrium, banks with zero switching costs, competing with each other, will set rates at the level of the central bank rate, and banks with switching costs will set the lowest rates at those to which their depositors will not go to banks offering a rate at central bank level. Banks with zero switching costs of depositors actually create a so-called *competitive fringe* for banks with market power, whose depositors have costs for switching to other banks. A virtual bank without depositors with zero profit could also play the role of a competitive fringe, setting an interest rate at the level of the central bank, thus threatening other banks with poaching their depositors if banks lower rates too much. There is no need for any competitive fringe if we consider equilibrium in *secure strategies*, see Iskakov et al. (2018); Iskakov (2005), a more general concept, than that of Nash, that avoids *threats*, when it is profitable for one bank to worsen the situation of another.

It is worth emphasizing that since depositors do not change banks in equilibrium and do not bear the associated costs, the costs of switching from bank to bank affect social welfare only via lower rates of commercial banks. To encourage banks to increase rates, their risk of losing depositors should be

[1] For the simplicity of the model, we only consider placement on central bank accounts rather than other instruments to invest funds.

increased, reducing the cost of switching from bank to bank. Moreover, these transition costs can be both a personal characteristic of the depositor (financial literacy) and the specific bank where he is serviced (fee for the money transfer).

2 Discrete distribution of depositors over switching costs

2.1 Competition with homogeneous switching costs

Banks set the deposit rates at the same time, maximizing profits

$$\Pi_i(r) = Q_i(r_i, r_{-i})\,(R - r_i) \to \max_{r_i \geq 1},$$

where R is the gross rate of the central bank, r_{-i} is the gross rate of the other bank, and $r = (r_i, r_{-i})$ is the strategy profile of interest rates.

Let us start with two banks $i \in \{1, 2\}$. Bank i attracts D_{-i} depositors of the other bank if the transfer covers the costs $z > 0$ including interest, $r_i - r_i z > r_{-i}$, see Section 8.2, otherwise banks have their initial depositors $D_1 \geq 0$ and $D_2 \geq 0$.

Thus, the demand functions for banks have the following form

$$Q_i = \begin{cases} D_i + (1-z)\,D_{-i}, & \frac{r_i}{r_{-i}} > \frac{1}{1-z} \\ D_i \quad , & \frac{r_i}{r_{-i}} \in [1-z, \frac{1}{1-z}] \\ 0 \quad , & \frac{r_i}{r_{-i}} < 1-z \text{ or } r_i < 1 \end{cases}.$$

There could be two types of equilibria depending on the switching costs:

- symmetric $r_1 = r_2 = 1$, with $D_i \geq D_{-i}\left(\frac{1}{z} - 1\right)(R(1-z) - 1)$ only if [2] $z \geq 1 - \frac{1}{\sqrt{R}}$, for example: $z \geq 1 - \frac{1}{\sqrt{R}} = 1 - \frac{1}{\sqrt{1.16}} \approx 0.07 = 7\%$ of the deposits. Here, banks have monopoly power over their depositors due to high switching costs and do not pay interest on deposits, and negative interest is not charged only because depositors can transfer deposits to cash without losses.
- asymmetric $D_1 = 0$, $r_1 = R$, $D_2 > 0$ $r_2 = \max\{1, R(1-z)\}$, for all $z \geq 0$, for example: $z = 1 - \frac{r_j}{R} = 1 - \frac{1.15}{1.16} \approx 0.009 = 0.9\%$ of the deposit. Asymmetric equilibria correspond to more realistic switching costs. Indeed, some banks charged a 1% fee for transfers to other banks, and even to their own branches in other regions.

[2] Banks do not poach depositors from each other if $D_i\,(R-1) \geq (D_i + (1-z)\,D_{-i})\,(R - r_i)\,, \forall r_i > \frac{1}{1-z}$, which is fulfilled if $D_i\,(R-1) \geq (D_i + (1-z)\,D_{-i})\left(R - \frac{1}{1-z}\right)$, where we set $r_i = \frac{1}{1-z}$. After grouping we get $D_i \geq D_{-i}\left(\frac{1}{z} - 1\right)(R(1-z) - 1)$, that is true for both banks, i.e. $D_{-i} \geq D_i\left(\frac{1}{z} - 1\right)(R(1-z) - 1)$ also holds, only if $\left(\frac{1}{z} - 1\right)(R(1-z) - 1) \leq 1 \Rightarrow R \leq \frac{1}{(1-z)^2}$. If $D_i > 0$, $r_i \geq r_{-i}$ and $r_i > 1$, the bank i can reduce r_i retaining depositors.

