# *Economic Synopsis*
# Deposit interest rate ceilings

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June 2020

**Abstract**
This article surveys two strands of literature on deposit interest rate ceilings. First, we provide an overview of articles on the so called 'Regulation Q', which was promulgated in the United States in 1933 and lasted for more than 50 years. It is a very rich experience with deposit rate controls and their subsequent liberalization, and it generated large controversy amongst American economists, in particular since the mid-1960s when the deposit rate ceilings became permanently binding. We also review a second and mostly unrelated strand of literature consisting of articles, some of them rather recent, which discuss and assess deposit rate ceilings as a prudential tool, alone or in conjunction with some form of minimum capital requirements, based on banking models developed for the purpose.

## 1. Introduction

Interest rate ceilings were commonly used in banking regulation until the 1980s. Before the implementation of the first Basel Accord (Basel I), signed in July 1988, there were already in place minimum capital ratios for banks in some advanced economies but with limited scope and low harmonization. Following Basel I, minimum capital requirements were gradual and formally adopted in most developed countries, whilst controls on (deposit and loan) interest rate were progressively eased or abandoned.[1]

There is a strand of economic and financial literature which assesses the experience with deposit rate controls and their subsequent liberalization in specific countries. A large part of this literature, and in our view the most interesting for its lessons, focus on the particular case of the regulation on deposit interest rates in the United States (US), generally known as 'Regulation Q', which was promulgated in 1933 and lasted for more than 50 years. It generated great controversy amongst the US economists, in particular since the mid-1960s when the deposit rate ceilings became permanently binding. In section 2, we will provide an overview of articles devoted to Regulation Q and its effects.

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1. In Europe, the Basel I Accord was laid down into Community law through the adoption in 1989 of the Solvency Ratio and Own Funds Directives. Together with the Second Banking Directive, they aimed at harmonizing prudential banking supervision regulation, and were transposed into national law by the member states by 31 December 1992.

In section 3, we will review an unrelated strand of literature, some of it rather recent, which discusses and assesses deposit rate ceilings as a prudential tool, alone or in conjunction with some form of minimum capital requirements, based on banking models developed for the purpose.

In section 4, we will conclude by summing up the main take-aways from our overview of the literature in terms of prudential banking supervision, monetary policy and also distributive consequences of imposing deposit rate ceilings.

## 2. Regulation Q in the United States

In March 1933, in the wake of the 1929 stock market crash and amidst the greatest spate of bank failures in the US history, a bank holiday was declared and the Congress reconvened in a special session to pass emergency legislation, including the Banking Act of 1933 (also called Glass-Steagle Act), which was adopted by Congress in May and signed by President Roosevelt on 16 June 1933. Interest rate controls were included at a final stage during the discussion of the Banking Act at the Congress. Its Section 11 amended the Federal Reserve Act and forbade interest on demand deposits, as well as empowered the Federal Reserve Board to limit by regulation the rate of interest to be paid by member banks on time and savings deposits. As a result, the so-called Regulation Q was subsequently promulgated by the Federal Reserve on 29 August 1933.

The Banking Act of 1935 extended deposit rate ceilings to non-members banks of the Federal Reserve. More than 30 years after, the Interest Rate Act of 1966 empowered the Federal Home Loan Bank Board, the thrift institutions regulatory authority, to set interest rate ceilings to deposits placed with savings and loan associations and other thrift institutions. The ceilings for time and savings deposit rates were phased out during 1981–1986 after the Depository Institutions Deregulation and Monetary Control Act of 1980. It established the Depository Institutions Deregulation Committee[2] whose main duty was to phase out Regulation Q. As of 31 March 1986, all interest rate ceilings had been eliminated except for the ban on demand deposit interest. The prohibition of interest-bearing demand deposit accounts was effectively repealed by the (Dodd–Frank) Wall Street Reform and Consumer Protection Act of 2010. Beginning 21 July 2011, financial institutions in the US have been allowed to offer interest-bearing demand deposits.

Cox (1967) and Gilbert (1986) are two references, *inter alia*, for the historical background of Regulation Q in the US. According to the latter author, that were four main congressional objectives which led to the introduction of deposit rates ceilings in the US in 1933:

(1) To incentivize small country banks to lend more in their regional communities rather than hold balances with larger banks in financial centers, as there was the perception

2. Voting members of the DIDC included the Secretary of the Treasury and the chairpersons of the reserve Federal Board, Federal Deposit Insurance Corporation, Federal Home Loan Bank Board, and National Credit Union Administration. The Comptroller of the Currency was a non-voting member.

that the latter used the funds for speculative purposes, thus depriving local business and individuals of credit that could have been used productively;

(2) To reduce liquidity problems of the large banks because there was the belief that deposit withdrawals of small local banks from their accounts with the large national banks were contributing to pronounced seasonal patterns in liquidity and the occasional financial panic;

(3) To curb excessive competition for deposits which not only reduced bank profits by raising interest expenses, but also might have caused banks to acquire riskier assets with higher expected returns in attempts to limit the erosion of their profits;[3]

(4) Finally, to moderate protests of bankers about the high cost of the federal deposit insurance premiums because there was the belief by some members of Congress that the savings in interest expense resulting from deposit rate ceilings would exceed those premiums.

