The Political Economy of Banking Competition

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[PRELIMINARY AND INCOMPLETE]

Abstract

This paper provides a banking competition rationale for the financial deregulation waves that happened in the United States from the 1980s onward. I claim that institutions that could take advantage of technological and regulatory advantages (shadow banks) gained market power with respect to traditional banks. In light of this element, the paper sees the waves of financial deregulation as the by-product of higher asymmetric competition in the banking system, which led traditional banks to lobby harder in order to level the playing field. As such, the paper is able to produce a root cause explanation for the financial deregulation process and its timing. I build a model to illustrate these dynamics, and run some preliminary empirical analyses. The model allows also for financial innovations to be pursued as a temporary and alternative mechanism to cope with failed lobbying attempts. The paper highlights the daunting task of providing macro-prudential policies and financial market regulation in a political economy environment in which lobbying against regulation itself and regulatory arbitrage are possible.

Keywords: Financial deregulation, shadow banking system, lobbying, political economy of finance, financial innovation.

JEL codes: G21, G23, G28, N22, N42, P19.

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1 Introduction

From a macroeconomic perspective, the importance of financial intermediation cannot be understated. Financial intermediaries create the conditions to generate growth in the so-called "real" sector by screening, monitoring and funding productive entrepreneurial projects, while providing liquidity and stable means of payments to the overall economy. However, the dynamics of credit creation can also generate excesses and crises (Gorton and Ordonez, 2020; Jordà, Schularick, and Taylor, 2017). A key aspect to guarantee the safety and soundness of the financial sector lies in its regulation. To this extent, the evolution of financial (de-)regulation waves happened in the U.S. banking sector from the 1980s deserve close scrutiny. The consequences of different forms of deregulation have been studied in a variety of forms in the literature; however, an explanation for why such process happened in the way it did is still missing. This article attempts to fill this void by looking at banking industry dynamics and its interconnections with the politico-economic environment.

Following WWII, the banking sector of the U.S. has gone through thirty years of rather stable and unchanged patterns in the organization of its business and operations. In environments such as the one of Savings & Loans institutions, the utmost stability of the industry is exemplified by the legendary "3-6-3 rule": Bankers would borrow at three percent, lend at six, and be on the golf court by 3 p.m. (Admati and Hellwig, 2014).[1] Since then, however, the financial sector has gone through major transformations. Between 1971 and 1979, exogenous events – such as two major oil shocks and the exit of the world from the Bretton Woods system – pushed the U.S. and the international financial infrastructure to re-think themselves and adapt to conditions vastly mutating over a relatively short period of time. These events proved regulatory requirements often inadequate for banks to cope with the new scenarios, hit traditional banks' rents in different ways, and paved the way to embolden an emerging niche of financial insti-

[1] In the academic literature, Koetter, Kolari, and Spierdijk (2012) document statistical evidence of the so-called "enjoy the quiet life" hypothesis in the banking sector at the time. They build a framework to show that minimum effort – rather than profit maximization – seems to be the objective function of market players at the time.

tutions that operated like banks while not being so, i.e., the shadow banking sector.[2] Also, in Laudati (2024) – I established the importance of rising inequality from the 1980s to generate a domestic safe asset shortage due to investors' portfolio needs, which created the conditions for the shadow banking sector to emerge as provider of synthetic safe assets (see also, Sarto and Wang, 2023). The concomitant external shocks put new non-bank financial intermediaries *de facto* in a position of competitive advantage – whether because of regulatory arbitrage or technological superiority. Therefore, as partly highlighted before, the credit system gradually moved away from traditional banking activities towards a market-based financial system, while the overall volume of intermediated assets has increased exponentially since then.

This paper tries to describe from a positive angle the emergence of financial deregulation and innovation as resulting from the *endogenous* incentives of asymmetric competition between traditional banks and the shadow banking system. I argue that non-bank financial institutions were able to grow faster thanks to their competitive advantages after a series of shocks favored the emergence of (unforeseen) stiff competition in the traditional banking sector from the 1980s. The rents built in the law that traditional banks enjoyed until the 1970s became increasingly challenged. I claim that such competitive process induced a migration of flows away from traditional depository institutions, thereby leading to higher pressure on banks' margins. Consequently, the banking sector lobbied harder to level the playing field by reducing the regulatory burden and regain competitiveness.

As such, the long 20 years wave of deregulation that lasted from the 1980s to the early 2000s can find a root cause explanation in the incentives that banks were facing in order to survive. Hence, the rush from banks to lobby policymakers can be rationalized as the effort to reduce the asymmetries by expanding the scope of operations. From this perspective, both the deregulation phase and the spurt of financial innovation in traditional banking could be paired and seen as the by-product of the same force: An attempt to relax stiffer banking competition. To put

[2] A remarkable example is Regulation Q cap on interests payable on deposits, see Drechsler, Savov, and Schnabl (2020).

it differently, the structural changes in the industrial organization of financial intermediation have created crucial incentives for market participants to push harder for liberalization, while producing more innovative and engineered instruments to deliver profits and meet investors' expectations. It is interesting to notice that in this case the efforts of legislators in the 1930s to create a safe system by preventing banking competition from generating the type of excesses seen before 1929 might have paradoxically engendered the very conditions for regulatory arbitrage and crises.

In order to rationalize the previous argument, I build a macrofinance dynamic general equilibrium model with multiple sectors. The modeling exercise allows to make explicit the effects of different access to the technology frontier and the role of regulatory arbitrage to express the increasing predominance of shadow banks vs. traditional banks.[3] The model can be thought of as a nested structural transformation model that features a real sector that becomes progressively smaller vis-à-vis the financial sector. In turn, in the financial sector depository institutions shrink in size with respect to other non-bank financial institutions. The model is subsequently extended to allow banks to "react" to such forces by investing in lobbying activities and the creating of equally innovative products. The main forces are supported both in terms of stylized facts, and in terms of time series analysis.

Related literature. The present work intersects different literature strands, most notably, the banking and financial intermediation literature, and the nascent literature on the political economy of finance. In the banking literature, the interconnections between traditional banks and shadow banks are part a growing and evolving set of studies – most notably, Acharya, Cetorelli, and Tuckman (2024), and Jiang (2023).[4]

A few papers speak directly to the present research question also in the "political economy

[3] One important aspect not being treated yet in this paper is the increasing intertwining of the two sides of banking and shadow banking. Such trend has become more pervasive with time (Acharya et al., 2024) – especially after 2010 – and excluded for now although to be duly included in the next iterations of the paper.

[4] For different analyses of this interconnection, see also: Buchak, Matvos, Piskorski, and Seru (2024); Duca (2016); Gopal and Schnabl (2022); Górnicka (2016); Kim, Pence, Stanton, Walden, and Wallace (2022); Shami (2024) Clark, Houde, and Kastl (2021) provide a recent review.

of finance" literature. Müller (2023) finds empirical evidence of the importance of electoral cycles for macroprudential policies in a cross-section of countries over the period 2000-2014. Rola-Janicka (2022) connects rising income inequality to voting behavior and (redistributive) borrowing and prudential policies.[5] Saka, Campos, De Grauwe, Ji, and Martelli (2020) show the reversal of regulatory stance following financial crises; and Igan and Mishra (2014) focus on the political influence on deregulation in the run-up of the 2008 financial crisis. Lambert (2019) and Papadimitri, Pasiouras, Pescetto, and Wohlschlegel (2021) find that political influence negatively affect the likelihood of initiating enforcement actions against lobbying commercial and savings banks. Engelberg, Henriksson, Manela, and Williams (2023) show the importance of political leanings at the SEC and Governors of the Federal Reserve to predict the following voting decisions.

Haselmann, Sarkar, Singla, and Vig (2022) take an international perspective, and analyze the Basel Committee on Banking Supervision rule-making process to show that national authorities vote against regulatory tightening if their "national champions" claim to be on the losing side of the deals. A cross-country perspective is also embraced by Sever and Yücel (2022) to show how macroprudential policies follow electoral cycles. Mügge (2013) and Mosk (2021) focus on modern European policymakers to describe the extent of regulatory capture in financial regulation. Delatte, Matray, and Pinardon-Touati (2023) show the quid-pro-quo nature of political elections and looser credit access for France. Kroszner and Strahan (1999) is a classical reference to explain the banking branching deregulation waves of the 1980s from a private-interest perspective.

From a theoretical point of view, the extent of direct political control vis-à-vis lobbying is analyzed by Perotti, Rola-Janicka, and Vorage (2023). Agur (2021) provides a model to connect political pressure, bank incentives and time consistency, and tries to create a framework for politically robust financial regulation. Almasi, Dagher, and Prato (2022) build a model of

[5] See also Frost and Van Stralen (2018) and Malovaná et al. (2023) on the connections between macroprudential policies and inequality outcomes.

regulatory cycles focusing on the interaction among financial innovation, public opinion, and policy-makers incentives. Asai (2024) builds a structural model to show that bank lobbying can act as a safety net when creditors' beliefs can lead to multiple equilibria. Delis, Hasan, To, and Wu (2024) find that lobbying banks improve the borrowers' performance when there exist valuable lender-borrower information thereby improving efficient in large firms' corporate financing.

Historically, Monnet, Riva, and Ungaro (2021) focus on the importance of asymmetric competition for financial stability using an empirical study on bank run in France in 1930-31. See also Benmelech and Moskowitz (2010) and Mitchener and Jaremski (2015) for political economy evidence behind the creation of usury laws in the 19th century, and the supervisory entities themselves, respectively.

More broadly, the interplay between political pressure and regulatory and/or legislative behavior starts to be better understood by a set of papers in political economy. See Adams and Mosk (2023), Akey et al. (2021), Bertrand et al. (2020, 2021, 2024), Degryse et al. (2018), Eisenbach et al. (2022), Egerod and Aaskoven (2024), Lambert et al. (2023), Mian et al. (2010), Neretina (2024), Wirsching (2018). The importance of regulatory arbitrage has been treated by a series of papers. Among others, see Beck et al. (2024), Buchak et al. (2018), Chen et al. (2023), Gorton and Metrick (2010), Gorton and Metrick (2012), Houston et al. (2012), Karolyi and Taboada (2015), Metrick and Tarullo (2021), Munyan (2017). A few excellent reviews on competition and regulation in banking, and on the interconnections with political economy aspects are also available: Pagano and Volpin (2001, 2005); Carletti (2008); Degryse and Ongena (2008); Kroszner and Strahan (2014); Barth and Caprio Jr (2018); Lambert and Volpin (2018); Metrick and Rhee (2018); Igan and Lambert (2019); Bombardini and Trebbi (2020).

The paper is structured as follows. Section 2 motivates the study by showing a few descriptive statistics. In Section 3, I build and explain my model and its extensions. Section 4 concludes and draws trajectories on how to expand on the current work for future research avenues. Initial empirical evidence and mathematical proofs are available in the Appendix.

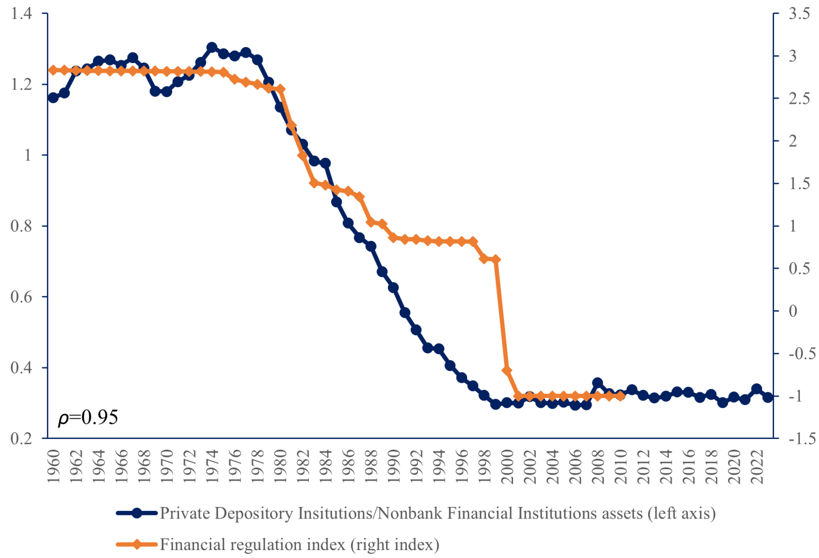
2 Motivating evidence

I provide a few stylized facts to introduce the topic. Figure 1 plots the ratio of total depository institutions assets as a fraction of non-bank financial institutions' loans from 1960 onwards. After years of stability, a drastic change occurs from the beginning of the 1980s. The shadow banking system began to earn a growing and systemic role in the financial sector thereby eroding the position that banks used to have. More interestingly, such trend did not stop at some random point in time but in 2000, after the Gramm-Leach-Bliley Act was passed in 1999. The Gramm-Leach-Bliley Act, also known as the Financial Services Modernization Act, is a pivotal moment in financial regulation because it is the ultimate piece of regulation to dismantle the post 1929 regulatory structure created by the Glass-Steagall Act in 1933. This date completed a gradual and continued twenty years process of financial liberalization, which had begun in the early 1980s when – among others – interest rate ceilings were levied nation-wide allowing banks to adjust their strategies. The pattern is suggestive with respect to the previous narrative. Banks managed to grow at the same rate as shadow banks (constant ratio) only after deregulation was completed and depository institutions were allowed to re-gain a competitive edge with respect to non-banks. More interestingly, it seems that deregulation episodes as systematically anticipated in a Granger-causality sense by the eroding positions of traditional banking institutions.[6] It is worth mentioning that the rise of banks' assets *per se* vs. economic output has also been quite stark. Over the period 1960 - 2020, assets grew by a factor of 8.64 in real terms, while real output grew by 4.87 times. However, non-bank financial institutions rose by more than 33 times in real terms over the same period of the time.