2.2 Competition with heterogeneous switching costs

Consider the case where depositors have different switching costs. When there are both zero and positive switching cost for depositors, there is no equilibria with a strictly positive number of depositors of two banks. This is the same result as for firms with informed and uninformed customers in Varian (1980), see e.g. Chapter 7 in Belleflamme and Peitz (2015).

For example, let bank 2 attract depositors of bank 1 without switching costs, $z_1 = 0$, and let bank 1 attract depositors of bank 2 if their strictly positive switching costs $z_2 = z > 0$ are covered including interest not received. Otherwise banks have their original depositors $D_1, D_2 > 0$.

Demand functions for the banks have the following forms

$$Q_1 = \begin{cases} D_1 + D_2(1-z), & \frac{r_1}{r_2} > \frac{1}{1-z} \\ D_1 \quad , & \frac{r_1}{r_2} \in [1, \frac{1}{1-z}] \\ 0 \quad , & r_1 < r_2 \text{ or } r_1 < 1 \end{cases},$$

$$Q_2 = \begin{cases} D_1 + D_2, & r_2 > r_1 \\ D_2 \quad , & \frac{r_2}{r_1} \in [1-z, 1] \\ 0 \quad , & \frac{r_2}{r_1} < 1-z \text{ or } r_2 < 1 \end{cases}.$$

Neither is there an asymmetric equilibrium, if $r_1 < r_2$ or $r_1 > r_2$, then bank 1 or 2 can increase its profit choosing $r_1 = r_2$ retaining its depositors, nor is there a symmetric equilibrium $r_1 = r_2$, because if $r_1 = r_2 > 1$, then bank 2 can choose $r_2 = \max\{1, (1-z)r_1\} \neq r_1$ increasing its profit, and if $r_1 = r_2 < R$, then bank 2 by an infinitesimal increase of r_2 attracts all depositors with zero switching costs from bank 1.

Notice that case $D_1 = 0$ is equivalent to the homogeneous switching cost situation considered in the previous section, while case $D_2 = 0$ is equivalent to a zero switching cost environment subject to Bertrand competition.

More asymmetric equilibria can be found in a more general case of $N > 2$ banks with different switching costs of depositors, where the demand functions of banks have the following form

$$Q_i(r_i, r_{-i}) = \begin{cases} D_i + \sum_{j \neq i, r_i > \frac{r_j}{1-z_j}} (1-z_j) D_j, & r_i \geq (1-z_i)\max_{j \neq i} r_j \text{ and } r_i \geq 1 \\ 0 \quad , & r_i < (1-z_i)\max_{j \neq i} r_j \text{ or } r_i < 1 \end{cases}$$

Similarly to what is described in subsection 2.1, a bank i retains its depositors if its rate is not lower than the maximum rate from other banks, taking into account the transfer costs of its depositors: $\frac{r_i}{1-z_i} \geq \max_{j \neq i} r_j$ and gets additional depositors from those banks whose rates are worse, taking into account the transfer costs of their depositors: $r_i > \frac{r_j}{1-z_j}$. If $\frac{r_i}{1-z_i} < \max_{j \neq i} r_j$ or $r_i < 1$, then bank i loses all depositors.

In addition to the previously described asymmetric equilibrium

$$r_1 = R, \quad D_1 = 0, \quad r_{i>1} = \max\{1, R(1 - z_i)\}, \quad \forall\ D_{i>1} \geq 0,$$

with strictly positive switching costs $z_i > 0$ of all banks, there are also asymmetric equilibria

$$r_i = \max\{1, R(1 - z_i)\}, \quad \forall\ D_i \geq 0. \tag{1}$$

when depositors of at least two banks have only zero switching costs $z_1 = z_2 = 0$. This is a Bertrand competition between these two banks resulting to $r_1 = r_2 = R$, thus providing a competitive fringe for other banks.

