Evaluating large bank risk using stock market measures in the Basel III period

Guoxiang Song

Department of Accounting and Finance, Faculty of Business, University of Greenwich,

Park Row, Greenwich, London, United Kingdom, SE10 9LS

email: goal2106@gmail.com

Abstract

There is a puzzle in the literature which seems to indicate that high capital levels introduced by Basel III increase bank risk. This paper attempts to solve this puzzle by investigating whether the risk of the eight U.S. global systemically important banks (GSIBs) increased in the Basel III period from previous periods.

This paper uses case studies of the eight U.S. GSIBs to evaluate whether Basel III has changed their risk perceived by the market.

Basel III has reduced the systematic risk of equity of U.S. GSIBs perceived by the stock market, and it does not explain the decline in return on equity (ROE) which may indicate some increase in large bank financial risk.

The paper breaks down stock market measures into drivers which capture systematic risk of equity and other drivers which capture financial risk, and it finds new evidence which solves the puzzle in the literature on large bank risk.

The findings of the paper help investors, creditors and regulators to have a clear understanding of the market perception of large bank risk.

The paper provides new methods and evidence which could help regulators to assess the impact of Basel III on bank risk perceived by the market.

1. Introduction

Responding to the 2008 to 2009 global financial crisis (GFC), Basel III increased the quantity and quality of bank capital requirements during 2014 to 2018. As a result, U.S. regulators claim that major U.S. banks are very much stronger due to their capital positions (e.g., COX (2017)). However, some researchers argue that the market perceived risk of these large banks has not been reduced as a result of higher capital levels (e.g., Clearing House (2016) and Sarin and Summers (2016)). Such conflicts over large bank risk in the literature have significant implications for investors, creditors and regulators. This paper attempts to contribute to this debate using case studies of stock market measures of the eight U.S. global systemically important banks (GSIBs) to evaluate whether their risk decreased in the Basel III period from previous periods.

The fundamental issue underlying this debate is the different views on the measures that reflect the risks of large banks. On one hand, regulators use accounting-based and risk-based capital adequacy ratios such as Tier 1 Ratio and leverage ratio to evaluate the financial risk (i.e., credit risk, market risk and operational risk) of banks: the average Tier 1 Ratio of the eight U.S. GSIBs increased from 13.55% in the second quarter of 2014 to 14.05% in fourth quarter 2017, and the average GAAP leverage ratio increased from 7% to 8.13%[1]. They argue that these banks are safe as their capital adequacy ratios are above the minimum capital requirements set by Basel III.

---

[1] Based on the FDIC Global Capital Index.

On the other hand, some researchers use market-based measures to evaluate the financial risk of large banks. For example, Sarin and Summers (2016) find that the average credit default swap (CDS) spread of six largest US banks in 2015 increased by nearly three times from its pre-crisis level, indicating that the credit risk of these banks increases even though these banks have increased their capital after the crisis. Moreover, Clearing House (2016) and Sarin and Summers (2016) find that the price-to-book ratios (PB ratios) of these banks declined significantly from the pre-crisis period. In addition, Clearing House (2016: 7) suggests that "the decline in the market value of banks' equity is in large part driven by regulatory changes in the post-crisis period". It seems that there is a puzzle in the literature: If banks are better capitalized and able to deal with adverse scenarios in the post-crisis period, the market should have a higher valuation of them and demand a lower price for credit risk insurance; however, the market valuation of banks is much lower and the CDS spreads are much higher.

To analyse this puzzle, this paper reviews the relevant literature to find the weaknesses in these findings and develops methodologies to deal with these weaknesses. One new method used in the paper is to break down the market valuation of book value, earnings and risk-weighted assets (RWAs) into their drivers respectively. In addition, to minimize the pro-cyclicality of different measures, a relative PB ratio and a relative price to earnings ratio (PE ratio) are used to control for the effect of the broad market on bank risk, and a relative return on equity (ROE) (which is defined as Earnings/Equity) is used to control for the effect of the general economy on banks' ROE. As a result, the impact of Basel III on bank risk can be estimated more accurately.

Then the paper investigates the relationships among three measures which are used to examine the change in bank risk from the pre-crisis period to the Basel III period during which Basel III comes into effect. Stock market measures are used to examine the risk perceived by the stock market. Then accounting-based measures and risk-based measures are used to analyse what factors drive the changes in the risk perceived by the market during the sample period. The paper investigates all the eight U.S. GSIBs because they have survived the GFC and have a significant impact on the global financial stability (Song, 2020).

The first finding of the paper is that it is important to separate the bank risk perceived by the market into systematic risk of equity (hereafter, systematic risk) based on an asset pricing model (e.g., the most popular one being the capital asset pricing model (CAPM) (Palepu et al., 2022; Penman, 2010)) and financial risk. With this classification of bank risk, investors, creditors and regulators can have a clear idea of the market perception of different types of bank risk.

The paper also finds that, although U.S. GSIBs are perceived to be more risky in terms of systematic risk by the market in the period immediately after the GFC than in the pre-crisis period, Basel III has reduced the systematic risk of them and they are perceived by the market to be less risky even though they have increased RWAs significantly in the Basel III period. Although the decline in ROE explains the significant decline in the PB ratios which may indicate some increase in bank financial risk, the decline in ROE cannot be explained by the Basel III regulation. In fact, the ROE of sample banks increases in the Basel III period relative to that in the period immediately after the GFC after controlling for the effect of the general economy. However, due to the decline in relative ROE, the stock market performance

of sample banks relative to other sectors is worse in the Basel III period than in the pre-crisis period, and this indicates that the market perceives large banks perform worse than other sectors.

The main contribution of the paper is a detailed analysis of stock market measures used to evaluate the effect of the Basel III capital regulation on large bank risk. The new evidence provided by these measures solves the puzzle in the literature which seems to indicate that high capital levels increase bank risk. In addition, the paper finds that relative to other sectors, large banks are perceived to have more systematic risk by the market in the Basel III period than in the post-crisis period although they perform better in most of the measures. This indicates that the cost for large banks to raise equity may increase relative to other sectors in the future.