In the plot on the right side of Figure 2, it is possible to further assess the loss of dominant position in the funding markets with respect to the behavior of deregulation. The competition on the funding side, as represented by the ratio of U.S. chartered institutions deposits vs. money

[6] I am currently in the process of extending the Philippon and Reshef (2012) indicator after 2010, but I expect it to be broadly in line with a relative flat trend even after considering the Dodd-Frank Act and the subsequent minor regulation waves under the Trump and Biden administrations.

Figure 1: Traditional bank assets relative to the total amount of assets issued by other non-bank financial institutions in the United States over the period 1960 – 2023.

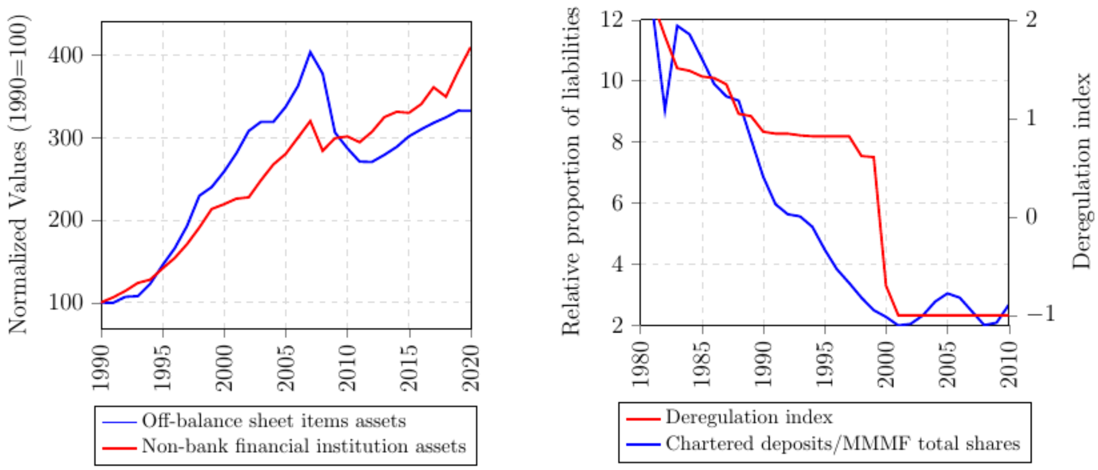


Notes: Banks assets stand for the total on-balance sheet loans of U.S. chartered depository institutions. Other financial institutions assets is obtained as the sum of: Money market mutual funds, mutual funds, close-end funds, ETFs, GSEs, Agency-and GSE-backed mortgage pools, issuers of asset-backed securities, finance companies, real estate investment trusts, equity real estate investment trusts, securities brokers and dealers, other financial business, property-casualty insurance companies, life insurance companies, private pension funds. All data are at annual frequency.

market funds' shares, mimics what seen in terms of overall total assets although slightly more volatile due to the different type of data.[7] While the amount of deposits represented an amount 12 times as big as the competitors in 1983, it shrank to just about 2 times as much before the 2008 crisis. This feature created increasing burdens for banks in the way they had to attract the major fuel for their operations, and eventually lead to shift themselves towards more debt instruments and so-called non-core funding (Barattieri, Moretti, and Quadrini, 2021). Similar to what has been seen on the asset side, also on the liability side a change in the pattern has emerged since the Great Recession. Deposits amounts seems to have gained new traction doubling their share with respect to money market instruments in less than ten years.

[7]Deposits were virtually the only form of financing for banks after WWII, and since then the fall has been dramatic. I cut the series of the ratio for the first years because MMMF were not even existent until 1974 and therefore the very small denominator would not allow to see the major dynamics happening in a continuous fashion all the way until the 2008.

Figure 2: Banks off-balance sheet assets vis-à-vis non-bank financial institution assets (*left*), and funding competition vis-à-vis deregulation index (*right*)



Notes: The measure of off-balance item is composed of the sum of total unused commitments (Revolving open-end lines secured by 1-4 family residential property, credit card lines, construction loan commitments, other unused commitments), and letters of credit. Non-bank financial institution assets are the sum of total assets (end of period) for: Pensions funds, insurance companies, other financial Business. Monetary authority's assets are always excluded. Data are normalized to 100 in 1990. The deregulation index from Philippon (2015) is a weighted average of four components: interest rate ceilings, possibility to have multiple branches, possibility to combine commercial and investment banking, possibility to combine insurance and financial activities. Chartered deposits is the sum of: U.S.-Chartered Depository Institutions checkable, savings and time deposits in levels. MMMF total shares are Money Market Funds total shares outstanding (liabilities) in levels. All data are deflated using CPI (total all items). Data is reported at annual frequency.
Sources: Off-balance sheet items form Enhanced Financial Accounts of the Federal Reserve Board. Non-bank financial institution assets are from Integrated Macroeconomic Accounts of the Fed, S.63.a S.65.a tables. Deregulation index is from Thomas Philippon's website. Chartered deposits and MMMF series are from tables L.111 and L.121 of the Financial Accounts of the Federal Reserve. CPI from OECD data retrieved through FRED.

This higher degree of competition seems to systematically anticipate the successive deregulation waves picked by the index built by Philippon and Reshef (2012), and extended to 2010. This feature speaks to the ability of banks to cope with other financial institutions once the regulatory arbitrage got extremely narrow. The deregulation here is only expressed in terms of passed legislation, and not actually implementation therefore giving a better sense on the actual moments in which laws (like the Glass-Steagall Act, above all) were amended.

In the same picture, it is also possible to see on the left hand side that banks have massively increased the amount of off-balance sheet operations to stay ahead of competition. The picture takes advantage of consolidated off-balance sheet operations, and shows that banks made great use of these items. The off-balance sheet items are composed of five main groups: unused commitments, letters of credit, credit derivatives (e.g. credit default swaps), interest rate derivatives (e.g. interest rate swaps), and other derivatives. The first two include: credit card lines, construction loan commitments, etc., which are key credit instruments. The latter three categories are the ones typically associated with risk-sharing arguments and hedging strategies, and thus excluded.[8] The special status of off-balance sheet items can be understood in light of the fact that they do not occupy space on banks' balance sheets, thus relaxing *de facto* the regulatory constraints, and allowing to expand the revenue stream without engaging in extra reserves or equity allocations.[9] Such liquidity provision component grew at even faster rates than the overall growth of non-bank financial institutions. Data are available in a harmonized fashion by the Federal Reserve from 1990 onward, when the overall outstanding amount was about $2 Tn in notional amount. In the following seventeen years, however, the growth was exponential and – after having deflated the series – the amount was more that four time as big, outpacing even the amount of liquidity produced by shadow banks by a third.

To conclude, there seems to be descriptive evidence in favor of the idea that, by being more constrained on the traditional side, banks took advantage of innovative ways to cope with the rise of other intermediaries. Sometimes by pushing for more deregulation, sometimes by acting themselves in innovative ways sidestepping the main provisions of regulation. Although such results can be only taken on a correlational level, they appear rather suggestive of the timing of events that could help explain the evolution of events: Deregulation has systematically followed the moments in which traditional banks where most declining in relative importance, and once the deregulation waves were completed such trend stopped. Furthermore, banks ended up massively shifting their operations off-balance sheet as a way to save on costly reserves and capital requirements.

[8] The system *as a whole* works under something similar to matched books in notional amounts, therefore it is impossible to tell the amount of actual lending facility from aggregate statistics. That said, the amount of derivatives traded would make the increase orders of magnitude larger.

[9] Berger and Bouwman (2015) for a thorough discussion.

3 Theoretical framework

I proceed to build a general equilibrium macrofinance model that can rationalize the patterns seen before. I propose a nested structural model in which the economy grows at some steady rate, while facing financial-deepening. At the same time, the model allows the financial sector to go through structural transformation by means of higher growth of the shadow banking sector vis-à-vis the traditional one. Crucially, in my framework I manage to construct a relatively simple mapping between deregulation and banking technology (which manifests in productivity). By imagining a continuum of products and geographic locations as potential productive tools, financial regulation effectively curbs the extent to which traditional banks can tap such opportunities. This is an interesting point, which allows to see regulatory arbitrage and financial innovation as intrinsically intertwined. The higher growth of the shadow banking system is going to be pinned down by a larger access to products and lack of reserve requirements – which, on the other hand, are features of the traditional banking system. Such difference in terms of access to different regulatory settings leads to a movement of the funds away from traditional banks to the shadow banking system. As a consequence, the relative shares of each sector changes over time. In fact, the baseline model predicts the disappearance of traditional banks. To address such counterfactual prediction, I extend the model to allow traditional banks to counteract such pressures by "investing" in deregulation through lobbying and by using innovations as financial arbitrage tools.

In terms of the model environment, the model is set in discrete time, and it features no uncertainty. An aspect that needs to be taken care of in the future paper's iterations. The economy is populated by: A representative household, two representative firms with consumption-specific and capital-specific sector technologies, respectively, the traditional and the shadow banking sector. The traditional banking sector is populated by heterogeneous retail branches (which benefit from market power on deposits), and wholesale branches that aggregate funds obtained from deposits into financial investment products. The shadow banking sector is similarly composed of a capital market side, which produces investment products financed on money markets (which are in direct competition with bank deposits in terms of returns).

Households provide labor and physical capital to the first two industries, while investing the remaining part of their income in financial assets. Both real and financial capital are reproducible. The retail units of banks take on deposits and earn a spread on them due to their monopsonistic power. They also set aside an amount of reserve proportional to their size, and pass on the funds at no cost to the wholesale unit – which is able to repackage the different loans and sell them on the market to the households. The extent to which these products can be sold is limited by financial regulation. The wholesale banks earn no direct spread on manufacturing such claims, although the model can easily be relaxed along this dimension.

The shadow banking system competes with the traditional banking activities in the following sense. On the liability side, money market funds do not earn a direct spread from households on their shares, but they are still profitable thanks to the demand of products coming from the financial firms populating capital markets. Also, they are not compelled to set aside reserves. Capital markets agents fund themselves on money markets to transform and repackage the loans that are eventually sold as financial investment products to households. Without loss of generality, this is assumed to happen with no extra mark-up. Credit is provided by banks to households only; however, given that households own firms, this is isomorphic to banks lending directly to non-financial business firms as well.

In order to explain the overall trend dynamics up to the financial crisis, the model abstracts from risk for now, and it does not investigate the direct effects on financial stability. This remains a future modification the model needs to be relaxed for.

3.1 Baseline set-up

Households. A representative household maximizes its utility over consumption C_t, and discounts the future at rate β. It earns a wage w_t by inelastically supplying labor, and by earning an interest return from renting its physical capital to firms, holding deposits and money market shares: $\{R_t^K,\ R_t^{BK},\ R_t^{SB}\}$ represent the tuple of returns from such holdings, respectively. Households inter-temporal optimization is expressed in Problem ($\mathscr{P}_1$).

$$\max_{\substack{\{C_t, F_{t+1}^{SB} \\ k_{t+1}, F_{t+1}^{BK}\}}} \sum_{t=0}^{\infty} \beta^t \log(C_t) \tag{$\mathscr{P}_1$}$$

$$\text{sub} \begin{cases} C_t + p_t^K I_t^K + p_t^{BK} I_t^{BK} + p_t^{SB} I_t^{SB} = R_t^K k_t + R_t^{BK} F_t^{BK} + R_t^{SB} F_t^{SB} + w_t L \\ I_t^K = k_{t+1} - (1-\delta) k_t \\ I_t^{BK} = F_{t+1}^{BK} - F_t^{BK} \\ I_t^{SB} = F_{t+1}^{SB} - F_t^{SB} \\ k_0 > 0, \quad C_0 > 0 \end{cases}$$

Households face customary consumption-savings decisions. Investments in physical capital are represented by $I_{K,t}$, the ones in traditional banks products by $I_{BK,t}$, and the ones in shadow banking assets as $I_{SB,t}$. Physical capital is denoted by k_t, and it depreciates at an exogenous rate δ. It gets accumulated by the law of motion expressed by the second constraint. Assets provided to banks and shadow banks are described by variables $F_{BK,t}, F_{SB,t}$, which increase by investing $I_{BK,t}, I_{SB,t}$ in financial assets, respectively. Abstracting from inflation, financial capital does not depreciate. In order to obtain such products, the household pays a tuple of prices $\{p_t^K,\ p_t^{BK},\ p_t^{SB}\}$, while the price of consumption goods is normalized to one and used as numéraire. The system features three Euler equations, and three no-arbitrage conditions between assets returns. See the Appendix for such derivations.