3 Equilibria in secure strategies

There is a more general concept of equilibrium than that of Nash, see Iskakov et al. (2018); Iskakov (2005). In our context, this means that each bank takes into account the ‘response move’ by any other bank, which could choose a strategy after seeing the bank’s rate. In other words, the bank chooses a ‘safe’ rate that ensures that even if some competitor wants to change his rate, it will not reduce the bank’s profit. Intuitively, a ‘safe’ rate will prevent a competitor from luring away depositors of the bank, even if the latter knows its rate in advance. Choosing their deposit rates banks avoid *threats*, which are the situations when it is profitable for any bank to worsen the situation of another.

Definition 1. *A* threat *of bank i against bank j at strategy profile r is a deviation* r_i' *such that* $\Pi_i(r_i', r_{-i}) > \Pi_i(\boldsymbol{r})$ *and* $\Pi_j(r_i', r_{-i}) < \Pi_j(\boldsymbol{r})$.

It is easy to show that for any $z_i \geq 0$ and any $D_i \geq 0$ gross interest rates in (1) are *secure strategies* composing *a secure profile* defined as follows.

Definition 2. *A strategy* r_i *of bank i is* a secure strategy *at strategy profile r if no bank* $j \neq i$ *has a threat against bank i at r. A strategy profile r is* a secure profile*, if all banks’ strategies are secure.*

This concept provides fewer equilibria than we would find in repeated games and includes all pure strategy Nash equilibria.

4 Continuous distribution of depositors over switching costs

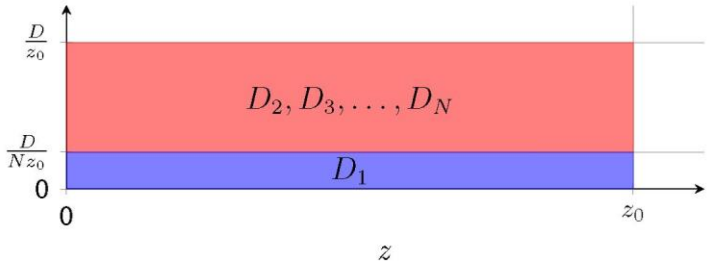
So far, we have considered a situation when each bank have depositors with the same switching costs. We will study a more general case in continuous setup.

4.1 Symmetric equilibrium

Consider symmetric equilibrium with the same gross interest rates $r_i = r$ and same uniform continuous distributions of depositors over switching costs $z \in [0, z_0]$ in the banks, see Fig. 4.

Gross interest rate $r_i \leq r$ would keep depositors with switching costs $z \geq 1 - \frac{r_i}{r}$ at bank *i*. Gross interest rate $r_i > r$ would attract all depositors with switching costs $z < 1 - \frac{r}{r_i}$ and deposits $1 - z \in [0, \frac{r}{r_i})$ form other banks to bank *i* of total amount $(N-1)\int_0^{1-\frac{r}{r_i}} (1-z)\,dz = (N-1)\left(z - \frac{z^2}{2}\right)\Big|_0^{1-\frac{r}{r_i}} = (N-1)\frac{1-\left(\frac{r}{r_i}\right)^2}{2}$.

Figure 4: Distribution of depositors among banks in symmetric equilibrium



The demand function of bank *i* has the form

$$Q_i(r_i, r) = \frac{D}{z_0 N} \times \begin{cases} z_0 - (1 - \frac{r_i}{r}) & , \quad r_i \leq r \\ z_0 + (N-1)\frac{1-\left(\frac{r}{r_i}\right)^2}{2}, & r_i > r \end{cases},$$

where *D* is the total mass of depositors equally distributes among $N > 1$ banks. Its profit $\pi_i(r_i, r) = Q_i(r_i, r)(R - r_i)$ for $r_i \leq r$ has decreasing w.r.t. r_i derivative $\frac{\partial}{\partial r_i}\pi_i(r_i, r) = \frac{R}{r} - \frac{2r_i}{r} - z_0 + 1 \geq \frac{R}{r} - 1 - z_0$, which is not negative iff $r \leq \frac{R}{1+z_0}$. For $r_i > r$ the derivative w.r.t. r_i is decreasing $\frac{\partial}{\partial r_i}\pi_i(r_i, r) = (N-1)\,r^2\left(\frac{R}{r_i^3} - \frac{1}{2r_i^2}\right) - z_0 - \frac{N-1}{2} \leq (N-1)\left(\frac{R}{r} - 1\right) - z_0$, which is not positive iff $r \geq \frac{R}{1+\frac{z_0}{N-1}}$. Inequalities $\frac{R}{1+\frac{z_0}{N-1}} \leq r \leq \frac{R}{1+z_0}$ are only compatible if $N = 2$. Thus there is a symmetric equilibrium only with two banks and $r = \frac{R}{1+z_0}$.

