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Bank systemic risk and macroeconomic shocks: Canadian and U.S. evidence

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ABSTRACT

This paper investigates how banks, as a group, react to macroeconomic risk and uncertainty; more specifically, it examines the relationship between bank systemic risk and changes and disruptions in economic conditions. Adopting the methodology of Beaudry et al. (2001), we introduce a new estimation procedure based on EGARCH to refine the framework developed by Baum et al. (2002, 2004, 2009) and Quagliariello (2007, 2009), and we analyze the relationship in the current industry context—i.e., in the context of market-based banking. Our results confirm that banks tend to behave more homogeneously vis-à-vis macroeconomic uncertainty. In particular, we find that both the cross-sectional dispersion of loans-to-assets and the cross-sectional dispersion of non-interest income share shrink during slow growth episodes, and particularly during financial crises, when the resilience of the banking system is at its lowest. More importantly, our main findings indicate that the cross-sectional dispersion of loans-to-assets has increased in the last decade, whereas the cross-sectional dispersion of non-interest income share appears to be more volatile and sensitive to macroeconomic shocks.

1. Introduction

The way that individual banks respond to external shocks can lead to common patterns that increase systemic risk, especially when disaster myopia is at work (Jain and Gupta, 1987; Pecchino, 1998; Borio et al., 2001; Hyytinen et al., 2003). For example, it is now widely accepted that the 2007 credit crisis has been severely accentuated by banking strategic complementarities in the face of regulatory constraints (Wagner, 2007, 2010; Adrian and Brunnermeier, 2008; Farhi and Tirole, 2009; Gauthier et al., 2010; Loutskina, 2011[1]; Schoenmaker, 2013). This paper focuses on this kind of clustering behaviour, through which *all* banks react simultaneously to a common regime change and rationally allocate assets in the same way. *Ceteris paribus*, the more that this behaviour occurs, the more likely it is that the banking system will lack resilience, and, consequently, the more financial stability will be at risk.

To analyze bank systemic risk defined in this sense—as the extent to which the banking system is immune to external shocks—we consider a theoretical underpinning derived from a signal extraction problem developed by Lucas (1973). We assume that in the presence of informational problems, aggregate shocks can disturb the signal quality of prices and distort bank resource allocation in a systematic way (Bernanke and Gertler, 1989; Kyotaki and Moore, 1997; Beaudry et al., 2001; Vives, 2010). To examine this hypothesis, Baum et al. (2002, 2004, 2009) and Quagliariello (2007, 2008, 2009) define bank systemic behaviour in terms of cross-sectional dispersion of loan portfolios. Based on a very large U.S. dataset spanning 1979–2003, Baum et al. (2009) find that an increase in macroeconomic uncertainty systematically generates a significant decline in the cross-sectional dispersion of loans-to-assets ratio after one year. The authors argue that this pattern is consistently observed regardless of the way dispersion is defined—whether considering total loans, loans to households, or commercial and industrial loans—and even when controlling for monetary regime changes, inflation, leading indicators or regulatory changes.[2]

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[1] According to Loutskina (2011), 40% of total loans outstanding were securitized at the end of 2007 in the U.S. (versus 2.2% in 1976). Securitization, trading and cross-selling by the largest U.S. banks fed a systemic risk bubble to its breaking point.

[2] Baum et al. (2009) also find that the Basel Accords increase this pattern.

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In this paper we work along these lines, but with a particular focus on the current industry context. While regulation has concentrated on the tightening of capital standards and liquidity requirements, financial institutions have shifted their business model towards market-based banking. Since this diversification impacts bank systemic risk (e.g., Haiss, 2005[3]; Wagner, 2007; Calmès and Théoret, 2010; De Jonghe, 2010; Loutskina, 2011),[4] we enlarge the scope of our investigation to include *all* banking business activities, considering not only loans but also non-interest income activities and, more precisely, the cross-sectional dispersion of non-interest income share (*snonin*).

We know that informational problems and agency costs are generally more severe during slow growth periods and especially during crises, when banks are most exposed to moral hazard and adverse selection. The banking business is typically riskier in these periods, because collateral value falls (Boyd and Gertler, 1994; Kyotaki and Moore, 1997). In this regard, the contribution of our paper is to introduce a new methodology specifically designed to detect the kind of asymmetric impact that macroeconomic shocks can have on bank systemic risk. Compared to Baum et al. (2002, 2004, 2009), our framework, based on an EGARCH approach (Nelson, 1991), provides a more precise account of the relative impact of macroeconomic risk (the first moment) and uncertainty (the second moment).[5] Both Canadian and U.S. data confirm that banks display a common pattern during times of heightened macroeconomic uncertainty, as measured by the conditional variance of standard series such as GDP and consumer price index. However, the generalized framework we propose also helps better identify the periods when the dispersion is at its lowest. From this perspective, the dynamics of the cross-sectional dispersion of the loans-to-assets ratio (*lta*) and non-interest income share (*snonin*) reveal that bank behaviour is actually more homogeneous during slow growth episodes and particularly so during financial crises. More precisely, we find that the *volatility* of the innovation[6] of the cross-sectional dispersion models displays an asymmetric pattern, and appears to be significantly lower in these kinds of periods.

