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## Proceedings

# Liquidity and Market Efficiency – Alive and well?

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# Liquidity and Market Efficiency Alive and Well?

**Edited by and introduction by**  
*Esa Jokivuolle and Jouko Vilmunen*

**Contributions by**  
*Erkki Liikanen • Petri Jylhä • George G. Pennacchi  
• Jussi Keppo • Peter Fisher*

*A joint publication with the Bank of Finland*

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Helsinki and Vienna 2015

SUERF Study 2015/3



CIP

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*Editors:* Esa Jokivuolle and Jouko Vilmunen

*Authors:* Erkki Liikanen, Petri Jylhä, George G. Pennacchi, Jussi Keppo, Peter Fisher

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## LIST OF AUTHORS

**Peter Fisher**

Senior Director, BlackRock Investment Institute, Senior Fellow at the Center for Global Business and Government at the Tuck School of Business at Dartmouth

**Esa Jokivuolle**

Senior Advisor in the Research Unit of the Monetary Policy and Research Department, Bank of Finland and SUERF Council of Management

**Petri Jylhä**

Assistant Professor, Imperial College Business School

**Jussi Keppo**

Associate Professor, National University of Singapore

**Erkki Liikanen**

Governor, Bank of Finland

**George G. Pennacchi**

Professor of Finance, University of Illinois

**Jouko Vilmunen**

Head of Research, Monetary Policy and Research Department, Bank of Finland



# 1. INTRODUCTION

*Esa Jokivuolle and Jouko Vilmunen<sup>1</sup>*

On 3 July 2015, SUERF organized its sixth joint conference with the Bank of Finland in Helsinki on the subject of liquidity and market efficiency. The one-day program consisted of an opening speech, six presentations, including three keynotes, and a lunchtime address. The present SUERF Study includes a selection of papers based on the authors' contributions to the Helsinki conference.

When planning the conference, we had been inspired by the thoughts of Bengt Holmström (MIT) on how liquidity and market efficiency may be linked<sup>2</sup>. According to him, liquidity in stock and debt markets, especially in short-term money markets, are maximized under very different conditions regarding the information content of market prices. In the stock market, transparency of information promotes market efficiency and symmetry of information is good for liquidity. Liquidity in debt markets also requires symmetry of information, but in this case it is a different kind of symmetry. Liquidity in debt markets arises from sufficient overcollateralization of debt so that no one has an incentive to become informed of the exact value of collateral securing the debt. As a result, liquidity in debt markets flourishes during symmetric ignorance. The downside of this is that debt market crises may take us by surprise as incentives for information collection have been limited.

In his opening speech of the conference, Bank of Finland's Governor, Erkki Liikanen, writes that the global financial crisis has given a serious blow to the doctrine of market efficiency. At the same time the need has arisen to better understand liquidity which evaporated in the midst of the crisis. Although it is important to foster liquidity, he writes that it is also important to understand that liquidity can sometimes be artificially abundant. This may create a false sense of security which hides true risks of certain assets. The deep question is about the optimal amount of liquidity that does not undermine financial stability.

In Chapter 3, Petri Jylhä's (Imperial College Business School) discusses his research findings concerning direct evidence on the causal link from funding liquidity to market liquidity. The author has studied market price reactions to a US regulatory change in options' margin requirements. By utilizing this quasi-experiment he was able to support the theories developed in the context of the

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<sup>1</sup> Bank of Finland.

<sup>2</sup> Professor Holmström gave the lunchtime address in the conference, which largely followed the ideas he already wrote about in his 2014 talk in the Bank for International Settlements; see Holmström (2014).

recent financial crisis that funding conditions partly drive market liquidity, also in normal times.

One of the keynotes of the conference was provided by George Pennacchi (University of Illinois). In Chapter 4, the autor explains his research in which he argues that developments in corporate taxation, by favoring debt relative to equity, can help explain how the historical share of banks and non-banks in liquidity provision has varied in the US. Another important driver of banks' liquidity provision has been development in banks' public safety net such as central bank liquidity provision to solvent banks which may suffer from bank runs, and, eventually, deposit insurance. His research also helps understand how growth in money market mutual funds and securitization of loans have coincided in the US over the past forty years. As policy responses to tackle the tax-induced distortions in liquidity provision, he brings up Belgian style tax deductions for equity or appropriately-designed contingent convertible (CoCo) securities to be accepted as part of banks' regulatory capital.

The effects of regulation on risks and liquidity are also discussed in the Chapter 5 by Jussi Keppo (NUS), based on his research. Regulation should always be justified by that it corrects for a certain market failure. In practice, it will also have side effects, and it may be circumvented. Designing good regulation is about being effective, and striking a balance between solving the market failure and limiting side effects. In this spirit, Keppo explains his and his co-author's findings on the announcement effects of the US Volcker rule on banks' risk taking and liquidity position. Their results indicated that the Volcker rule may not become very effective: although the US banks have reduced activities banned by the rule, banks have also reduced their hedging, leaving their original risk positions largely unaffected.

The last keynote of the conference was given by Peter Fisher (Dartmouth College and BlackRock Investment Institute). Based on that, his text discusses the role of central banks, addressing the present policies against historical background. He is concerned about risks stemming from the low interest rates environment and the quantitative easing policies. He thinks it is possible that low, even negative yields of central bank liabilities may have induced hoarding of other high-quality assets among private agents. According to him, this does not constitute a normal state of liquidity and market efficiency. Central banks should put more weight on financial stability issues. Their focus has been too much on price stability or, more generally, on solely finding a good macroeconomic equilibrium.

## 2. OPENING WORDS: LIQUIDITY AND MARKET EFFICIENCY

*Erkki Liikanen*<sup>1</sup>

### 2.1. INTRODUCTION

Good morning. It is my great pleasure to welcome you all to this conference on liquidity and market efficiency, which the Bank of Finland is organizing together with SUERF, the European Money and Finance Forum.

I greatly value our bank's long cooperation with SUERF. SUERF is a rather unique organization in bringing together financial practitioners, central bankers and academics to discuss topical issues.

I am particularly delighted to see the active participation from the financial and insurance industry, from both home and abroad. Your participation is an important sign that the choice of topic for the conference has been successful.

I hope today's conference will provide all of us with a stimulating forum to learn and share new ideas.

### 2.2. FUNDING AND MARKET LIQUIDITY

The global financial crisis has taught us many lessons in respect of both liquidity and the efficiency of markets. The two are linked in important ways.

In the years preceding the crisis, liquidity was abundant, but then it evaporated during the crisis. This happened to both the funding liquidity of financial institutions and the market liquidity of financial assets.

Cheap and increasingly short-term funding helped create market liquidity for many new financial assets in the run-up to the crisis. But when funding liquidity dried up as big shocks started to undermine the trust of investors in the value of the new assets as collateral, market liquidity froze.

My colleague, Tuomas Vähimäki, will discuss in his presentation later today what central banks did in that situation to overcome the malfunctioning of the interbank markets. Professor Petri Jylhä will, in turn, present new evidence of the causal link from funding liquidity to market liquidity.

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<sup>1</sup> Governor, Bank of Finland.

### 2.3. THE EFFICIENCY OF MARKETS

Before the crisis, the idea of the ability of markets to price assets efficiently was still strong.

As financial theory tells us, market efficiency means that asset prices reflect all relevant information in a timely manner. As a result, risks should be correctly priced.

After the crisis we understood that risks must have been underpriced. The idea of market efficiency has taken a serious hit.

Why is it that market prices failed to give early warning signals of looming risks?

Dr Shin, from whom we shall soon have the privilege to hear more, has provided intriguing thoughts on possible reasons<sup>2</sup>. Thanks to the laws of arbitrage, markets are good at setting relative prices between financial instruments at a point in time. But at the same time they may well overprice all assets in booms and underprice them in busts. Market mechanisms to correct such deviations over time may be much weaker.

As a result, exuberance in pricing can be very procyclical. Importantly, liquidity cycles can go hand in hand with excesses in market pricing.

What are the policy implications of the waning reliance on market efficiency?

One far-reaching implication has been the rebirth of more interventionist regulation. Sufficient trust in markets' ability to discipline and regulate themselves is simply no longer there.

Secondly, new macroprudential tools can provide instruments to moderate risks that markets may collectively miss.

Detecting 'bubbles' or vulnerabilities is inherently difficult, but promising research is well on its way to develop better early warning indicators. To be truly effective, the word 'early' should be taken quite ambitiously in this research agenda, to mean months and years rather than days and weeks.

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<sup>2</sup> H.S. SHIN, 2012, *Procyclicality and the Search for Early Warning Indicators*. Presented at the IMF conference "Financial Crises: Causes, Consequences, and Policy Response", Washington DC, September 14, 2012.

## 2.4. LIQUIDITY EFFECTS OF RESTORING FINANCIAL STABILITY

When we were preparing the report on regulating bank structures in 2012, we thought a lot about liquidity. And it continues to be a key issue now that the EU is working on the reform.

There is concern among many that separation or an outright ban on proprietary trading, and separation of parts of market making could be detrimental to market liquidity. Professor Jussi Keppo may provide us with early evidence from the Volcker rule in his afternoon talk today.

However, I believe it is key to understand that liquidity can sometimes be artificially abundant. This may create a false sense of security and hide the true risks of certain assets.

It is important to foster liquidity, but we should not have bank structures that may indirectly support excessive creation of liquidity. This can happen if the benefits of government safety nets, such as deposit insurance, leak to the side of banking operations that should always stand on their own feet.

The deep question is about the optimal amount of liquidity that does not undermine financial stability.

I am sure Professor Bengt Holmström, who has written extensively on these issues since the crisis, will enlighten us more on this in his lunchtime talk.

We are also very pleased to have with us Professor George Pennacchi, who (together with Gary Gorton) is well-known for his pioneering research on the role of banks and other financial intermediaries in liquidity creation.

## 2.5. ‘WHAT IS MONEY?’

In recent years, the Bank of Finland’s experts have been active in talking to high school students about what central banks do.

One of the profound questions we often get from students is ‘what is money?’

The same question is in the topic of the last presentation today. I am sure that our speaker, Peter Fisher, with his great experience in both the private sector and as a public servant, will give us the definitive answer.