Same result holds for any differentiable cumulative distribution $F(z)$ of depositors over their switching costs, such that $F(0) = 0$, $F(z_0) = 1$, $F'(0) > 0$. The demand function of bank *i* has the form

$$Q_i(r_i, r) = \frac{D}{N} \times \begin{cases} 1 - F(z) & , \quad z = 1 - \frac{r_i}{r} \geq 0 \\ 1 + (N-1)\int_0^{\tilde{z}} (1-z)\,dF(z), & \tilde{z} = 1 - \frac{r}{r_i} > 0 \end{cases},$$

and its profit $\pi_i(r_i, r) = Q_i(r_i, r)(R - r_i)$

$$\pi_i(r_i, r) = \frac{D}{N} \times \begin{cases} (1 - F(z))(R - r + rz) & , \quad z = 1 - \frac{r_i}{r} \geq 0 \\ \left(1 + (N-1)\int_0^{\tilde{z}} (1-z)\,dF(z)\right)\left(R - \frac{r}{1-\tilde{z}}\right), & \tilde{z} = 1 - \frac{r}{r_i} > 0 \end{cases}$$

Necessary conditions for $r_i = r$ being the best response are the following inequalities

$$\frac{\partial}{\partial z}\left(1-F(z)\right)\left(R-r+rz\right)\Big|_{z=0} \leq 0,$$

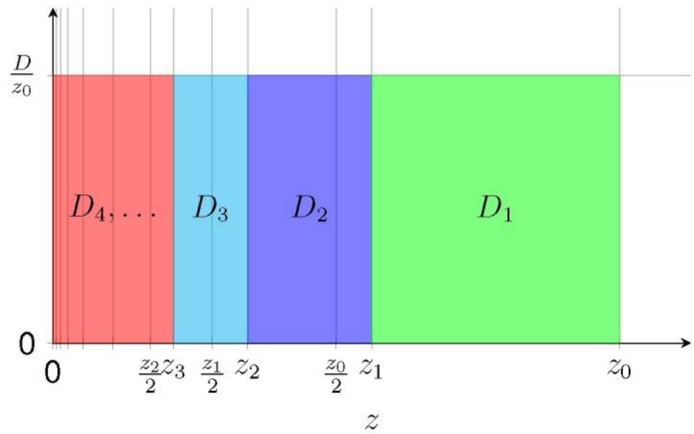
$$\frac{\partial}{\partial z}\left(1+(N-1)\int_0^{\tilde z}(1-z)\,dF(z)\right)\left(R-\frac{r}{1-\tilde z}\right)\Big|_{\tilde z=0} \leq 0,$$

which result into the chain of inequalities

$$\frac{R}{1+\frac{1}{F'(0)(N-1)}} \leq r \leq \frac{R}{1+\frac{1}{F'(0)}},$$

compatible only when $N = 2$ and unique rate $r = \frac{R}{1+\frac{1}{F'(0)}}$.

Figure 5: Distribution of depositors among infinite number of banks in asymmetric equilibria, where banks set gross interest rates $r_i = R(1-z_i)$



4.2 Asymmetric equilibria

Consider uniform distribution of depositors over switching costs from 0 to $z_0 \in (0, 1-\frac{1}{R})$, see Fig 5. It is easy to show that there is the following asymmetric equilibrium, including intervals $(z_i, z_{i-1}]$ of all depositors distribution that are clients of bank *i*, so that

$$D_i = D\,\frac{z_{i-1}-z_i}{z_0}, \quad r_i = R\left(1-z_i\right),$$

where $z_i \in [\frac{z_{i-1}}{2}, z_{i-1}]$ and $\lim_{i\to\infty} r_i = R$ with infinite number of banks. Indeed, $r_i = R(1-z_i)$ is the optimal response maximizing profit,[3] see Fig. 6.