Interestingly, we find that the cross-sectional dispersion of *lta* seems sensitive to credit variables (as proxied by macroeconomic conditions) rather than to supply factors such as the return on assets. Consistent with Bikker and Hu (2002),[7] our results would better accord with the balance sheet channel than with the lending channel (Bernanke and Gertler, 1995; Kashyap and Stein, 2000). More importantly, we find that, as compared to previous studies, the cross-sectional dispersion of *lta* has increased in the last decade. However, our main findings also indicate that bank systemic risk—as captured by the cross-sectional dispersion of *snonin*—is quite substantial. The fluctuations of non-interest income are large, both in Canada and in the U.S., and they are naturally more significant in the latter case, since the U.S. banking system has experienced more severe financial crises.

[3] Haiss (2005) provides an extensive literature review on the subject.

[4] For example, the probability of bank failure seems to be positively correlated to the ratio of non-traditional to traditional activities (Barrell et al., 2010).

[5] More precisely, the firsts moments may be GDP growth (or the output gap) and inflation. The corresponding second moments are the conditional volatility of GDP growth and the conditional volatility of inflation. The first moments measure macroeconomic risk, while the second moments gauge macroeconomic uncertainty.

[6] In econometrics, "innovation" refers to the error term of a regression (cf. Greene, 2000).

[7] We tried several financial variables to represent the supply and demand sides of risky assets (e.g., returns on assets, short-term interest rates), term structure variables (e.g., the spread between long-term and short-term interest rates) and credit spreads (e.g., the difference between the yields on *BBB* and *AAA* bonds and stock index returns). These variables were usually not significant, so we eliminated them from our analysis. This observation is in line with Bikker and Hu (2002) who find that financial variables—such as money supply and interest rates—do not seem to explain bank profitability.

This paper is organized as follows. Section 2 presents the theoretical framework supporting our main hypothesis—i.e., how the cross-sectional dispersion of bank risky assets (on-balance-sheet and off-balance-sheet related items) is linked to macroeconomic shocks. This section also describes the empirical framework and the EGARCH procedure followed in the experiments. Section 3 discusses the data and some key stylized facts related to the cross-sectional dispersion of *lta* and *snonin*. In Section 4 we report our main results, and in Section 5 we perform robustness checks and provide complementary results before concluding in Section 6.

2. Empirical framework

2.1. Risk, uncertainty and bank systemic behaviour

Many studies document the influence of the first moments of macroeconomic aggregates—i.e., macroeconomic risk—on bank common patterns (e.g., Barth et al., 1999; Borio et al., 2001; Bikker and Hu, 2002; Bikker and Metzemakers, 2005; Baele et al., 2007; Wagner, 2007; Somoye and Ilo, 2009; Nijskens and Wagner, 2011). However, even though all moments are capable of influencing bank systemic behaviour, few authors look at the role played by higher moments—i.e., macroeconomic uncertainty. For example, we would expect that, in absolute terms, the homogeneity of bank portfolios would increase in response to an increase in macroeconomic risk and uncertainty, as such an increase would lead to a decrease in the aggregate cross-sectional dispersion of the composition of bank portfolios. Our first goal, therefore, is to confirm that risk *and* uncertainty have this kind of negative impact on cross-sectional dispersion.

To study the degree of business homogeneity when banks adjust to macroeconomic shocks, we adopt a research strategy based on the island paradigm developed by Lucas (1973). This kind of approach has been successfully applied in several studies, including analyses of the cross-sectional dispersion of firm investments, financial markets, and bank portfolios (Beaudry et al., 2001; Baum et al., 2002, 2004; Hwang and Salmon, 2004; Quagliariello, 2007; Vives, 2010). As a matter of fact, there is a growing body of evidence which documents that the cross-sectional dispersion of a variety of variables is actually countercyclical (e.g., Bloom, 2009; De Veirman and Levin, 2011; Christiano et al., 2013).

In the banking literature, Baum et al. (2004, 2009) and Quagliariello (2009) study specifically how macroeconomic shocks affect bank signals about expected returns. Their main theoretical predicament is that greater economic uncertainty hinders banks' ability to foresee investment opportunities. The testable prediction that derives from this theory is that deteriorating information quality should lead to a narrowing of the cross-sectional dispersion of the composition of bank portfolios, as banks allocate assets in their portfolio more homogeneously when macroeconomic uncertainty increases. In this paper we aim at empirically testing this conjecture with a new dataset that includes all banking activities. To do so, we introduce an empirical framework linking bank systemic behaviour to the first and second moments of the proxies for risk and uncertainty, as described below.

2.2. The model

Following Baum et al. (2004, 2009), our bank portfolio includes two kinds of assets: a risk-free asset (a security) and a risky asset. However, since macroeconomic shocks can distort the allocation of funds both to interest and non-interest income activities, our risky assets comprise loans and non-interest income activities. More precisely, to test our hypothesis we consider the following reduced-form model: