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Research Report

Financial market dynamics and regulation

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FINMAP -

**FINANCIAL DISTORTIONS AND MACROECONOMIC
PERFORMANCE: EXPECTATIONS, CONSTRAINTS AND
INTERACTION OF AGENTS**

DATE: 10/04/2016

TITLE

FINANCIAL MARKET DYNAMICS AND REGULATION

by: Jesper Riedler (Center for European Economic Research)

The current banking regulation laid down, for example, in the Capital Requirements Regulation and Directive (CRR/CRD IV) for the European Union, consist of a large number of detailed rules for diverse areas of bank risk such as market risk, liquidity risk, credit risk, and operational risk, just to mention the most important. Even for individual regulatory measures such as the minimum capital requirements, it is difficult to assess the effects on a single bank, but very hard to get an estimate for the complete banking sector. However, from an economic policy perspective it is necessary to know how a regulatory measure will affect economic development and growth. It would be of even higher importance to have such knowledge for the regulatory rulebook as a whole, but this seems to be far beyond the scope of theoretical or applied economic models.

The aim of our project was to develop a multi-purpose agent-based model targeted to measure the effects of banking regulation, both for the banking sector and for the whole economy. A first important application is to find out if and how strongly banking regulation impacts monetary policy. In the years after the beginning of the financial market crises (i.e. in the years after 2008) the European Central Bank (ECB) did a good job in preventing a collapse of the banking sector in the Eurozone. Nevertheless, even after many years of very low costs of loans for private households and companies (both in nominal and real terms), growth rates of loans to the private sector and M3 are still below pre-crisis levels. Also inflation is still far below the target level of the ECB. This shows in a glance how difficult it is for the ECB to normalise the transmission mechanism of monetary policy.

The transmission mechanism of monetary policy could now be further affected by the rules of banking regulation, in particular the liquidity coverage ratio (LCR). The LCR aims at reducing banks' short term liquidity risk by means of minimum holding requirements of highly liquid assets. Not much research has been conducted with regard to the impact of the LCR on monetary policy. In an early paper Bech and Keister (2013) find that the LCR will change the way how central banks are able to conduct monetary policy, but does not reduce its overall effectiveness. Bonner and Eijffinger (2012) show that banks with low liquidity reduce lending particularly strongly and this effect will be more pronounced by the LCR in time of crisis. Aaron et al. (2015) and Rezende et al. (2016) confirm the findings of the earlier papers that the LCR will affect the transmission mechanism in numerous ways, for example, by reducing demand for repos. These research findings show that it is important to consider individual characteristics of banks, e.g. whether the LCR is binding or not, as this significantly changes banks' behaviour and the way monetary transmission will work after the introduction of the LCR.

Whereas these papers are mostly based on econometric methods; in our own research we are using an agent-based model that allows us to consider the relevant details of banks' behaviour in much more detail. Using our model we analysed the effects of the LCR on the balance sheet of banks, as well as on the transmission mechanism of monetary policy (e.g. on different interest rates) and the stability of the banking sector.

The liquidity coverage ratio (LCR) regulation is part of the Basel III framework and has been designed in order to address the problem of insufficient liquidity in times of stress. Specifically, the regulation requires banks to hold sufficient high quality liquid assets (HQLA) in order to meet the expected net cash outflows over thirty days of stress. The stress scenario is thereby defined by the regulator via fixed run-off rates for liabilities, inflow rates for assets that do not count as HQLA and haircuts for assets that count as HQLA. The run-off rate and the inflow rate specify how much of the liabilities and assets cannot be rolled over in times of stress, whereas the haircut implies a potential loss in value of an HQLA in times of stress. The regulation that should be fully implemented in the European Union by 2018 requires that in normal times the ratio of HQLA to net outflows is greater than or equal to 100%, i.e.