[3] Function $\left(z_{i-1}-1+\frac{r}{R}\right)(R-r)$ is concave with maximum at $r = R\left(1-\frac{z_{i-1}}{2}\right) \geq R\left(1-z_i\right)$ due to $z_i \geq \frac{z_{i-1}}{2}$.

$$r_i \in \arg\max_{r\geq 1}\left\{0, \left(z_{i-1} - \max\left\{z_i, 1-\frac{r}{R}\right\}\right)\right\}(R-r).$$

Similar equilibria exist for finite number of banks $N > 1$, when depositors are uniformly distributed over switching cost $[\underline{z}, z_0]$ staring form positive value $\underline{z} > 0$:

$$D_i = D\,\frac{z_{i-1} - z_i}{z_0 - \underline{z}}, \quad r_i = R\,(1 - z_i)\,, \quad \forall\, i < N$$

where $z_i \in [\frac{z_{i-1}}{2}, z_{i-1}]$ and $r_N = R$, $D_N = 0$, so that $z_{N-1} = \underline{z}$ see Fig. 7.

Figure 6: Profit (solid blue line) of bank i *having depositors with switching costs in* $(z_i, z_{i-1}]$ *reaches maximal value at* $r_i = R(1 - z_i)$*, because we require* $z_i \geq \frac{z_{i-1}}{2} \iff r_i \leq \frac{r_{i-1}+R}{2}$.

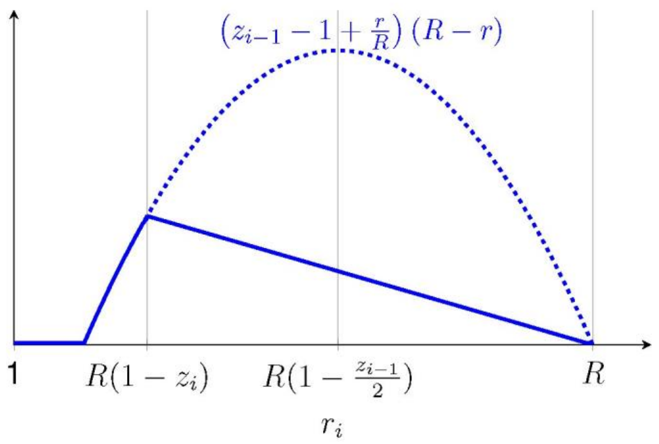
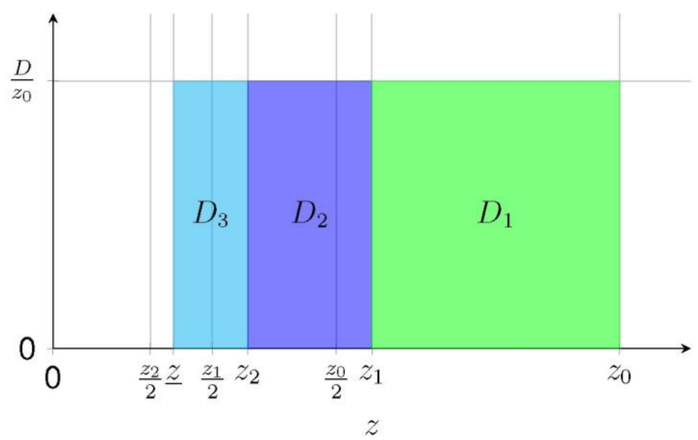


Figure 7: Distribution of depositors among banks in asymmetric equilibria, where $r_1 = R\,(1 - z_1) \geq R\left(1 - \frac{z_0}{2}\right)$, $r_2 = R\,(1 - z_2) \geq R\left(1 - \frac{z_1}{2}\right)$, $r_3 = R\,(1 - \underline{z})$, $D_3 = 0$, $r_4 = R$, $D_4 = 0$



Similar result holds for any differentiable cumulative distribution *F*(*z*) of depositors over their switching costs with the following profit function of bank *i*

$$D\,R\,\max\{0,(F(z_{i-1})-\max\{F(z_i),F(z)\})\}\,z\to\max_z$$

if the derivative of the profit is negative for all $z\in[z_i,z_{i-1}]$:

$$F(z_{i-1})-F(z)-z\,F'(z)<0.$$

5 Market power of banks and policy

We measure the market power of banks by the Lerner index

$$L_i=\frac{R-r_i}{R}=z_i,$$

that for equilibrium (1) is the switching cost, and the market power in the market as the average Lerner index (weighted by market shares)

$$L=\sum_{i=1}^{N}L_i\,\frac{D_i}{D}=\frac{\sum_{i=1}^{N}z_i\,D_i}{D},$$

which is the average switching cost.