Objectives (2) and (3) have a clear macroprudential flavor (the term did not exist at the time the legislation was passed).

From 1933 through 1965, Regulation Q ceilings constrained deposit rates paid by most banks for only short intervals. However, after 1966 the ceilings effectively constrained the rates paid by commercial banks and thrift institutions on at least some categories of deposits. The second half of the 1960s were characterized in the US by rising inflation and market interest rates.

In the fall of 1966, interest rate ceilings on deposits were set slightly higher at thrifts than at commercial banks. Higher interest rates at thrifts were intended to induce depositors at commercial banks to shift their deposit accounts to thrift institutions. However, this policy did not yield the anticipated results. Keeping deposit rate ceilings (including those at thrift institutions) clearly below market interest rates (as they were for most of the period from 1966 to 1986), contributed to slow down the growth rate of deposits at banks and thrifts.

Since deposit rate ceilings became binding since mid-1960s, banks and thrifts competed for deposits by offering depositors a variety of gifts, 'free' services, and an expanded office network more conveniently located. Spellman (1980) discusses this non-rate competition of banks for deposits, which is the financial analogue to non-price competition in the goods and services markets. He remarked that besides the explicit and observed deposit rate, one may define and estimate an implicit deposit rate in the form of financial services and goods, determined by costs incurred by banks and thrifts besides those associated with the payment of interest on deposits.

Barro and Santomero (1972), when estimating the demand for money in the US, had provided a series of estimates of the implicit interest rate paid on demand deposits (which by law had a zero explicit interest rate). Startz (1983) followed on this issue using

3. Two studies carried out in the 1960s, Benston (1964) and Cox (1966), claimed that in the 1920s, before US bank deposit rates were regulated, there was little relationship between deposit rates and bank risk-taking, contrary to had been thought in the 1930s. Using more sophisticated statistical techniques and better data, Rolnick (1987) reassessed this conclusion and showed a strong multivariate correlation between the passbook deposit rate and risk variables like the leverage ratio.

a theoretical monopolistic competition model adapted from Chamberlain (1962) and concluded that a legal restriction on the demand deposit rate results in only a partially effective economic restriction. When a binding ceiling on the explicit deposit rate exists, the implicit rate will be positive but below the shadow rate. Also according to Startz (1983)'s model, given a binding ceiling on the explicit deposit rate, an increase in the number of banks competing in the deposit market will increase the implicit rate.

A relevant effect of Regulation Q was that it altered the distribution of wealth in the economy, discriminating against the relatively less wealthy savers. The wealthier savers could always shift their deposits to liquid market securities and escape the financial penalty induced by the deposit rate ceilings. This distributional effect was aggravated by the Federal Reserve decision in June 1970 to exempt from Regulation Q deposits of USD 100,000 or more.

Several prominent US economists reacted strongly against the Federal Reserve management of interest rate ceilings from the mid-1960s under Regulation Q and one of their main points was the allocative and distributive consequences of a policy of deliberately keeping low ceilings relative to market interest rates. Tobin (1970) claimed that it discriminated against the small saver who could not earn market interest rate (although the small borrower paid it). He wrote that small savers cannot easily go into the open market in search of higher yields because they are impeded by the significant minimum denominations and lot sizes of market instruments, by brokerage fees, and by their own unfamiliarity and ignorance. According toTobin (1970), by conducting the low deposit rate ceilings policy, the Federal Reserve was denying the small saver the compensation for the high inflation,[4] anticipating that such discriminatory policy could not last long and would gradually be eroded by some form of market arbitrage.

Tobin (1970) also dismissed the Federal Reserve arguments that increasing the deposit rate ceilings would be expansionary and thus would further contribute to increase inflation. He stated that, in principle, the same degree of effective monetary restraint can be easily achieved with low ceilings, high ceilings or with no ceilings, because the overall monetary effects of ceiling regulations tend to be small and easy to neutralize by traditional market-oriented monetary controls.