$$LCR = \frac{HQLA}{net\ outflows\ of\ 30\ days} \geq 100\%$$

We investigate the impact of the liquidity coverage ratio regulation via simulations of an agent-based model of the financial system. By comparing simulation results generated under two different setups, we can infer the impact of the LCR regulation on the financial system. In the benchmark setup the liquidity regulation is inactive, while in the LCR setup the regulation is the binding constraint on the behaviour of banks. For each analysis we conduct 20 simulation runs in order to reduce the probability that the observed results are due to chance. The advantage of using simulations instead of an empirical assessment lies in the ability to perfectly control the setup of the investigation. All external influences can be eliminated, which means that the observable difference between simulation outcomes of both setups represents the isolated effect of the LCR regulation on the artificial financial system. Nevertheless, an economic model remains a strong simplification of reality. The findings we present below should therefore be taken with a pinch of salt. They provide an indication, rather than a prophecy of how the LCR regulation will impact the financial system in reality.

With our framework, we assess the impact of the liquidity coverage ratio regulation on bank balance sheets, interest rates, monetary policy transmission and some aspects of financial stability. Our findings confirm existing impact assessments in that they suggest that the regulation will lead to a lower supply of bank loans to the real sector, higher interest rates and a shift towards longer term wholesale funding of banks. In this policy brief we will discuss in detail the implication of the LCR regulation on monetary policy.

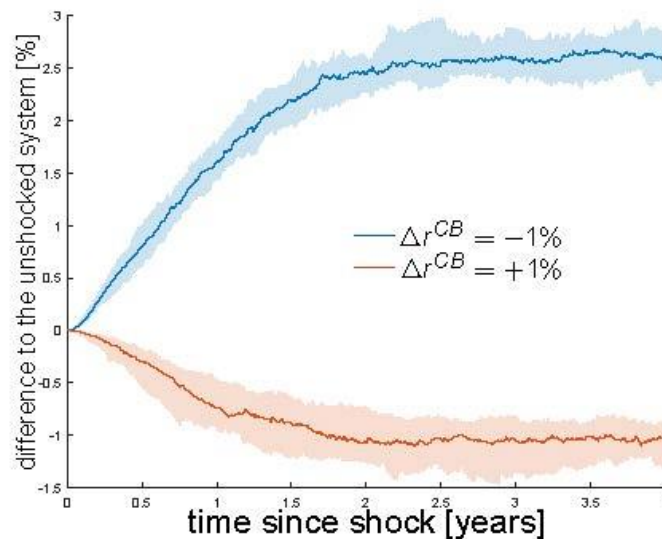


Figure 1: Under the benchmark setup: Impact of a change in the marginal lending facility rate on the loan supply of banks to the real sector.

The setting of key interest rates by the central bank is an important tool of monetary policy. In our model, monetary policy is conducted exclusively through the marginal lending rate, which specifies at which interest rate the central bank offers overnight credit to banks. Figure 1 shows how a sudden 1 percentage point change in the marginal lending rate leads to a change in the average volume of loans banks in our model provide to the real sector. The lines track the percentage difference in the average loan supply of the median simulation run between the unshocked and the shocked system. The shaded areas depict the variation (the 90% confidence interval) across simulation runs. As expected, a loosening of monetary policy leads to an increase in the loans volume, while a tightening leads to a decline in loans to the real sector. Note that it takes about two years before the average loan supply of banks stabilizes at a new level, which is approximately 2.5% higher or 1% lower than the loan supply of the unshocked system. Although the monetary policy shocks takes full effect only after a substantial time span, changing the marginal lending rate proves to be an effective tool under the benchmark setup. In contrast, a change in the marginal lending rate is largely ineffective under the LCR setup, as illustrated in Figure 2. For the first half year after the shock there is on average no impact of the policy shock on the loan supply. Thereafter the loan supply does deviate from the unshocked system. While the direction of the deviation is largely consistent with the results under the benchmark setup, the size of the impact is economically insignificant under the LCR setup. With other words, the transmission channel of changes to short term central bank interest rates within our framework breaks down under the liquidity regulation. The main reason for this breakdown is a drastic change in the funding structure of commercial banks. When the LCR regulation is the binding constraint on balance sheets, a sharp decline in the role of short term (typically overnight) interbank market as a funding source is the consequence. In order to meet the minimum liquidity requirement, an increase in short term funding raises a bank's demand for high quality liquid assets such as cash or sovereign bonds. It becomes unfeasible to finance long term illiquid assets such as long term loans to the real sector, with short term debt.