The remainder of the paper is as follows. Section 2 reviews the recent literature. Section 3 describes the data sources and research methodologies. Section 4 presents and analyses the results. Section 5 concludes.

2. Literature review

There is some literature arguing that the banking system is much safer now. The main reason is that the largest banks have increased their capital adequacy ratios since the GFC as required by Basel III. For example, Yellen (2017: 11) finds that "If the largest banks are defined as either the eight U.S. global systemically important banks or the U.S. bank holding companies that participated in the CCAR in 2017 (and for which data are available for

2009:Q1), Tier 1 common equity has more than doubled in dollar terms and relative to risk-weighted assets from the first quarter of 2009 to the most recent observations", and the market assigns a low probability to the distress of a large U.S. banking firm as indicated by CDS spreads. She also points out that in recent years, market values of equity lie in the range of book estimates of equity (Yellen, 2017).

The main weakness of this argument is that there are serious flaws with capital requirements (e.g. Johnson and Kwak (2010) and Konczal (2017)). This is because it is difficult to determine the appropriate levels of capital adequacy ratios (Johnson and Kwak, 2010), e.g., Calomiris and Nissim (2014) argue that book value of equity ignores the future cash flows that are expected to be generated by intangible assets and liabilities. In addition, the reported capital ratios can be manipulated by banks (Johnson and Kwak, 2010; Konczal, 2017).

Moreover, capital adequacy ratios are affected by the pro-cyclicality of regulatory capital and risk-weighting (e.g. FSA (2009), Song (2014) and Konczal (2017)). For example, Song (2014) documents that the Basel III regulatory capital of six U.S. GSIBs has significant positive correlation with U.S. GDP growth rate and significant negative correlation with long-term interest rates. As a result, the current high capital adequacy ratios of U.S. GSIBs could be lifted by the recent U.S. economic growth and low long-term interest rates, and these ratios probably do not reflect these banks' true solvency risk in the long run.

Due to these flaws of the Basel III capital standards, it is possible that the stock market has a different perception of the risk of large banks. And some academic papers do provide evidence supporting this view. For example, Sarin and Summers (2016: 60) find that the

average PB ratio of six U.S. GSIBs declined from 2.09 in the pre-crisis period to 0.94 in the post-crisis period, and they conclude that major banks are more vulnerable in the post-crisis period as "the proportional loss on assets sufficient to cause insolvency has decreased". And Clearing House (2016) argues that such decline in market value of equity will increase bank equity risk as it is more expensive to raise bank capital.

Moreover, some researchers find that regulatory changes are in large part responsible for such decline in the market value of equity (e.g., Clearing House (2016) and Sarin and Summers (2016)). For example, Clearing House (2016) argues that most of the decline in the PB ratio arises from the decline in ROE which is caused by reductions in leverage and fee income from securitization, and these reductions are due to the significant increase in the capital requirements as well as the risk-weights for securitization exposures under the Basel III capital regulation. Cecchetti (2014) also documents that the increase in capital as required by Basel III has a significantly negative impact on bank profitability in terms of pre-tax profits as a fraction of total assets.

However, there is also some literature which points out serious weaknesses of market measures. For example, FSA (2009) finds that market prices such as CDS prices and stock prices are pro-cyclical and sometimes irrational, and they systematically underestimate risks in the upswing and overstate risks in the downswing. Moreover, it is not appropriate to measure the change in credit risk by comparing the CDS spreads of large banks after the crisis directly to those before the crisis because large banks are much less likely to be bailed out after the crisis (Sarin and Summers, 2016). Yellen (2017) also finds that market-based indicators did not reflect true risks in the mid-2000s and argues that they should not be

overemphasized. She points out that the assessment of Sarin and Summers (2016: 12) "may understate the improvement in fundamental risk within the banking sector, as it takes the elevated valuations and low assessment of default risk implied by market prices during the earlier period as indicative of fundamentals".

Furthermore, there are still some important questions on stock market measures of GSIBs which have not been addressed in the literature. First, is the decline in PB ratio specific to GSIBs? Both Clearing House (2016) and Sarin and Summers (2016) compare the PB ratio in the post-crisis period with that in the pre-crisis period, but they do not report whether the change also occurs in other sectors. Calomiris and Nissim (2014) do not control for the effect of the broad market either. However, this is important because if this happens in other sectors at the same time, it suggests that the decline in the banking sector could be pro-cyclical and affected by the broad market. In fact, in the 1970s, the PB ratios of S&P500 were less than 1 (Penman, 2010).

Second, is the decline in PB ratio indicating that bank risk is increasing? Calomiris and Nissim (2014) find that since the crisis, the increase in the ratio of tangible common equity to total assets is associated with high PB ratios. It necessary to decide what causes the decline in PB ratio, i.e., the increase in discount rate or the decrease in earnings[2]. The increase in discount rate indicates that the risk is increasing whereas the decrease in earnings may indicate that the growth rate of earnings is declining as perceived by the market (Penman, 2010). But the change in discount rate represents the change in the systematic risk which is different from financial risk.

---

[2] Calomiris and Nissim (2014) acknowledge this issue but do not offer any views.

Third, is the decline in ROE indicating that bank risk is increasing? ROE is indeed a factor which has significant impact on financial risk (Palepu et al., 2022). It is argued that the decrease in the ROE of GSIBs is the main reason for the decline in PB ratios of these banks (e.g. Clearing House (2016)). However, the decline in ROE does not indicate that financial risk is increasing as it is argued that the high ROE of large banks in the pre-crisis period was generated by their unsustainable high risk-taking activities and the implicit too-big-to-fail subsidy from the state (Haldane, 2012).