There are many asymmetric equilibria in section 4.2, depending on distribution of depositors among banks satisfying condition $z_i\in[\frac{z_{i-1}}{2},z_{i-1}]$ so that bank market power is not necessarily related to the number of its depositors. But we can outline a natural distribution appearing if banks emerge consequently so that initially all depositors with $z\in[0,z_0]$ were at the first bank. When the second bank emerges the first bank keeps only $(z_0/2,z_0]$ setting $r_1=R\left(1-\frac{z_0}{2}\right)$. The second bank keeps $(z_0/4,z_0/2]$ setting $r_2=R\left(1-\frac{z_0}{4}\right)$ when the third bank emerges, and so on. The resulting equilibrium would be

$$r_i=R\left(1-\frac{z_0}{2^i}\right),\quad D_i=\frac{D}{2^i},\quad i=1,2,3,\ldots\quad\Rightarrow\quad L_i=\frac{z_0}{2^i}.$$

So it looks like there is negative relation

$$r_i=R\left(1-\frac{z_0}{D}D_i\right)$$

between sizes D_i and interest rates r_i of banks, see Fig. 8, but this is just one equilibrium of many, although historically plausible and having the smallest average Lerner index among all asymmetric equilibria under assumption that banks do not discriminate their depositors over switching costs:

$$L=\sum_{i=1}^{N}L_i\,\frac{D_i}{D}=z_0\sum_{i=1}^{\infty}\frac{1}{2^i}\frac{1}{2^i}=\frac{z_0}{3}.$$

Figure 8: Relation between amounts and interest rates of bank deposits in a historically plausible equilibrium.

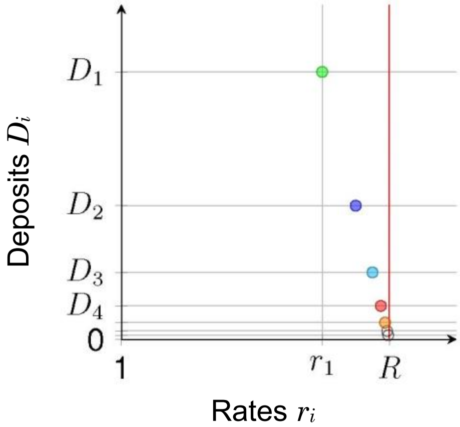
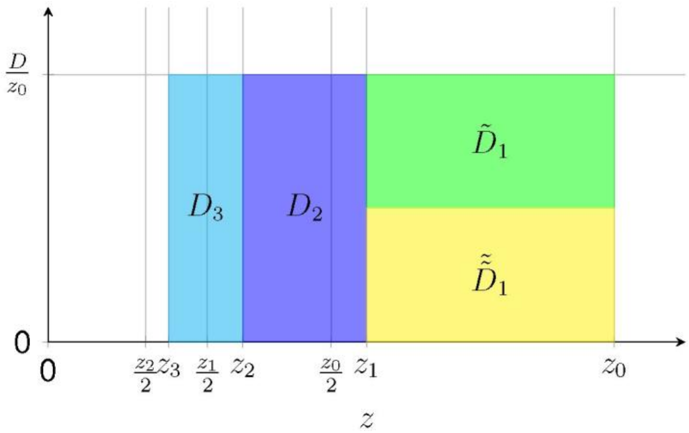


Figure 9: New banks will set the same rate $\tilde{r}_1 = \tilde{\tilde{r}}_1 = R(1 - z_1) = r_1$.



