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How useful is the Marginal Expected Shortfall for the measurement of systemic exposure? A practical assessment ☆

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ABSTRACT

We explore the practical relevance from a supervisor's perspective of a popular market-based indicator of the exposure of a financial institution to systemic risk, the Marginal Expected Shortfall (MES). The MES of an institution can be defined as its expected equity loss when the market itself is in its left tail. We estimate the dynamic MES recently proposed by Brownlees and Engle (2012) for a panel of 68 large US banks over the last decade and a half. Running panel regressions of the MES on bank characteristics, we first find that the MES can be roughly rationalized in terms of standard balance-sheet indicators of bank financial soundness and systemic importance. We then ask whether the cross section of the MES can help to identify *ex ante*, i.e. before a crisis unfolds, which institutions are more likely to suffer the most severe losses *ex post*, i.e. once it has unfolded. Unfortunately, using the 2007–2009 crisis as a natural experiment, we find that some standard balance-sheet ratios are better able than the MES to predict large equity losses conditionally to a true crisis.

1. Introduction

The financial crisis of 2007- and in particular the widespread disruption of financial markets triggered by the bankruptcy of Lehman Brothers in the autumn of 2008 has pushed concerns about systemic risk and its measurement at the forefront of both academic research and supervisory policy agenda. In particular, ongoing work by the Basel Committee and the Financial Stability Board striving to set new regulatory requirements for Systemically Important Financial Institutions (SIFI) requires that an agreement can be reached on which characteristics make a financial institution more prone than others to be severely hit by system-wide shocks (systemic resilience or participation) or to propagate such shocks to other institutions, thereby amplifying their overall impact (systemic contribution).[1] Recently, several academic contributions have aimed to account for the interconnectedness of institutions as well as the rapidity of contagion of a systemic event and proposed high frequency measures of individual institutions' systemic importance and systemic exposure that rely exclusively on public market information (like bank stock prices or CDS premia), using sophisticated econometric techniques (cf. e.g. Adrian and Brunnermeier, 2008; Brownlees and Engle, 2012; Goodhart and Segoviano, 2009; Huang et al., 2009). While they have received notable attention, given the real-time monitoring they allow, these market-based systemic risk measures remain complex tools in which the determinants of the vulnerability of a given institution to systemic events remain undefined. As such, they do not fully meet the needs of regulators (Drehman and Tarashev, 2011), which would

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[1] Analytically, one may want to distinguish between situations where bank A reacts more than others to an exogenous shock and situations where Bank A is a source or an amplifier of endogenous systemic events. Both dimensions of systemic importance are in practice clearly inter-related. The participation vs contribution approach was proposed by Tarashev and Drehmann (2011).

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have an easier task if they could rely on indicators based on more usual metrics of the financial soundness of institutions. Nor is it clearly established that these indicators, which are generally highly procyclical, can prove forward-looking enough to provide valuable early warning signals to bank regulators ahead of a financial turmoil.

We look in this paper at one particular but popular statistical measure of systemic resilience, the so-called Marginal Expected Shortfall (MES) and assess empirically for a large sample of big US banks how well this indicator meets such practical concerns. First, we investigate how the MES reconciles with more standards measures of financial weaknesses as computed from individual institutions' balance-sheet information.[2] Second, we check whether the MES is of greater help than more standard balance-sheet indicators to identify *ex ante* which institution would be the most affected should systemic risk really materialize. Overall, our evidence suggests that the case for a practical use of the MES for supervisory purposes is weaker than what is claimed by its proponents.

Recently adapted to systemic risk measurement from an earlier literature on risk-management at the firm level (cf. notably Tasche, 2000), the MES of a financial institution is defined as the expected equity loss per dollar invested in this firm if the overall market declines by a certain substantial amount (then identified to a "tail event" in the market). To overcome the limitations of historical measures of the MES, in particular their lack of flexibility, Brownlees and Engle (2012) recently proposed a multi-step modeling approach based on GARCH, dynamic conditional correlations (DCC) and non-parametric tail estimators. Recently, Acharya et al. (2010) found that the MES of a large sample of US financial firms (banks and non-banks), as measured on the verge of the last crisis, was a good predictor of the total decline in equity valuation that these firms actually experienced during the crisis.