Finally, what is the impact of RWAs on the market value? Sarin and Summers (2016) document that the stock price to risk-weighted assets ratio (price/RWAs) declines in the post-crisis period. It is necessary to find whether this decline is due to the increase in RWAs or the decrease in stock price. If it is due to the increase in RWAs, then this is not in line with the argument that Basel III has reduced the risk-taking activities which has reduced the income of banks as suggested by Clearing House (2016).

To sum up, it is hard to conclude from the literature whether the largest banks are less risky since the implementation of Basel III because of the weaknesses of current risk measures. The paper contributes to this literature by improving stock market measures and providing new evidence on this question through case studies of U.S. GSIBs.

3. Data and methodology

3.1 Sample and data

The paper investigates the eight U.S. GSIBs. These banks are JPMorgan Chase (JPM), Bank of America (BAC), Citigroup (C), Goldman Sachs (GS), Wells Fargo (WFC), State Street (STT), Morgan Stanley (MS), and Bank of New York Mellon (BK). They are selected for the case study because of several considerations. First, their failure could impact the world financial system because of their size, interconnectedness, substitutability, cross-jurisdictional activity, and complexity (Haubrich and DeKoning (2017), Koutmos (2019)). Second, GSIBs are very different from other banks and it is important to evaluate them separately (Song, 2014). Third, the results of this case study can be compared with those in the literature and as a result contribute to the debate in the literature.

The sample period of this case study is from 2005 to 2017. This period is investigated because Basel III was implemented during the period so its impact on bank risk could be significant, and the results of the period since the GFC can be compared to those of the period before the GFC[3]. Most of the data for sample banks are hand-collected from the annual reports of U.S. GSIBs with only some data of stock prices being collected from the website of Yahoo Finance. The data of U.S. GDP annual growth rate are collected from the website of bea.gov. The PB ratio of S&P500 in 2017 is collected from the website of Morningstar.com, and the PB and PE ratio of S&P500 in other years are collected from the website of

---

[3] 2018 is not included in the sample period because the Tax Cuts and Jobs Act of 2017 went into effect on January 1, 2018, and 2019 to 2021 is not included in the sample period because of the Covid-19 pandemic. It is difficult to control for their impacts on different bank risk measures.

Multpl.com. It is worth noting that Goldman Sachs and Morgan Stanley were approved as BHCs at the end of 2008 and they did not report RWAs until 2008.

3.2 Methodology

To evaluate bank risk perceived by the market, the paper will examine the stock market measures in detail. The CDS spreads of the sample will not be investigated due to the weaknesses of CDS prices in measuring credit risk discussed above, and it is documented that credit pricing information flows from stocks to CDS (Hilscher et al. (2015), Lee et al. (2018)). To address the weaknesses of stock market measures and assess the full effect of Basel III, the paper breaks down these measures into drivers which capture systematic risk and other ones which capture financial risk, and investigates the most relevant risk measures using the following methodology.

First, in terms of stock market measures, the paper examines the changes in PE ratio and ROE to assess to what extent the change in PB ratio reflects the change in different types of bank risk perceived by the market. This is based on formula (1). The change in PE ratio can show the change in systematic risk perceived by the market based on Formula (2). If the dividend payout ratio is assumed to be 100% and the growth rate of earnings per share (EPS) is assumed to be G, then PE ratio can be estimated using formula (2) based on the dividend growth model.

PB ratio = PE Ratio * ROE   (1)

PE ratio = (1 + G)/(Required rate of return for equity – G)   (2)

Formula (2) suggests that the change in PE ratio can be caused by G and required rate of return for equity[4]. Required rate of return for equity captures the systematic risk that the market perceives of the firm, which reflects the sensitivity of bank earnings to the movements of the broad market (Palepu et al., 2022). As a result, decreases in earnings do not always indicate that a higher systematic risk will be perceived by the market. For example, when EPS decreases and the stock price remains the same or increases, the PE ratio will increase, and this indicates a lower required rate of return for equity. Therefore, the PE ratio will be used as the main systematic risk indicator which is separated from ROE which will be used as financial risk measure (Palepu et al., 2022). In this way, it is more accurate to determine to what extent the change in PB ratio is due to the changes in financial risk and systematic risk respectively.

Second, in terms of accounting-based risk measures, the paper will use the Equity/Total Assets ratio as a main financial risk indicator. This is because this ratio is very close to the leverage ratio in Basel III and it is used by the market and literature as an important relevant measure of bank capital adequacy and credit risk (Song, 2020; Palepu et al., 2022). Although ROE will be used as a bank financial risk measure, it is worth noting that low ROE does not necessarily mean high risk if it is due to high Equity/Total Assets ratio (Song, 2022).

---

[4] Based on the formula (2), it is not necessary to use forecasted earnings in the next period when calculating PE ratio if G can be forecasted. To estimate G, this paper examines the averages of earnings per share and GDP growth rates in different sample periods.

Third, in terms of risk-based measures, this paper will examine the Total Assets/ RWAs ratio, which is the inverse of RWA density ratio, as the main bank risk indicator. This is because based on formula (3), the drivers of the market valuation of RWAs (Price/RWAs ratio) are PB ratio, Equity/Total Assets ratio and Total Assets/ RWAs ratio. The Total Assets/ RWAs ratio captures the riskiness of total assets. If this ratio increases, i.e., RWA density ratio, decreases, banks are taking less risks, then the market valuation of RWAs increases.

In addition, the paper will examine the Return on RWAs ratio (which is defined as Earnings/RWAs) as a risk-based financial risk indicator based on formula (4). If the Return on RWAs ratio increases, then the market valuation of GSIBs will increase. But this ratio has similar weaknesses as ROE ratio discussed above.

Price/RWAs ratio = PB ratio* (Equity/Total Assets)*(Total Assets/ RWAs)   (3)

Price/RWAs ratio = PE ratio* Return on RWAs   (4)

Fourth, to control for the impact of other sectors, relative PB ratio, relative PE ratio and relative ROE ratio are computed using the following methods.