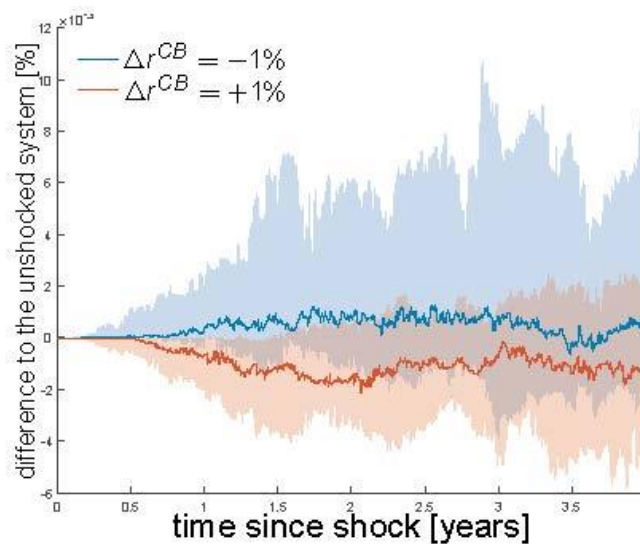


Figure 2: Under the LCR setup: Impact of a change in the marginal lending facility rate on the loan supply of banks to the real sector.

Because under circumstances when the LCR regulation is not binding, the marginal lending facility of the central bank is an alternative to overnight interbank credit, the interbank market is part of the transmission channel of monetary policy. When the marginal lending rate is lowered, banks will be inclined to increase their share of central bank funding. In order to compete with the central bank's facility, creditor banks on the interbank market will need to cut their lending rates as well. This is the first link in the transmission of monetary policy under normal circumstances. Interest rates of longer term wholesale debt also adjust because they compete with short term wholesale debt, which is now offered at a lower rate. In essence, monetary policy is transmitted through a chain of competing funding instruments. When the transmission channel is open, lower central bank interest rates lead to a general decrease in funding costs, which will free resources to expand the loan supply to the real sector. Under the LCR regulation, on the other hand, the short term interbank market is severely disrupted in our simulations. The first link in the chain of competing funding instruments is broken, which interrupts the transmission channel of monetary policy conducted through changes in the marginal lending rate.

While the breakdown of the transmission channel is a robust outcome in our simulations, it is unclear whether this would also be a probable outcome in reality. Two issues need to be discussed in this context. The first part of the discussion pertains to the condition under which the transmission channel breaks down in our simulations. It seems unrealistic that under the LCR regulation the interbank market in reality will lose its *raison d'être* as it does in our simulations. Funding long term loans is not the only motive for banks to borrow on the interbank market. Banks e.g. borrow and lend on the interbank market in order to fulfil minimum reserve requirements. Since reserves normally consist of cash, which is a high quality liquid asset, funding the minimum reserve requirement with overnight interbank debt is a neutral transaction in terms of the liquidity coverage ratio. However, reserve requirements have lost their importance as a tool for monetary policy over time. For instance, until the 1980s German banks needed to hold cash reserves amounting to almost 20% of their deposits. Presently, the reserve requirement in the Eurozone amounts to merely 1%. In sum we infer that although the interbank market is unlikely to disappear in reality, the transactions volumes are likely to be markedly reduced by the liquidity regulation. The second part of the discussion on the degree of realism of our simulation output focusses on the behavioural assumptions contained in the model. In our framework, the marginal lending facility is part of the interbank market. This is a sensible assumption when the liquidity coverage ratio regulation is inactive. However, because the treatment of central bank loans and overnight interbank loans differ under the LCR regulation, our

