Effects of Basel III Higher Capital and Liquidity Requirements on Banking Sectors across the Main South East Asian Nations*

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ABSTRACT

This paper analyzes the cost impact of the Basel III higher capital and liquidity requirements on bank capital, lending spreads, and steady state output across the main Southeast Asian nations (ASEAN-5). We also investigate potential long-run economic benefit expressed as a gain in steady state output (GDP). By emphasizing the use of dynamic stochastic general equilibrium and vector error correction models, we find that ASEAN-5 banking sectors are comfortably capitalized and need no recapitalization by January 1st 2019 deadline when Basel III is fully enforced. The new Basel III rules are assumed to force ASEAN-5 banks to increase lending spreads to pass down a portion of increasing funding costs to bank customers. The impact of 1 percentage point rise in common equity Tier 1 ratio on lending spreads is analyzed; to meet the regulatory capital minima of 7% as of 2015, ASEAN-5 banks will have to increase lending spreads by 30 basis points on average; to meet 10.5% fully effective by January 2019, ASEAN-5 banks will have to increase average lending spreads by 68 basis points. In terms of economic benefits, the estimates of this study indicate that the projected economic benefits across ASEAN-5 outweigh the economic costs in the long-run.

Keywords: Financial stability; Basel III; ASEAN-5; procyclicality
JEL classification: E44, E61, G21

1. Introduction

Financial turmoil in the 1970s, financial deregulation and privatization of state-owned enterprises in the 1980s, and the fast-paced globalization throughout the 1990s resulted in ever more interconnectedness among internationally active banks. Although these developments and events were perceived as positive, unforeseen risks (i.e. systemic risk) and vulnerabilities to macroeconomic events were unthinkable. The homegrown Asian crisis of 1997-98 unmistakably proved that the systematic assessment of both systemically important banks and banking sectors was imperative. Against the backdrop of increased financial turmoil due to the unprecedented 2008 global financial crisis (GFC), the implementation of the new Basel III rules has become a central focus (Adrian and Shin, 2008). The Basel Committee on Banking Supervision ("Basel Committee") has stressed that the enhanced Basel III capital and liquidity regulations have the objective of strengthening the global banking resilience plus reducing the probability of a financial crisis occurring in the long-run (BCBS, 2010).

Banks are at the epicenter of financial intermediation and there is no perfect substitute for them in the capital markets. To compensate for the higher capital and liquidity requirements imposed by Basel III, banks are assumed to pass a portion of the increasing funding costs to bank customers by raising lending spreads; further, some banks may hoard capital by reducing lending volumes or cut down fixed costs by downsizing. Monetary policy decisions by the central banks in conjunction with precautionary measures taken by banks are argued to cause a contraction in broader economic activity and a decline in the steady state output (Yan et al., 2011). The aim of this paper is to analyze the effects of the Basel III higher capital and liquidity rules on bank capital, lending spreads, and steady state output across banking sectors of the ASEAN-5.[3] Our work is related to empirical studies by Bank for International Settlements (BIS, 2010), Macroeconomic Assessment Group (MAG, 2010), Angelini et al. (2011), Elliott et al. (2012), Slovik and Cournède (2011), and King (2010).

We estimate, in the absence of monetary policy actions by ASEAN-5 central banks, the cost impact of the Basel III higher capital and liquidity requirements on bank capital, lending spreads, and steady state output by means of dynamic stochastic general equilibrium (DSGE) model and vector error correction (VEC) model; second, we assess the economic benefits expressed as a gain in steady state output underpinned by a strict assumption that strengthened banking sectors due to rigorous Basel III capital and liquidity requirements will reduce the probability of a high-magnitude crisis in the future. Because DSGE models have a weakness in quantifying both endogenous risks and defaults, therefore these models are fully or partially calibrated (Angelini et al., 2011). The recorded historical data shows that a banking crisis is infrequent, occurring every 20-25 years with the probability of about 5% (BIS, 2010). During the period of 1985-2009, G-10 countries[4] faced crisis with the probability of 5.2% (e.g. Reinhart and Rogoff, 2009) and 4.1% (e.g. Laeven and Valencia, 2008).