In conclusion, we are very glad to have you all here, and I wish you a very productive conference day.

You are all warmly welcome!

### 3. ON THE EFFECTS OF MARGIN REQUIREMENTS

*Petri Jyllha*<sup>1</sup>

#### Abstract

In this survey, I review the theoretical foundations and empirical evidence on the effects – both positive and negative – of requiring traders to post higher margins. The results reviewed here are interesting on their own and shed light on the roles played by investors' leverage in financial markets.

#### 3.1. MARGIN REQUIREMENTS

Margins are required in order to protect leveraged investors, their counterparties, and the functioning of the market as a whole against adverse moves in asset prices. Margin requirements dictate the equity proportion an investor must hold in her margin account when borrowing to purchase securities, borrowing securities for short-selling, or entering a position in derivative securities. This equity serves as a cushion against future liabilities resulting from adverse market moves.

As an illustration of margin requirements, consider an investor who wishes to borrow money from a broker to purchase 500 shares of Apple at a price of \$100 each. The total value of this purchase is naturally \$50,000. If the broker was to lend the full amount, it would be exposed to a sizeable default risk. A default would occur if Apple's share price drops below \$100, say to \$99, causing the investor not to repay the loan. The broker would then sell the shares for \$49,500 and suffer a loss of \$500. As protection against such losses the broker requires the investor to contribute capital, or margin, to the trade. If the broker requires a 60% margin the investor must provide 60% of the purchase value (\$30,000) in cash to finance the purchase. The remaining 40% (\$20,000) can then be borrowed from the broker. With the margin acting as a buffer against drops in Apple's share price, the broker's default risk is significantly lowered. The share price would have to drop below \$60 (rather than \$100 in case of no margin) to trigger the investor's default.

As is clear from the above example, margin requirements limit the maximum leverage an investor can achieve. In the example, the 60% margin requirement means that the investor can borrow \$20,000 against equity capital of \$30,000, or achieve a debt-to-equity ratio of 0.67. A lower margin requirement would

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<sup>1</sup> Imperial College London.

allow for more leverage, whereas a higher margin would constraint the maximum leverage ratio even further. More formally, with margin requirement of  $m$  ( $0 < m < 1$ ) the maximum leverage ratio is  $1/m-1$ . Protecting the lenders and borrowers against the hazards of excessive leverage is the key purpose of margin requirements (Fortune, 2003). Other purposes include protecting the functioning of the market by reducing the likelihood of fire sales (resulting from liquidation of overly leveraged portfolios) and preventing over-allocation of credit to speculation at the cost of productive businesses.

Given the prevalence of leveraged investors and traders and the importance of margin requirements for market participants, it is interesting to study whether margin requirements affect the markets as a whole. Quite obviously, margin requirements should affect investors' leverage ratios. Theoretically, they could also affect the riskiness of the markets, investors' required compensation for bearing risk, and market liquidity. The next section discusses the challenges of identifying such causal effects, and some solutions employed by researchers. The later sections review the empirical literature on the effects of margin requirements.

### 3.2. IDENTIFYING EFFECTS

Measuring the effects of margin requirements is complicated by concerns of endogeneity or reverse causality. Consider a researcher who studies the effect of margin requirements on stock market volatility, and finds the two to be positively correlated. This correlation could arise from a number of sources. First of all, a higher margin requirement could cause higher volatility. Second, the opposite may be true and higher volatility causes higher margin requirements. This could happen if brokers foresee higher volatility and increase margin requirements in anticipation. Third, both margin requirements and volatility could be affected by a common confounding factor. For example, poor stock market returns could lead to higher volatility because of the leverage effect (Black, 1976) and, independently, lead brokers to increase margin requirements. Hence, a correlation between margin requirements and volatility does not establish a causal relation from the former to the latter. What the researcher needs to find are situations where the margin requirements change independently of prevailing and expected market conditions. If such exogenous changes in margin requirements lead to changes in future volatility, the researcher can conclude that margin requirement changes cause volatility to change.

One source of such exogenous variation in margin requirements is changes in laws and regulations. The reasoning is that the regulatory changes are not driven by short-run fluctuations in market conditions and can hence be used as exogenous explanatory variables. Ultimately the margin requirements are set by

the brokers. Depending on the jurisdiction, they may, however, be subject to laws and regulations dictating the minimum levels of margins that need to be required. In the United States, federal regulation of margin requirements dates back to the Securities Exchange Act of 1934. Prior to this, the New York Stock Exchange and other exchanges were responsible for regulating the margin lending. The regulation, however, was loose and many investors had very high leverage ratios. In fact, Lefèvre (1923) provides examples of up to 100-to-1 leverage ratios in the late 19<sup>th</sup> and early 20<sup>th</sup> century. In the early 1930's, the widely-held view was that the stock market boom of the 1920's was largely fuelled by low margin requirements and excessive leverage. Also, the severity of the 1929 crash was attributed to the unwinding of excessively levered portfolios in the face of margin calls. To prevent such external costs of excessive leverage, the Act of 1934 transferred the responsibility of margin regulation to the Board of Governors of the Federal Reserve System. The Fed regulates margins primarily via its Regulation T, which specifies minimum margin requirements for various types of transactions. Among those is the minimum margin on leveraged stock purchases, which was originally set at 45%. This minimum requirement was changed 22 times between 1934 and 1974, and ranged between 40% and 100%. This variation in the legal minimum margin requirement has been used by researchers to gauge the causal effects of margin requirements on investors' leverage, market riskiness, and the price of risk.

Whereas Regulation T specifies the margin requirement on a position-by-position basis (i.e. each position in a portfolio must be margined separately), the SEC recently approved the use of portfolio margining which calculates a single margin requirement for a whole portfolio. The portfolio margining approach takes into account potential negative correlation between various positions – especially in the case of options – which are ignored by the Regulation T margins. Hence, portfolio margins tend to be significantly lower than Regulation T margins. The use of portfolio margining in the United States was gradually approved over 2005-2007. Some researchers have also used the implementation of portfolio margining in measuring the effects of margin requirements on investors' leverage and markets' liquidity.

### 3.3. EFFECTS ON LEVERAGE

The first, and most obvious, question is how margin requirements affect investors' leverage. As is discussed above, a margin requirement translates directly into a cap on the investor's leverage ratio. Hence, one should expect a higher margin requirement to lower leverage ratios. However, this mechanism only works if some investors are actually constrained by the margins. If all investors wish to borrow much less than the maximum amount, altering the

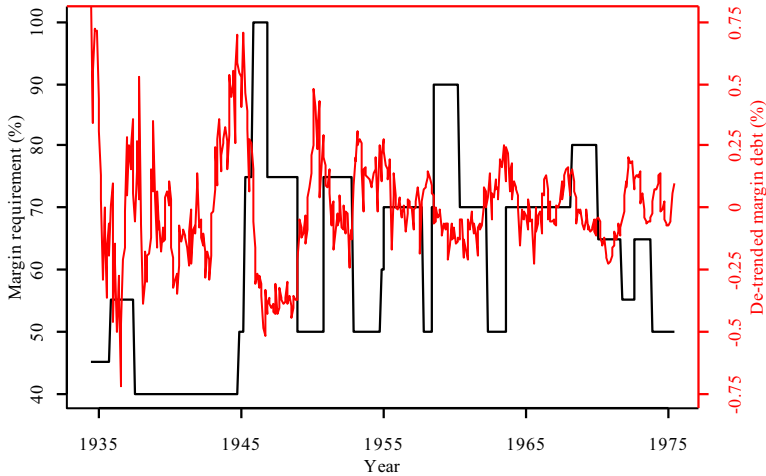


margin requirement will not affect their borrowing as the leverage constraint is not binding.

Figure 1 plots the time series of the Regulation T margin requirement and the de-trended total level of the NYSE brokers' margin credit (i.e. the amount the brokers have lent to their customers to finance stock purchases) relative to the market capitalization of the NYSE listed stocks<sup>2</sup>. The sample period (from October 1934 to September 1975) corresponds to the period when the Federal Reserve actively altered Regulation T minimum margin requirement for levered stock purchases. The figure shows a clear negative association between the margin requirement and margin credit: an increase in the margin requirement typically leads to a decrease in the margin credit and vice versa. This effect is especially pronounced during 1945 and 1946, when the margin requirement was changed from 40% to 100% in three steps. During the sample period, the correlation between the two variables is -0.32.

Using the changes in Regulation T minimum margins, Hsieh and Miller (1990) study this relation more formally and also find a very significant negative association. Consistent with Figure 1 (p. 12), they find that an increase in the margin requirement decreases investors' leverage. Matsypura and Pauwels (2014) provide more recent evidence by showing that the implementation of portfolio margining – which for the most part decreases margin requirements – has led to an increase in margin credit.

Figure 1: Margin requirement and margin debt



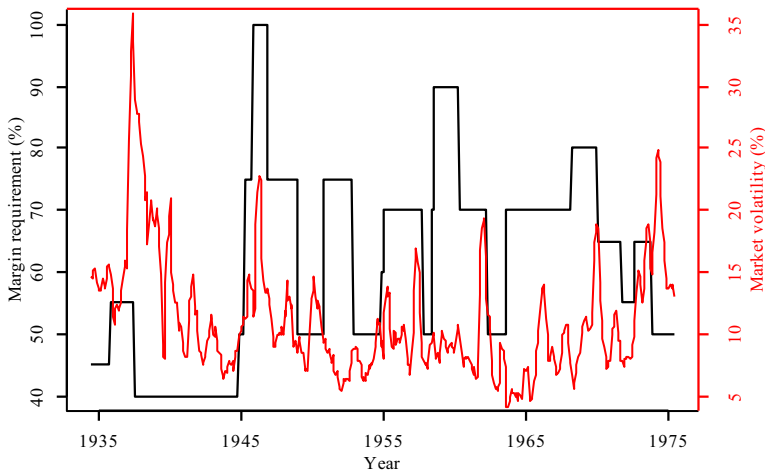
<sup>2</sup> The data on the margin credit extended by the NYSE brokers is from Federal Reserve Board (1976a, 1976b) and the NYSE Facts and Figure online database ([www.nyxdata.com/nysedata/asp/factbook/main.asp](http://www.nyxdata.com/nysedata/asp/factbook/main.asp)). The relative margin credit exhibits a strong downward trend over the sample period and is hence de-trended here using a Hodrick-Prescott (1997) filter with the smoothing parameter set to 10<sup>6</sup>.