modelling choice can become problematic. Specifically, while the run-off rate for overnight interbank loans is 100%, it is 0% for central bank credit (national regulators may demand higher rates). Taking this into account, banks could very well fund their required HQLA with short term central bank loans instead of long term wholesale debt. Yet, it is unclear if such behaviour could completely restore the transmission of monetary policy. If under the LCR regulation banks start relying more on central bank credit to finance HQLAs, and evidence for the U.S. suggests that they do, it may become more difficult for the central bank to manage the amount of liquidity in the banking system with conventional tools. On the other hand, if the central bank does not reliably satisfy the increasing demand for central bank liquidity (the LCR was in part introduced to reduce the dependence on the central bank), banks will, as our simulation results suggest, seek to replace short term funding (including borrowing from the central bank) with long term funding, breaking the link between central bank and wholesale interest rates.

In general, we expect the calibration of monetary policy with conventional tools to become more difficult when the LCR regulation is a binding constraint on banks. In normal times, central banks typically calibrate the amount of liquidity in the banking system by equalizing the probability of banks borrowing from the marginal lending facility and holding excess liquidity in the deposit facility. In the presence of a functioning interbank market, such a calibration will result in an average interbank interest rate half way between the two facility rates. Both, the suggested reduced role of the interbank market under the LCR regulation as well as the fact that short term central bank funding and short term wholesale funding cease to be perfect substitutes, imply that central banks need to reassess their calibration procedure with regard to the amount of liquidity they supply to the economy.

While our simulation results imply that standard monetary policy will become less effective under the LCR regulation, researchers from the New York Fed have recently suggested that the regulation could help to strengthen the so called bank lending channel of monetary policy.¹ They argue that since wholesale debt has become a common funding source for commercial banks, a monetary policy induced decrease in deposits would quickly be replaced by wholesale funding, while an increase in deposits would lead to a reduction in wholesale funding. The result of this behaviour is a reduced effect of monetary policy on bank lending. We can test their hypothesis of a more pronounced bank lending channel under the LCR regulation by simulating a shock on deposits and by comparing the impact on loan supply for our two setups.

¹ The hypothesis was suggested by Dong Beom Choi and Ulysses Velasquez on the blog Liberty Street Economics: <http://libertystreeteconomics.newyorkfed.org/2016/07/could-liquidity-regulation-revive-the-bank-lending-channel.html>

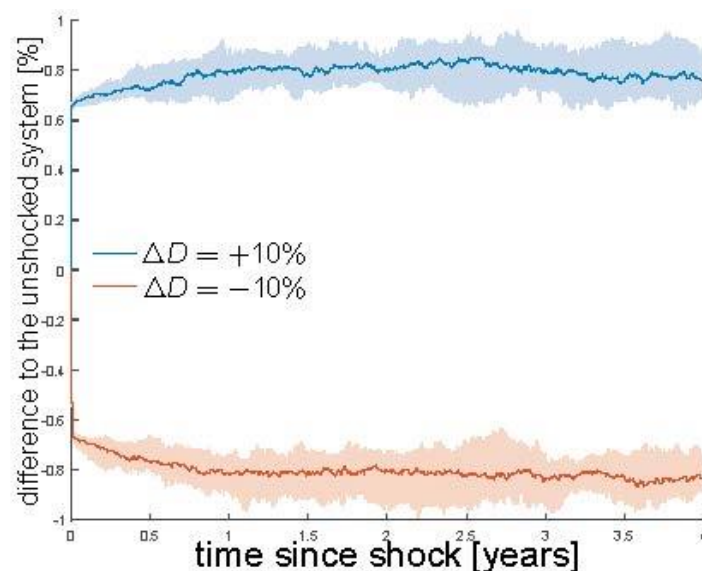


Figure 3: Under the benchmark setup: Impact of a change in customer deposits on the loan supply of banks to the real sector.