Friedman (1970) categorized the consequences of deposit rate ceilings into four classes: Equity, efficiency of capital markets, effect on monetary aggregates, and effects on inflation. As for equity, the arguments are very similar to the ones put forward by Tobin (1970): depositors who receive less interest on their deposits are mostly holders of relatively small deposits, generally individuals with small incomes and wealth, and these people have the fewest alternative ways to invest their limited assets and are least sophisticated about the alternatives. One populist justification was that the "poor" are

4. Tobin (1970) also argued that the low deposit rate ceilings policy had been advocated and supported by the Federal Home Loan Bank Board, the regulatory authority of savings and loans associations, on cosmetic grounds, such that losses would not show up either in the balance sheets or in the income statements of the thrift associations. Borrowing short (deposits) and lending long (home mortgage loans), the thrifts institutions had suffered significant capital losses when there was the general rise in interest rates (their portfolios were full of mortgages made at the low interest rates of the past).

borrowers, not lenders, and deposit rate ceilings keep down the interest rate charged to borrowers. In any event, this argument would call for limiting interest rates on loans, not rates paid to depositors. Friedman (1970) considered that borrowers who were able to acquire funds at a lower interest rate were not those who borrowed from institutions affected by the controls but those who borrowed from other lenders. The deposit rate ceilings reduced the real volume of funds available to the institutions affected because it rendered less attractive to place funds with those institutions. Given the smaller volume of funds to lend, in some situations the interest rate charged for loans may even had been higher not lower than in the absence of controls.

Regarding the effect of deposit rate ceilings on the efficiency of capital markets, Friedman (1970) remarked that controls, if effective, distort the capital markets. Defenders of deposit rate ceilings in their argumentation had claimed they wanted to distort the market to favor housing, in order to divert funds from commercial banks (specialized in lending to businesses) to saving and loan associations (specialized in financing housing and construction). However, the deposit rate ceilings clearly had reduced the total real volume of funds going to banks and thrifts combined, resulting in both having less funds available, and meaning that credit to housing and construction had been hurt, not helped.

Concerning monetary aggregates, Friedman (1970) highlighted that one side effect of deposit rate ceilings is that they rendered the usual monetary aggregates difficult to interpret and they promoted instability of the relationship between monetary aggregates and income and other macroeconomic indicators. This is explained by the fact that, insofar as the controls are effective, they lead to changes in the ratio of demand to time and savings deposits as the spreads between ceilings and market rates change, thus affecting the relative rates of growth of monetary aggregates M1 and M2. If ceilings on time and savings deposits are clearly below market rates, M1 tends to be higher due a larger volume of demand deposits, and M2 becomes smaller with deposit rate ceilings than without controls due to disintermediation, i.e. leakage of deposits to close substitutes.

Therefore, if one sees in M2 more merit in terms of stability of the relationship with income, Regulation Q appeared as having anti-inflationary effects. However, the relationships of M1 and M2 with income are less stable than without controls and the effects on the velocity of money may be substantial, making it quite hard to establish a presumption whether the net result of regulation Q is anti- or pro-inflationary. According to Friedman (1970), in terms of monetary policy, the only possible advantage in using Regulation Q was political. The existence of ceilings on rates paid by banks was reducing the pressure for an expansive monetary policy from the housing industry, savings and loan associations.

As mentioned, these papers by Tobin (1970) and Friedman (1970) were published as a reaction to the management of deposit rate ceilings by the Federal Reserve (and the Federal Home Loan Bank Board) in the late 1960s. During the 1970s, interest rates were kept below market rates for time and savings deposits under USD 100,000. In June 1978, when market rates were rising sharply, the Federal Reserve authorized banks and thrifts to issue Money Market Certificates, with a minimum denomination of USD

10,000 and an interest rate ceiling that fluctuated with the yield on 6-month Treasury bills (the ceiling for thrifts was set each week 25 basis point higher than for commercial banks). Sharp increases in market interest rates in late 1979 and early 1980, combined with Regulation Q ceilings, induced large outflows of small denomination deposits from banks and thrifts. The situation triggered the above mentioned decision to gradually phase out Regulation Q. The Monetary Control Act of March 1980 increased federal deposit insurance from USD 40,000 to USD 100,000 and gave the Depository Institutions Deregulation Committee broad discretion in choosing the method for phasing out the ceilings, but the committee was not allowed to raise the ceilings above market rates before 1986.

Berger *et al.* (1995) reviews the changes undergone by the US banking industry over the period 1979-1994. Amongst the topics covered by this rather extensive paper, there is a discussion of deposit accounts deregulation following the establishment in 1980 of the Depository Institutions Deregulation Committee. The authors claim that market innovations played a fundamental role in the dismantling of regulatory restrictions on deposit interest rates in the US. As a consequence of the creation of rather safe deposit-like instruments that were not subject to Regulation Q and paid market interest rates, the banking industry lost much of its monopsony power over depositors in the early 1980s.