### 3.4. EFFECTS ON RISK

A more interesting question is whether margin requirements affect the riskiness of markets. Theoretically, a higher margin requirement and lower maximum leverage could decrease the likelihood that the levered investors are forced to liquidate their positions in a fire sale triggered by margin calls. This, in turn, could lower the volatility of prices. Further, by limiting fire sales, margin requirements could potentially decrease the risk of market crashes which could manifest as increased skewness of market returns<sup>3</sup>.

Figure 2 (p. 13) plots the Regulation T margin requirement and annualized volatility of daily returns of the US stock market. The association between the two time series does not seem to be particularly strong. Sometimes, such as during the first half of the 1940's, a low margin requirement coincides with low volatility, whereas in the mid-70's, high volatility prevails during a relatively low margin level. Also, high levels of margin are associated with both high volatility (e.g. in 1946) and low volatility (e.g. 1958-1960).

Figure 2: Margin requirement and volatility



An extensive literature has studied the effects of the federal margin regulation on stock market volatility. Early studies by Officer (1973) and Ferris and Chance (1988) conclude that margin requirements do not affect stock market volatility. The stock market crash of 1987 reinvigorated the discussion, especially as Hardouvelis (1990) provides evidence that a higher margin requirement actually

<sup>3</sup> Negative skewness of returns implies that large negative returns are more likely than equally large positive ones. Hence, lower crash risk is equivalent to greater (less negative) skewness.

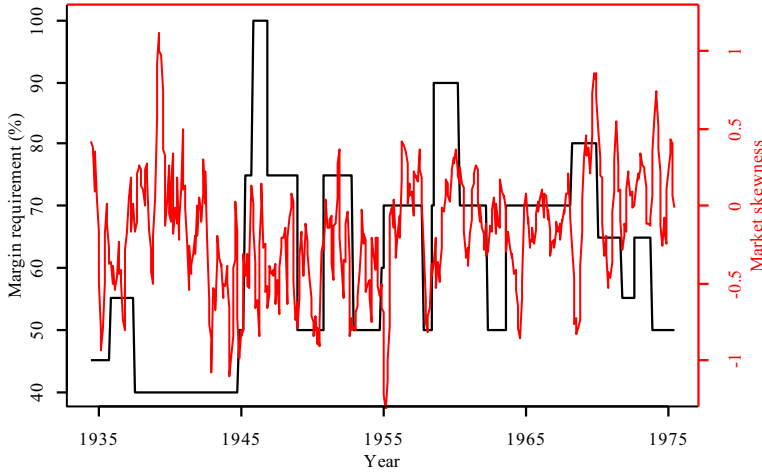
does result in lower volatility. This result, however, has been disputed by, among others, Kupiec (1989), Schwert (1989), and Hsieh and Miller (1990), who attribute the findings of Hardouvelis (1990) to methodological flaws. In an extensive review of the literature, Kupiec (1997) concludes that there is no undisputed evidence that the variation in the Regulation T margin requirement would affect market volatility either positively or negatively.

The abovementioned studies investigate the relation between the federally set minimum margin requirement and stock market volatility. It is possible that the variation in the Regulation T margin requirement level is not sizeable enough to significantly affect volatility. Even at its lowest level (40%) Regulation T limits the investors' borrowing to below 1.5 times equity – far below the 100-to-1 leverage ratios of the late 19<sup>th</sup> and the early 20<sup>th</sup> centuries discussed by Lefèvre (1923). By making such excessive levels of leverage impossible, margin regulation might actually lower market volatility even though there is no correlation between Regulation T margin levels and volatility. Studying this hypothesis formally is challenging, as there are really only two points of data (before and after the establishment of the regulation) and any change in volatility could be caused by a number of other changes taking place simultaneously.

The annualized volatility of monthly returns of the S&P 500 index between January 1871 and the establishment of Regulation T in October 1934 is 15.7% whereas it is 12.8% between October 1934 and June 2015. This simplistic analysis seems to point to a statistically significant reduction in volatility resulting from federal margin regulation. However, most of the volatility in the earlier period is due to the market turmoil in the late 1920's and early 1930's. If the period from October 1929 to October 1934 is excluded, the volatility of the period preceding Regulation T (January 1871 to September 1929) is 11.3%, which is actually significantly lower than the volatility of the Regulation T era. Overall, the empirical evidence does not lend robust support for margin requirements having an effect on volatility.

As argued above, a higher margin requirement could decrease the frequency and size of market crashes by making systemic fire sales less likely. This should result in a positive correlation between the margin requirement level and the skewness of market returns. Figure 3 investigates this relation by plotting the monthly skewness of daily returns of the US stock market and the level of the margin requirement. There seems to be no association between the two time series. Formally, the correlation between the two is only 0.03, which is not statistically significant, indicating that the margin requirement does not have any impact on the skewness of market returns.

Figure 3: Margin requirement and return skewness



Another way to assess the effect of margin regulation on crash risk is comparing the magnitudes of crashes before and after the establishment of Regulation T. At the height of the stock market crash in October 1929 (before Regulation T), the US stock market lost 11.2% and 12.0% of its value on two consecutive days totalling a loss of 21.9%. On Black Monday, October 19, 1987, the value of the US stock market dropped 17.4%. If one includes the losses of the previous Friday, the total size of the 1987 crash is 21.4%, which is very close to the magnitude of the 1929 crash. Hence, the size of crashes does not seem to be affected by the federal margin regulation. Overall, the empirical evidence does not support the hypothesis that a higher margin requirement would result in a lower crash risk.

Even though margin requirements do not seem to affect the riskiness of the market, they can still have an impact on investors' attitude toward risk, especially the compensation investors require for bearing risk. More specifically, higher margin requirements and tighter leverage constraints may decrease the price of risk. The mechanism for this effect is as follows. In the frictionless world of the capital asset pricing model (CAPM; Sharpe, 1964, Lintner, 1965, and Mossin, 1966), an investor with low risk aversion will borrow large amounts in the risk-free asset and invest in the market portfolio. However, if the investor's maximum leverage is constrained by a margin requirement, her portfolio will be very different. In order to satisfy her risk appetite, she will buy a levered portfolio that over-weights the riskier asset and under-weights the safer assets. This leads the prices of high-risk assets to be higher, and expected returns lower, in a world with leverage constraints than in a frictionless world. Conversely, the low risk assets will have higher expected returns when investors face leverage constraints. As a result, the price of risk, i.e. the difference in expected returns between riskier and

safer assets, is lower the tighter the leverage constraint or the higher the margin requirement. This mechanism is formalized by Black (1972) and Frazzini and Pedersen (2014). Jylhä (2015a) tests this theoretical prediction empirically. Using the time variation in the Regulation T margin requirement, Jylhä (2015a) shows that, consistent with the theory, the return difference between high and low beta stocks is lower during periods of a high margin requirement<sup>4</sup>.

Overall, the results reviewed here show that margin requirements do not affect market riskiness measured by volatility, skewness, and crash magnitude. However, via its effect on investors' ability to leverage, margin requirements affect the price of risk: a higher margin requirement results in a lower price of risk.

### 3.5. EFFECTS ON LIQUIDITY

The ability of investors to leverage can also affect the liquidity of financial markets. Higher margin requirements may result in less trading – as investors' positions are limited by the leverage constraints – which in turn may make the markets less liquid. Consider the following example. The shares of Royal Dutch Shell are traded on the London Stock Exchange as well as the Amsterdam Stock Exchange (currently Euronext Amsterdam). The prevailing price in London is £16 and in Amsterdam €22. Let us fix the GBP/EUR exchange rate at 1.375 making the two prices equal. Now assume that an investor wishes to buy one million shares of Royal Dutch Shell in Amsterdam. In the absence of margin requirements, a liquidity providing trader (e.g. a hedge fund) can buy the one million shares in London and simultaneously sell short one million shares in Amsterdam to fill the original buy order. As this transaction does not tie up any of the liquidity provider's capital, in the case of perfectly competitive financial markets, the original investors can buy the one million shares for €22<sup>5</sup>. Hence, the market can be said to be fully liquid, as the buy order does not change the market price.

Let us now change the setup so that the liquidity provider must post margin both on the long leg (i.e. purchase of shares in London) and the short leg (i.e. short sale of shares in Amsterdam) of the transaction. These margin requirements tie up capital, and limit the size of the liquidity provider's position. Now, with margin requirements in place, the liquidity provider may only be able to buy half a million shares in London and sell those in Amsterdam. The rest of the original

<sup>4</sup> Beta is the measure of systematic risk in the CAPM, and is measured by the covariation of an asset's return with the market return.

<sup>5</sup> Competition between liquidity providers drives the price equal to the price in London, i.e. €25. The cost of providing liquidity is zero as no capital is tied in margins. Hence, the revenue needs to be zero as well.

order needs to be filled by other investors who require a higher price to sell. Also, the liquidity provider can no longer sell at €22 because the transaction ties up capital, which has opportunity costs. Hence, the one million share buy order must increase the price of Royal Dutch Shell in Amsterdam to, say, €23. The margin requirements hinder the liquidity provider's ability to provide liquidity and hence make the underlying markets less-than-perfectly liquid. A higher the margin requirement results in a smaller liquidity provider's position and worse market liquidity.

This mechanism of margin requirements affecting market liquidity is formalized theoretically by Gromb and Vayanos (2002) and Brunnermeier and Pedersen (2009). The difficulty of identifying such an effect empirically is highlighted by the feedback effect in the dynamic model of Brunnermeier and Pedersen (2009). In their model, an exogenous shock increases the margin requirement, which worsens market liquidity. The lower market liquidity leads brokers to require higher margins, which further worsens the liquidity, setting off a liquidity spiral. Given this feedback effect, a mere correlation between margin requirements and market liquidity measures is not enough to establish a causal effect from the former to the latter.