Firms. There are two distinct goods on the "real" side of the economy: Consumption and capital goods. This side of the economy is highly stylized and replicates models in an AK fashion in order to obtain endogenous growth in the most parsimonious way. There is a measure one of risk-neutral consumption good firms which operate under perfect competition. Firms rent labor and a fraction, ϕ_t^K, of physical capital from the households, and produce an amount of final goods C_t, with a constant Hicks neutral productivity, A_t^C. Factor shares $\{\alpha, 1-\alpha\}$ accrue to real capital and labor, respectively.

$$\max_{\{(\phi_t^K k), L\}} \quad \underbrace{A_t^C (\phi_t^K k_t)^{\alpha} L^{1-\alpha}}_{\triangleq C_t} - R_t^K \phi_t^K k_t - w_t L \tag{$\mathscr{P}_2$}$$

The previous problem gives two optimal conditions for capital returns invested in consumption goods and wages:

$$\frac{\partial \pi_t}{\partial(\phi_t^K k_t)} = 0 \Leftrightarrow R_t^K = \alpha \frac{C_t}{\phi_t^K k_t} \tag{1}$$

$$\frac{\partial \pi_t}{\partial(\phi_t^K k_t)} = 0 : \Leftrightarrow w_t = (1-\alpha)\frac{C_t}{L_t} \tag{2}$$

The remaining fraction of capital $(1-\phi_t)k_t$ is invested in capital goods technologies, which pay off at rate R_t^K, i.e., capital is assumed to be mobile across sectors in each period following a no-arbitrage condition. A linear technology transforms capital into real investments goods, where A_t^K being the technology-shifter. The problem is simply posed as:

$$\max_{(1-\phi_t^K)k_t} p_t^K \underbrace{A_t^K (1-\phi_t^K) k_t}_{\triangleq I_t^K} - R_t^K (1-\phi_t^K) k_t \tag{$\mathscr{P}_3$}$$

which gives rise to the following optimal condition:

$$\frac{\partial \pi_t}{\partial(1-\phi_t^K)k_t} = 0 : R_t^K = p_t^K A_t^K. \tag{3}$$

As aforementioned, such characterization is a stripped down version of more complex settings, and allows for consumption and investment sectors to reach a stationary equilibrium in growth rates rather than in levels. The financial sector will grow in size vis-à-vis this real output benchmark.

Proposition 1. *On a balanced growth path, the fraction of capital allocated between consumption and physical investment sector is constant over time and equal to:* $\phi_K^* = (1-\beta)\frac{A_K+1-\delta}{A_K} \quad \forall t.$

Proof. *See the Appendix.*

Demand for deposits. When households deposit their income at their retail banks, they face a monopolistically competitive supply of such services, which allows each bank, *n*, to earn a spread on their deposits.[10] As such, the upward sloping supply curve can be written as stemming from the following problem:

$$\max_{\{F_t^{BK}(n)\}} \int_0^1 R_t^{BK}(n) F_t^{BK}(n) dn$$
$$\text{s.t.} \left[\int_0^1 \left(F_t^{BK}(n)\right)^{\frac{1+\nu}{\nu}} dn\right]^{\frac{\nu}{1+\nu}} \leq F_t^{BK} \qquad (\mathscr{P}_4)$$

with $\nu > 1$, being the elasticity parameter customary with the CES aggregator. I am allowing a measure one of banks to exist, even though a more generic continuum *N* can be allowed for. Each household earns a return, $R_t^{BK}(n)$, on their deposits, $F_t^{BK}(n)$, from bank *n*. R_t^{BK} is the price index, and F_t^{BK} the overall amount of deposits channeled to the banking system. The amount of deposits attracted by each bank is a function of their competitive returns with respect to the weighted average of the industry. The final supply can be written in the canonical form: $F_t^{BK}(n) = \left(R_t^{BK}(n)/R_t^{BK}\right)^{\nu} F_t^{BK}$.

Traditional banking sector.

— Retail units. Each bank, *n*, has a continuum of *j* branches and products to invest in, with $Z_t^{BK} \in (0, \infty)$ being the upper bound of branches and/or profitable products to invest in. There exists a single wholesale unit for each bank *n*. For simplicity, I assume the fraction of deposits attracted by each bank, $F_t^{BK}(n)$, to be composed by a uniform distribution of own retail units. Regulation is expressed by the index $1/D_t$, where $D_t > 1$ is the degree of financial deregulation.

[10]See Drechsler et al. (2017) for an argument on deposits spread.

Regulation constraints the size of the banks (or the number of products the bank can sell). Under this representation, it is possible to write regulation as a productivity wedge, $(1 - 1/D_t)$, with respect to the financial innovation frontier, Z_t, such that $Z_t^{BK} = Z_t\,(1 - 1/D_t)$.[11] For now, Z_t, D_t, Z_t^{BK} are assumed to be time invariant, an assumption very easy to relax.

Each retail unit *j* at bank *n* transforms a share of deposits $f_t^{BK}(n,j)$ into financial claims, $\iota_t^{BK}(n,j)$. When doing so, it needs to set aside a fraction $S_t(n,j) = sf_t^{BK}(n,j)$ as reserves, with $s \in (0,1)$. The problem is presented in ($\mathscr{P}_5$):

$$\max_{f_t^{BK}(n,j)} \; [1 + r_t^{BK}(n,j)]\iota_t^{BK}(n,j) + S_t(n,j) - [1 + R_t^{BK}(n)]f_t^{BK}(n,j) \tag{$\mathscr{P}_5$}$$

$$\text{s.to} \begin{cases} \iota_t^{BK}(n,j) + S_t(n,j) = f_t^{BK}(n,j) \\ S_t = sf_t^{BK}(n,j) \qquad s \in (0,1) \\ R_t^{BK}(n) = \left(\dfrac{F_t^{BK}(n)}{F_t^{BK}}\right)^{\frac{1}{\nu}} R_t^{BK} \\ F_t^{BK}(n) = \displaystyle\int_0^{Z_t^{BK}} f_t^{BK}(n,j)dj \end{cases}$$

The constraints account for: an accounting identity (with exogenous reserve requirements imposed on chartered institutions), a downward sloping demand curve for deposits coming from the households (as described before), "internal market clearing" of funds received/allocated across units by each bank. Assuming symmetry across branches, we can say $f_t^{BK}(n,j) = \frac{F_t^{BK}(n)}{Z_t^{BK}}$. Loans are subsequently provided to the wholesale unit that "repackages" them and sells them on the market. The model leads to an optimal pricing condition: $r_t^{BK}(n,j) = \frac{1+\nu}{\nu(1-s)}R_t^{BK}(n)$, and profits: $\pi_t^{BK}(n,j) = \frac{1-s}{1+\nu}r_t^{BK}(n,j)f_t^{BK}(n,j)$.

— Wholesale unit. The wholesale unit of a traditional bank takes the loans produced by each branch, and transforms them by bundling them together to obtain an amount $I_t^{BK}(n)$. The

[11] Z_t can be seen as the number of products potentially existent at the frontier.

problem is expressed in ($\mathscr{P}_6$).

$$\max_{\iota_t^{BK}(n,j)} \quad p_t^{BK}(n) I_t^{BK}(n) - r_t^{BK}(n,j)(1-s) F_t^{BK}(n) \tag{$\mathscr{P}_6$}$$

$$\text{sub} \begin{cases} I_t^{BK}(n) = \left(\int_0^{Z_t^{BK}} \left(\iota_t^{BK}(n,j) \right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}} \\ F_t^{BK}(n) = \int_0^{Z_{BK}} f_t^{BK}(n,j) dj \\ \iota_t^{BK}(n,j) = (1-s) f_t^{BK}(n,j) \end{cases}$$

where $\sigma > 1$ represents the elasticity across units, $r_t^{BK}(n,j)$ is the price "charged" to the retail unit, and it has to be intended as a shadow price (given that the wholesale unit does not charge an actual price on itself). On the other hand, p_t^{BK} is the final price at which the products are sold to the households on the market. For simplicity, banks are assumed to be perfectly competitive when selling such products, therefore, all their consolidated profits derive from deposits.[12] From the optimal first order conditions, it follows that:

$$r_t^{BK}(n,j) = \left(\frac{\iota_t^{BK}(n,j)}{I_t^{BK}(n)} \right)^{-1/\sigma} p_t^{BK}(n) \tag{4}$$

In the Appendix, I show that:

$$I_t^{BK}(n) = (1-s) A_t^{BK} F_t^{BK}(n)$$

with $A_t^{BK} \triangleq \left(Z_t^{BK}\right)^{\frac{1}{\sigma-1}}$. This is an important result because it links the productivity of the banking sector to its scale and operational capacity: The stronger the regulatory constraint, $1/D_t$, restraining $Z_t^{BK} = Z_t(1 - 1/D_t)$, the lower the productivity that the bank will achieve. Furthermore, the higher the complementarity of contracts and type of loans, the higher the

[12] This assumption can be easily relaxed in order to have double margins on both loans and deposits and it would not alter the properties of the model.

productivity. This speaks to the efforts of finance to create contracts that could tranche different parts of, say, risk operations as happened when bonds risks where replicated by different products bearing credit risk, interest risk, etc..

Notice that – in its simplest form without risks – the model speaks only to the "bright side" of financial innovation. Given that $p_t^{BK}(n) = r_t(n,j)/A_t^{BK}$, we need to conclude that the higher productivity of the banks translates into cheaper services for households. Such statement does not seem to be true in practice, as highlighted by Philippon (2015), and will need to be relaxed.

Shadow banking sector.

— Capital markets. The shadow banking system operates in ways that are similar to the ones of the traditional banking system to facilitate and make evident the importance of regulatory arbitrage and technological aspects. I begin by defining the "upstream" part of it, where capital markets repackage and produce *j* securities for households by financing themselves on the (monopolistically competitive) money market funds. These units face regulatory requirements normalized to zero, therefore they do not have operational capacity limited by the wedge, $1 - 1/D_t$, as for the traditional banks showed before. Hence, they can work up to the innovation frontier: $Z_t^{SB} = Z_t$.[13] The problem can be written as:

$$\max_{\iota_t^{SB}(j)} \quad p_t^{SB} \underbrace{\left(\int_0^{Z_t^{SB}} \left(\iota_t^{SB}(j)\right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}}_{I_t^{SB}} - \int_0^{Z_t^{SB}} R_t^{SB}(j) m_t^{SB}(j) dj \qquad (\mathscr{P}_7)$$

$$\text{s.t.} \quad m_t^{SB}(j) = \iota_t^{SB}(j)$$

where $\{\iota_t^{SB}(j)\}$ is the specific set of contracts funded with $m_t^{SB}(j)$ resources. I assume the elasticity σ not to differ between the traditional banking and shadow banking sector to maintain the focus on the regulatory side. It goes without saying that elasticities can be sector-specific. As before, it will be true that the productivity will depend on the range of products, $A_t^{SB} \triangleq \left(Z_t^{SB}\right)^{\frac{1}{\sigma-1}}$

[13]Furthermore, as shown below, they will be able to attract a larger fraction of capital in light of the lack of reserve requirements demanded "downstream" to money market funds.

but given the same σ, the only variable to explain the divergence between the two sector is opportunity to take advantage of the regulatory arbitrage.