Figure 3 shows, for the benchmark setup, the change in the loan supply compared to the unshocked system for a 10% increase and decrease in customer deposits. Clearly, the loan supply increases when customer deposits increase and vice versa. However, without any compensation of the shock through wholesale debt, we would expect lending to increase or decrease by approximately 3%, which is far higher than the observed change in average loan supply. The fact that a bank lending channel is observed at all is due to the different characteristics of deposits and wholesale funding. Since deposits constitute a cheaper and more stable source of funding than wholesale debt, increasing them allows for a small balance sheet expansion, while a decrease in customer deposits leads to a slight contraction of the balance sheet. In order to show the impact of the LCR on loan supply, Figure 4 plots the cumulative difference between the shock responses under both setups. At each point in time, the cumulative difference states how much more or less loans (in percent) would have been supplied in total under the LCR setup since the unexpected change in deposits. The figure confirms the hypothesis that the bank lending channel becomes more pronounced under the LCR regulation. However, large impulses for the real economy are not to be expected. At its best, i.e. in the first months after the shock, commercial banks provide approximately 0.05% more or less loans under the LCR setup than under the benchmark setup. In the longer run, the effect on the bank lending channel remains positive, but loses intensity.

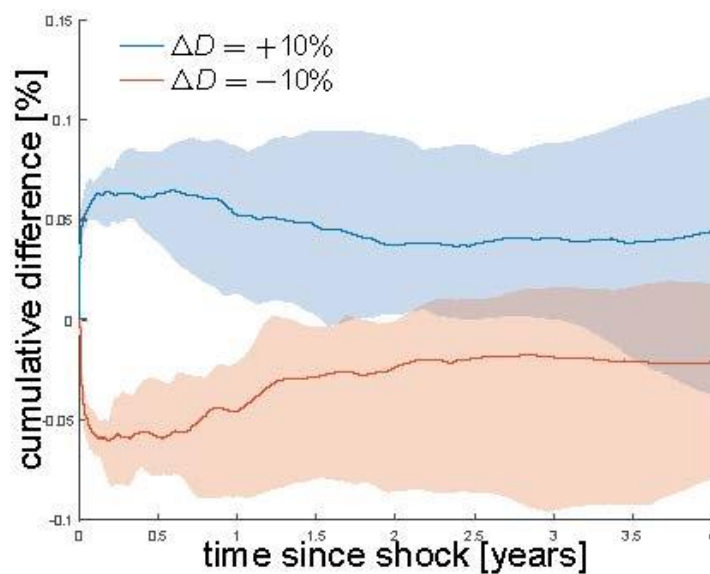


Figure 4: Cumulative difference in the impact of a change in customer deposits on the loan supply of banks to the real sector between the benchmark setup and the LCR setup.

The mechanism that leads to the slightly more pronounced bank lending channel works as follows: A positive shock on deposits under the LCR regulation eventually leads to a reduction in cash holdings, while a negative shock eventually increases cash. The reason for this dynamic lies in the specification of the LCR. Customer deposits are assigned a run-off rate of 3% because they are deemed a rather safe funding instrument by the regulator. Unsecured wholesale debt, on the contrary, is deemed a very risky funding instrument. The regulator assumes that in times of stress banks will not be able to refinance maturing unsecured wholesale debt, which translates into a run off rate of 100%. Consequentially, banks need to hold more high quality liquid assets the larger the proportion of assets funded by run-prone wholesale debt. Higher volumes of HQLA will partially crowd out loans in the LCR setup. Lower required holdings of HQLA, on the other hand, will add to a bank's capacity to provide loans to the real sector.

POLICY IMPLICATIONS AND RECOMMENDATIONS

Our analysis shows how regulation in general and the liquidity regulation in particular have an impact on the financial system that often goes beyond the intended effects. The liquidity coverage ratio regulation was supposed to help stabilize the financial system. A reduced supply of loans to the real sector, higher interest rates and higher maturity of funding sources might have been expected and accepted consequences of the regulation. It is, however, less likely that regulators anticipated that the LCR regulation could change the way monetary policy needs to be conducted. If our assessment is correct, the transmission channel of standard monetary policy will become impaired when the LCR becomes the binding constraint on banks' balance sheets. What does this imply?

