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Time-Varying Betas of the Banking Sector

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Abstract. This paper analyses the evolution of systematic risk of banking industries in eight advanced countries using weekly data from 1990 to 2012. The estimation of time-varying betas is done by means of a Bayesian state space model with stochastic volatility, whose results are contrasted with those of the standard M-GARCH and rolling-regression models. We have shown that systematic risk of the sectors varies considerably over time. Furthermore, we show that both country specific and global events affect the perceived systematic risk, while the impact of the latter differs largely across countries. Out findings also support the hypothesis that certain markets behave in a similar fashion, even independently on their geographical location. Finally, our results do not support the previous findings that systematic risk of the banking sector was underestimated before the last financial crisis.

Keywords: CAPM, Time-varying Beta, Multivariate GARCH, Bayesian State Space, Gibbs Sampler, Stochastic Volatility

1. Introduction

The concept of Capital Asset Pricing Model (CAPM) has been under constant attention of both academicians and practitioners for almost 50 years. One of the most important implications of this model is that we can use the contribution of an asset to the variance of the market portfolio (asset's beta) as the proper measure of the asset's systematic risk. This risk is determined by general market conditions and cannot be diversified away.

The assessment of the systematic risk became also used for financial stability purposes (to estimate the cost of equity [1]) or even to measure the level of financial stress. Looking at the properties of systematic risk, it is now widely held that beta is not time-invariant. However, no consensus has been found on the methodology for estimating time-varying betas. We extend the current literature by employing a Bayesian state space model with stochastic volatility to estimate time-varying betas of banking sectors in eight advanced countries. This approach combines the advantages of both Kalman filter approach (modelling beta as an unobservable process in a state-space model) and the approach based on M–GARCH model (allowing for heteroskedasticity of residuals).

This innovative approach allows us to study both cross-country differences and time evolution of the betas. We concentrated on banking sector only in eight advanced countries after 1990. The choice was driven by the specific development of the banking sector in recent years and its role during the financial crisis. Moreover, key question for the financial stability is whether the risk of banking stocks are systematically mispriced in tranquil times when the inherent instability is built up. Our method should be more suitable as the noise present in M-GARCH estimates is filtered out and the estimation is not biased by the size of the window in a rolling regression.

2. Literature Overview

No similar study to that in this paper, i.e. the comparison of time-varying betas in banking sector in different countries, can be found in the literature. Betas of banking sectors have been usually estimated in the literature as a part of sectoral analyses in the financial sector. For example, [2] estimate time-varying betas of a financial sector (including insurance companies) in a pan-European portfolio. A similar exercise is performed by [3] on Australian sectors. The estimation on an individual stock level is performed by [4], who

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estimate time varying betas of 15 financial sector companies in Australia on daily data. They use GARCH model and Kalman filter, which generates better results based on in-sample MAE and MSE.

Another pure banking-sector analysis is by [5], who estimates the costs (required rate of return) of capital in six developed countries using rolling regression. He claims that the costs declined until 2005 in all countries, except for Japan, when they started to rise. The decline in the costs reflects both the declining beta and declining risk-free rate. He also suggests that the low beta may point to mispricing of the banking shares.

More recently, [6] performs tests for structural breaks in the market model of the US banking sector. He identifies three structural breaks - 1960.12, 1989.09 and 2000.03, after which banking betas were at historical lows (the sample ends in 2008). He suggests that the risk was mispriced (systematic risk was underestimated), as the banks took highest leverage and risk in this time, while expected risk was low.

3. Methodology

For the purposes of this paper (estimating betas of the banking sectors), we consider the standard CAPM model. As we have stressed in the previous chapter, there is a large body of evidence that this relation is time-dependent and various approaches to estimating time-varying betas lead to different results (e.g. [7], [2], [4]). In order to draw credible conclusions, we employ three approaches to estimating betas, and compare their results.

The first approach is based on a simple rolling-regression model. The second approach is based on M–GARCH model introduced by [8], which is based on estimating conditional covariances between returns on market portfolio and an asset under consideration. The third approach is based on a Bayesian state space model with stochastic volatility, which estimates betas as an unobserved component and allows for time-varying variance of shocks.