As of 1979, the ratio of banks' interest expenses over total assets was more than 5 percentage points below the one-year Treasury yield. By 1986, when deposit rates were already totally deregulated, the spread had decreased by more than 4 percentage points. These extra interest costs were not offset by a reduction in non-interest expenses, which could have been achieved by pruning extra branches and other services previously created in the spirit of increased non-interest competition amongst banks. On the contrary, between 1979 and 1986 the non-interest expenses rose somewhat, the number of banking offices increased by almost 16 percent and the number of ATMs more than quadrupled. These data suggest that external competition to the banking industry on the liability side, as well as competition amongst banks for deposits, encouraged banks to provide not only additional interest payments to depositors, but also raised the level of customer convenience services during the first half of the 1980s. In turn, this implied a substantial rise in costs of US banks and a corresponding fall in their franchise value.

The decline in the banking industry's profitability, along with severe problems of loan performance experienced by many banks, contributed to a dramatic increase in the number of bank failures, up to 1988 mostly of very small banks. By the end of the 1980s, about 200 banks were failing each year in the US. Before 1988, only five banks with assets over USD 1 billion had been closed, but in the next five years twenty seven banks of at least that size failed. From 1981 through 1994 a total of 1,455 banks failed in the US, with an estimated cost of around USD 50 billion.

Berger *et al.* (1995), the exact relationship between the deregulation of deposit rates and the high incidence and great public cost of bank failures is unknown, but a possible theory is that the reduction of profitability incentivized troubled banks to gamble by increasing their portfolio risk. Most banks that failed in the late 1980s and early 1990s

had both high costs and large quantities of non-performing loans, indicating that moral hazard played an important role in the process.

Berger *et al.* (1995) also document that the failures occurred in spite of deposit rate ceilings being progressively replaced by capital requirements. Up to 1981, there were no formal minimum capital ratios in the US, and supervisory oversight generally required less capital for large banks because of their presumed better diversification of risks.[5] From December 1981, when deposit rate ceilings were being phased out, flat (i.e. non risk-weighted) capital requirements were introduced for regional and community banks, and only in June 1983 were the standards extended to cover banks with business in multiple states and/or different countries. These flat-rate capital standards did not require any capital against off-balance sheet activities, and therefore encouraged the substitution of off-balance sheet counterparty guarantees (such as standby letters of credit and loan commitments backing up commercial paper) for on-balance sheet loans.

It appears that in 1980s the largest banks significantly increased their credit risk exposure by substituting from cash and securities holdings into loans.[6] About half the growth in loans was associated with commercial real estate lending, one of the riskiest investments that banks can make.[7]

Sherman (2009) summarizes and assesses the main regulatory changes that took place in the US banking system during the three decades previous to the Global Financial Crisis of 2008, thus also covering the phasing out period of Regulation Q. He reports that, from the late 1970s, investors could lend directly to borrowers in the commercial paper market, bypassing banks as intermediaries. Brokers and other financial institutions began to create money market mutual funds, which pooled investors' funds to purchase commercial paper. These money market funds operated without reserve requirements or restrictions on rates of return, and quickly became popular, even amongst small investors who shifted their money out of deposits.

In 1982, the US Congress passed the Depository Institutions Act (also known as the Garn-St. Germain Act) which authorized thrifts to engage in commercial loans up to 10 percent of their assets and offer a new type of deposit account to compete directly with money market funds. It also provided direct capital assistance to distressed institutions and expanded federal regulators' ability to deal with them. While intending to benefit thrift institutions, the Garn-St. Germain Act allowed them to behave more like banks and take new types of risks which proved some years later to be a problem.

Moreover, the thrift industry was already in distress since the end of the 1970s, and in the early 1980s was facing the disappearance of the advantage that it held over banks due to higher specific deposit rate ceilings. In their traditional business, in a period

5. In 1979, the leverage ratio (i.e. equity to total non-risk-weighted gross assets) for megabanks in the US was 3.9%, while it was 8.5% for small banks.

6. Between 1979 and 1989, banking groups with more than USD 100 billion in total assets increased the fraction of assets invested in loans and leases from 57.7% to 69.8% (and correspondingly decreased their cash and securities holdings from 32.2% to 19.4%).

7. Between 1979 and 1989, the share of assets going into commercial real estate nearly doubled from 6.3% to 11.6%.

of high inflation and strong competitive pressures for deposits, thrifts were especially vulnerable to the typical asset-liability mismatch (short-term deposits and very long term loans). Most thrifts reported large losses in the early 1980s, and institutions failed at a regular pace. However, no large-scale action was taken by the authorities for a variety of reasons. For one, the industry's deposit insurance fund was ill equipped to deal with the prospect of widespread insolvency. According to estimates at the time, it needed around USD 25 billion to bail out the industry in 1983 and had reserves of only around USD 6 billion.