Central banks need to take the potential impairment of monetary transmission into account. In the current economic environment, a changed mode of action of monetary policy, at least in Europe, is unlikely to be observable. Interest rates at the zero lower bound, low inflation rates and the abundant provision of liquidity through unconventional measures such as quantitative easing speak against the LCR regulation being the binding constraint on the average bank's balance sheet. However, a time will come when the economy enters a boom, inflation rises and banks pass on their excess

liquidity to the real sector (in the form of loans). In this case it may become crucial that the central bank can react quickly in order to avoid an overheating of the economy. An unexpected impairment of an important transmission channel could become a problem. In this context, it could prove to be instructive to carefully observe the upcoming economic developments in the United States of America and the Fed's reaction to them. Large infrastructure programs, which have been advertised by president-elect Donald Trump, could boost the already well-functioning U.S. economy and trigger higher inflation rates. In such a situation the Fed would be inclined to increase interest rates more aggressively. We assume that even though not all banks in the U.S. need to comply with the LCR regulation, an improper functioning of the transmission channel due to the LCR regulation would not go unnoticed. A reassessment of the costs and benefits of liquidity regulation would become appropriate. Designing liquidity regulation that upholds the link between central bank interest rates and interbank market rates could circumvent the inadequacies of the LCR regulation suggested by our analysis. Higher and more flexible minimum reserve requirements could be considered in this context.

In general, our work emphasizes the importance of assessing financial market regulation with a framework that allows for a detailed and holistic view on the financial system. Taking a partial view neglects the interactions between parts of the system, which can significantly alter the impact of any regulatory measure. Furthermore, the cumulative effect of the regulatory rulebook, which is potentially detrimental, can only be evaluated within a comprehensive framework. Developing a holistic assessment of financial regulation hinges on the availability of high quality and high frequency data for an ex post empirical evaluation and on a more eclectic (than current mainstream theory) approach to economic theory for an ex ante evaluation. In this context, efforts to enhance the quality and availability of data as well as efforts to build models suitable for holistic impact assessments seem promising activities worthy of institutional support.

RESEARCH PARAMETERS

Why did the recent financial crisis come as a surprise to most economists? While the basic mechanisms of shock propagation that amplified losses from the U.S. subprime crisis into the global financial crisis were well explored in the academic literature, it was an in-depth knowledge of the interconnections and interactions of financial institutions that was arguably lacking. A jointly detailed and holistic view on the financial system would have been necessary to recognize its systemic fragility prior to the crisis. Such a view is essential in order to assess the consequences of regulation passed in the wake of the crisis. However, the complexity that ensues when the parts of the financial system are assembled into an integrated framework is a major challenge for standard economic theory. The results described in this policy brief are derived from an extensive agent-based model of the financial system. The agent-based methodology constitutes a very flexible modelling approach ideally suited for the analysis of complex systems such as the financial sector. This allows us to integrate the actors/agents and institutions that have proved crucial in the financial crisis starting in 2007. Agents in our model represent different types of banks (commercial banks, investment banks, shadow banks, etc.) that interact on wholesale debt markets. Beside a short term interbank market and long term bank bonds, other funding sources for banks in our model include insured customer deposits, uninsured investor deposits, secured short term debt (repo contracts) as well as the possibility to borrow securities for the purpose of short selling. Loans to the real sector is the principal asset of commercial banks in our model, while other bank types specialize in trading assets, which may differ according to risk, maturity and liquidity. We endow banks with sophisticated tools to manage the asset and liability side of their balance sheets. Based on their expectations, banks try to behave optimally. Therefore, they can quickly adapt to changing circumstances such as the introduction of new regulation.