Jylhä (2015b) use the implementation of portfolio margining as an exogenous shock to study the causal effect from margins to liquidity. The first phase of the portfolio margining pilot project turns out to be particularly fruitful. In this first phase, on July 14, 2005, the SEC approved portfolio margining of index options only. This change significantly lowered the margin requirements for trading index options, especially portfolios of index options. Importantly, nothing changed regarding the margin requirements on equity options (i.e. options on individual stocks). Basically, Jylhä (2015b) compares the changes in the liquidity of index options and equity options around the portfolio margining approval date. If the liquidity of index options improves significantly more than that of the unaffected equity options, one can conclude that the cut in the margin requirement has a causal positive effect on market liquidity. This is exactly what Jylhä (2015b) finds: the trading volume increases, the bid-ask spread decreases, and the price impact of trading decreases significantly more for the index options than for the equity options. These results provide strong empirical support for the theories of Gromb and Vayanos (2002) and Brunnermeier and Pedersen (2009) that a higher margin requirement results in worse market liquidity.

### 3.6. CONCLUSIONS

This paper presents a survey of the empirical literature on the effects of margin requirements on financial market outcomes. The reviewed results show that a higher margin requirement results in lower investor leverage and worse market liquidity. However, there is no robust evidence that higher margins would result in lower riskiness of the market. Due to lower leverage, a higher margin requirement also results in a lower price of risk.

These results are interesting on their own and also speak to the importance of investors' leverage constraints – especially in determining the price of risk and market liquidity. Further, these results should be of interest to regulators considering tightening or relaxing the laws and regulations governing margin requirements. Ideally, the results of rigorous research on the costs and benefits of margin requirements are taken seriously in making such decisions.

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## 4. LIQUIDITY AND LENDING: BANKS VERSUS SHADOW BANKS<sup>1</sup>

*George Pennacchi*<sup>2</sup>

### Abstract

Nonbank financial institutions that provide bank-like services, so-called ‘shadow banks’, have become more prominent in recent decades. This paper analyzes the factors that determine the market shares of banks versus shadow banks for both lending services and liquidity (transactions) services. It emphasizes how market shares are affected by differences in economies of scope, government regulation, and corporate taxation. When banks face competition from nonbank liquidity (transactions) providers, such as money market mutual funds, higher corporate income taxes or higher regulatory capital requirements lead banks to raise interest rates on retail loans. However, higher retail loan rates create incentives for entry by nonbank lenders such as tax-exempt special purpose vehicles that hold securitized loans. These phenomena describe the post-1970s U.S. financial system.

### 4.1. LIQUIDITY AND LENDING: BANKS VERSUS SHADOW BANKS

Since the 2007-2009 financial crisis, the roles played by both banks and nonbank financial institutions have received greater attention by policymakers and academics. In particular, nonbank financial institutions that provide services similar to those of traditional banks have had a growing influence on the global financial system. These so-called ‘shadow banks’ often compete directly with traditional banks in markets for liquidity and lending services.

A prime example of a shadow bank that provides liquidity in the form of deposit-like transactions services is a money market mutual fund (MMF). MMFs issue deposit-like liabilities but, rather than make loans, invest in money market instruments. Other types of shadow banks compete with traditional banks by investing in loans. These include special purpose vehicles (SPVs) that hold mortgages, consumer loans, or corporate loans and issue liabilities in the form of mortgage-backed securities (MBS), asset-backed securities (ABS), or collateralized loan obligations (CLOs). Other examples of this type are ‘prime’ mutual funds that invest in syndicated loans and business development

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<sup>1</sup> I am grateful for valuable comments provided by participants of the 2015 SUERF / Bank of Finland Conference.

<sup>2</sup> Department of Finance, University of Illinois.

companies (BDCs) that are closed-end mutual funds that invest in loans to small and medium-sized enterprises (SMEs)<sup>3</sup>.

## 4.2. DIFFERENCES BETWEEN BANKS AND SHADOW BANKS

It is noteworthy that, in all of these examples, shadow banks hold loans or provide deposit-like transactions services, but do not combine both of these activities in one financial institution. The separation of lending services from transactions (liquidity) services is a potential disadvantage for shadow banks relative to traditional banks which, by definition, fund loans with deposits. Theory and empirical evidence predicts that traditional banks enjoy an economy of scope when they issue transactions deposits to the firms or individuals that also borrow from them. Black (1975) and Fama (1985) argue that information obtained from deposit transactions reduces the cost of screening the credit of loan applicants and monitoring the creditworthiness of borrowers. In addition, when banks invest in a network of branch offices that gives them access to more retail deposits, the existence of this branch network also permits banks to be physically closer to more potential borrowers. The close proximity of banks to loan applicants also reduces the cost of credit screening and monitoring borrowers due to the easier acquisition of relevant ‘soft information’ (Brevoort and Wolken, 2008).

Empirical evidence in Mester *et al.* (2007) supports the view that banks are ‘special’ because they simultaneously make loans and issue deposits. Hence, traditional banks may be able to more efficiently reduce default losses from lending relative to shadow banks that hold loans but do not issue deposits. Furthermore, traditional banks may be able to issue deposits at lower interest rates relative to shadow banks such as MMFs. One reason is that banks have greater freedom to adjust deposit rates in response to the degree of competition in local markets<sup>4</sup>. Another reason why banks may have an advantage in issuing transactions accounts is a government ‘safety-net’. Government central banks act as ‘lenders of last resort’, providing liquidity to banks in times of financial stress. Moreover, government deposit insurance reduces the incentive for depositor runs. Both forms of government backing can increase investor confidence and lower the deposit interest rate that banks would need to pay<sup>5</sup>.

While banks have advantages due to economies of scope that lowers the cost of monitoring loans and due to their ability to pay lower deposit interest rates, espe-

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<sup>3</sup> See BELTRATTI, BOCK, JEWISIKOW, and NELSON, 2014, for a review of BDCs.

<sup>4</sup> In contrast, MMFs must pass through all interest revenue on their investments less management fees and administrative expenses. MMFs are limited to charging reasonable fees and have been subject to lawsuits when they fail to do so (Gorton and Pennacchi, 1993).

<sup>5</sup> This is especially true when deposit insurance is offered at subsidized rates, which historically has often been the case (Pennacchi, 2010).

cially on insured deposits, they have a potentially important disadvantage. Like most other corporations, banks must pay corporate income taxes. It is well known that corporate taxes create a tax disadvantage to funding assets with shareholders' equity. Unlike debt whose interest expense is deductible from income prior to the computation of corporate income taxes, returns to a corporation's equityholders are not tax-deductible. If investors require competitive returns, the corporate tax disadvantage of shareholders' equity will make it relatively more expensive than debt<sup>6</sup>.

Though most banks tend to be subject to corporate income taxes, most shadow banks are corporate tax exempt<sup>7</sup>. Nonbanks that are exempt from corporate taxes include SPVs holding securitized loans, BDCs, and mutual funds, including MMFs and 'prime' funds. For example, an SPV whose assets are a pool of mortgages obtains the funds to purchase these loans by issuing mortgage-backed securities to investors. Often, these MBS securities take the form of senior and subordinated (junior) debt tranches (securities) as well as an equity tranche. The balance sheet of the SPV resembles that of a bank whose assets are mortgage loans and whose liabilities are debt (deposits) and shareholders' equity. However, unlike a bank, the SPV is exempt from corporate income taxes<sup>8</sup>.

### 4.3. BANKS' CHOICE OF CAPITAL STRUCTURE

Since the corporate taxes paid by a bank is increasing in its proportion of equity financing relative to debt and deposits, corporate taxes will tend to reduce the amount of equity capital that a bank issues to fund a given level of assets. In the U.S., banks were not subject to corporate income taxes prior to 1909 and, indeed, the average ratio of shareholders equity capital to bank assets was much higher during the 19<sup>th</sup> century than was during the 20<sup>th</sup> century. This is shown in Panel A of Figure 1. In addition to not being penalized by corporate taxes, another reason that banks funded their assets with a relatively high proportion of equity was to protect themselves from runs by depositors or holders of their bank notes. Having a significant equity cushion to absorb potential loan losses enabled banks to have sufficient asset value to meet potential withdrawals by depositors and noteholders.

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<sup>6</sup> More precisely, equity is more expensive when its total tax burden, both personal and corporate, exceeds that of debt. Much empirical evidence, such as Graham (2000), confirms that the sum of personal and corporate taxes tends to be greater for equity relative to debt.

<sup>7</sup> Exceptions include U.S. banks that are organized as S-corporations which are exempt from corporate income taxes but can face greater personal income tax burdens. Credit unions are depository institutions that also are exempt from corporate income taxes. Among shadow banks, finance companies make loans funded with uninsured debt, often in the form of commercial paper, but are subject to corporate income taxes.

<sup>8</sup> SPVs are typically organized as limited liability corporations (LLCs). If the LLC passes through all loan income to its MBS or ABS investors, it is exempt from corporate taxes. Of course the income received by investors is subject to personal taxation, but in a symmetric fashion so is the income received by a bank's depositors and equityholders. See Bank for International Settlements (2009).

The implementation of corporate taxes was not the only reason why banks reduced the proportion of equity relative to debt and deposits. A central bank lender of last resort that provides liquidity to banks during times of stress could partially substitute for equity capital by providing liquidity to banks to meet potential depositor withdrawals. Figure 1 Panel B shows that average equity capital ratios of U.S. banks declined from 18.7% in 1913 to 11.8% in 1920 after the Federal Reserve was established in 1913 to provide ‘an elastic currency’. Another government intervention in the form of deposit guarantees had a similar effect on the amount of equity capital needed to avoid bank runs. Panel B also shows that average bank capital ratios also declined substantially following the Banking Acts of 1933 and 1934 which established the Federal Deposit Insurance Corporation (FDIC).

Government safety nets in the forms of a central bank lender of last resort and deposit insurance had another effect on bank behavior. In the 19<sup>th</sup> century and the first decade of the 20<sup>th</sup> century, bank lending was typically short term. Lending was often in the form of bills of exchange that financed trade and was collateralized by goods in transit. Or, it was frequently in the form of short-maturity promissory notes secured by a borrower’s and any co-signer’s personal wealth. Many U.S. banks followed the Scottish banking tradition whereby banks should lend at maturities of no more than 60 days since notes and deposits should be backed by short-term ‘self-liquidating’ loans (Bodenhorn, 2000). Moreover, when banks had limited lending opportunities, they often invested in short-term commercial paper<sup>9</sup>. In summary, banks were involved in much less ‘maturity transformation’ compared to modern banks: they issued short-term notes and deposits backed by short-term loans and securities.