In addition, between the years of 1982 and 1985, thrifts invested in condominiums and other commercial real estate, shifting the investment portfolios away from the traditional home mortgages into higher-risk loans. After the passage of the Tax Reform Act of 1986, which eliminated many of the tax shelters that had made real estate such an attractive investment, the boom in real estate went burst and deposits fled from thrifts. The thrift industry declined from 3,234 to 1,645 institutions and the failures cost to the tax payers around USD 210 billion (with the industry itself providing another USD 50 billion).

There are three other papers worth mentioning as regards the effects and consequences of Regulation Q in the US. The first of them is Mertens (2008), which claimed that the regulatory deposit rate ceilings and their removal was an important cause behind the change in output and price volatilities in the US. Output and inflation volatility had dropped considerably since the early 1980s, the so-called Great Moderation. Clarida *et al.* (2000) and Cogley and Sargent (2005), *inter alia*, focused on shifts in monetary policymaking, arguing that the Federal Reserve had become more successful in fighting inflation and stabilizing economic activity. Others, such as Bernanke and Mihov (1998) and Sims and Zha (2006), found little evidence for a break in the conduct of monetary policy in the US. Against this background in the literature, Mertens (2008) argued that a large part of the reduction in volatility was likely explained by the removal of the deposit rate ceilings. He based his conclusion on the results of two models, one theoretical (a dynamic stochastic general equilibrium model, based on a money-in-utility framework) and the other model empirical (a two-regime structural autoregressive model, one with and the other without binding deposit rate ceilings).

Regulation-induced disintermediation occurs when depository institutions experience drops in deposit inflows because legal ceilings prevent the payment of higher interest rates offered on market instruments. Whenever banks were unable to raise deposit rates above the legal ceilings, banks could not compete effectively with market instruments and failed to manage their liabilities in the same way as without binding regulations. Disintermediation potentially has real effects if the resulting shortage of loanable funds forces banks to cut back on lending to borrowers that rely on intermediated finance. In that case, deposit rate ceilings affects monetary policy transmission mechanism and provides monetary policy with a greater leverage over real activity. Thus binding deposit rate ceilings from mid-1960s up to the early 1980s may have contributed to business cycle volatility since, in contrast to the post 1980s years, every recession during that period was associated with outflows in all deposit categories.

In turn, Koch (2015) addressed empirically the related question of how deposit rate ceilings embodied in Regulation Q affected individual banks' lending and the transmission of monetary policy to credit in the US until de mid-1980s. For that purpose, Koch (2015) considered a panel of quarterly bank balance sheet data from 1959Q4 to2014Q4 containing about one million bank-quarter observations.

According to Koch (2015)'s results, during the Regulation Q era, large part of credit growth responses of banks can be explained by the interaction between rate ceilings and monetary policy (i.e. changes in the federal funds rate), whilst afterwards during the Great Moderation monetary policy seems to have had only very minor effects on bank level credit growth. All else being equal, the propagation of monetary policy through bank loan supply shifts seems to have diminished substantially, pointing to an attenuation of shock propagation driven by regulation. Hence, the result of deposit rate ceiling deregulation was primarily the diminished ability of the Federal Reserve to directly shift loan supply schedules of individual banks, implying that the traditional bank lending channel at the business cycle frequency is orders of magnitude weaker than in Regulation Q era, if not completely defunct.

Lucas (2013) concurs that the interaction of Regulation Q and the US inflation in the 1970s drove business deposits out of the regulated commercial banks and into substitute forms of liquidity, possibly setting the stage for the crisis of 2008. By 1980, the spread between the market rates and deposit rates were on the order of 8 percentage points. Such returns attracted competitors that offered substitute forms of liquidity paying depositors something closer to market interest rates. These processes of substitution scattered deposits out into the world of 'shadow banking' and largely ended the constraints imposed by Regulation Q, making the Glass-Steagall Act repeal just a formality. According to Lucas (2013), none of the substitutes of deposits (Eurodollars, money market funds, etc.) involved technical or conceptual advances in banking practice. They were simply workarounds designed to evade the restriction imposed by Regulation Q, contrary to other genuine financial innovations like the repo market and the derivative assets.

## 3. Deposit rate ceilings as a prudential tool

Financial liberalization tends to increase the intensity of competition between banks at the same time that banks are given greater freedom to allocate assets and to determine interest rates. As a consequence, the potential scope for gambling by banks also increases, thus raising the need for effective prudential regulation.

Besides papers on specific country experiences, especially those on the US Regulation Q summarized in the previous section, there is an another strand of literature developing (mostly theoretical) models of banking where deposit rate ceilings are discussed and assessed as a prudential tool, alone or in conjunction with some form of minimum capital requirements.