The PB ratio of GSIBs is compared to that of S&P500 index. The relative performance of GSIBs is measured using formula (5). In this way, it can be shown whether the decline in PB ratio is specific to GSIBs or pro-cyclical. If the relative PB ratio declines over the sample period, then it suggests that the market valuation of GSIBs relative to other sectors is deteriorating.

The relative PB ratio = the PB ratio of GSIBs / the PB ratio of S&P500 Index   (5)

The PE ratio will also be compared to that of S&P500 index using formula (6), as this can be used to investigate whether the change in PE ratio is specific to GSIBs or pro-cyclical. If the relative PE ratio declines, then it indicates that the market perception of GSIBs' risk is increasing relative to other sectors (Rajan, 2005).

The relative PE ratio = the PE ratio of GSIBs / the PE ratio of S&P500 Index   (6)

As the change in ROE is also affected by business cycles, the ROE of S&P500 Index is used to control for this impact. Formula (7) is used to compute the relative ROE which can show whether the change in banks' ROE is mainly caused by factors specific to the banking sector. If the relative ROE decreases, it indicates that banks perform worse than the general economy.

The relative ROE = the average ROE of GSIBs / the average ROE of S&P500 Index   (7)

Fifth, three GSIBs (i.e. GS, JPM and WFC) which have remained profitable during the sample period will be investigated individually. This is because other banks reported loss during the sample period and this makes it difficult to examine their earnings-related measures such ROE and PE ratio.

Finally, to assess the impact of Basel III, the sample period is divided into four sub-periods. To determine the sub-period in which Basel III has full effect, it is important to find the dates

when U.S. GSIBs actually started to meet Basel III's capital requirements. Most large banks increased their common equity Tier 1 capital significantly by the end of 2009 and met the requirements of Basel III by the end of 2013 (Cecchetti, 2014). But for U.S. GSIBs, Basel 2.5 rules became effective on January 1, 2013 and Basel III became effective in 2014. So the paper uses the period from 2014 to 2017 as the Basel III period.

The paper uses the period 2005 to 2007 as the pre-crisis period. This is because most of the sample banks were performing well before 2008, and the National Bureau of Economic Research (NBER) states that the Great Recession in the US officially began in December 2007. But there are some differences in the literature on the definition of the pre-crisis period. For example, Clearing House (2016) uses the period from 2005 to 2006. However, Sarin and Summers (2016) and Cecchetti (2014) include 2007.

The paper defines the period from 2008 to 2010 as the crisis period for U.S. GSIBs. This is because five sample banks were in difficulty during the period although the Great Recession officially ended in June 2009 according to the NBER. The period from 2011 to 2013 is defined as the post-crisis period. This period suffers less from the bias due to procyclicality and government support, therefore, comparing the Basel III period with this period can provide a relatively unbiased view of bank risk perceived by the market in the Basel III period.

4. Results

In this section, stock market measures are examined to report the market perception of bank systematic risk and financial risk. Accounting-based measures and risk-based measures are investigated to report how GSIBs take risks in operations and their financial risks.

4.1 Stock market measures: Bank systematic risk decreases in the Basel III period than in other periods

4.1.1 PB ratio

The results of the average PB ratio for U.S. GSIBs show a much worse picture than those in the literature. Both the Basel III period and the post-crisis period perform worse than the pre-crisis period in terms of both PB ratio and relative PB ratio (see Table 1). This indicates that the stock market valuation of U.S. GSIBs has not changed for better since the crisis period, and it is much worse than that of other sectors. However, the average PB ratio for U.S. GSIBs increases to 1.25 during the Basel III period which is better than the crisis period and the post-crisis period, and the Basel III period is also better than the post-crisis period in terms of relative PB ratio.

(Insert Table 1 here)

These overall findings are in line with those for the three GSIBs which have remained profitable during the sample period. Only WFC in the Basel III period performs slightly worse than the post-crisis period in terms of relative PB ratio.

4.1.2 Price/RWAs

The results for the average of price/RWAs of U.S. GSIBs are, in general, in line with those of the PB ratio (see Table 1)[5]. This suggests that PB ratios explain the changes in price/RWAs based on formula (6). All three profitable banks in the Basel III period perform better than the post-crisis period.

4.1.3 PE ratio

Although the average PE ratio in the post-crisis period is slightly worse than the pre-crisis period, it increases in the Basel III period and is slightly greater than all periods before (see Table 2)[6]. This increase is due to the increase in average stock price and the decline in average earnings or the increase in stock price is much greater than the increase in average earnings (see Table 3), which suggests that the systematic risk perceived by the market is decreasing based on formula (3) as G is decreasing or remains stable due to the much lower US GDP growth rate after the GFC than before the GFC (see Table 2). Based on formula (2) and formula (7), PE ratio cannot explain the change in the PB ratio and Price/RWAs respectively. This suggests that the change in PB ratio and Price/RWAs should be caused by the change in the ROE and return on RWAs.

---

[5] However, this result is qualified because of the change in Basel III's methodology for calculating RWAs.

[6] It is worth noting that the results for the PE ratio of the crisis period are not a good measure for bank risks. This is because only three sample banks did not report losses during this period.

The results of relative PE ratio are very different from those of PE ratio. They show some declines and explain a small portion of the decline in relative PB ratio. This finding is slightly worse than that of Sarin and Summers (2016). The relative PE ratio in the Basel III period is less than that in the pre-crisis period and the post-crisis period. This suggests that the market discounts other sectors' earnings at a much lower rate which could suggest that other sectors are doing much better than the banking sector.

(Insert Table 2 here)

(Insert Table 3 here)

The three GSIBs which have remained profitable during the sample period have different results. The PE ratios of JPM and WFC in the Basel III period are better than those in the post-crisis period and the pre-crisis period. However, they are much worse than those in the crisis period because the increase in stock price is less than that in EPS. And the relative PE ratios of JPM and WFC in the post-crisis period and Basel III period are worse than those in the crisis period and the pre-crisis period. These results suggest that JPM and WFC are riskier now than in the crisis period. But there are important qualifications in interpreting these findings because they could be due to the unprecedented support for large banks from US government and US Federal Reserve during the crisis period (Song (2020)), and JPM and WFC have the lowest EPS in this period[7]. However, both the PE ratio and relative PE ratio

---

[7] One more explanation could be that JPM and WFC engaged in large takeovers during the crisis period whereas GS did not (Song (2022)).

of GS in the post-crisis period and the Basel III period are much better than those in the crisis period and the pre-crisis period because its stock price increases more than the change in EPS.