While the initiation of corporate taxation and government safety-net support occurred relatively close in time making it difficult to detect their independent effects on bank capital structure, recent empirical research has attempted to isolate the independent influence of corporate taxes. Schandlbauer (2014) also uses variation in U.S. states’ corporate income tax rates to test whether higher rates affect banks’ choices of leverage. Using a difference-in-difference approach that compares similar banks in geographically close states, he finds that, on average, banks increase their non-deposit debt by 5.9% in the year before a corporate tax increase is enacted in the state where the bank operates. Thus, banks appear to reduce their proportion of shareholders’ equity to debt in anticipation of a higher tax rate.

In 2006, Belgium initiated a notional interest deduction for a corporation’s shareholders’ equity equal to the 10-year government bond rate. This tax policy

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<sup>9</sup> Foulke (1931) documents that prior to the 1930s, banks held the vast majority of commercial paper. That compares to their holding of less than 1% of the stock of commercial paper in modern times.

change, to a close approximation, equalized the corporate income tax treatment for debt and equity. Schepens (2014) finds that this reduction in the corporate tax disadvantage of equity changed the equity capital ratios of Belgian banks relative to similar European banks: Belgium banks' equity ratios increased by 14%, on average, relative to the control group of banks.

#### 4.4. THE EFFECTS OF CORPORATE INCOME TAXES ON BANKS' LOAN AND DEPOSIT INTEREST RATES

When banks face minimum equity capital requirements, they may be constrained in their ability to change capital ratios in response to corporate income taxes. However, banks can respond on other dimensions including the interest rates they charge on retail loans and the interest rates they pay on retail deposits. Using a model of spatial competition similar to Salop (1979), Chiappori, Perez-Castrillo, and Verdier (1995), and Park and Pennacchi (2009), Pennacchi (2015) finds that two main types of equilibria can occur.

First, suppose there is a banking market with limited opportunities for making retail loans but with plentiful retail savers wanting to deposit their funds in banks. This environment can be described as one that is 'loan poor and deposit rich'. In this case, a bank will want to issue retail deposits until its weighted after-tax cost of equity and marginal cost of retail deposits equals the competitive return on securities, where the weights are determined by the bank's minimum regulatory equity capital requirement. Moreover, the bank will make loans until the marginal loan return equals the competitive security return. Any excess retail deposits will then be invested in competitively priced securities, such as Treasury bills. Hence, in this equilibrium, the market interest rate on retail loans is tied to the competitive security return and is unaffected by the level of corporate income taxes. Rather, by increasing the after-tax cost of equity financing, corporate taxes lead to a lower equilibrium interest rate paid on retail deposits in order to keep the overall weighted average financing cost equal to the competitive security rate. As a result, in equilibrium retail depositors bear the 'burden' of higher corporate taxes via a reduction in deposit interest rates. Deposits rates are lower in proportion to the corporate tax rate and the minimum required equity capital ratio<sup>10</sup>.

<sup>10</sup> This result assumes that the number of banks operating in the market for retail loans and deposits remains fixed. Since higher corporate taxes also reduce bank profitability (rents), the longer run effect is that some banks will leave the market and market concentration will increase. Consequently, not only do retail deposit rates decline but retail loan rates will rise. Hence, in the longer run, retail borrowers also bear some of the burden of higher taxes.

Second, consider the opposite case of a banking market where there are plentiful opportunities for making retail loans but few retail savers available to supply deposits to banks. Such a setting can be described as a ‘loan rich and deposit poor’ environment. In this case, a bank issues retail deposits until their marginal cost equals the competitive rate that the bank must pay on wholesale deposits<sup>11</sup>. Consequently, the bank’s overall marginal cost of financing equals a weighted average of the after tax-cost of equity financing and the competitive rate on wholesale deposits. Since corporate taxes raise the after-tax cost of equity financing above the competitive rate on wholesale deposits and competitive securities, in this equilibrium it will never be profitable for a bank to invest in securities. Rather, the bank will make retail loans until their marginal loan revenue equals this weighted average after-tax equity and wholesale deposit cost, where the weights are, again, determined by the bank’s regulatory capital requirement.

Therefore, in this loan rich and deposit poor environment, equilibrium retail deposit rates are tied to the competitive rate on wholesale deposits and are unaffected by corporate taxes. Rather, by raising the after-tax cost of equity financing and, therefore, the overall weighted average marginal cost of financing loans, higher corporate taxes increase the required marginal revenue from loans. Consequently, higher taxes or a higher regulatory equity capital requirement raises the equilibrium retail loan rate so that retail borrowers, rather than retail depositors, bear the burden of corporate income taxes<sup>12</sup>.

#### 4.5. COMPETITION BETWEEN BANKS AND SHADOW BANKS

The above discussion considers a retail loan and retail deposit environment where only banks compete against each other. However, it sets the stage for understanding how shadow banking institutions have an incentive to evolve. Consider Figure 2 that graphs U.S. banks’ aggregate cash, securities, and loans as a proportion of their total assets. At the end of World War II, cash and securities made up about 80% of bank assets while loans were only 20%. In addition, FDIC-insured retail deposits were plentiful and represented a low-cost source of financing. Reinforcing low deposits interest rates were Depression-era banking regulations that set a ceiling on deposit interest rates, known as Regulation Q. These facts describe a ‘loan poor and deposit rich’ setting in which the burden of corporate taxes are borne by depositors via low deposit rates.

<sup>11</sup> For example, this competitive wholesale rate might equal the rate on large-denomination certificates of deposit or an interbank borrowing rate such as LIBOR.

<sup>12</sup> Similar to the loan poor and deposit rich setting, higher corporate taxes reduce bank profitability and would lead to exit by some banks. The long-run rise in market concentration results in both a rise in retail loan rates and a decline in retail deposit rates.

This environment creates incentives for nonbank savings and transactions account providers to enter. Indeed, MMFs began to compete with banks starting in the 1970's by offering returns to retail (and wholesale) savers that were close to competitive money market security rates. The model in Pennacchi (2015) shows that entry by MMFs reduces the amount of retail savings deposited in banks and also compels banks to raise their retail deposits rates. Figure 3 shows that the ratio of MMF assets to the sum of MMF assets and bank deposits, which is defined as the 'MMF Share', rose to a peak of almost 35% by the year 2000.

During this period of 'disintermediation' of retail savings from banks to MMFs, aggregate borrowing needs grew while bank's holdings of cash and securities declined. Consequently, the environment faced by banks switched from one that was loan poor and deposit rich to one that was loan rich and deposit poor. As intuition suggests, the model in Pennacchi (2015) predicts that banks' equilibrium retail loan rates would rise and now reflect the additional cost of corporate taxes. But once that happens, there is an incentive for nonbank lenders in the form of MBS, ABS, and CLO securitization vehicles to enter. Because SPVs which hold securitized loans are exempt from corporate taxes, they can have a lower cost of funding compared to banks when, at the margin, banks are required to pay competitive rates on deposits, as occurs in a loan rich and deposit poor market. The model predicts that funding via SPVs, rather than bank on-balance sheet funding, will be more likely for loans that do not require intensive credit screening and monitoring. For these loans, banks advantage for credit screening and monitoring due to their economy of scope from issuing retail deposits will be small. Such loans might include mortgages and consumers loans for which credit scoring and underwriting are standardized.

Figure 4 documents that the share of total loans funded by SPVs issuing ABS and MBS securities grew rapidly starting in the 1980s and roughly paralleled the rise in MMFs. Theory predicts that these similar trends were not a coincidence. Rather, greater MMF competition that increased banks' cost of funding led to retail borrowers bearing the burden of corporate income taxes, thereby creating incentives for more tax-exempt securitization of retail loans.

Han, Park, and Pennacchi (2015) empirically test this corporate tax-induced securitization hypothesis. They analyze data on individual U.S. commercial banks' originations and sales (securitizations) of mortgages over the period 2001 to 2008. These banks faced different corporate income tax rates depending on the U.S. state in which they operated. Banks also differed by whether they operated in a loan rich and deposit poor market or a loan poor and deposit rich market. As theory predicts, the empirical results show that banks that operate in higher tax states tend to securitize relatively more of their mortgages, but only when these banks also operate in a loan rich and deposit poor market. For such banks,

a one-standard deviation increase in the state corporate income tax rate raises mortgage sales (securitization) by 24.6%.

## 4.6. CONCLUDING REMARKS

In summary, both theory and empirical evidence predict that higher corporate income taxes give banks an incentive to minimize their equity capital and, in loan rich and deposit poor environments, to increase nonbank lending (securitization) activity. What policy reforms might remedy these tax-induced distortions?

Clearly, repealing the corporate income tax is an obvious remedy, though implementing such a reform is likely to be politically difficult. A more indirect channel for reducing the tax disadvantage of bank equity might be to implement a Belgium-like tax deduction for a notional return on equity. Another alternative is to allow issuance of appropriately-designed contingent convertible (CoCo) securities<sup>13</sup>. Such CoCos take the form of tax-deductible debt when a bank is financially healthy but convert to stabilizing equity capital at the onset of bank distress.

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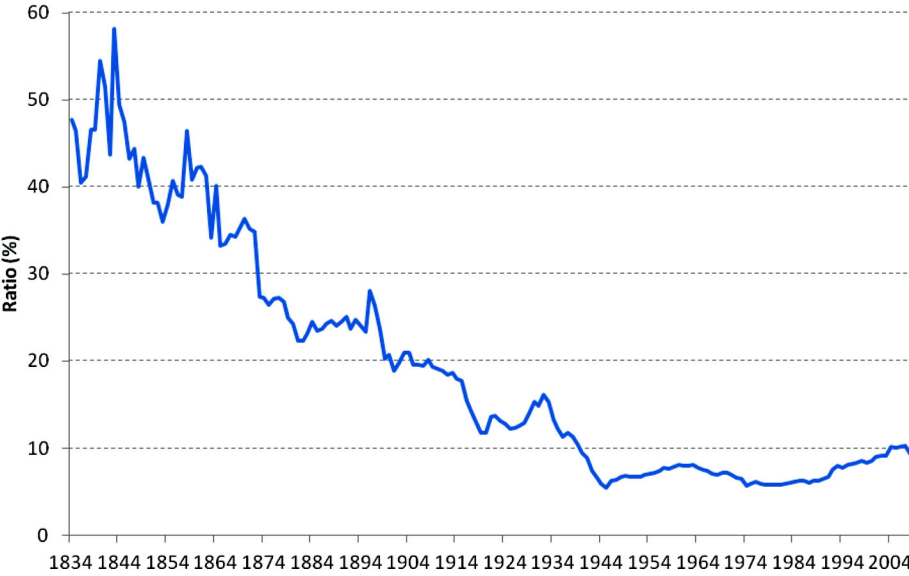
<sup>13</sup> Calomiris and Herring (2013) and Pennacchi, Vermaelen, and Wolff (2014) propose particular designs for “going-concern” CoCos.



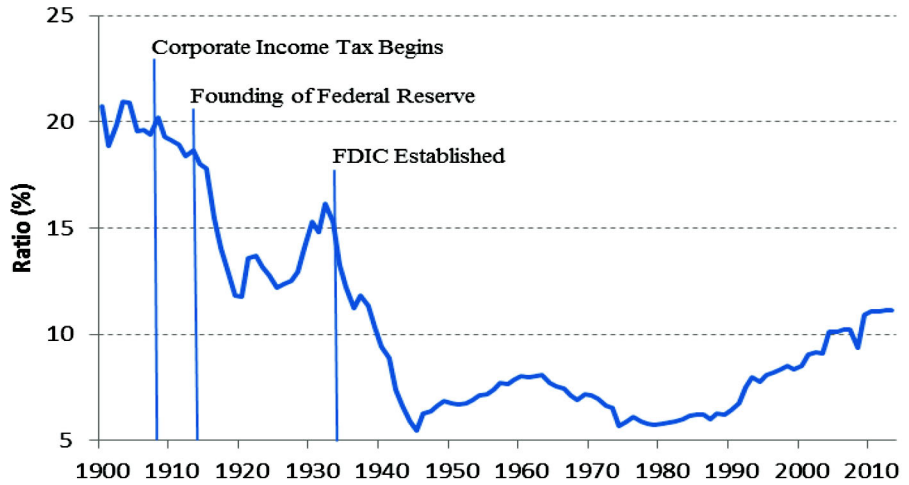
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Figure 1.

Panel A: Ratio of Equity Capital to Assets of All U.S. Commercial Banks, 1834 to 2013

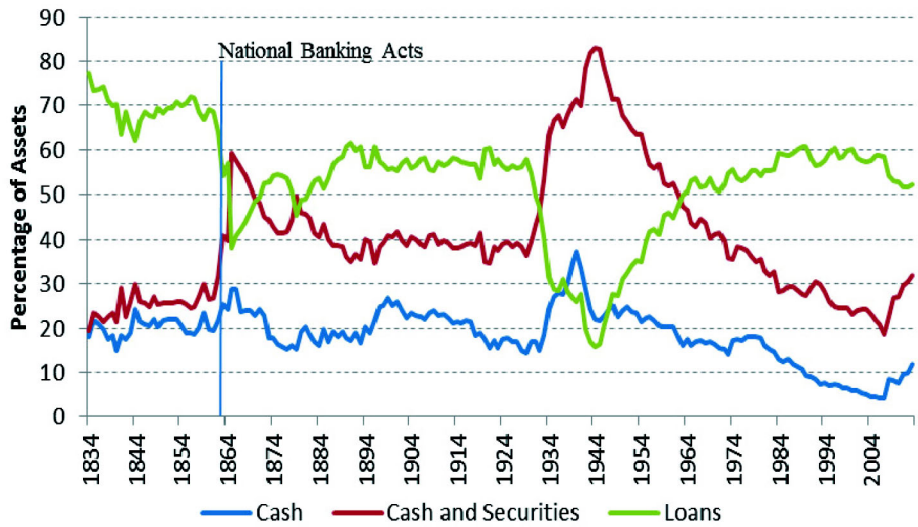


Panel B: Ratio of Equity Capital to Assets of All U.S. Commercial Banks, 1900 to 2013



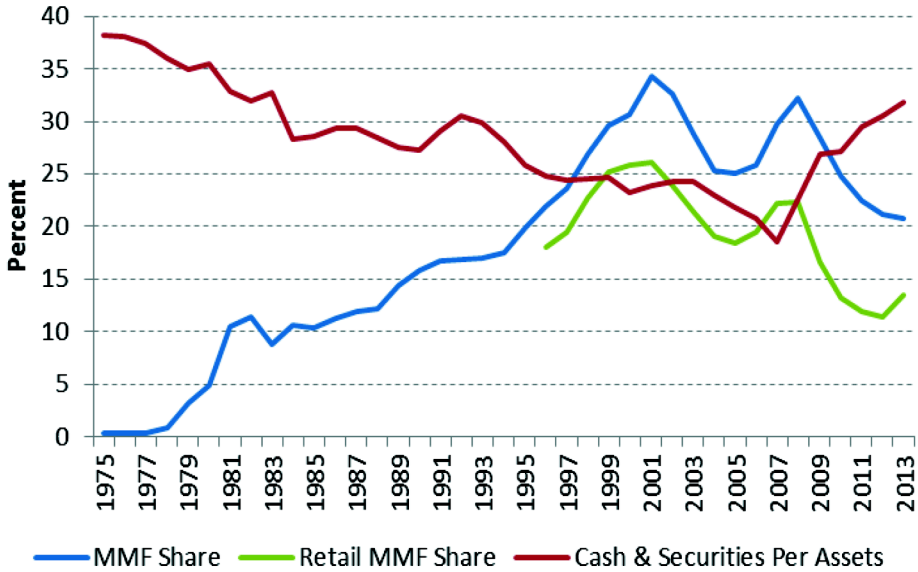
Sources: U.S. Statistical Abstract and FDIC Call Reports

Figure 2. Aggregate Cash, Securities, and Loans as a Percentage of Commercial Bank Assets, 1834 to 2013



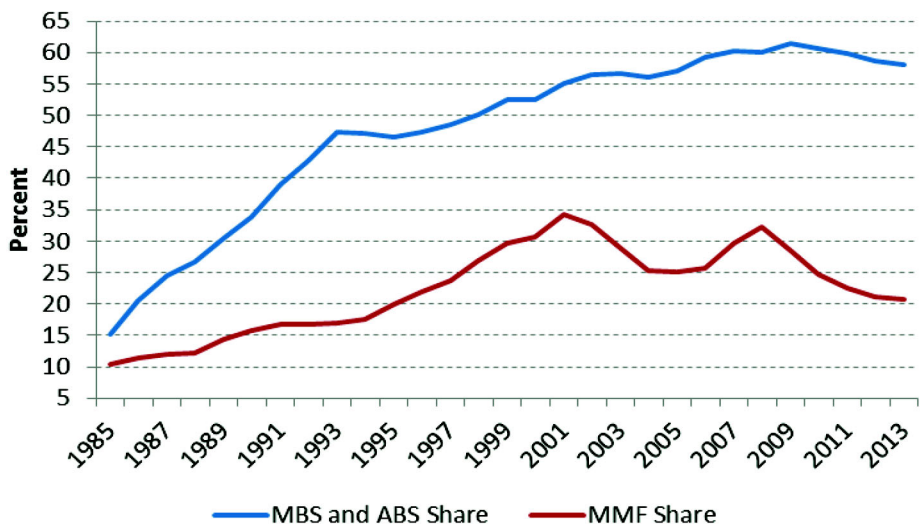
Sources: U.S. Statistical Abstract and FDIC Call Reports

Figure 3. Money Market Mutual Fund Share of Savings/Transactions Account Balances



Sources: Investment Company Institute and FDIC

Figure 4. MBS and ABS Share of All Loans



Sources: Securities Industry and Financial Markets Association, FDIC, and Investment Company Institute

## 5. THE VOLCKER RULE'S UNINTENDED CONSEQUENCES

*Jussi Keppo*<sup>1</sup>

The most profound change in banking regulation since the global financial crisis has been the Volcker Rule, passed five years ago as part of the Dodd-Frank Act in the United States. The rule aims to reduce imprudent risk-taking by banks by restricting their business models and prohibit risky activities to increase financial stability. This is done by limiting banks' proprietary trading and their investments in hedge funds and private equity. More specifically, under the rule the total size of these activities has to be less than 3% of the banking entity's tier 1 capital.

While full compliance is not required until next year, major affected bank holding companies in the US have announced reconfigurations of their business models, shutting down proprietary trading desks and selling shares in hedge funds<sup>2</sup>. However, despite the compliance announcements, the effect of the Volcker Rule could be dubious as the final rules have a long list of exemptions. Further, regulators may find it difficult to differentiate between prohibited and permitted activities such as trading on behalf of customers, market-making, or hedging. As a result, affected banks could keep their overall risk levels unchanged.

Even if the above discussed implementation risks were not there, banks can still take risks in many ways such as increasing leverage or risks in the trading or the banking book, or decreasing the hedging of the banking book. Thus, policy makers should not assume that a decrease in the trading book or its particular activities decreases banks' overall risk. Thus, the rule might have unintended consequences because it could be that the rule just changes risk-taking channels, not the banks' overall risk.

Based on my research with my co-authors Sohhyun Chung and Josef Korte (Chung *et al.*, 2014; Korte and Keppo, 2015), this is indeed the case. First, we show in a theoretical model that when regulators limit the size of trading book then banks' optimal response is to change dividend and recapitalization policy in a way that default probability might increase. This is because banks' objective is to maximize the equity value and not to minimize the default probability. More specifically, limiting the trading book size decreases banks' cash flow risk.

<sup>1</sup> NUS Business School, National University of Singapore.