An earlier paper in this literature is Eichberger and Harper (1989). They present a very simple theoretical model, loosely motivated by the experience of financial

deregulation in Australia, with one single bank and one single non-bank financial institution which compete in duopsony for deposit balances. Deposits offered by the two institutions are imperfect substitutes, and they both have the objective of profit maximization. It is shown that the imposition of a deposit interest rate ceiling on the bank can increase its profit in the detriment of the non-bank. However, an increase in the degree of substitutability between the two types of deposits can reverse this conclusion.

Therefore, according to Eichberger and Harper (1989), if bank deposits and investments with non-banks are not close substitutes, deposit-rate ceilings prevent destructive competition amongst banks. If banks are forced to pay more for deposits then they are tempted to invest in riskier assets to help defray their larger financing costs, implying an increase of the chance of a bank crisis. In other words, there is a public interest in imposing a deposit-rate ceiling.

Nielsen and Weinrich (2019), using a relatively simple theoretical model of perfect competition in the banking sector, deal with a similar issue, and reiterate Eichberger and Harper (1989)'s conclusion. In their model, depositors maximize utility and live for only one period in non-overlapping generations. Each has an initial wealth at the beginning of the period, a portion of which can be transferred to the end of the period by depositing with a bank or investing in an outside asset. The bankers invest the funds raised as deposits either in a risk-free asset or in a risky asset. Depositors fund the deposit insurance through taxes and receive any bank profit at the end of the period. Depositor's utility depends both on consumption during the period and the final amount of his wealth.

If the return of the risky asset is close to the risk-free rate of return, i.e. if the risky asset is not too risky, deposit-rate regulation dominates no regulation in terms of welfare. As the return of the risky asset increases, there is market leakage out of deposits and deposit rate ceilings become ineffective. According to Nielsen and Weinrich (2019)'s model, there are two opposing forces at play when riskiness increases. On the one hand, the risky asset becomes more distortive making the absence of regulation less efficient. On the other hand, deposit rate regulation will suppress savings further.

To our knowledge, Hellman *et al.* (2000) was the first paper to confront the pros and cons of interest rate ceilings and minimum capital requirements as prudential tools. They considered a reduced form model of the deposit market. Deposits are fully insured by a government agency. A bank offers an interest rate on deposits in competition with other banks. The total volume of deposits mobilized by the bank depends positively on its own rate and negatively on the competitors' rates. The degree of competition in the deposit market is indirectly introduced through the elasticity of bank's deposits relative to its own rate (the larger the elasticity, the higher the competition). The bank allocates its resources (deposits and equity, the latter set as a proportion of the former) to an asset portfolio, and may choose between two assets: a prudent asset and a gambling asset. Competition erodes bank profits implying lower franchise values (i.e. the capitalized value of expected future profits) and thus lower incentives for granting prudent loans, increasing moral-hazard issues (because bank's owners have less at stake).

Some form of prudential regulation is needed so that banks bear some of the downside risk from investing in risky assets. The standard regulatory response has

been to tighten capital requirements, so that higher capital implies higher losses for the banks' shareholders in case of default. However, in addition to this "capital at risk effect", there is a "franchise value effect" that goes in the opposite direction. Higher capital requirements reduce the return on equity, and hence the banks' franchise values, so the combined effect of capital at risk and franchise value is ambiguous. Thus, with sufficient competition banks will find desirable to gamble and prudential regulation just making use of a capital requirement is a Pareto-inferior policy choice (because besides the private loss of bank shareholders there is the large social loss generated when banks become bankrupt).

Bank deposits are government insured and so banks are essentially borrowing using the government´s credit rating. When insured financial institutions deviate to gambling, they can use the government´s own credit rating to offer high deposit rates in (socially inefficient) competition with the government. That is the reason why deposit-rate ceilings should be set, preferably in relative terms and not in absolute terms. If the deposit-rate ceiling were set at some fixed maximum spread above the equivalent-duration government bond yield, then the ceiling would adjust in a timely way to changes in market conditions.

The equilibrium analysis in Hellman *et al.* (2000) relied on first order conditions that cannot be solved explicitly, implying that the effects of capital requirements cannot be precisely ascertained. Building on Hellman *et al.* (2000), Repullo (2004) developed a dynamic model of imperfect competition in the deposit market (with fully insured deposits) that overcomes the limitation. Imperfect competition was introduced as in Salop (1979) using a circular road model with uniformly distributed customers (depositors). Depositors incur in a searching cost for the best investment conditions, which is the source of banks' market power.

In the absence of capital requirements, there are two possible equilibria, one in which banks invest in the prudent asset, and other in which banks invest in the gambling asset. In that situation, if the intermediation margins are low (i.e. very competitive markets) only the gambling equilibrium exists, while for high margins (i.e. very monopolistic markets) only the prudent equilibrium exists. For intermediate margins, both equilibria coexist.