4.2 Accounting-based measures: Bank capital adequacy increases in the Basel III period than in other periods

4.2.1 ROE

The average ROE of U.S. GSIBs in the Basel III period is much worse than in the pre-crisis period and slightly worse than in the crisis period. It is about half that in the pre-crisis period for the eight GSIBs (see Table 4). Therefore, the decline in profitability is the cause of the much lower PB ratio in the Basel III period and the post-crisis period than in the pre-crisis period, and this is in line with the findings in the literature. Although the results for the relative ROE are slightly better, they show a similar picture to that of ROE. The changes in ROE do not suggest that bank financial risk is increasing in the Basel III period because it is estimated that the average annual too-big-to-fail subsidy from the state to the world's GSIBs is about 50% of these banks' average post-tax profits over the period 2002 to 2007 (Haldane, 2012), and such subsidy has started to decline from 2011 because the investors' expectations of government support have declined over time (GAO, 2014), and the annual living wills submitted by the eight U.S. GSIBs to solve the too-big-to-fail problem have made significant progress in recent years (FED and FDIC, 2017). In addition, such changes of ROE could be

partly due to the increase of the Equity/Total Assets ratio during the period (e.g., Clearing House (2016)), which will be discussed in detail in the next section.

Moreover, the average ROE of U.S. GSIBs in the Basel III period is performing much better than that in the post-crisis period, and the corresponding relative ROE performs even better. This indicates that Basel III improves the profitability of GSIBs after controlling for the effect of the general economy. It seems that the negative effect of the Basel III regulation on banks' profitability is overestimated by the literature which ignores the impact of overall economy.

(Insert Table 4 here)

The performance of the three profitable GSIBs is similar to the average of the eight GSIBs. In the Basel III period, although WFC's ROE is slightly worse than that in the post-crisis period, the relative ROE of JPM is better than that of the pre-crisis period. This indicates that in the Basel III period, banks can achieve a relative ROE as high as one in the pre-crisis period.

4.2.2 Equity/Total Assets

The equity/total assets ratio shows that U.S. GSIBs have been increasing their equity over the sample period, indicating that bank capital adequacy has increased based on accounting measures. The average equity/total assets ratio of the sample banks is over 10% in the Basel III period which is 44.79% higher than the pre-crisis period and 5.86% higher than the post-crisis period (see Table 4), and this suggests that the change in equity/total assets cannot explain the change in price/RWAs during the same period.

However, the changes in equity/total assets of the three profitable GSIBs are very different. GS increases its equity/total assets from the pre-crisis period to the Basel III period by nearly 141% whereas JPM and WFC increase their ratios by around 17% and 22% respectively. This finding suggests that the highest increase in equity/total assets of GS may have contributed to the highest increase in the PE ratio among the three banks during the sample period because low leverage decreases the systematic risk of equity (Palepu et al., 2022). In addition, the change in equity/total assets of JPM in the Basel III period relative to other periods is in line with the change in its price/RWAs. Therefore, the increase in equity/total assets reduces the financial risk perceived by the market, and this is in line with Calomiris and Nissim (2014).

Although it is argued that Basel III decreases banks' ROE in part because of the increase in equity/total assets, it seems that the change in equity/total assets does not have a dominant impact on banks' ROE. This is because when the Basel III period is compared to the post-crisis period, the increase in equity/total assets is associated with the increase in both ROE and relative ROE for the sample, and this finding is in line with Clearing House (2016).

4.3 Risk-based measures: Bank risk-taking activities decreases in the Basel III period than in the pre-crisis period

4.3.1 Total assets/RWAs

On the assets side, bank risks come from RWAs. Although total assets/RWAs for U.S. GSIBs increased in the post-crisis period, it declines in the Basel III period (see Table 5). RWAs have been increasing since the crisis period and the Basel III period has the fastest growth

rate, and this is in line with the fact that the average of total assets of U.S. GSIBs has been increasing as well. This suggests that U.S. GSIBs are taking more risks in the Basel III period than they did in the crisis period and the post-crisis period. Basel III does not reduce large banks' risk-taking activities.

However, the total assets/RWAs of the Basel III period is greater than that of the pre-crisis period, therefore, banks' risk-taking activities are relatively less than the pre-crisis period. This finding is also applicable to the three profitable banks.

(Insert Table 5 here)

It seems that the risk measured by the total assets/RWAs does not explain price/RWAs. For example, JPM has higher total assets/RWAs than WFC during the sample period, but it has lower price/RWAs than WFC. This is not in line with the finding in the literature that less RWAs imply higher stock returns (e.g. Das and Sy, 2012).

4.3.2 Return on RWAs

Return on RWAs shows that, on average, the profitability of U.S. GSIBs remains relatively stable since the crisis period, and it is much less than the return of the pre-crisis period. The Basel III period is slightly worse than the post-crisis period. This suggests that these banks' profitability is still very weak and there is no decrease in financial risk. It explains why price/RWAs is declining in the Basel III period and the post-crisis period relative to the pre-crisis period.

However, the three profitable banks perform very differently (see Table 5). In the Basel III period, JPM performs much better than other periods, and WFC performs also much better than the crisis period and slightly better than the post-crisis period but not as good as the pre-crisis period. But GS performs much worse than the crisis period and the post-crisis period. Overall, it is difficult to generalize that Basel III has decreased bank profitability and increased bank financial risk based on this measure.

5. Conclusions

Overall, the paper finds that U.S. GSIBs are much safer in the Basel III period than in other periods as perceived by the stock market. This finding accords with the significant decrease of the CDS spreads of six largest US banks since the European debt crisis in 2011- 2013 as documented by Sarin and Summers (2016) and Koutmos (2019). The paper also finds that U.S. GSIBs are more risky in the post-crisis period than in the pre-crisis period which is in line with the findings in the literature.

The paper reports that stock market measures show different results which suggests that changes in the stock price of GSIBs cannot show the real picture of bank risk. Although PB ratios and price/RWAs decline in the Basel III period relative to those in the pre-crisis period, PE ratios increase. This suggests that the direction of systematic risk may be different from that of financial risk. Indeed, the change in PE ratio arises from the increase in stock price being more than the change in earnings, and this indicates that the market perceives that

GSIBs have less systematic risk although financial risk may have increased as indicated by ROE and Return on RWAs.

There are several reasons why U.S. GSIBs are less risky in terms of systematic risk in the Basel III period than in other periods. First, bank capital adequacy in terms of equity as a fraction of total assets increases significantly in the Basel III period relative to those ratios in the pre-crisis period and the crisis period. Second, RWAs as a fraction of total assets (RWA density ratio) decline significantly in the Basel III period relative to the pre-crisis period although they increase slightly from the crisis period.

Moreover, although financial risk may have increased in the Basel III period than in other periods, such change is not specific to banks. The paper finds that the decline in the average ROE of U.S. GSIBs is the main cause of the decline in PB ratio in the Basel III period relative to that in the pre-crisis period, one cause of this decline in banks' ROE being due to the change in the ROE of the broad economy as documented by the relative ROE, and this indicates that such increase in financial risk is general in the economy. The fact that both ROE and relative ROE increase in the Basel III period relative to those in the post-crisis period indicates that Basel III does not decrease the profitability of U.S. GSIBs. Price/RWAs shows a similar pattern. Its significant decline in the Basel III period relative to the pre-crisis period is due to a rapid increase in RWAs and a significant decline on Return on RWAs. However, not all banks' Return on RWAs declines, and this indicates again that Basel III does not reduce the profitability or the risk-taking activities of U.S. GSIBs. This finding is in line with that of the largest US bank holding companies documented by Hirtle et al. (2020) and that of the largest European banks by Adelopo et al. (2022).

However, when the relative measures of PB ratio, PE ratio and ROE are examined, the Basel III period performs worse than the pre-crisis period after controlling for the effect of pro-cyclicality. But the decline in relative ROE explains much of the decline in relative PB ratio, and the decline in relative PE ratio is small. This indicates that the worse stock market performance of GSIBs relative to other sectors is mainly caused by earnings rather than systematic risk. However, when the Basel III period is compared to the post-crisis period, all measures increase except for the relative PE ratio, indicating that large banks are less risky in terms of financial risk but still more risky in terms of systematic risk than other sectors, suggesting that the cost of equity for GSIBs can be relatively higher than other sectors in the long run.

To sum up, the paper finds that the puzzle in the literature on large bank risk disappears when the market perception of bank risk based on stock market measures is split into systematic risk and financial risk. Large banks are less risky due to higher equity/total assets rather than higher earnings growth rate in the Basel III period. Moreover, there is no evidence that Basel III reduces banks' profitability and risk-taking activities. Overall, Basel III is effective in enhancing the safety of large banks which, however, still show a weak performance relative to other sectors.

References:

Adelopo, I., Vichou, N. and Cheung, K.Y. (2022). Capital, liquidity, and profitability in European banks. Journal of Corporate Accounting & Finance. Volume 33 (1): 23-35.

Cecchetti, S. G. (2014). "The Jury is In", CEPR Policy Insight 76, December.

Calomiris, C. W. and Nissim, D. (2014). Crisis-related shifts in the market valuation of banking activities. Journal of Financial Intermediation, vol. 23(3): 400-435.

Clearing House. (2016). "Why Have Banks' Market-to-Book Ratios Declined?" Research Note, November 1. New York, https://www.theclearinghouse.org/issues/articles/2016/11/20161110l_tch_research_note_market-to_book_ratios.

Cox, J. (2017). Yellen: Banks 'very much stronger'; another financial crisis not likely 'in our lifetime'. Avaliable at https://www.cnbc.com/2017/06/27/yellen-banks-very-much-stronger-another-financial-crisis-not-likely-in-our-lifetime.html.

Das, S. and Sy, A. N. R. (2012). How risky are banks' risk weighted assets? Evidence from the financial crisis. IMF working paper, WP/12/36.

FED (Board of Governors of the Federal Reserve System) and FDIC (Federal Deposit Insurance Corporation). (2017). Agencies announce joint determinations for living wills. Joint Press Release, December 19.

FSA (Financial Services Authority). (2009). The Turner review: A regulatory response to the global banking crisis. March. Available at: http://www.fsa.gov.uk/pubs/other/turner_review.pdf.

GAO (Government Accountability Office). (2014). Large Bank Holding Companies – Expectations of Government Support, GAO14-621, July: 40-55.

Haldane, A. G. (2012). "On Being the Right Size," speech given at the Beesley Lectures, Institute for Economic Affairs, London, October 25, 2012.

Haubrich, J. and DeKoning, C. (2017). Sizing Up Systemic Risk Federal Reserve Bank of Cleveland Economic Commentary, August 23, 2017.

Hilscher, J. , Pollet, J.M. , Wilson, M. (2015). Are credit default swaps a sideshow? Evidence that information flows from equity to CDS markets. Journal of Financial and Quantitative Analysis 50: 543–567.

Hirtle, B., Kovner, A., and Plosser, M. (2020). The Impact of Supervision on Bank Performance. Journal of Finance, 75, 2765–808.

Johnson, S., and Kwak, J. (2010). "Capital Requirements Are Not Enough." Economix blog. New York Times, April 1.

Konczal, M. (2017). Why Banking Leverage Requirements Are Not Enough. Available at: http://rooseveltinstitute.org/why_we_need_both_capital_requirements/.

Koutmos, D. (2019). Asset pricing factors and bank CDS spreads. Journal of International Financial Markets, Institutions and Money, 58: 19-41.

Lee, J., Naranjo, A. and Velioglu, G. (2018). When do CDS spreads lead? Rating events, private entities, and firm-specific information flows. Journal of Financial Economics,130 (3): 556-578.

Palepu, K.G., Healy, P.M., and Peek, E. (2022). Business Analysis and Valuation. 6th ed. Cengage Learning EMEA.

Penman, S. H. (2010). Financial Statement Analysis and Security Valuation. 4th ed. McGraw-Hill.

Rajan, R. G. (2005). "Has Financial Development Made the World Riskier?" NBER WORKING PAPER 11728.

Sarin, N., and Summers, L. H. (2016). Understanding Bank Risk through Market Measures. Brookings Papers on Economic Activity, Fall 2016: 57-109.

Song, G., (2022). Large US bank takeovers in 2008: performance and implications. Journal of Capital Markets Studies. Vol. 6 (1): 33-47.

Song, G. (2020). The role of fair-value accounting in the global financial crisis: Evidence from U.S. global systemically important banks. Journal of Banking, Finance & Sustainable Development. 1 (1): 84-103.

Song, G. (2014). The pro-cyclical impact of Basel III regulatory capital on bank capital risk. In: J. A. Batten and N.Wagner, Ed., Risk Management Post Financial Crisis: A Period of Monetary Easing (Contemporary Studies in Economic and Financial Analysis, Volume 96). Emerald Group Publishing Limited, pp.59-81.

Yellen, J. L. (2017). Financial Stability a Decade after the Onset of the Crisis. At "Fostering a Dynamic Global Recovery," a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 25.

Table 1 PB ratios and Price/RWAs for eight U.S. GSIBs during the period 2005 to 2017

		a Pre-crisis period (2005-2007)	b Crisis period (2008-2010)	c Post-crisis period (2011-2013)	d Basel III period (2014-2017)	e (d-a)/a %	f (d-b)/b %	g (d-c)/c %	h (c-a)/a %
PB ratio									
Eight GSIBs	PB	2.15	1.01	0.89	1.25	-41.97	22.98	40.59	-58.72
	Relative PB	0.77	0.48	0.39	0.43	-44.96	-11.35	9.31	-49.65
JPM	PB	1.31	0.97	0.89	1.28	-2.03	32.62	43.98	-31.96
	Relative PB	0.47	0.46	0.39	0.44	-7.36	-4.59	11.27	-16.74
GS	PB	2.54	1.18	0.91	1.24	-51.25	5.02	35.93	-64.13
	Relative PB	0.91	0.55	0.40	0.42	-53.75	-23.73	5.70	-56.24
WFC	PB	2.43	1.52	1.30	1.62	-33.25	7.11	25.14	-46.66
	Relative PB	0.88	0.72	0.57	0.56	-36.33	-22.89	-2.80	-34.49
Price/RWAs									
Eight GSIBs		26.90	15.42	14.95	21.54	-19.93	39.70	44.06	-44.42
JPM		16.04	13.61	13.75	21.32	32.90	56.60	54.99	-14.25

Table 2 PE ratios for eight U.S. GSIBs during the period 2005 to 2017

	a Pre-crisis period	b Crisis period	c Post-crisis period	d Basel III period	e (d-a)/a	f (d-b)/b	g (d-c)/c	h (c-a)/a
GS	NA	19.72	16.15	18.08	NA	-8.31	11.96	NA
WFC	26.19	20.32	19.08	24.96	-4.68	22.84	30.84	-27.15

Source: own calculation

Notes:

The figures reported are the averages for different periods.

Relative PB ratios are calculated using the bank PB ratio as a fraction of the S&P500 PB ratio.

e: Change of the Basel III period relative to the pre-crisis period (%)

f: Change of the Basel III period relative to the crisis period (%)

g: Change of the Basel III period relative to the post-crisis period (%)

h: Change of the post crisis period relative to the pre-crisis period (%)

NA: No. value

..

		(2005-2007)	(2008-2010)	(2011-2013)	(2014-2017)	%	%	%	%
PE ratio									
Eight GSIBs	PE ratios	15.48	16.25	14.36	16.76	8.26	3.11	16.65	-7.19
	Relative PE	0.81	0.59	0.86	0.75	-7.75	26.46	-12.61	5.56
JPM	PE ratios	13.02	17.50	9.79	13.43	3.19	-23.26	-37.19	24.78
	Relative PE	0.70	0.63	0.58	0.59	-15.92	-5.94	1.54	-17.19
GS	PE ratios	10.46	12.69	13.51	17.29	65.40	36.32	27.96	29.26
	Relative PE	0.56	0.47	0.84	0.75	33.47	60.01	-10.73	49.51
WFC	PE ratios	13.68	23.85	10.54	13.79	0.82	-42.17	30.88	-22.97
	Relative PE	0.73	0.73	0.63	0.61	-16.60	-16.83	-3.61	-13.48
U.S. GDP growth rate (%)		5.67	1.17	3.70	3.83	-32.50	227.86	3.38	-34.71

Source: own calculation

Note:

The figures reported are the averages for different periods.

Relative PE ratios are calculated using the bank PE ratio as a fraction of the S&P500 PE ratio.