— Money markets. When funding themselves on the money markets, the shadow banks on the capital markets generate a downward sloping demand curve. The money market funds can earn a profit as a result. To maintain a slightly more parsimonious structure and without loss of generality, money market funds will not be able to earn a monopolistically competitive margin also on their liabilities. They face perfect competition when offering their products to households. I assume symmetry among all j money market funds. The problem can be described as:

$$\max_{f_t^{SB}(j)} \quad R_t^{SB}(j) m_t^{SB}(j) - R_t^{SB} f_t^{SB}(j) \tag{$\mathscr{P}_8$}$$

$$\text{sub} \quad \begin{cases} m_t^{SB}(j) = f_t^{SB}(j) \\ R_t^{SB}(j) = p_t^{SB} \left(\dfrac{m_t^{SB}(j)}{I_t^{SB}} \right)^{-1/\sigma} \\ F_t^{SB} = \displaystyle\int_0^{Z_t^{SB}} f_t^{SB}(j) dj \end{cases}$$

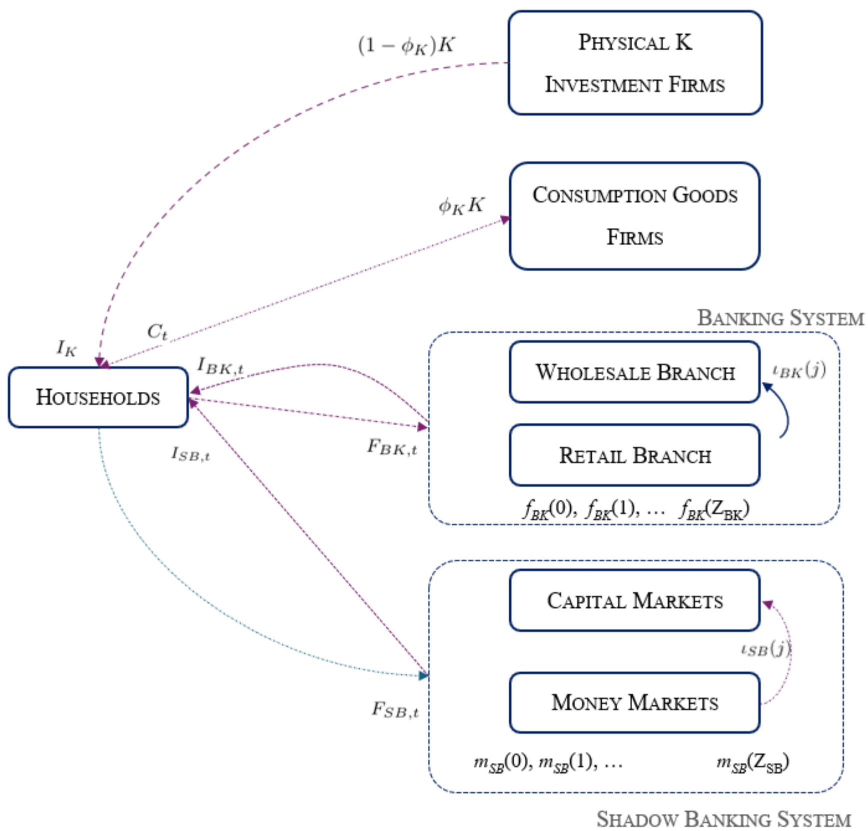
The optimal profits condition for money market funds is: $\pi_t^{SB}(j) = \sigma^{-1} r_t^{SB}(j) f_t^{SB}(j)$. Notice that there is an implicit assumption about funds being symmetric: $f_t^{SB}(j) = F_t^{SB}/Z_t^{SB}$.

Figure 3 depicts the model dynamics.

Equilibrium. Given initial prices $p(0)$, and economy-wide initial endowments $\{L, k(0), F^{BK}(0), F^{SB}(0)\}$, a competitive equilibrium is a set of prices: $\{p_t^C, p_t^K, p_t^{BK}, p_t^{SB}, R_t^{BK}, R_t^{BK}(n), r_t^{BK}(n,j), R_t^{SB}, R_t^{SB}(j), r_t^{SB}(j)\}_{t \in (0,\infty)}$, quantities $\{C_t, k_t, F_t^{BK}, F_t^{BK}(n), f_t^{BK}(n,j), \iota_t^{BK}(n,j), F_t^{SB}, f_t^{SB}(j), \iota_t^{SB}(j), m_t^{SB}(j)\}_{t \in (0,\infty)}$, and sector allocations $\{\phi_t^K, (1-\phi_t^K)\}_{t \in (0,\infty)}$ such that:

1. Households optimize their consumption and savings/investments decisions according to

Figure 3: Model baseline description



Problem ($\mathscr{P}_1$).

2. Consumption goods firms maximize profits according to Problem ($\mathscr{P}_2$), by taking prices as given.

3. Physical capital investment firms maximize profits according to Problem ($\mathscr{P}_3$), by taking prices as given.

4. Banks, Shadow banks and their product units branches maximize profits by choosing the optimal quantities amount, and by taking reserve constraints as given, according to Problems: ($\mathscr{P}_5$), ($\mathscr{P}_6$), ($\mathscr{P}_7$), and ($\mathscr{P}_8$).

5. Markets clear for commodities, labor, capital, banking services, and shadow banking services.

Solution. The details of the model's solution and derivations are provided in the appendix. Looking at the effects of regulatory arbitrage on the banking sector, it is possible to show that the following conditions for growth rates hold: $g_{BK} = 1 + (1-s)A_t^{BK}, \;\; g_{SB} = 1 + A_t^{SB}, \;\; g_K = \beta(A_t^K + (1-\delta))$. To the extent that $Z_t^{SB} > Z_t^{BK}$, as provided by regulatory burdens, we have $A_t^{SB} > A_t^{BK}$. But then, for $A_t^{SB} > (1-s)A_t^{BK} > \beta A_t^K$ we can conclude that $g_{SB} > g_{BK} > g_K$. In other words, growth rates are constant – because of constant productivity – but unequal. The financial sector grows as a fraction of the economy, and the shadow banking system grows as a fraction of the financial sector.

The economy also faces capital-deepening, i.e., the growth rate of consumption is lower than the one in capital $g_C = g_K^\alpha$. As such, the economy undergoes both capital- and financial-deepening while changing its banking structure. In this respect, households increase their reliance on shadow banks for credit instruments. Asymptotically, financial-deepening gets increasingly determined by the growth rate of the funds made available by shadow banks. Furthermore, it is relatively easy to show that if commodity firms take on a fraction of banking and shadow banking products to enhance production (potentially buying from both financial fringes) then commodity firms become "financialized" themselves. When confronting this with the reality, it seems that such a dynamic process is very much ongoing: firms have been sitting on higher and higher amounts of cash over the past decades and used that to progressively increase their exposure to financial assets.

To sum up the previous result – capital markets become increasingly more important within the financial world, and the financial world becomes increasingly more important with respect to the production in the economy.

Growth rates in nominal terms maintain the same properties, although modulated by the extent of market power. In fact, the larger the profits that can be exploited by the banking sector, the larger the amplification of growth in nominal terms.

With that being said, in the current set-up traditional banks asymptotically disappear. Although the banking system did shrink in relative terms, it was able to stop such decline – in fact it stabilized. At this point, I add a political economy element of banking competition. I claim that the ability of the traditional banking sector to survive was by means of pushing back by: lobbying for deregulation, and restructuring its operations to become more innovative.

With that in mind, I proceed to model two relevant extensions: in the first case, banks are able to lever their resources to obtain deregulation with some probability; in the second case, the banks are able to set up a Special Purpose Vehicle (SPV) that is able to get around regulatory burdens by using off-balance sheet items. In other words, the following two extensions reflect potential strategies that banks have utilized in order to remain in the business: Innovating and lobbying to become more similar to shadow banks. As such, financial deregulation can be seen as the *endogenous* by-product of competitive pressures – which is quite importantly a departure from the interpretation of the literature.

3.2 Asymmetric banking competition in a political economy environment

In order to model the process of deregulation, I allow banks to invest a fraction of their funds in lobbying activities to reduce the regulatory burden. For now, regulation is passive – although this aspect will be extended in the future.

Banks need to solve two subproblems: manufacturing financial assets and lobbying. When financing the lobbying industry, I assume them to make no profits in equilibrium.[14] Once deregulation is successful, banks are able to enjoy a larger share of products to invest into (and a faster growth rate as a result). Let the original problems of banks ($\mathscr{P}_5$) and ($\mathscr{P}_6$) be condensed in one layer as in Problem ($\mathscr{P}_9$), without loss of generality.

Subproblem 1. *Lending.*

$$\max_{\{\psi_t F_{BK,t}(n), D_t\}} \; p_t^{BK}(n) A_t^{BK}(1-s)\psi_t F_t^{BK}(n) - R_t^{BK}(n)\psi_t F_t^{BK}(n) - p_t^D(n) D_{t+1}$$
$$\text{s.to} \quad \psi_t F_t^{BK}(n) = \left(\frac{R_t^{BK}(n)}{R_t^{BK}}\right)^{\nu} F_t^{BK} \qquad (\mathscr{P}_9)$$

[14]Effectively, I am interpreting the lobbyists as being part of the bank itself, not outsourced.

where $A_t^{BK} = Z^x (1 - 1/D_t)^x$, $x = 1/(\sigma - 1)$, and ψ_t is the fraction of original funds *not* being diverted to lobbying. The attempts to deregulate are idiosyncratically uncertain, but deterministic in aggregate. The upward sloping supply curve follows from the Problem described by ($\mathscr{P}_4$). The profits and a pricing conditions are the same as in the baseline case up to a rescaling by a factor ψ_t. Further action happens in the second subproblem of lobbying. As aforementioned, I assume a perfectly competitive lobbying market, which transforms the funds provided by the banks to deliver a larger degree of deregulation in the following period.

Subproblem 2. *Lobbying.*

$$\max_{(1-\psi_t)F_t^{BK}(n)} \; p_t^D(n) D_t - R_t^{BK}(n)(1-\psi_t)F_t^{BK}(n)$$
$$\text{s.to } \; D_t = \lambda \left((1-\psi_t)F_t^{BK}(n)\right)^{\alpha_D} \tag{5}$$

where the parameter α_D pins down the decreasing returns to scale of the lobbying unit, and $\lambda \in (0,1)$ is the aggregate probability of lobbying investments to be successful.[15] As a consequence, banks need to equalize the rate of return at the margin that allows them to allocate the optimal amount $\psi_t F_t^{BK}$ of funds between standard loan production, and lobbying to obtain deregulation D_t. Figure 4 provides a graphical representation of the new forces.

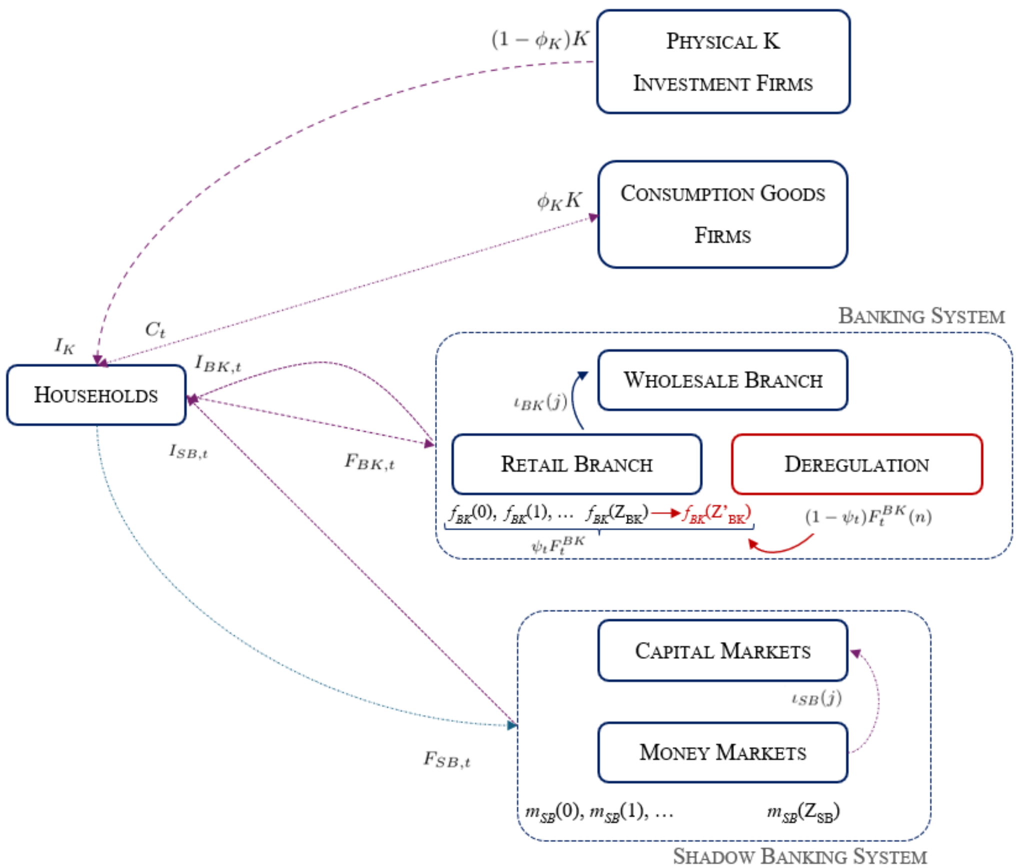
The optimal condition for ψ is captured by the following expression:

$$\psi_t^* = \left[1 + \frac{(1+\nu)(\sigma-1)\alpha_D \lambda}{\nu(D_t - 1)}\right]^{-1} \tag{6}$$

Equation (6) has some interesting implications. First of all, $\lim_{t\to\infty} \psi_t^* = 1$, i.e. the higher the number of successful attempts to deregulate (as *t* grows), the lower the amount that is spent in such activity because the banks get closer to the technology frontier. Notice that this feature implies that the share of funds is non-constant even in equilibrium along the balanced growth

[15] Each bank may be idiosyncratically unsuccessful in its attempts, but the aggregate output of the coalition is deterministic.