4. Time-Varying Beta of the Banking Sector

We estimate time-varying betas of banking industries in 8 advanced countries – United States, United Kingdom, Germany, France, Switzerland, Japan, Hong Kong and Australia. The countries were chosen based on their market capitalization and the number of banks. The major stock market indices were used as the indices representing the market portfolio. In some cases, banking sector indices are published by stock exchanges but to ensure the consistency, we opted for banking sector indices constructed by Thomson Reuters. Finally, risk-free rate of most countries were chosen as those recommended by Datastream, the risk-free rate of Hong-Kong was chosen based on the literature. Weekly data spanning from January 1990 to February 2011 are used for the analysis. The exceptions are Germany and France, whose data are used since January 1999 when the Euribor was introduced.

We have estimated time varying betas of each banking sector using 3 approaches - rolling regression, multivariate GARCH and finally using state space model with stochastic volatility. The rolling regression approach has two major drawbacks - there is no means of estimating an optimal size of the window and the technique is sensitive to outliers. Further, the drawback of the multivariate GARCH is that the resulting time series contain a large amount of noise, which causes the time series to be very erratic. Since each new observation affects volatility of the market and the sectoral index and therefore the beta, changes between two subsequent observations should be interpreted cautiously.

Finally, from the last approach we can observe that the largest differences between this approach and the former two occur in times of increased volatility, which is because the last method filters out the noise brought about by every new observation. This is also the reason why we employ this third method.

All three approaches strongly support the idea of time-varying nature of beta and several important features are apparent. First, we cannot observe any steady decline in the banking sector beta after 1990. This is in contrast with [5], who concludes that the bank betas trended downward for most countries over the 20-year period, with substantial increase only in the latest period. He used the bank level estimates that are lower than the equity subindices estimates we employ. The differences are considerable mainly in the case of the UK and increased during the recent crisis period (mainly due to a different weighting and sample). Still,

our aim is to follow investors reasoning (perceived riskiness) and global factors for the most important banking groups rather than measure exactly the cost of equity for financial stability purposes.

Second, our more precise estimate of beta indicates that the banking sector risk in tranquil times can still be priced in. As for the period after 2005, it is often argued in the literature that the market expectations of banking risk in the US were low while bank leverage and risk taking were rising during the housing market credit boom. Still we cannot fully agree that the mispricing of this instability built-up took place. The US banking beta started to rise as soon as in July 2006 from levels close to 0.6, growing steadily to 1.5 two years later, when the financial crises fully developed. Similarly, the sovereign debt crisis was expected to hit mainly French banking sector, so its beta remained at elevated levels (more than 1.6) in most of 2010. In the first months of 2011 the beta for French banking sector started to rise again, reaching 2.5 at the end of 2011.

Third, also the reaction of the markets to the crises changed substantially. While the dot-com bubble in 2000 increased perceived riskiness of American banking sector and lowered it for other countries, the global financial crisis increased beta of many banking sectors all around the world at the same time. The same pattern, to lesser extent, can be found in the data for more recent euro area sovereign debt crisis. This may be due to systemic nature of the crisis, when the transmission of shocks was facilitated by the international banking network. The growth of banking sector linkages between several countries (like US, UK or Germany) could have contributed to higher perceived riskiness of their banking sectors. In the following part we will try to shed more light on this last issue. Our aim is to understand why the evolution of banking sector betas for some countries seems to be more synchronized by identifying the global factor.

5. Conclusion

In this paper, we have estimated time-varying betas of banking sectors in eight advanced countries. We have shown that systematic risk of the sectors varies considerably over time using three approaches - the rolling regression model, the M–GARCH model and a Bayesian state space model. The variation reflects the inherent nature of the banking sector, which bridges the real and financial sector in an economy and makes the sector vulnerable to both real and financial shocks.

We have shown that the systematic risk of banking sectors is determined by domestic factors, but some countries share a degree of co-movement in their banking sector betas. Contrary to some previous literature, we have not found strong evidence of declining systematic risk before the recent financial and sovereign crisis (which would signal mispricing of the risk, according to the literature).

We believe that our innovative approach to estimating time-varying betas is superior to M–GARCH or the rolling regression in that it subtracts noise from the data (similarly to the Kalman filter approach) but assumes heteroskedastic residuals at the same time (similarly to the M–GARCH approach). This is certainly worth exploring further in several other dimensions. First, tests of asset pricing models could be repeated using the results of our model. Also, forecasting performance of this model could be compared with the competing models. Then, more interestingly, the model can be used to extend the current literature on estimating the cost of equity for financial stability purposes. Finally, a rather limited attention has been paid to the determinants of the banking sector risks. In this sense it would be highly interesting to investigate, for example, whether monetary policy affects bank risk taking, i.e. whether a period of pro-longed low interest rates contributed to the inherent built-up of instability in the banking sector.

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