Under rather general conditions, capital requirements are always effective in ensuring the existence of a prudent equilibrium through the workings of the capital at risk effect (but the required level of capital requirements may need to be quite high if the margin is low). Indeed, the probability of losing the equity reduces the incentives to invest in the gambling asset. Importantly, the efficiency of capital requirements as a regulatory tool increases when they discriminate in favor of investment in the prudent asset (i.e. when a larger risk weight is attached to the gambling asset when computing the denominator of the capital ratio).

Like capital requirements, deposit rate ceilings are also effective in ensuring the existence of a prudent equilibrium. But unlike capital requirements which work mainly through the capital at risk effect, the relevant channel for deposit rate ceilings is the franchise value effect. By enlarging the interest margin of banks, deposit rate ceilings increase the present value of the banks' future profits and so stakeholders have more

to lose when the bank gambles. However, in order to be effective, deposit rate ceilings may require very low (even negative) interest rates so as to generate a sufficiently large margin. This is a similar limitation as obtained for flat (i.e. non-risk-weighted) capital requirements, which may require a large capital ratio in order to ensure the existence of a prudent equilibrium. The issue is solved when one resorts to a regulatory policy based on risk-weighted capital requirements, which does not need very high minimum capital ratios if the risk weights sufficiently discriminate against the gambling assets.

Egan *et al.* (2017) proposed a structural empirical model of the US banking sector inspired on the theoretical models put forward by Diamond and Dybvig (1983), Goldstein and Pauzner (2005), and related literature. It makes the important distinction between insured and uninsured deposits, and pays particular attention to the presence of multiple equilibria and the possibility of bank runs.

Deposits represent over three-quarters of the funding of US commercial banks and approximately half of the deposits are uninsured. Uninsured deposits become frequently impaired in cases of bank default, and therefore are potentially prone to runs. The strength of the feedback between deposits and financial distress depends on how costly deposits withdrawals are for banks, and how they respond to a raised probability of withdrawals (for example, by raising interest rates). Egan *et al.* (2017)'s model aims at quantifying these forces and at assessing the effects of different alternative regulatory policies (in particular, capital requirements and deposit-rate ceilings) with respect to bank stability and overall welfare. It was estimated and calibrated on a dataset covering the largest US banks over the period 2002-2013.

In the model, depositors are fully rational, anticipate the probability of default, and incorporate these beliefs when choosing a bank to place their deposits. Every period, depositors choose among banks to place insured and uninsured deposits, taking interest rates offered by banks as given. Besides interest rates, deposit demand responds to changes on the financial health of the bank in the case of uninsured deposits (but not in the case of insured deposits). The probability and magnitude of a bank run are influenced by the elasticity of uninsured deposit demand with respect to financial distress (the banks' probabilities of default are taken as given by depositors). The demand for deposits also depends on the differentiation of services associated with deposits from which depositors derive utility.

As regards banks, they compete for insured and uninsured deposits by setting interest rates in a standard Bertrand-Nash differentiated products setting (following Matutes and Vives (1996)). Banks earn stochastic returns from the investments made with the funds collected from deposits, long term debt and equity issuance, and choose optimal deposit rates given the demand for deposits which they face. Each period, banks decide (endogenously) whether to continue operations by repaying deposits and the long-term debt coupon. Alternatively, banks can declare bankruptcy if returns are low and fall short of required payments. A bank in financial distress has to offer higher interest rates on deposits, which decreases its profitability. Equity holders are allowed to recapitalize the bank in distress at the end of each period. Regulators then inspect whether the bank can repay all deposits and other debt that has come due. If not, the bank is taken into receivership.

Hence, in the model uninsured depositor utility depends on bank survival, and bank survival depends on demand for deposits. This interaction leads to potential multiple equilibria, in which different levels of default are possible for the same fundamentals of banks. If some depositors choose to not deposit with a bank, its value decreases, making it more likely that equity holders will allow the bank to slide into bankruptcy and that other depositors will not place funds with the bank. The bank will fail if it does not have enough funds to repay deposits and debt come due, and if equity holders decide not to recapitalize the bank.

The instability of one bank can propagate to other banks through competition, in particular through interest rates. The unstable bank mobilizes funds (both insured and uninsured deposits) by raising interest rates. Insured depositors will be less sensitive to the bank's probability of default and that may imply a rise in the bank's market share of insured deposits. In other words, the bank in distress has incentive to take advantage of the deposit guarantee with two consequences: 1) by raising interest rates it will lead other banks to also raise interest rates in order to minimize the outflow of insured deposits, decreasing their profitability and therefore increasing their instability; 2) in case of default, the distressed bank's higher market share of insured deposits will increase the cost faced by the deposit insurance scheme (ultimately by the tax payer).