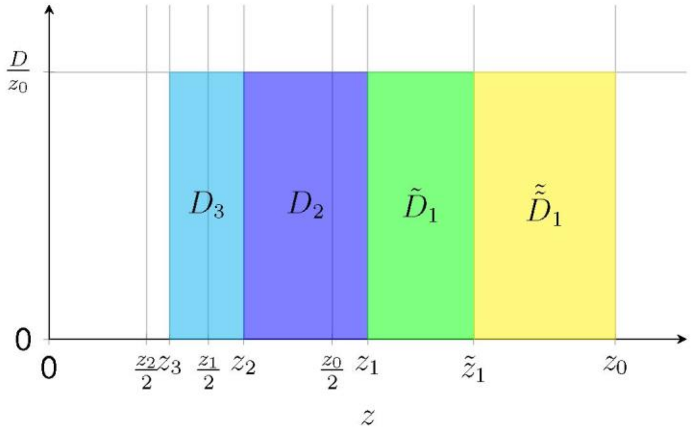
When banks can discriminate as if each depositor is at separate bank, we have maximum market power

$$L = \int_0^{z_0} z\, dF(z) = \int_0^{z_0} z\, d\frac{z}{z_0} = \frac{z_0}{2}.$$

Thus, smaller market concentration results to higher market power.[4] That is why policy that divides big banks cannot decrease the market power, Figs. 9, 10.

[4] This is because there is a price competition rather than quantity competition, where the market power is directly proportional to the market concentration (measured, e.g. by Herfindahl-Hirschman index).

Figure 10: One of the new banks will set a lower rate $\tilde{\tilde{r}}_1 = R(1-\tilde{z}_1) < \tilde{r}_1 = R(1-z_1) = r_1$.



6 Conclusions

In almost all settings of switching costs, there are asymmetric equilibria, when banks set different interest rates, having a kind of competitive fringe, where for example, one bank without depositors sets the central bank rate, or at least two banks do the same due to Bertrand competition between them, when their depositors have only zero switching costs. Other banks with positive switching costs set the lowest interest rates at which their depositors still remain with them. Same equilibria in secure strategies exist even without a competitive fringe. These asymmetric equilibria can describe lock-in of consumers effect without difference of banks in their quality of reliability.

The empirically observed negative relationship between a bank's size and its weighted average deposit rate in our model reflects the outcome of the banking market formation process.

Breaking up large banks into smaller ones is unlikely to intensify competition among banks and may instead lead to greater discrimination against depositors in the market. If depositors' switching costs remain high, even a formally developed deposit market (with a large number of participants) may exhibit persistent rate segmentation and weak competition. Artificially low deposit rates could potentially impede the mechanism of transmission of monetary policy to deposit rates. Banks with a large share of depositors facing high switching costs may be less responsive to regulatory signals, adjusting deposit rates less aggressively.

Thus, the key driver for intensifying price competition in the deposit market lies in reducing depositors' switching costs. In recent years, the Bank of Russia has implemented both structural and regulatory measures to enhance competition in the financial market.

The introduction of the Faster Payments System (FPS) and its adoption by nearly all banks has significantly enhanced interbank competition. This infrastructure enabled customers to execute 24/7 instant transfers and QR code payments for goods and ser vices.[5] From 1 May 2020, the Bank of Russia has mandated zero fees for peer-to- peer FPS transfers up to 100,000 rubles monthly. The cap was raised to 1 million rubles per transaction on 1 May 2022. As of 1 May 2024, individuals can transfer up to 30 million rubles monthly between accounts at different banks (including financial platform operators)[6] through both account-based (online/mobile banking) and phone-number-based (FPS) channels. These measures have significantly improved payment system efficiency and reduced consumer transaction costs. The legally enshrined right of employees to choose their salary deposit bank, introduced in 2019, was further reinforced by imposing penalties on employers for refusing to change the payroll bank.[7] This expanded opportunities to combat what is called ‘salary slavery’, the practice of forcing employees to use a specific bank. In coordination with the Pension Fund of the Russian Federation (now the Social Fund of Russia), policy measures were implemented to mitigate pensioner lock-in effects[8] – pensioners were granted the right to choose their pension deposit bank.

Among structural measures, it is also worth noting the 2020 legislation on financial platforms, which allows citizens to remotely access a broad spectrum of financial services and compare bank offerings.[9] This granted firms without extensive branch networks to have access to the national market while expanding consumer choice in financial products. By eliminating geographical constraints, these platforms facilitate competition between regional banks and national market leaders for depositors.