Figure 4: Model description: Asymmetric banking competition allowing for deregulation.



path.

Also, $\partial\psi_t^*/\partial\nu > 0$: As profits from lending increase, there is less need to lobby harder to deregulate – effectively, the challenge coming from shadow banks is smaller, hence, the incentives to lobby to obtain deregulation lower. Clearly, both $\partial\psi_t^*/\partial\alpha_D < 0$ and $\partial\psi_t^*/\partial\lambda < 0$. The previous two results are rather mechanical and easy to explain: The lower the probability of succeeding in deregulation, or the less efficient the lobbying technology, the lower the incentives of banks to lobby. In addition, some comparative statics lessons can be derived. I begin with by noticing that $\partial\psi_t^*/\partial\sigma < 0$. This is a peculiar feature that seems to be true in reality: the less complementary the loan products become, the lower the room from profits out of diversification and differentiation, the more commodified the financial products become, thereby reducing the profits to be investable to obtain deregulation.

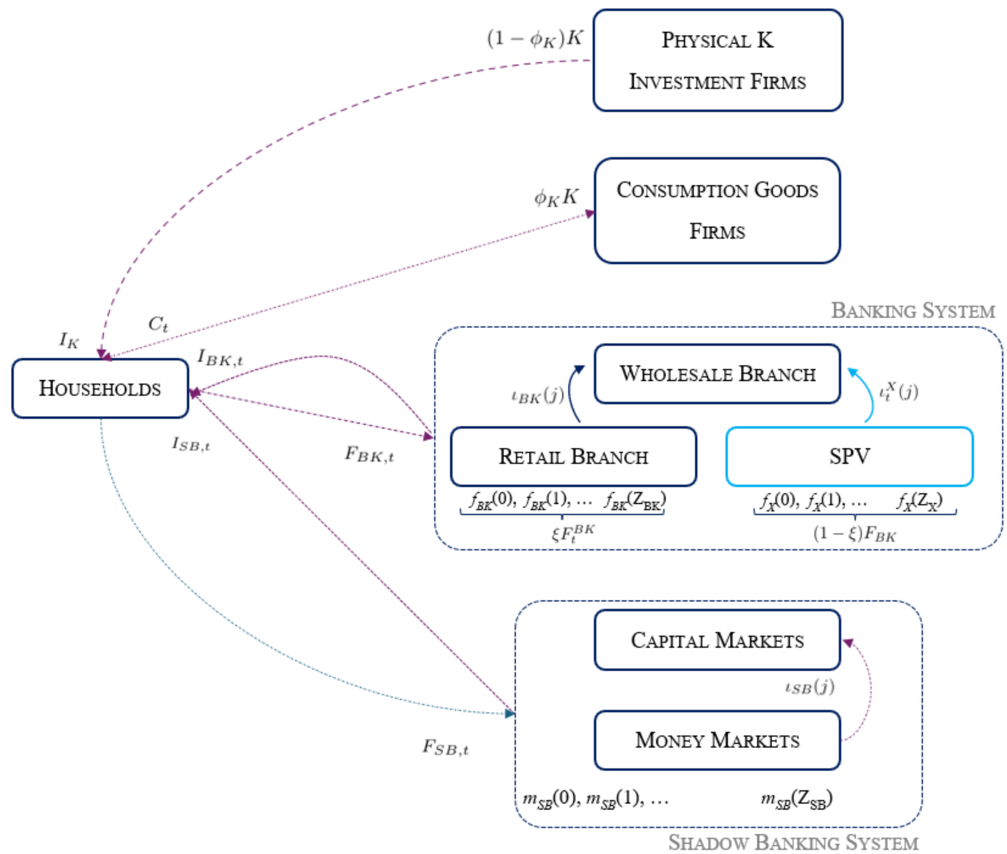
Abstracting from market power, the growth rate of deregulation is: $g_D = g^{\alpha_D}_{(1-\psi_t)} g^{\alpha_D}_{BK,t}$, where the first term is the growth rate of the expenditures in lobbying, and the second the growth rate of banks' assets. Here, the true non-trivial effects of feedback loops emerge. Differently from before, the growth rate of banks assets is now time-varying as well. This is the by-product of a progressively higher productivity growth stemming from higher deregulation, asymptotically: $\lim_{t\to\infty} g_{BK,t} = g_{SB}$. However, as banks grow and have more funds to deregulate, they also have fewer incentives to do so because they are already becoming more similar to the shadow banks (thereby making more profits on the regulated items). This is something that can match the dynamics observed in Figure (1). After about twenty years of systematic loss of market power, banks eventually managed to catch up with shadow banks in terms of asset growth once the deregulation process was completed at the beginning of the 2000s. We may almost call this a "double and non-trivial feedback dynamic". The paradox is that in a political economy environment in which regulatory arbitrage can happen by non-bank financial institutions, and banks can undo the regulatory framework by exercising lobbying, only a laxer regulatory environment decreases the efforts of banks to divert funds away from lending. When adding risks and financial stability issues to the current framework, things may certainly look even more paradoxical and realistic.

With that being said, however, the banking sector has reacted to increasing competition not only by increasing the market power of the remaining subjects, or by pushing for higher deregulation, but also by adopting different strategies, such as setting up SPVs that could invest or take advantage of investments in products that could not managed in the normal operations on balance sheet.

3.3 Asymmetric banking competition allowing for financial innovation

In this section, I add off-balance sheet operations in the baseline scenario removing the possibility to also lobby to deregulate. In other words, I am not allowing for a contemporaneous combination of off-balance sheet operations and deregulation. Let the bank now invest part of

Figure 5: Model description: Off-balance sheet extension.



its proceeds, $1-\xi$, in an SPV, which can generate – de facto – shadow banking activities. In this case, the SPV can invest in all the Z products available without regulatory constraints of sort. Subsequently, the overall quantity of financial investments sold to the market is a bundle of products built on- and off-balance sheet. The bank substitutes one with another according to an elasticity $\eta > 1$. When investing off-balance sheet, the bank does not have to post regulatory reserves in such entities.[16] Figure 5 represents graphically this scenario. The problem that the bank faces can now be re-written as:

$$\max_{\{\iota_t^{BK}(j),\iota_t^X(j)\}} \quad p_t^{BK}(n)I_t^{BK} - \int_0^{Z_{BK}} r_t^{BK}(n,j)\iota_t^{BK}(n,j)dj - \int_0^{Z} r_t^X(j)\iota_t^X(j)dj \qquad (\mathscr{P}_{10})$$

[16]I do not allow shadow banks to buy such products although that is the most realistic case, and a further avenue to expand the current section.

$$\text{sub}\quad \begin{cases} I_t^{BK} = \left[\xi \tilde{I}_t^{BK}(n) + (1-\xi) I_t^X(n)\right] \\ \tilde{I}_t^{BK} = \left(\int_0^{Z_t^{BK}} (\iota_t^{BK}(j))^{\frac{\sigma-1}{\sigma}} dj\right)^{\frac{\sigma}{\sigma-1}} \\ I_t^X = \left(\int_0^{Z_t} (\iota_t^X(j))^{\frac{\sigma-1}{\sigma}} dj\right)^{\frac{\sigma}{\sigma-1}} \end{cases}$$

Given that a fraction ξ is allocated to the production of the standard sector and $1-\xi$ to the production of securities off-balance sheet, we can re-write: $f_t^{BK}(j) = \xi F_t^{BK}/Z_t^{BK}$, $f_t^X(j) = (1-\xi)F_t^{BK}/Z_t$. The equalization of the first order conditions for the two prices:

$$\frac{\partial \pi_t}{\partial \iota_t^{BK}} = 0 : p_t^{BK}\left(\frac{\iota_t^{BK}(n,j)}{I_t^{BK}(n)}\right)^{-1/\sigma} = \xi r_t^{BK}(n,j) \tag{7}$$

$$\frac{\partial \pi_t}{\partial \iota_t^{X}} = 0 : p_t^{BK}\left(\frac{\iota_t^{X}(n,j)}{I_t^{X}(n)}\right)^{-1/\sigma} = (1-\xi) r_t^{X}(n,j) \tag{8}$$

gives the optimal mix of activities on- and off-balance sheet:

$$\xi^* = \frac{1}{1 + (1-s)^{\frac{\sigma-1}{\sigma}}\left(\frac{Z_t^{SB}}{Z_t^{BK}}\right)^{1/\sigma}} \tag{9}$$

$$= \frac{1}{1 + (1-s)^{\frac{\sigma-1}{\sigma}}\left(\frac{1}{1-\frac{1}{D_t}}\right)^{1/\sigma}} \tag{10}$$

There are a number of interesting features that can be noticed from this framework. First of all, notice that $\partial\xi/\partial A_{X,t} < 0, \partial\xi/\partial A_{BK,t} > 0$. This implies that banks attempt to bring off balance sheet when the growth rate of shadow banks is larger than the one of traditional banking activities. The larger the distance between the technology of shadow banks vis-à-vis the one of traditional banks, $A_{X,t}/A_{BK,t}$, the larger the incentives to deviate from the current regulatory framework and find innovative loopholes in the system. The same idea can also be seen from a different perspective in the second equation as: $\partial\xi/\partial D_t > 0$. When banks manage to achieve deregulation, the push to increase such a measure decreases. This also seems to be true in practice. From Figure 2, it is almost possible to visualize that from the beginning of the 2000s, the extent of liquidity provision through off-balance sheet has not been as strong as it used to be. To conclude the set of comparative analyses exercises, it is important to notice that reserve requirements are not sufficient *per se* to halt the growth of the financial sector, $\partial\xi/\partial s \lesseqgtr 0$ according to the value of σ.

The deeper message of the previous derivations is that regulation by itself suffices neither to prevent an increase in the growth of finance nor in the shadow banking activities *per se*. How to define the regulatory perimeter seems to be particularly challenging when financial innovations and lobbying against those very regulatory norms is possible. It seems that this can only be achieved by putting a cap on the maximum amount of lobbying allowed, and limiting the financial contracts and innovations created in the first place. By limiting the entry of financial innovations or lobbying attempts, it is possible to limit the growth rate of the sector. These may be seen as a new macro-prudential policy instruments to be included in the policy toolkit. For instance, by treating financial innovation from the same perspective as pharmaceutical innovation,[17] i.e. by setting a system and a procedure that has to deliberate on the nature of the new contracts brought forward, a more ordered growth rate of the system can be ensured. The previous derivations become all the more important in light of the potential systemic risks stemming from a larger financial structure, which have not been tackled yet.

4 Concluding remarks

In this paper I investigated the overarching phenomenon of explosive growth of financial assets with respect to real output from the 1980s on, which can be defined as *financial deepening*, the

[17] A similar point is made in Haliassos (2013).

structural transformation happening in the financial sector, and – more importantly – the endogenous nature of financial deregulation as the by-product of banking competition dynamics.

In this respect, the framework I proposed allowed me to tackle deregulation as a proximate rather than a root cause for the spurt in financial activities. Deregulation has been identified as the tool to prevent the disappearance of depository institutions when facing with stiff business stealing from asymmetric competition. As a consequence, I provided the first attempt, to my knowledge, to characterize deregulation neither as an exogenous given evidence, nor as a behavioral process à la Minsky.

The model, although tractable, allowed for a fairly rich set of dynamics, and helped to rationalize and describe all the major trends characterizing the economy. When looking at the overall long-run dynamics, the most important take-away from a macro-prudential perspective is that regulation in a realistic political economy environment is rather hard: Successful lobbying attempts, and financial innovations that have the same result as regulatory arbitrage, need to be considered as pivotal for the design of financial regulation. For example, one may want to include limits to financial lobbying, and financial innovations to be examined also *ex ante* before being introduced, when considering the systemic risks they can induce.