Only positive PE ratios are used in calculations and the PE ratio of 556 for BOA in 2011 is excluded as an outlier.

e: Change of the Basel III period relative to the pre-crisis period (%)

f: Change of the Basel III period relative to the crisis period (%)

g: Change of the Basel III period relative to the post-crisis period (%)

h: Change of the post crisis period relative to the pre-crisis period (%)

Table 3 Stock price and EPS for eight U.S. GSIBs during the period 2005 to 2017

	a Pre-crisis period (2005-2007)	b Crisis period (2008-2010)	c Post-crisis period (2011-2013)	d Basel III period (2014-2017)	e (d-a)/a %	f (d-b)/b %	g (d-c)/c %	h (c-a)/a %
Stock price								
Eight GSIBs	66.05	41.98	45.65	75.30	14.00	79.39	64.94	-30.88
JPM	43.88	38.54	45.23	80.46	83.36	108.77	77.88	3.08
GS	187.45	138.66	131.75	217.07	15.80	56.54	64.76	-29.72
WFC	32.39	29.15	35.71	56.24	73.63	92.91	57.48	10.26
EPS								
Eight GSIBs	5.29	5.03	3.96	4.93	-6.80	-1.92	24.59	-25.20
JPM	3.56	2.52	4.67	5.95	67.06	135.70	27.36	31.18
GS	18.54	13.26	11.37	13.63	-26.51	2.77	19.89	-38.70
WFC	2.37	1.55	3.36	4.08	72.29	162.50	21.47	41.83

Source: own calculation
Note:
The figures reported are the averages for different periods. Only positive earnings per share (EPS) is used in calculations.

e: Change of the Basel III period relative to the pre-crisis period (%)

f: Change of the Basel III period relative to the crisis period (%)

g: Change of the Basel III period relative to the post-crisis period (%)

h: Change of the post crisis period relative to the pre-crisis period (%)

Table 4 ROE and Equity/Total Assets for eight U.S. GSIBs during the period 2005 to 2017

		a Pre-crisis period (2005-2007)	b Crisis period (2008-2010)	c Post-crisis period (2011-2013)	d Basel III period (2014-2017)	e (d-a)/a %	f (d-b)/b %	g (d-c)/c %	h (c-a)/a %
ROE (%)									
Eight GSIBs	ROE	15.79	8.41	7.29	8.25	-47.76	-1.91	13.20	-53.85
	Relative ROE	1.07	0.95	0.54	0.64	-40.20	-32.65	-18.46	-49.52
JPM	ROE	10.48	6.20	9.31	9.57	-8.69	54.35	2.80	-11.17
	Relative ROE	0.71	0.70	0.69	0.74	4.51	5.98	7.58	-2.85
GS	ROE	24.71	11.20	7.79	7.87	-68.15	-29.76	1.02	-68.47
	Relative ROE	1.67	1.26	0.58	0.61	-63.55	-51.77	5.73	-65.52
WFC	ROE	17.75	7.63	12.27	11.81	-33.47	54.68	-3.74	-30.88
	Relative ROE	1.20	0.86	0.91	0.91	-23.85	6.21	0.74	-24.41
Equity/Total Assets (%)									
Eight GSIBs		7.13	9.11	9.75	10.32	44.79	13.25	5.86	36.78
JPM		8.47	8.03	8.50	9.93	17.25	23.58	16.79	0.39
GS		4.02	8.03	8.10	9.67	140.69	20.41	19.36	101.65
WFC		8.92	9.46	11.10	10.90	22.27	15.21	-1.75	24.45

Source: own calculation

Note:

The figures reported are the averages for different periods. Only positive return on equity (ROE) is used in calculatio

The relative ROE is calculated using the average ROE of GSIBs / the average ROE of S&P500 Index.

e: Change of the Basel III period relative to the pre-crisis period (%)

f: Change of the Basel III period relative to the crisis period (%)

g: Change of the Basel III period relative to the post-crisis period (%)

h: Change of the post crisis period relative to the pre-crisis period (%)

Table 5 Total Assets/RWAs, RWAs, Total assets and Return on RWAs for eight U.S. GSIBs during the period 2005 to 2017

	a Pre-crisis period (2005-2007)	b Crisis period (2008-2010)	c Post-crisis period (2011-2013)	d Basel III period (2014-2017)	e (d-a)/a %	f (d-b)/b %	g (d-c)/c %	h (c-a)/a %
Total Assets/RWAs (%)								
Eight GSIBs	1.57	1.97	2.13	1.79	14.35	-8.69	-15.63	35.53
JPM	1.45	1.75	1.82	1.66	14.72	-5.21	-8.77	25.75
GS	NA	2.08	2.16	1.51	NA	-27.05	-29.79	NA
WFC	1.21	1.23	1.32	1.41	16.98	14.37	6.81	9.53
RWAs ($millions)								
Eight GSIBs	606,717	700,724	703,526	837,923	38.11	19.58	19.10	15.96
JPM	946,934	1,205,670	1,293,146	1,502,085	58.63	24.59	16.16	36.56
GS	NA	425,519	430,060	578,904	NA	36.05	34.61	NA
WFC	426,249	1,031,868	1,074,733	1,303,859	205.89	26.36	21.32	152.14

Total assets ($millions)

					e	f	g	h
Eight GSIBs	923589.75	1179222.00	1261215.00	1327355.06	43.72	12.56	5.24	36.56
JPM	1370869.67	2108215.33	2346331.33	2487136.00	81.43	17.97	6.00	71.16
GS	888267.00	881607.00	924184.67	875850.50	-1.40	-0.65	-5.23	-4.04
WFC	513059.67	1270471.00	1419705.00	1839164.75	258.47	44.76	29.55	176.71

Return/RWAs (%)

					e	f	g	h
Eight GSIBs	1.79	1.50	1.51	1.49	-16.60	-0.59	-0.97	-15.78
JPM	1.28	0.89	1.44	1.58	23.48	78.03	9.52	12.75
GS	NA	1.87	1.41	1.16	NA	-37.76	-17.44	NA
WFC	1.91	1.02	1.80	1.81	-5.07	77.35	0.68	-5.71

Source: own calculation

Note:

The figures reported are the averages for different periods. Only positive return on RWAs is used in calculations.

NA: No value

e: Change of the Basel III period relative to the pre-crisis period (%)

f: Change of the Basel III period relative to the crisis period (%)

g: Change of the Basel III period relative to the post-crisis period (%)

h: Change of the post crisis period relative to the pre-crisis period (%)