<sup>2</sup> See, e.g., S. CRAIG, "Goldman Moves to Comply With Volcker Rule", *New York Times*, May 10, 2012; L. BLANKFEIN, "Goldman Sachs CEO Views the World From Wall Street", *Remarks at the Economic Club*, July 18, 2012; D. CAMPBELL and J. SHENN, "Citigroup's Raytcheva Survives Volcker Rule as Prop Trader", *Bloomberg*, June 25, 2014.

However, since the cash flows are less risky then the banks need less hedging, i.e., less hedging of the banking cash flows and lower capital buffer that acts as a buffer against future losses. By using historical model parameter estimates before the Volcker Rule was put into law in July 2010 we find that on average the rule raises the banks' default probability. This is illustrated in Table 1.

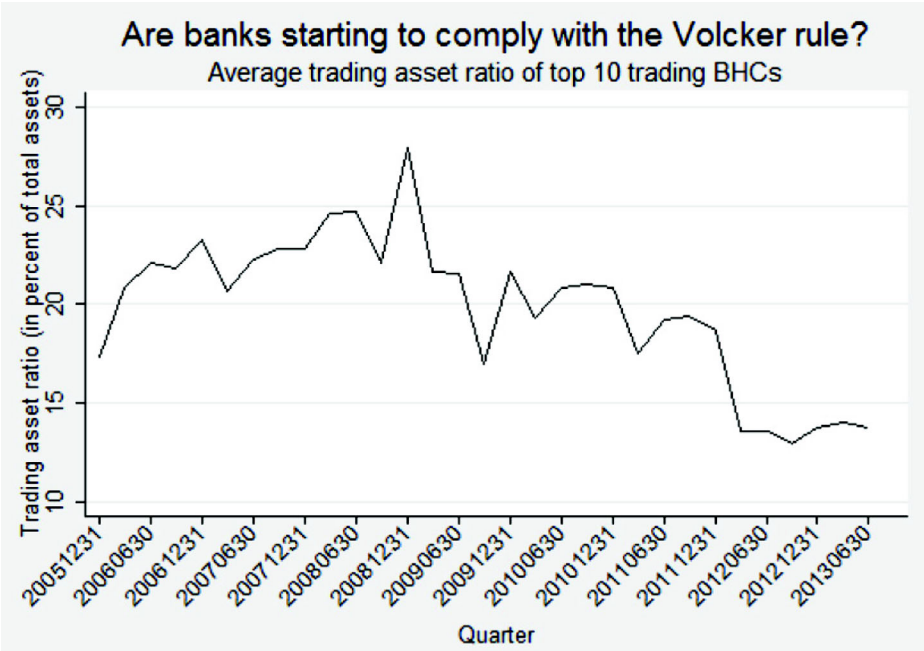
**Table 1:** The simulated effect of Volcker Rule on equity value and default probability with different parameter estimates. *Here 'mean' means that the model parameters equal the mean over the affected banks' parameter estimates during 2000-2010. Affected banks are those whose trading assets are more than 3% of the equity capital in 2010. Median, asset value weighted mean and median are calculated in the corresponding way.*

Parameter estimation	Value diff: without – with Volcker,%	DP diff: with – without Volcker
Mean	1.66%	25.64%
Median	2.99%	56.62%
Asset-weighted mean	5.39%	19.29%
Asset-weighted median	23.58%	0.00%

By Table 1, our model with the historical parameter estimates predicts that the negative effect on banks' equity value and default probability is between 0 and 25%. This indicates that on average the Volcker Rule raises banks' default probability and decreases their equity value. In that sense it is ineffective. These results are consistent with Schaefer *et al.* (2013) who find somewhat similar effects in an event study evaluating market reactions around the announcement and enactment of the Volcker Rule, with banks' stock market returns decreasing and credit default swap spreads increasing.

Second, we use more data and use a difference-in-differences setup and test these theoretical findings. As expected, we find that the affected banks have reduced significantly more their trading books than banks that are not affected by the rule (banks with trading book less than 3% of tier 1 equity). Figure 1 illustrates this. This result is robust to various specifications, alternative affectedness definitions, variations in timing, and a propensity score matching approach. Further, this result is consistent with banks' compliance announcements. After that we analyze the effect on risk-taking and find consistent results with our theoretical model. Thus, while the banks are at least closer to complying with the rule so far they have been able to keep their risk targets.

Figure 1. Average trading asset ratio of top 10 trading bank holding companies (BHCs). *This figure plots the average trading asset ratio of the 10 BHCs with the highest trading asset ratio in the 10 quarters previously to 2007. The Volcker Rule was put into law in July 2010.*



We also test the Volcker Rule’s announcement effect on banks’ stock price volatility and banks’ liquidity ratio measured by cash and balances at other depository institutions relative to total assets, but we do not find any significant differences between banks that are affected by the rule and those that are not.

If the reduction of bank risk is an objective of the rule, our findings suggest that the Volcker Rule has so far not led to its intended consequences. However, these effects are not necessarily surprising. Banks make profits by taking risks and if regulators prevent them to take risk in one way, they do it in another way since the rule does not change the risk-taking incentives.

To be fair, the final rulebook for the Volcker Rule has only recently been published and it is not yet fully binding on banks. However, our results (together with several banks’ self-declared compliance) identify serious risks in the Volcker Rule. Thus, US regulators might want to analyze further possible implementation risks and unintended consequences in order to ensure financial stability, especially because the rule is expensive for both the banks and regulators.

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## 6. WHAT IS MONEY AND WHO SAYS SO?

*Peter R. Fisher*<sup>1</sup>

Are liquidity and market efficiency alive and well? No, I don't think so. But why do you ask?

Why are central bankers and policy makers the world over so concerned with this thing called liquidity? Is this an outpouring of sympathy for the plight of the hard working bond trader? More likely you are wondering whether current valuations can be sustained or if prices of financial assets might go down. This seems a reasonable concern.

First, for the market as whole, there is no such thing as liquidity. Finance capitalism is premised on a profound liquidity illusion. Central bankers, in particular, should not be confused about this.

Second, this generation of central bankers is committed to stabilizing macroeconomic outcomes and they do this by manipulating financial conditions and asset prices. Having pushed financial conditions with extraordinary policies in the hope of creating a good equilibrium between the supply and demand for labor and other resources, it is *unlikely* that central bankers have simultaneously engineered an enduring equilibrium in financial asset prices. If we hope to find both economic and financial equilibrium we will need an internally consistent articulation of the objectives and the constraints of monetary policy.

Third, consider the possibility that central banks have put Gresham's Law into operation by inducing the hoarding of the 'good money' of sovereign debt and high-quality assets while the expanded supply of low and negative-yielding 'bad money' of central bank liabilities circulates through the banking system.

Fourth, with Gresham's Law in mind, let me suggest that the risks are more symmetric than you think. There is the risk that hoarding behavior stops and we then see price declines in government bonds and other assets. But there is also the risk that hoarding behavior does not stop and that central bankers find themselves with diminished influence over the shape of the yield curve.

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<sup>1</sup> Senior Fellow, Center for Global Business and Government, Tuck School of Business at Dartmouth.

## 6.1. OUR FINANCIAL SYSTEM IS BASED UPON LIQUIDITY ILLUSION

In relation to market efficiency, when we say ‘liquidity’ we mean our ability to sell an asset – to convert our claims on future cash flows into cash – without material loss and, preferably, for a merely-frictional transaction cost. The larger the pools of available cash and of potential buyers the more liquidity we expect to find.

Markets may not be always and everywhere efficient but they have a strong tendency toward efficiency. As long as financial agents record their profits and losses on a calendar basis, but incur costs and earn fees on a transaction basis, market participants will be incented to increase the volume of transactions conducted on given pools of funds and counterparties.

Reforms instituted since the crisis, particularly stricter leverage ratios and liquidity requirements, have reduced the ability of some intermediaries to conduct their habitually preferred size and volume of transactions. But as innovations in trading, clearing and settlement unfold, market participants will press for higher throughput. All of these changes in the technology of trading – both those that may diminish and those that may enhance the volume of transactions – should not confuse you about the nature of market liquidity.

Liquidity is not a quantity, it is a behavior. The pool of potential buyers is highly elastic. Humans are not good at being time consistent. Uncertainty about the key variables that influence asset valuation will reduce liquidity just when having it will be most desired.

Individual transactions can be liquid and individual financial agents can find liquidity for some of their assets some of the time. But we cannot all withdraw our deposits from the bank the same day, nor can we all sell all of our bonds and stocks at the same time. Our financial system rests on a liquidity illusion.

In financial markets when we all rush for the exits the doors actually get smaller. The history of fixed income investing, in particular, has been the history of moving our liquidity illusion around – and hiding it behind complexity.

If we look at narrow segments of the market, and short enough time horizons, we observe behaviors that look like liquidity. Or we can look at very long horizons and comfort ourselves that we are bound to regress to the mean eventually. Neither will shed much light on the conditions in which we will be *unable* to sell assets without material loss.

With the financial world now fretting about liquidity, consider how far we have come from Keynes’s observation that:

*Of the maxims of orthodox finance none, surely, is more anti-social than the fetish of liquidity, the doctrine that it is a positive virtue on the part of investment institutions to concentrate their resources upon the holding of 'liquid' securities. It forgets that there is no such thing as liquidity of investment for the community as a whole<sup>2</sup>.*

Central banks were, in fact, invented to provide an elastic currency that would backstop our liquidity illusion. When sovereigns found it awkward that their credit was beholden to Medici and Fugger bankers, they sought to have their debt held by a wider group of creditors. To comfort these creditors, particularly in times of war and high levels of debt, central banks turned out to be useful expedients in supporting the 'liquidity' of sovereign bonds. In the nineteenth century, we discovered that, in a similar manner, central banks could provide a liquidity backstop to the banking system.

Modern central bankers are slightly embarrassed by their origins as mere liquidity providers and lenders of last resort. They have resolved not to be satisfied with merely stabilizing the value of sovereign debt and money and, rather, have committed themselves to ensuring good macro-economic outcomes.

## 6.2. FINDING EQUILIBRIUM REQUIRES INTEGRATED THINKING ABOUT ECONOMICS AND FINANCE

In our post-crisis, weak economic environment this commitment is best expressed by the powerful idea that if the supply of labor and other resources exceeds the demand for these same resources then, by definition, interest rates are too high. This is viewed both as a fact and an imperative: both as an accurate description of how the world works and how it should work, particularly so as not to repeat the mistakes of the 1930s.