Many more elements may be introduced to further enrich the current framework both from a theoretical and an empirical point of view. For instance, the model can allow for a direct interconnection between banks and shadow banks through inter-banking market (which is currently outside of the picture, yet highly relevant in practice); the risks for financial stability, and the consequent welfare assessments are still lacking. A calibration exercise also remains a must to quantitatively estimate the dynamics taken from a positive side.

On the empirical side, analyses on the time series relationships among relevant variables seem to be conducive to some interesting insights. Waves of financial liberalization have systematically followed shrinking positions by the traditional chartered institutions even when they looked closer to catch up the pace of shadow banks. Furthermore, such shrinking positions systematically pushed banks harder towards off-balance sheet operations. However, a more refined and identified time-series and cross-sectional event study can further corroborate the multivariate and long-run reduced form approach followed so far.

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A.1 Appendix

A.1.1 Proofs

Households problem. From the FOCs of the household, we can find the the Euler equations and the no-arbitrage conditions:

$$\frac{c_{t+1}}{c_t} = \beta \frac{R^K_{t+1} + p^K_{t+1}(1-\delta)}{p^K_t} \tag{EE_K}$$

$$= \beta \frac{R^{BK}_{t+1} + p^{BK}_{t+1}}{p^{BK}_t} \tag{EE_{BK}}$$

$$= \beta \frac{R^{SB}_{t+1} + p^{SB}_{t+1}}{p^{SB}_t} \tag{EE_{SB}}$$

Equation (EE_K) is the Euler equation with respect to capital, while (EE_{BK}) and (EE_{SB}) pin down the conditions with respect to the banking and shadow banking sectors, respectively. By combing the three conditions, it is possible to derive the *no arbitrage* conditions:

$$\frac{p^{SB}_t}{p^{BK}_t} = \frac{R^{SB}_{t+1} + p^{SB}_{t+1}}{R^{BK}_{t+1} + p^{BK}_{t+1}} \tag{A.1}$$

$$\frac{p^{SB}_t}{p^K_t} = \frac{R^{SB}_{t+1} + p^{SB}_{t+1}}{R^K_{t+1} + (1-\delta)p^K_{t+1}} \tag{A.2}$$

The consumption goods maximization problem leads to two optimal conditions with respect to R^K_t and w_t:

$$\alpha \frac{C_t}{\phi^K_t k_t} = R^K_t \tag{A.3}$$

$$(1-\alpha)p^C_t C_t = w_t \tag{A.4}$$

While the problem ($\mathscr{P}_3$ for real investments lead to the optimal condition: $p^K_t A_K = R^K_t$.

Proof of Proposition 1 Recall the Euler Equation:

$$\begin{aligned}\frac{c_{t+1}}{c_t} &= \beta\frac{R^K_{t+1} + p^K_{t+1}(1-\delta)}{p^K_t} \\ &= \beta\frac{R^K_{t+1}}{R^K_t}(A_K + 1 - \delta) \qquad (EE_{K.bis})\end{aligned} \tag{A.5}$$

where the second line follows from: $p^K_t A_K = R^K_t$; but from (A.3), we have:

$$R^K_t = \alpha\frac{C_t}{\phi^K_t k_t} \Rightarrow \frac{R^K_{t+1}}{R^K_t} = \frac{g_C}{g_{\phi_K} g_K} \tag{A.6}$$

therefore:

$$g_C = \beta\frac{g_C}{g_{\phi^K} g_K}(A_K + 1 - \delta) \tag{A.7}$$

$$g_{\phi_K} g_K = \beta(A_K + 1 - \delta) \tag{$EE_{K.ter}$}$$

But: $g_K = A_K(1-\phi^K_t) + 1 - \delta$, therefore:

$$g_{\phi_K} = \frac{\beta(A_K + 1 - \delta)}{A_K(1-\phi^K_t) + 1 - \delta} \tag{A.8}$$

If ϕ^K_t constant, then $g_{\phi_K} = 1$, and:

$$\phi^K = 1 + (1-\beta)\frac{1-\delta}{A_K} - \beta$$

Assume $g_{\phi_K} > 1$ then $(1-\phi^K_t)$ decreases in time. We have two cases, of which only one is economically meaningful. If ϕ^K_t is not bounded, then given that $g_{\phi_K} g_K$ is constant, and from the expression in Equation (A.8) we conclude that g_{ϕ_K} is negative, but given that $g_{\phi_K} > 1$ by assumption, we reach a contradiction. If ϕ^K_t is bounded in the interval (0,1), then after having increased to 1, $g_{\phi_K} = \frac{\beta(A_K+1-\delta)}{1-\delta}$ which is again a contradiction. The same steps can be applied if we assume $g_{\phi_K} < -1$. We conclude ϕ_K must be constant for all t. □

Growth rates: From the Euler equations and the optimal pricing conditions, we have:

$$\begin{aligned} \frac{C_{t+1}}{C_t} &= \beta \frac{R^K_{t+1} + p^K_{t+1}(1-\delta)}{p^K_t} \\ &= \beta \frac{R^K_{t+1}}{R^K_t}(A_K + 1 - \delta) \\ \text{but} \quad \frac{R^K_{t+1}}{R^K_t} &= \frac{C_{t+1}/C_t}{k_{t+1}/k_t} \\ \underbrace{\frac{K_{t+1}}{K_t}}_{g_K} &= \beta(A_K + 1 - \delta) \end{aligned}$$

Given the proof of $\phi^K_t = \phi^K \forall t$, and using the law of motion of real capital:

$$\begin{aligned} \underbrace{\frac{K_{t+1}}{K_t}}_{g_K} &= A^K_t(1-\phi^K_t) + 1 - \delta \\ \text{but} \;\; g_K &= \beta(A^K_t + 1 - \delta) \\ \Rightarrow \phi^*_K &= (1-\beta)\frac{A^K_t + (1-\delta)}{A^K_t} \\ \Rightarrow \underbrace{\frac{C_{t+1}}{C_t}}_{g_C} &= \frac{A_C(\phi_K k_{t+1})^\alpha L^{1-\alpha}}{A^C_t(\phi_K k_t)^\alpha L^{1-\alpha}} \\ &= \left(\frac{k_{t+1}}{k_t}\right)^\alpha \\ &= (\beta(1 + A^K_t - \delta))^\alpha \end{aligned}$$

For the financial sector:

$$
\begin{aligned}
g_{I_{BK}} &= \frac{A_t^{BK} F_{t+1}^{BK}}{A_t^{BK} F_t^{BK}} \\
&= \frac{F_{t+1}^{BK}}{F_t^{BK}} \\
&= \frac{I_t^{BK}}{F_t^{BK}} + 1 \\
&= 1 + A_t^{BK} \\
&= g_{F_{BK}}
\end{aligned}
$$

$$
\begin{aligned}
g_{F_{SB}} &= \frac{I_t^{BK}}{F_t^{BK}} + 1 \\
&= 1 + A_t^{SB}
\end{aligned}
$$

For the nominal shares, we have:

$$
\begin{aligned}
\frac{C_{t+1}}{C_t} &= \beta \frac{R_{t+1}^{BK} + p_{t+1}^{BK}}{p_t^{BK}} \\
\text{but } \; p_t^{BK} A_{BK} &= \frac{\sigma}{\sigma - 1} R_t^{BK} \\
\frac{C_{t+1}}{C_t} &= \beta \frac{R_{t+1}^{BK}}{R_t^{BK}} \left[\frac{(\sigma - 1) A_{BK} + \sigma}{\sigma} \right] \\
\text{but } \frac{C_{t+1}}{C_t} &= (\beta(1 + A_K - \delta))^{\alpha} \\
\Rightarrow \frac{R_{t+1}^{BK}}{R_t^{BK}} &= \frac{(\beta(A_K + 1 - \delta))^{\alpha}}{\beta(1 + A_{BK} \frac{\sigma - 1}{\sigma})} \\
\frac{R_{t+1}^{BK} F_{t+1}^{BK}}{R_t^{BK} F_t^{BK}} &= (1 + A_{BK}) \frac{(\beta(A_K + 1 - \delta))^{\alpha}}{\beta(1 + A_{BK} \frac{\sigma - 1}{\sigma})} \\
\frac{p_{t+1}^{BK} F_{t+1}^{BK}}{p_t^{BK} F_t^{BK}} &= (1 + A_{BK}) \frac{(\beta(A_K + 1 - \delta))^{\alpha}}{\beta(1 + A_{BK} \frac{\sigma - 1}{\sigma})}
\end{aligned}
$$

One can apply the same logic to the shadow banking sector growth rates with the only difference of having A_{SB} as productivity for the sector. As such, the relative growth rate of one with respect to the other are:

$$\frac{F_{t+1}^{BK}/F_t^{BK}}{F_{t+1}^{SB}/F_t^{SB}} = \frac{1+A_{BK}}{1+A_{SB}}$$
$$\frac{(p_{t+1}^{BK}F_{t+1}^{BK})/(p_t^{BK}F_t^{BK})}{(p_{t+1}^{SB}F_{t+1}^{SB})/(p_t^{SB}F_t^{SB})} = \frac{1+A_{BK}}{1+A_{SB}}\frac{\sigma+A_{SB}(\sigma-1)}{\sigma+A_{BK}(\sigma-1)}$$

which is increasing in the ratio of productivities A_{BK}/A_{SB}.

Technology-Banking output lemma

I want to show that $I_t^{BK}(n) = (1-s)A_t^{BK}F_t^{BK}(n)$ with $A_t^{BK} = \left(Z_t^{BK}\right)^{\frac{1}{\sigma-1}}$.

Proof. Notice that $F_t^{BK}(n) = Z_t^{BK}f_t^{BK}(n,j)$ by symmetry with $f_t^{BK}(n,j) = \iota_t^{BK}(n,j)/(1-s)$ by accounting identity. It follows

$$F_t^{BK}(n) = \frac{Z_t^{BK}\iota_t^{BK}(n,j)}{1-s} \Leftrightarrow \iota_t^{BK}(n,j) = (1-s)F_t^{BK}(n)/Z_t^{BK}.$$

But,

$$I_t^{BK}(n) = \left(Z_t^{BK}\right)^{\frac{\sigma}{\sigma-1}-1}(1-s)F_t^{BK}(n)$$
$$= \left(Z_t^{BK}\right)^{\frac{1}{\sigma-1}}(1-s)F_t^{BK}(n)$$

Define $A_t^{BK} = \left(Z_t^{BK}\right)^{\frac{1}{\sigma-1}}$ and the result follows. □

Off-balance sheet resource constraint.

Given a fraction ξ, of funds F_t^{BK}, with $\xi \in (0,1)$, we have:

$$F_t^{BK} = \xi F_t^{BK} + (1-\xi)F_t^{BK}$$
$$= \int_0^{Z_{BK}} f_{BK,t}(j)dj + \int_0^{Z} f_{X,t}(j)dj$$

by symmetry: $f_t^{BK}(j) = \dfrac{\xi F_t^{BK}}{Z_{BK}}$

$$f_t^X(j) = \frac{(1-\xi)F_t^{BK}}{Z}$$

Off-balance sheet solution:

$$\max_{\{f_t^X(j)\}} \quad r_t^X(j)\iota_t^X(j) - R_t^{BK} f_t^X(j)$$

$$\text{sub} \quad \begin{cases} \iota_t^X(j) = f_t^X(j) \\ r_t^X(j) = p_t^{BK} \left(\dfrac{I_{X,t}}{I_{BK,t}}\right)^{-\frac{1}{\eta}} \left(\dfrac{\iota_{X,t}}{I_{X,t}}\right)^{-\frac{1}{\sigma}} \end{cases}$$

$$\begin{aligned} g_{BK} &= \frac{I_t^{BK}}{F_t^{BK}} + 1 \\ &= \frac{1}{F_t^{BK}} \left[(\tilde{I}_t^{BK})^{\frac{\eta-1}{\eta}} + (I_t^X)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \\ &= \frac{1}{F_t^{BK}} \left[(A_{BK,t}\xi F_{BK,t})^{\frac{\eta-1}{\eta}} + (A_{X,t}(1-\xi)F_{X,t})^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} + 1 \\ &= \left[(\xi A_{BK,t})^{\frac{\eta-1}{\eta}} + ((1-\xi)A_{X,t})^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} + 1 \end{aligned}$$

ξ is endogenous and can be computed from the optimal pricing conditions: $R_t^{BK} = \frac{\sigma-1}{\sigma} r_t^X(j)$, and $R_t^{BK} = \frac{\sigma-1}{\sigma} r_t^{BK}(j)(1-s)$. Divide the two expression in order to find the optimal expression for ξ:

$$\frac{r_t^{BK}(j)}{r_t^X(j)} = \left(\frac{\iota_{BK,t}}{\iota_{X,t}}\right)^{-\frac{1}{\sigma}} \left(\frac{\tilde{I}_t^{BK}}{I_t^X}\right)^{-\frac{1}{\eta}+\frac{1}{\sigma}}$$

which leads to: $\xi^* = \dfrac{1}{1+(1-s)^{-\eta}\left(\frac{A_{X,t}}{A_{BK,t}}\right)^{\eta-1}} \quad \square.$