To facilitate remote banking services, depositors have been granted the ability to undergo identification and authentication through the Unified Biometric System (UBS).[10] Since 1 September 2022, banks with a universal license have been required to allow customers to open deposit accounts and obtain ruble-denominated loans remotely using the UBS.[11] Furthermore, the ‘Gosuslugi

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[5] Bank of Russia Regulation No. 732-P dated 24 September 2020, ‘On the Payment System of the Bank of Russia.’

[6] Federal Law No. 482-FZ dated 4 August 2023, ‘On Amendments to Articles 29 and 36 of the Federal Law ‘On Banks and Banking Activities.’

[7] Federal Law No. 221-FZ dated 26 July 2019, ‘On Amendments to Certain Legislative Acts of the Russian Federation.’

[8] Federal Law No. 400-FZ dated 28 December 2013, ‘On Insurance Pensions.’

[9] Federal Law No. 211-FZ dated 20 July 2020, ‘On Conducting Financial Transactions Using a Financial Platform’, Federal Law No. 212-FZ dated 20 July 2020, ‘On Amendments to Certain Legislative Acts of the Russian Federation Regarding Financial Transactions Using a Financial Platform.’

[10] Federal Law No. 441-FZ dated 30 December 2021, ‘On Amendments to Article 15.3 of the Federal Law ‘On Information, Information Technologies, and Information Protection’ and Articles 3 and 5 of the Federal Law ‘On Amendments to Certain Legislative Acts of the Russian Federation.’

[11] Federal Law No. 479-FZ dated 29 December 2020, ‘On Amendments to Certain Legislative Acts of the Russian Federation.’

Biometrics' mobile application has been introduced for the provision and withdrawal of biometric data processing authorizations.

In adapting competition legislation to digital platform regulation, specific criteria for dominant position have been established. Abuse of dominance, including discriminatory terms and artificial price manipulation, has been explicitly prohibited.[12]

[12] Federal Law No. 301-FZ dated 10 July 2023, 'On Amendments to the Federal Law 'On Protection of Competition.'

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8 Appendix

8.1 Depositor's utility function

Let a depositor change the size of the deposit $x \le y - c$

$$u(c,x) = r\,x - \frac{\sigma}{1+\sigma}(y-c)^{\frac{1+\sigma}{\sigma}} \to \max,$$

choosing consumption c, where $\sigma > 0$, y is income, as well as *bliss point* on consumption for simplicity.

If $x \ge 0$, then $c \le y$ and the budget constraint is $x = y - c$.

Then the first-order condition is $r - x^{\frac{1}{\sigma}} = 0$ and the size of the deposit is

$$x = r^{\sigma}$$

The optimal utility of the depositor has value $u(y - r^{\sigma}, r^{\sigma}) = \frac{r^{1+\sigma}}{1+\sigma}$.

The bank's profit from such a depositor is $r^{\sigma}(R-r)$.

8.2 Condition of non-switching to another bank

When switching to another bank, the budget constraint is $x = y - z - c$ and the demand for deposits is:

$$x = r^{\sigma} - z,$$

where z is the cost of switching to another bank.

Utility $u(y - r^{\sigma}, r^{\sigma} - z) = \frac{r^{1+\sigma}}{1+\sigma} - r\,z$.

The bank's profit from a switching depositor is $(r^{\sigma} - z)\,(R-r)$.

When choosing between his bank *i* and another bank *j* with a maximum interest rate of r_j, a depositor with switching costs *z* will remain in his bank if

$$\frac{r_i^{1+\sigma}}{1+\sigma} \ge \frac{r_j^{1+\sigma}}{1+\sigma} - r_j\,z$$

Note that for $\sigma \to 0$, which we assume for the sake of simplicity, the condition takes the form

$$r_i \ge r_j - r_j z.$$

8.3 Increase in social welfare

The increase in the utility of the depositor

$$\frac{r^{1+\sigma}}{1+\sigma} - \frac{1^{1+\sigma}}{1+\sigma} = \frac{r^{1+\sigma} - 1}{1+\sigma}$$

plus bank's profit

$$r^{\sigma}(R-r)$$

is the increase in social welfare per depositor:

$$Rr^{\sigma} - \frac{\sigma r^{1+\sigma} + 1}{1+\sigma} > 0 \quad \text{when} \quad r > 0 \quad \text{and} \quad \sigma > 0,$$

increasing in *r* and maximum in [1, *R*] at *r* = *R*