Only two constraints are acknowledged to the objective of ensuring that the observed rate of interest should be lowered to the 'natural rate' at which demand and supply for real resources will meet. The first constraint is if inflation is, or is expected to be, too high. The second, begrudgingly admitted, are so-called 'financial stability concerns'.

But to solve your curiosity about whether we have an efficient market in financial assets, we need to do a better job of describing both the economic and the financial consequences of central bank behavior in a consistent framework.

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<sup>2</sup> J. MAYNARD KEYNES, *The General Theory*, Chapter 12 (1936).

Whenever central banks lower the rate of interest, from whence do they conjure the additional aggregate demand? It can come from only two places: from foreigners or from the future.

With lower interest rates we can weaken our exchange rate and can take demand from our trading partners.

We can also try to take demand from the future by two means: first, by inducing people to borrow more against their future income and, second, via a 'wealth effect' that takes place when we lower the rate of discount on future cash flows making them appear more valuable.

Stated in plain terms, by manipulating financial conditions central banks can steal demand from foreigners or they can take demand from the future, either by inducing people to borrow more than they would otherwise be inclined to or by making rich people *appear* richer. Monetary policy is a grubby business but someone has to do it.

Foreigners can defend themselves, but the future is defenseless. It is also in the future that we will discover whether financial asset prices are now in equilibrium. So while exchange rates are an important part of the financial conditions that central bankers try to manipulate, I suggest we focus on borrowing from the future.

We can think of finance as intermediation between different agents and sectors. But the more important role of finance is the intermediation that takes place between the present and the future. With this in mind, we can integrate 'financial stability concerns' and monetary policy if we think more symmetrically about the risks of borrowing too little from the future and the risks of borrowing too much. We can also be more specific about too little or too much 'compared to what'.

If we borrow too little from the future we risk under performing our economic potential.

A great virtue of finance capitalism is the opportunity we have to convert our potential future income into current consumption and investment, while at the same time these claims on future income become assets (and savings vehicles) for others. If we borrow too little we miss the chance to realize our potential and, thus, 'too little' should be compared both to our likely future income and to our current potential. This is the powerful idea that animates the imperative that if current supply exceeds demand then interest rates should be lowered.

But the current proponents of solving the imbalance between supply and demand by lowering the price of money are passing over the possibility that prices for resources could already be too high and need to adjust rather than the price of money. Easing financial conditions in order to increase demand would then push us away from equilibrium rather than toward it.

The lower-the-rate-of-interest imperative turns out to be a mechanism for pushing prices higher in the hope of discovering a high-price equilibrium and avoiding a low-price one. But pushing the prices of labor and other resources ever higher might not be the best route to equilibrium prices, both for real resources and for financial assets.

So we should also consider the risks that we borrow too much from the future and the constraints that these risks imply. There are several.

First, there is widespread agreement that if we bring too much demand from the future into the present we might create an imbalance of demand relative to supply and, thereby, risk creating inflationary pressures, so too much demand compared to our current productive potential. This would be particularly likely if we stimulate more current consumption than investment.

Second, we might borrow too much investment from the future – we might over-invest – and create too much output compared to demand. This would contribute to deflationary forces. Today's central bankers are conflicted about this: they recognize the desirability of increasing our productive potential but they are opposed to any decline in prices, seeking instead a persistent inflation. (This is a topic for another day.)

Third, we might borrow too much from the future compared to our future income. Too much debt relative to income might limit our disposable income and constrain our propensity to consume. This would be a deflationary force, weakening future demand.

In borrowing too much against our future income we might also incur a debt burden in excess of our ability to repay it. This would be likely to reduce the value of financial assets, as they come to reflect lower cash flows, a lower probability of repayment and a higher probability of default. This introduces us to financial instability risk: the risk that claims on future income may be of uncertain value and, thus, volatile.

Fourth, we can also 'borrow' from the future via the wealth effect. As already mentioned, by lowering the rate of discount on future cash flows we can make claims on these cash flows *appear* more valuable in present value terms. By itself, this does not increase wealth it only increases apparent wealth, which might, in turn, stimulate current consumption and investment.

When might this form of borrowing via the wealth effect become too much? Converting future expected returns into present values may make us appear wealthier today but, at the same time, it diminishes our expectations about the future. Increasing current apparent wealth but reducing expected further accretions to wealth is a trick that can work its magic but once and, by definition, must push us closer to uncertainty about the sustainable level of asset prices. If

the rate of discount (and the term premium, in particular) were to mean revert to higher levels then the apparent increase in wealth would be erased, likely reversing any benefits to confidence.

We can think of the risk of financial instability as the risk that financial asset values decline sharply or unexpectedly in a manner that might undermine confidence, lowering consumption and investment.

But a more important risk of financial instability is that we both borrow beyond our likely income and also do so against the collateral of unsustainably elevated asset prices. Debt in excess of income leveraged against unsustainably priced collateral creates exactly the balance-sheet mismatch most likely to lead to a debt deflation and, hence, to the conditions where we would expect to find chronically weak demand for resources – supply in excess of demand – and perhaps even secular stagnation. (This balance sheet mismatch also defines the predicament of banks and even countries in stress, bringing to mind the current situation in Greece.)

So there are significant risks of borrowing too much from the future that are alluded to as ‘financial stability concerns’ but that, I would suggest, are more accurately recognized as directly relevant to the price stability and economic objectives of monetary policy.

### 6.3. HAVE CENTRAL BANKS UNLEASHED GRESHAM’S LAW?

Over the past year, as I have tried to understand the extremely low and even negative yields on high-quality, fixed-income securities, particularly in Europe, it struck me that their high prices and low yields could be described as reflecting ‘hoarding behavior’. This made me think of Gresham’s Law that bad money drives out good money. More precisely, if a government accepts a lesser-valued coin (like copper) at par as a substitute for a high-valued coin (like silver or gold), then the higher-valued coin will be ‘driven out of circulation’ and hoarded off of the market, while the lesser-valued coin will circulate.

In bond markets we put the idea behind Gresham’s Law into practice every day with the concept known as ‘the cheapest to deliver’. If a lender demanding collateral will accept a bond of lower credit quality in the place of a higher quality bond, without applying a different credit ‘haircut’ to the lower quality one, the borrower can satisfy the collateral requirement with the security that is the cheapest to deliver. In this way, high quality bonds are held back (to the extent possible) and lower quality ones are used instead to secure extensions of credit.

This helps to explain how European capital markets came to be confused about the credit quality of Euro-member sovereign debt. From its inception, the

European Central Bank accepted the debt of all member nations in its repurchase operations as if they were of identical credit quality – with no difference in haircuts for the lower-rated sovereigns – thereby giving a strong impulse to price convergence between core and peripheral sovereigns as they all were deemed equally ‘money good’ collateral for the creation of euros.

Quantitative easing influences asset prices in a number of ways. Significantly, the open-ended commitments of QE-practicing central banks are functionally equivalent to the issuance of free options and, thereby, compress implied volatility. More obviously, QE results in a compression of the term premium in long-term interest rates. Both of these forces tend to push up asset prices.

We can also think of QE-practicing central banks as putting Gresham’s Law into practice by vastly expanding the supply of low duration central bank liabilities while buying up high duration government debt and other high quality bonds.

But with the combination of negative deposit rates and QE, the ECB has, I think, unleashed Gresham’s Law with particular force. By buying up and hoarding the ‘good money’ of coupon-paying sovereign debt and other high-quality assets while issuing the ‘bad money’ of negative-interest rate deposits, the ECB is powerfully creating the conditions in which financial intermediaries hoard whatever high-quality, income-producing financial assets they can find.

Wherever we look, we see that income-producing assets – that is, claims on future cash *flows* – are highly valued when priced in terms of *cash*. We see this in sovereign debt and corporate debt markets. We also see this in the share and debt buy-backs of corporations who wish to hoard their own internal cash flows.

## 6.4. WHAT IS MONEY AND WHO SAYS SO?

The textbooks told us that central bank liabilities are the best and most important form of money, the so-called high-powered money at the base of our monetary system. This story suggests that central bankers control both the quantity and the price of the most important form of money.

I have long thought that this view was mistaken, at least as a characterization of monetary arrangements for most of the last 40 years. The base asset of our monetary regime has been central *government* liabilities, not central *bank* liabilities. Sovereign debt has been the collateral that underpins our monetary system. While this would suggest that quantity has been regulated by the accident of fiscal policy, central bankers could still take comfort from their influence over the price of sovereign debt, and the shape of the yield curve, through their influence over the expected path of short-term rates.

Perhaps QE can be thought of as the central bankers' counter offensive, reclaiming control over the quantity of high-powered money by flooding the banking system with their own liabilities.

But having themselves become the major hoarders of sovereign debt – both via QE and foreign reserve accumulation – and also having induced others to hoard sovereign debt at higher and higher prices and lower and lower yields, what if reversing this process – of reverse engineering Gresham's Law – is harder than expected?

The 'portfolio rebalance channel' sounded so simple and reasonable: QE would push private agents to rebalance their portfolios away from high-quality assets into lower quality ones, thereby stimulating us all to borrow more from the future. But why would changes in the size and composition of central bank balance sheets change the rest of our risk preferences so as to induce us to take more credit risk at the same time that our duration risk was being increased so significantly?

What if, independent of the supply and price of central bank liabilities, the hoarding behavior, the safe haven bid, the scarcity premium for sovereign debt is unimpressed with relatively small changes in the expected path of short-term interest rates? What if central bankers find that they have diminished their own influence over the shape of the yield curve? What if *this* is the exit that is hard to achieve?

The risks going forward are more symmetric than you think. There is the risk that hoarding behavior ceases and the value of sovereign bonds, and other financial assets, decline. There is also the risk that they don't – that hoarding behavior is harder to reverse and that the ability of central banks to encourage us to borrow more or less from the future will be diminished.

So, are liquidity and market efficiency alive and well? My response is that markets seem to be dominated by a hoarding behavior of central banks' own invention and that hoarding is not a concept that I normally associate with either liquidity or efficiency.



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