Table A.1: Gross real and nominal growth rates for each sector of the economy

	Consumption / Wages	*Real Investments*
Real	$g_C = (\beta(1 + A_K - \delta))^{\alpha} = g_w$	$g_K = \beta(1 + A_K - \delta)$
Nominal	$g_{\hat{C}} = g_C;\ g_{\hat{w}} = g_w$	$g_{\hat{K}} = g_K^{\alpha}$
	Banking	*Shadow Banking*
Real	$g_{I_{BK}} = 1 + (1 - s)A_{BK} = g_{F_{BK}}$	$g_{I_{SB}} = 1 + A_{SB} = g_{F_{SB}}$
Nominal	$g_{\hat{I}_{BK}} = \dfrac{(1 + (1 - s)A_{BK})(\beta(A_K + 1 - \delta))^{\alpha}}{\beta\left(1 + \frac{\nu}{1+\nu} A_{BK}\right)}$	$g_{\hat{I}_{SB}} = \dfrac{(1 + A_{SB})(\beta(A_K + 1 - \delta))^{\alpha}}{\beta\left(1 + \frac{\sigma-1}{\sigma} A_{SB}\right)}$

A.1.2 Empirical evidence

In this section, I test empirically the narrative just mentioned. Although I cannot account for a precise identification strategy, I propose to begin by assessing the phenomenon through a lag-lead type of structure, which builds on arguments of weak exogeneity and takes advantage of insights from Granger non-causality tests. I first look at the effect of competition from non-bank financial intermediaries on the liability side (given its importance for banks revenues).[1] I proxy such competition from other wholesale funding institutions as the proportion of chartered deposits to money market funds shares (the direct competitor, although other money market instruments as Asset Backed Commercial Papers, and other repurchase agreements – RePos – could be added). Shadow banking only works through money market funding of capital market lending, and – as such – the size of money markets is an instrument to capture the overall growth of shadow banking. Deposits, on the other hand, are a distinctive feature of banks, and still represent the overwhelming majority of banks funding as of 2020 (beyond 80 per cent).

In Table A.2, I evaluate the effect of a percentage change in the funding competition index

[1] The same kind of analysis can be carried out for the lending amounts on the assets' side, which leads to similar results.

vis-à-vis the subsequent change in deregulation.[2] I lag backward the independent variable to an arbitrary number of periods in order to discover the time length necessary to generate a change in deregulation. I also introduce an autoregressive component and additional controls, so that a full-fledged ARDL model is considered, and the long-run effects from partial adjustment can be evaluated, as expressed in Equation (A.9).

$$\Delta D_{t+4} = \alpha + \beta \Delta x_{t-i} + \theta \Delta D_t + \boldsymbol{\gamma}' \mathbf{X}_t + \epsilon_t \qquad i = 0, 1, \ldots 8; \tag{A.9}$$

Stiffer competition seems to deliver a stronger push for laxer regulation already four quarters ahead, and reach a peak in intensity and significance the following quarter.[3] The indicator keeps being significant for up to two years and ceases in intensity after that (additional lags reflect the non-significant results provided in the last column). The long-run effect is also systematically important, and follows the same pattern over time corroborating what was the thirty years evidence highlighted before. Notice that none of the control variables here nor in the appendix appears to be systematically significant to explain deregulation.

With that being said, one needs to be careful about reverse causality, namely, to what extent an increase in deregulation did not actually favor shadow banks and increase competition. Equation (A.10) deals with this issue, and Table A.3 shows the results for this channel.

$$\Delta x_t = \alpha + \beta_1 \Delta D_{t-i} + \beta_2 \Delta D_{t-i-1} + \theta \Delta x_{t-1} + \boldsymbol{\gamma}' \mathbf{X}_t + \epsilon_t \qquad i = 1, 2 \ldots 22; \tag{A.10}$$

I compress the effect of two subsequent quarters together to convey the message in one table, but results are always significant also when considering one quarter in isolation. As shown in this case, for the first two years after liberalization measures were passed, the impact on banks and shadow banks does not seem to be statistically significant. This is probably also due to

[2] The effect of deregulation is taken as a year-to-year change rather than quarter-to-quarter given its slow moving nature. The index is non-serially correlated after taking the absolute difference; I correct for autocorrelation following Newey-West.

[3] Table **??** in the Appendix shows that such results are robust to introduction of a relatively large number of macro-financial control variables.

the fact that deregulation takes time to be actually implemented since the moment it is passed. After two years, however, the coefficient starts to be significant and negative in sign – and it does so for the following three years (lags after that replicate the non-significant coefficients in Column 9). Furthermore, notice that coefficients are negative, i.e. higher deregulation does benefit banks more than shadow banks, and allows them to grow stronger than other financial intermediaries. The effects are robust to different specifications, and the long-run effects mimic what observed in the short run.

With that in hand, I proceed to carry out a similar type of analysis by means of local projections (Jordà, 2005).

$$\Delta D_{t+h} = \alpha + \beta \Delta x_t + \theta \Delta D_{t+h-4} + \boldsymbol{\gamma}' \mathbf{X}_t + \epsilon_t \qquad h = 1, 2, \ldots 20; \tag{A.11}$$

As shown in Equation (A.11), the opposite type of lag structure is assessed. The independent variables are kept fixed (except for the autoregressive component), and the dependent variables are forecast in the future. As such, the expression in Equation (A.11) can be thought of as following the similar idea as the one in Equation (A.9). Figure A.1 plots the impulse response functions derived for this case. It is interesting to notice that, not only the pattern of the impulse response follows the one shown of the coefficients of the ARDL analysis, but also that the IRF follows almost an 'M' with a first wave being eight quarters ahead (i.e. two years), and the following sixteen (i.e. four years). Although purely suggestive, it is interesting to notice how these two horizons coincide with midterm elections periods, and a full mandate in the U.S. political cycle.

The bottom panel of Figure A.1 is the by-product of the impulse response from Equation A.12, and it replicates the same idea expressed in Equation A.10.

$$\Delta x_{t+h} = \alpha + \beta \Delta D_{t-1} + \theta \Delta x_{t+h-1} + \boldsymbol{\gamma}' \mathbf{X}_t + \epsilon_t \qquad h = 1, 2, \ldots 23; \tag{A.12}$$

Table A.2: Quarterly estimates of the effect of funding competition on deregulation over the period 1980q1-2008q4

	Deregulation index (ΔD_{t+4})								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Funding competition	0.782*	0.840**	0.781*	0.765**	0.619**	0.518**	0.364*	0.357**	0.328
(Δx_{t-i})	(0.419)	(0.410)	(0.424)	(0.361)	(0.311)	(0.253)	(0.199)	(0.179)	(0.213)
Fund competition – LT effect	1.196*	1.253**	1.160*	1.119**	0.902**	0.753**	0.531*	0.519**	0.480
$\beta/(1-\theta)$	(0.648)	(0.621)	(0.628)	(0.526)	(0.443)	(0.355)	(0.286)	(0.255)	(0.305)
Lag=0 (Δx_t)	yes								
Lag=1 (Δx_{t-1})		yes							
Lag=2 (Δx_{t-2})			yes						
Lag=3 (Δx_{t-3})				yes					
Lag=4 (Δx_{t-4})					yes				
Lag=5 (Δx_{t-5})						yes			
Lag=6 (Δx_{t-6})							yes		
Lag=7 (Δx_{t-7})								yes	
Lag=8 (Δx_{t-8})									yes
Deregulation index (ΔD_t)	0.346***	0.329***	0.327***	0.316***	0.314***	0.311***	0.315***	0.313***	0.317***
	(0.088)	(0.085)	(0.084)	(0.077)	(0.080)	(0.080)	(0.082)	(0.081)	(0.082)
Output growth (Δy_t)	-0.232	2.452	1.144	0.642	1.859	-0.424	-0.703	-1.465	-0.907
	(3.386)	(3.532)	(3.627)	(3.102)	(3.700)	(3.145)	(3.016)	(2.727)	(2.939)
Inflation (Δp_t)	-0.805	-0.010	-0.518	-0.919	-0.463	-0.522	0.845	0.972	1.170
	(5.350)	(5.140)	(5.463)	(5.232)	(5.025)	(4.647)	(4.739)	(4.574)	(4.507)
U.S. real equity price (Δeq_t^{US})	0.630*	0.433	0.490*	0.560*	0.417	0.548*	0.521*	0.570*	0.556*
	(0.342)	(0.267)	(0.288)	(0.298)	(0.272)	(0.292)	(0.298)	(0.316)	(0.314)
U.S. long term *i* rate (Δlr_t^{US})	29.859*	20.673	22.946	28.822	18.996	30.520*	26.152	27.551	22.021
	(17.195)	(15.768)	(15.456)	(17.510)	(15.630)	(17.317)	(16.563)	(17.130)	(16.673)
R-squared	0.235	0.240	0.240	0.246	0.229	0.223	0.206	0.207	0.204

Notes: 'Funding competition' is the ratio between U.S. chartered depository institutions checking, savings, and time deposits and the total amount of outstanding MMMF shares. The deregulation index is taken as absolute difference with respect to four quarters before. Long term interest rates are quarterly absolute first difference. All other variables are first difference of the natural logarithm one quarter before. The deregulation quarterly variables are obtained by linearly interpolating the original annual indicator. The long term effect of funding competition is computed from the specification of an ARDL with partial adjustment. Errors are corrected following Newey-West. All data are quarterly. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. **Sources**: U.S. deposits and MMMF shares: Financial Account of the Fed, Z.1 tables (quarterly frequency). Deregulation index: Philippon and Reshef (2012). Output growth: U.S. Bureau of Economic Analysis. CPI: OECD accessed through FRED. U.S. real equity price, and long term *i* rate: GVAR dataset, Mohaddes and Raissi (2020).

Table A.3: Quarterly estimates of the effect of deregulation on funding competition over the period 1980q1-2008q4

	Funding competition (Δx_t)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Deregulation index	-0.035	-0.062**	-0.068***	-0.051**	-0.050**	-0.061***	-0.063***	-0.042**	-0.022
$(\beta_1 + \beta_2)$	(0.030)	(0.026)	(0.022)	(0.020)	(0.020)	(0.019)	(0.021)	(0.019)	(0.016)
Deregulation – LT effect	-0.039	-0.067**	-0.074***	-0.056***	-0.055***	-0.066***	-0.068***	-0.045**	-0.024
$(\beta_1 + \beta_2)/(1-\theta)$	(0.033)	(0.027)	(0.020)	(0.020)	(0.019)	(0.016)	(0.017)	(0.018)	(0.016)
Lag=6, 7 (ΔD_{t-6}, ΔD_{t-7})	yes								
Lag=8, 9 (ΔD_{t-8}, ΔD_{t-9})		yes							
Lag=10, 11 (ΔD_{t-10}, ΔD_{t-11})			yes						
Lag=12, 13 (ΔD_{t-12}, ΔD_{t-13})				yes					
Lag=14, 15 (ΔD_{t-14}, ΔD_{t-15})					yes				
Lag=16, 17 (ΔD_{t-16}, ΔD_{t-17})						yes			
Lag=18, 19 (ΔD_{t-18},ΔD_{t-19})							yes		
Lag=20, 21 (ΔD_{t-20}, ΔD_{t-21})								yes	
Lag=22, 23 (ΔD_{t-22}, ΔD_{t-23})									yes
Funding competition (Δx_{t-1})	0.113	0.081	0.082	0.088	0.088	0.072	0.072	0.086	0.103
	(0.117)	(0.118)	(0.118)	(0.119)	(0.115)	(0.116)	(0.117)	(0.119)	(0.121)
Output growth	-1.099	-0.995	-0.976	-1.124	-1.239	-1.239	-1.203	-1.198	-1.235
	(0.969)	(0.983)	(0.977)	(0.982)	(0.931)	(0.918)	(0.918)	(0.939)	(0.948)
Inflation	4.051**	4.287**	4.261**	4.266**	4.086**	4.233**	4.266**	4.262**	4.227**
	(1.867)	(1.835)	(1.794)	(1.871)	(1.877)	(1.876)	(1.859)	(1.873)	(1.887)
US real equity price	-0.119	-0.151	-0.153	-0.131	-0.081	-0.093	-0.101	-0.106	-0.099
	(0.128)	(0.127)	(0.129)	(0.137)	(0.129)	(0.128)	(0.123)	(0.126)	(0.127)
US long term i rate	-4.796	-6.172	-6.330	-5.750	-4.176	-4.400	-4.766	-4.692	-4.322
	(5.874)	(6.226)	(6.081)	(6.395)	(6.313)	(6.289)	(6.304)	(6.244)	(6.148)
R-squared	0.287	0.295	0.311	0.296	0.288	0.298	0.305	0.288	0.276

Notes: 'Funding competition' is the ratio between U.S. chartered depository institutions checking, savings, and time deposits and the total amount of outstanding MMMF shares. The deregulation index is taken as absolute difference with respect to four quarters before. Long term interest rates are quarterly absolute first difference. All other variables are first difference of the natural logarithm one quarter before. The deregulation quarterly variables are obtained by linearly interpolating the original annual indicator. The long term effect of funding competition is computed from the specification of an ARDL with partial adjustment. Errors are corrected following Newey-West. All data are quarterly. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. **Sources**: U.S. deposits and MMMF shares: Financial Account of the Fed, Z.1 tables (quarterly frequency). Deregulation index: Philippon and Reshef (2012). Output growth: U.S. Bureau of Economic Analysis. CPI: OECD accessed through FRED. U.S. real equity price, and long term *i* rate: GVAR dataset, Mohaddes and Raissi (2020).