We first estimate Brownlees and Engle's (BE) MES on a daily basis over the period from 1996 to 2010 for a sample of 68 large US bank holding companies, for which we have access to detailed balance-sheet information. A simple look at the median MES confirms that this indicator does a good job in tracking episodes of financial turmoil, which makes it a potentially relevant coincident indicator of the exposure of individual banks to systemic risk. Interestingly, we find that the half-decade leading up to the crisis was characterized by a very low level of average MES, reflecting in turn extraordinary low levels of bank stock volatility, as well as a very low dispersion of individual MES. We view this as indicative of a phase of exacerbated optimism where investors in bank equity did not pay enough attention to individual sources of bank vulnerability.

We then run panel regressions of quarterly bank MES on selected bank balance-sheet variables that are routinely monitored by bank regulators, thus putting the MES to a weak form of market efficiency test. The regression results suggest that the information delivered by the MES is consistent with characteristics that are intuitively viewed as sources of bank fragility or systemic importance. Indeed, banks that generally rely more on wholesale funding, are less profitable, have a higher share of non-performing loans and lend more to corporates turn out to have a higher MES on average. The effects of a low profitability on the MES were significantly amplified during the recent crisis, while size also turned out to signal higher risk.

Finally, taking the 2007–2009 crisis as a natural experiment, we ask whether the MES as measured before the crisis (i.e. conditional to the information available at that point in time, what we call an *ex ante* view in the following)would have been useful to identify which institutions were the most likely to be severely hit should a crisis occur. Based on cross-sectional rank correlations as well as cross-sectional regressions, we conclude that some standard balance-sheet ratios already routinely monitored by regulators, like the ratio of non-performing loans to assets, would have been more useful than the MES at predicting which banks were bound to suffer the most severe equity losses during the crisis. Although we focus in this paper on a specific model-based approach of the MES (the dynamic MES of BE), it is important to note that this conclusion still holds with a simple historical version of the MES, or, for a sub-sample of banks also considered in the rankings posted on the Systemic risk website of NYU Stern, using the simulated long-run extension of the MES recently advocated by Acharya et al. (2012).[3]

The rest of the paper is organized as follows. In Section 2 we estimate daily MES for a panel of large US banks. In Section 3 we present our bank balance-sheet dataset and explore the link between balance-sheet indicators of bank financial fragility and quarterly version of the MES for our panel of banks. In Section 4, using rank tests, we assess the predictive power of the MES compared with usual standard banking risk metrics in the light of the last crisis. Finally, Section 5 concludes.

2. The Marginal Expected Shortfall

2.1. Definition

We focus in this study on a specific measure of the sensitivity of a financial firm to systemic risk called Marginal Expected Shortfall (MES). While alternative metrics have been proposed in the burgeoning literature on systemic risk measurement, we think that the MES deserves a particular attention because of both the large audience gained by its dynamic version as developed by Brownlees and Engle (2012) (not least thanks to the regular updates of MES-based rankings of the systemic importance of US institutions posted on the website of NYU) and also recent claims by Acharya et al. (2010) that the MES would have been able to predict the cross section of losses incurred by US financial firms during the 2007–2009 crisis.

Following Acharya et al. (2010), we define the MES of a financial firm as its short-run expected equity loss conditional on the market taking a loss greater than its Value-at-Risk at $\alpha\%$. Let us denote $r_{i,t}$ the daily (log) stock return of the firm and $r_{m,t}$ the daily index return of the larger market the firm belongs to. Then the MES reads:

$$MES_{i,t} = E_t\left(r_{i,t+1} | r_{m,t+1} < q_{\alpha,t}(r_{t+1}) = C\right) \quad (1)$$

where C is a constant corresponding to our definition of "tail risk" in the market.

Let us also define the Expected Shortfall of the market (ES) as the expected loss in the index conditional on this loss being greater than C, that is: $ES_t = E_t(r_{m,t+1} | r_{m,t+1} < C)$. Whenever all the considered firms belong to the market, it is straightforward to see that the MES of one firm is simply the derivative of the market's ES with respect to the firm's market share (or capitalization), hence the term "marginal". Note that in this case, the MES of a firm can be interpreted as reflecting its participation in overall systemic risk. However, it is still possible to define the same statistic whenever

[2] De Jonghe (2010) runs a similar exercise for a sample of European banks to explore the determinants of heterogeneity in another measure of systemic risk exposure, the tail beta.

[3] Our findings thus echoe those of Danielsson et al. (2012) who focus specifically on the model risk associated with usual metrics of the systemic risk contribution of financial institutions, including the MES. They find that, because of this source of uncertainty, these metrics provide unreliable measures of banks' riskiness in both absolute and relative terms. Although the exercise they run is quite different from ours, they also conclude that a bank regulator concerned with identifying systematically important institutions would be better off monitoring some simple leverage ratios.