In the baseline model, without capital requirements and deposit rate ceilings, limited liability protects equity holders and in case of default they only lose their investment. When a minimum capital ratio is considered, the return on equity decreases and banking sector stability in the model's best equilibrium declines (due to the reduced profitability). In this good equilibria, depositors believe banks are quite stable and demand for deposits is high, and so the consequences of imposing capital requirements are not very significant. However, while slightly deteriorating the good equilibria, capital requirements have the advantage of removing some of the worst equilibria faced by the banking sector when no capital requirements are considered. It is worth mentioning that, with the data for the US, the model indicates that overall welfare losses in bad equilibria are substantial for capital requirements below 18 percent (and that in the worst equilibrium welfare starts to decrease after capital requirements exceed 39 percent, but the latter value is not robust to model perturbations).

The imposition of a deposit rate ceiling might prevent banks from taking advantage of the deposit insurance scheme and will limit the effect of spillovers on the other banks. However, while a deposit rate ceiling makes the banking system more stable from the perspective of default rates and less costly to the deposit insurance scheme, it can have an adverse effect on the level of uninsured services provided by the banking system. Indeed, when including in the model limits on deposit rates, the model leads to several possible equilibria in which uninsured deposits leave the banking system even if banks are more stable.

## 4. Main take-aways from the literature

We conclude this article by summing up which are, in our opinion, the main take-aways from the economic and financial literature on the advantages and drawbacks of imposing deposit rate ceilings.

Higher capital requirements reduce the return on equity and hence banks' franchise value. They also imply larger losses for the banks' shareholders in case of default. With sufficient competition, banks will find desirable to gamble and prudential regulation making use of minimum capital requirements may become a Pareto-inferior policy choice due to the large social loss generated when banks default. The problem is mitigated if capital requirements efficiently discriminate in favor of investment in prudent assets by attaching a larger risk weight to riskier assets when computing the denominator of the capital ratio.

Deposit rate ceilings may be envisaged as a possible alternative or, more likely, as a complementary prudential banking regulatory tool, either on a permanent or on a temporary basis. If banks are forced to pay more for deposits then they are tempted to invest in riskier assets to help defray their larger financing costs, implying an increase of the chance of a bank crisis. Unlike capital requirements, which work mainly through the increase of capital at risk for banks' shareholders, the relevant channel for deposit rate ceilings is the franchise value effect. By enlarging the interest margin of banks, deposit rate ceilings increase the present value of the banks' future profits and so stakeholders have more to lose when the bank gambles.

Furthermore, in the absence of deposit rate ceilings, a bank in distress has the incentive to take advantage of the public deposit insurance by raising interest rates. But doing so it will lead other banks to also raise interest rates in order to minimize the outflow of deposits, decreasing their profitability and therefore increasing their instability. In case of default, the distressed bank's higher market share of insured deposits will increase the cost faced by the deposit insurance scheme (ultimately by the taxpayer).

However, deposit rate ceilings are subject to several important shortcomings.

Significant regulation-induced disintermediation may occur if legal ceilings prevent banks from the payment of higher interest rates on deposits as offered on market instruments. Deposit rate ceilings are only effective if bank deposits and other liquid investments with non-banks are not close substitutes. In advanced economies these processes of substitution would tend to scatter a significant part of deposits out of banks, largely compromising the effectiveness of the legal ceilings and at the same time pushing household savings to securities often of under-perceived riskiness. This movement out of deposits will be more pronounced for large uninsured deposits, although it may be non-negligible even for relatively small time and savings insured deposits.

The imposition of deposit rate ceilings might encourage banks to strongly raise the level of customer convenience services by offering depositors a variety of services free-of-charge, and to excessively expand their office network in order to become more conveniently located. This non-rate competition of banks for deposits may imply a substantial increase in costs incurred by banks besides those associated with the

payment of interest on deposits. The corresponding fall in their franchise value will counteract the main channel through which deposit rate ceilings exert their prudential effect.

Disintermediation has real effects if shortage of deposit funds arises and forces banks to cut back on lending to borrowers that rely on intermediated finance. This response by banks may be mitigated by the central bank through appropriate financing which becomes crucial in the presence of binding deposit rate ceilings. Indeed, the latter have the potential to affect monetary policy transmission mechanism and thus provide monetary policy with a greater role due to the increased leverage over real activity.

Last but not least, a relevant effect of a policy of deliberately keeping low deposit rate ceilings relative to market interest rates is that it may have strong allocative and distributive consequences, discriminating against individuals with small incomes and wealth. Wealthy savers can always shift their deposits to liquid market securities and escape the financial penalty induced by the ceilings, whereas small savers have the fewest alternative ways to invest their limited assets and are least sophisticated about using those alternatives.

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