Again, we can see that for the first two years the effects are rather noisy and non-significant before dipping into negative for the following three years. After five years from the implementation of deregulation, the coefficients cease to matter for the benefits of banks vis-à-vis non-banks financial institutions.

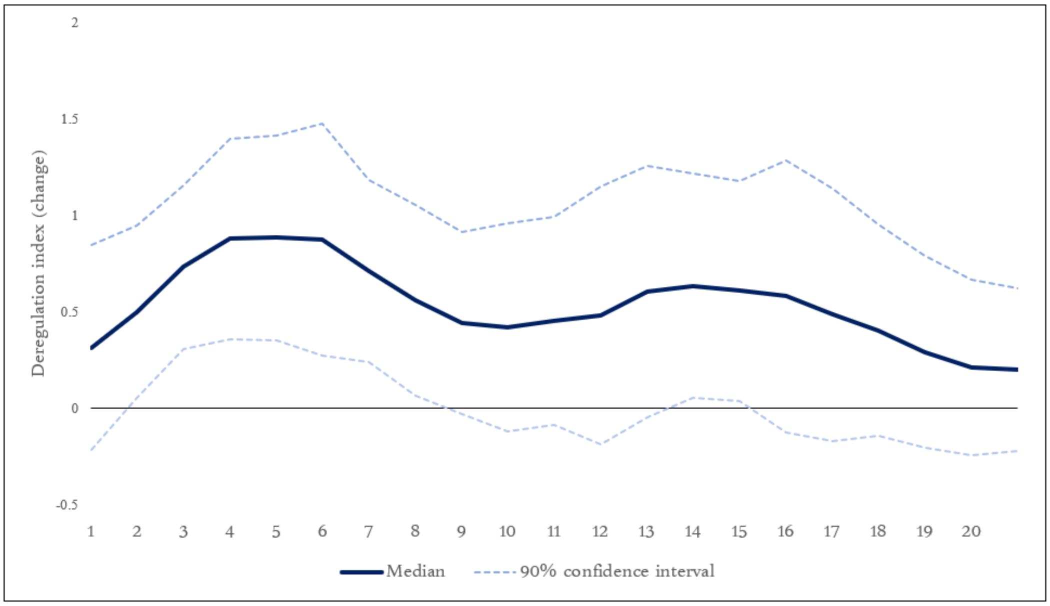
One final point of interest is the extent to which funding competition also has an impact on- the off-balance sheet operations. Equation (A.13) depicts the set of regressions conducted in Table A.4. O_t here refers to the ratio of off-balance sheet assets as a fraction of the overall consolidated assets.[4]

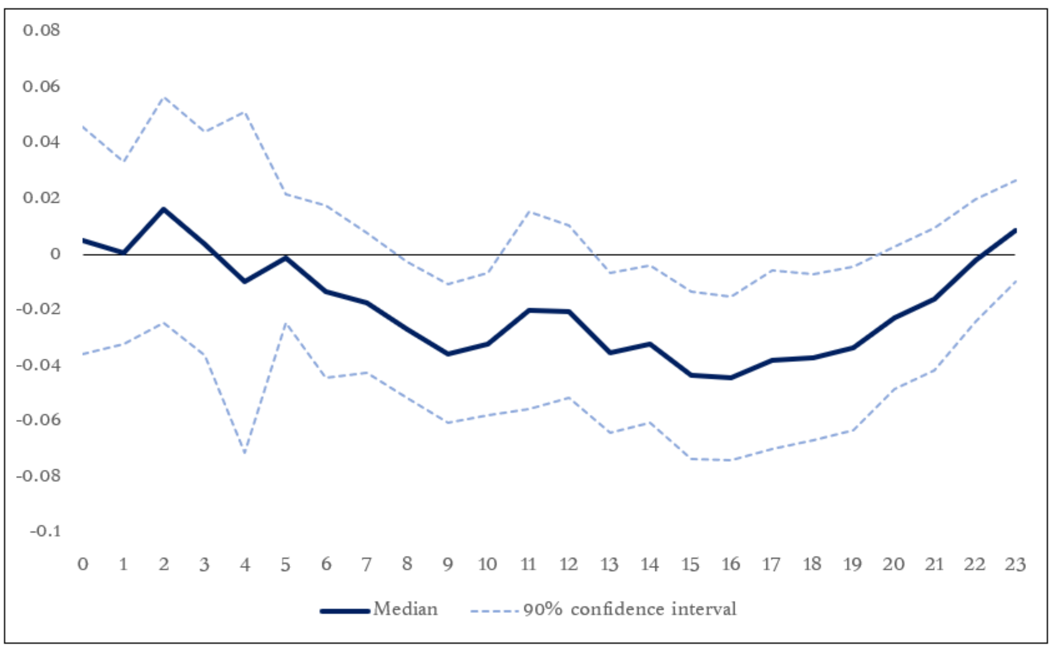
$$\Delta O_t = \alpha + \beta \Delta x_{t-2} + \theta \Delta O_{t-1} + \mathbf{X}_t \boldsymbol{\gamma} + \epsilon_t \tag{A.13}$$

As aforementioned, off-balance operations are utilized to save on regulatory requirements imposed on banks, and are associated with entering into financially innovative contracts in the literature. Thus, I use this as a proxy to estimate the likelihood of seeing a higher push for securitization and financial engineering, as a result of stiffer competition. The previous ARDL structure is maintained by adding a number of controls and an autoregressive component which parses out additional autocorrelation left after having taken the ratios in first difference and having corrected for Newey-West standard errors. As shown in Table A.4, the effects are systematically positive and significant regardless of the choice of controls used. Furthermore, the coefficients are highly stable both in the short- and long-run. A percentage point of increase in MMMF with respect to deposits leads to 0.16 per cent growth of off-balance sheet operations with respect to the overall asset growth. Once again, the results lean in the direction that these channels may be selectively used over time according to the market environment. Other controls seems to be non-significant. One important remark is that the time lag of the explanatory variable x_t is rather important here. The effects seem to be not significant before and after that.

[4]Off-balance sheet operations are harmonized on a balance-sheet consolidate fashion, and therefore need to be accordingly evaluated with respect to the overall size of assets, as specifically indicated by the Federal Reserve Board explanation of the Enhanced Financial Accounts.

Figure A.1: Local projections over the period 1980q1–2008q4





Notes: *Top:* One standard deviation shock in the funding competition index. *Bottom:* One standard deviation shock in the deregulation index. 'Funding competition' is the ratio between U.S. chartered depository institutions checking, savings, and time deposits and the total amount of outstanding MMMF shares. The deregulation index is taken as absolute difference with respect to four quarters before. Long term interest rates are quarterly absolute first difference. All other variables are first difference of the natural logarithm one quarter before. The deregulation quarterly variables are obtained by linearly interpolating the original annual indicator. The long term effect of funding competition is computed from the specification of an ARDL with partial adjustment. Errors are corrected following Newey-West. All data are quarterly. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. **Sources**: U.S. deposits and MMMF shares: Financial Account of the Fed, Z.1 tables (quarterly frequency). Deregulation index: Philippon and Reshef (2012). Output growth: U.S. Bureau of Economic Analysis. CPI: OECD accessed through FRED. U.S. real equity price, and long term *i* rate: GVAR dataset, Mohaddes and Raissi (2020).

Table A.4: Effect of funding competition on off-balance items as a fraction of total assets. Sample period 1990q1-2007q4

	Off-balance sheet ratio (ΔO_t)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Funding competition	0.162**	0.163**	0.149**	0.152**	0.162*	0.166**	0.166**	0.152**	0.161**	0.164*
(Δx_{t-2})	(0.072)	(0.076)	(0.065)	(0.074)	(0.092)	(0.073)	(0.076)	(0.065)	(0.079)	(0.094)
Funding competition – LT effect	0.194***	0.194***	0.179***	0.182**	0.188**	0.197***	0.197***	0.183***	0.191**	0.189**
$\beta/(1-\theta)$	0.0728	0.0744	0.0668	0.0744	0.0910	0.0735	0.0748	0.0675	0.0781	0.0928
Off-balance sheet ratio (ΔO_{t-1})	0.161	0.161	0.170**	0.165*	0.136	0.158	0.158	0.166**	0.154*	0.132
	(0.107)	(0.118)	(0.073)	(0.084)	(0.084)	(0.107)	(0.118)	(0.071)	(0.085)	(0.087)
Output growth (Δy_t)		0.018	0.098	0.217	0.601		-0.000	0.085	0.246	0.615
		(0.602)	(0.493)	(0.629)	(0.647)		(0.605)	(0.496)	(0.632)	(0.667)
Inflation (Δp_t)			0.445	0.474	0.593			0.485	0.554	0.634
			(0.914)	(0.953)	(0.852)			(0.933)	(0.977)	(0.910)
Oil price (Δp_t^{oil})			-0.063***	-0.063**	-0.064**			-0.063***	-0.066**	-0.065**
			(0.021)	(0.025)	(0.025)			(0.022)	(0.025)	(0.025)
US real equity price (Δeq_t^{US})				-0.014	-0.080				-0.026	-0.082
				(0.057)	(0.091)				(0.062)	(0.093)
US long term *i* rate (Δlr_t^{US})				-1.158	-4.880				-1.290	-4.998
				(3.077)	(7.144)				(3.120)	(7.221)
Global realized volatility (grv_t)					-0.265***					-0.258***
					(0.096)					(0.095)
Global real equity price (Δeq_t^{US})					0.014					0.014
					(0.099)					(0.100)
Global long term *i* rate (Δglr_t)					0.041					0.044
					(0.188)					(0.189)
Global output growth (Δy_t^*)					-1.023					-1.038
					(0.709)					(0.726)
Deregulation index (ΔD_{t-2})						-0.003	-0.003	-0.004	-0.006	-0.002
						(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
R-squared	0.143	0.143	0.232	0.235	0.302	0.145	0.145	0.234	0.238	0.303

Notes: 'Off-balance sheet ratio' is the fraction of Unused commitments and letters of credit out of consolidated U.S. depository institutions' assets. 'Funding competition' is the ratio between U.S. chartered depository institutions checking, savings, and time deposits and the total amount of outstanding MMMF shares. The deregulation index is taken as absolute difference with respect to four quarters before. Long term interest rates are quarterly absolute first difference. All other variables are first difference of the natural logarithm one quarter before. The deregulation quarterly variables are obtained by linearly interpolating the original annual indicator. The long term effect of funding competition is computed from the specification of an ARDL with partial adjustment. Errors are corrected following Newey-West. All data are quarterly. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. **Sources**: Off-balance sheet items, and consolidated assets: Enhanced Financial Accounts, Federal Reserve Board. U.S. deposits and MMMF shares: Financial Account of the Fed, Z.1 tables (quarterly frequency). Deregulation index: Philippon and Reshef (2012). Output growth: U.S. Bureau of Economic Analysis. CPI: OECD accessed through FRED. U.S. real equity price, and long term *i* rate: GVAR dataset, Mohaddes and Raissi (2020).

However, this can be thought as a reasonable reaction time, the first quarter may be needed to actually assess the stress, while it may need no more than between three and six months to respond to heightened competitive pressure.

To conclude, the empirical evidence, although not accounting for a full-fledged exogenous structure, remarks the overall stream of reasoning and descriptive evidence highlighted in the previous two sections. Namely, higher deregulation is systematically observed between two and three years of increased pressure on banks, such deregulation seems to make banks grow larger than shadow banks with a lag comprised between two and five years, and in the short term banks push their assets off-balance sheet with a lag of about six months as a result of higher shadow banks growth – in this case, deregulation is not important at any horizon considered.