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[3] ASEAN-5 represents the Association of Southeast Asian Nations: Indonesia, Malaysia, Philippines, Singapore, and Thailand.
[4] G-10 refers to the following group of countries: Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, the United Kingdom (UK) and the United States (US). Even though the group consists of 11 countries, the name has remained as G-10.

Our empirical framework is based on solid foundations. MAG (2010) employs a semi-structural VECM model in connection with the vector autoregression (VAR) approach to estimate the log-run relationships among a small sample of macro variables for the U.S. The main advantage of VECM is that it helps unravel the demand and supply curve factors, but the distinct disadvantage of the model is that it does not allow counterfactual experiments. Roger and Vlček (2011) use two versions of DSGE models to assess the macroeconomic impact of the Basel III higher capital and liquidity requirements; one analysis is based on data and parameters for the Euro area and the second one is based on the United States. In both analyses, exogenously determined liquidity is in the form of bank assets held in low-risk government bonds. In other studies, the liquidity requirement is determined endogenously (e.g. Dellas et al., 2010) and Gambacorta (2010) uses liquidity-to-deposit ratio in the VECM model for the U.S.

By building on the approach developed by Slovik and Cournède (2011), we focus on quantifying the impact of Basel III capital requirements on bank capital. We define key components of capital along with its limits and minima, our empirical analysis pays greater focus on common equity Tier 1 capital. A majority of studies since 2010 has analyzed the impact of Basel III standards on banks by way of capital elements. Locarno (2011), Giordana and Schumacher (2012) and Angelini et al. (2011) employ capital adequacy ratio (CAR), liquidity coverage ratio (LCR), net stable funding ratio (NSFR); Slovik and Cournède (2011), Miles at al. (2012), Gauthier et al. (2012) use CAR; Milne (2013), Boissay (2011), Barrell et al. (2010a, b), and Hartlage (2012) use LCR; differently from the rest, Cincotti et al. (2012) and Georg (2011) use countercyclical buffer and global systemically important bank (G-SIB) surcharge respectively; in addition to CAR and LCR, Kato et al. (2011) use countercyclical buffer.

We concentrate here on those papers that have applied related accounting identities, DSGE and VEC models to estimate the impact of Basel III on bank lending spreads. Angelini et al. (2011) measures the long-term economic impact of the Basel III rules on 30 G-SIBs using a DSGE model. MAG (2010) allows banks to improve capital ratios by injecting liquidity, retaining more earnings, reducing/canceling dividend payouts, or cutting operational costs. Locarno (2011) uses a semi structural model to estimate the impact of Basel III on lending spreads across banks in Italy. Similarly, Gerali et al. (2010) applies a DSGE model to estimate the impact of Basel III on lending spreads in Euro area. Albertazzi and Marchetti (2010) investigates if the contraction in credit markets is associated with low levels of bank capitalization that have led to bankruptcies following the fall of Lehman Brothers. Cecioni (2010) and Gambacorta (2010) use a VEC model to analyze the impact of Basel III on lending spreads for U.S. banks. Šútorová and Teplý (2013) employ the simultaneous equations model to analyze the impact of the Basel III higher capital requirements on lending spreads for 594 European banks during the 2006–2011 period.

Several studies investigate the inverse relationship between Basel III higher capital and liquidity requirements and the steady state output. We follow Yan et al. (2011) and Caggiano and Calice (2011) who use a vector error correction (VEC) model. Slovik and Cournède (2011) examine the three main OECD economies using adjusted semi-elasticities of the OECD *New Global Model*. They argue banks holding insufficient capital (both in quantity and quality) will become more prone to crisis, this in turn may cause a shrinkage in GDP growth. Albertazzi and Marchetti (2010) analyze Italy's banking sector during 2007-2009, they find evidence that low bank capitalization leads to a contraction in the credit supply following the collapse of Lehman Brothers. Elliott et al. (2012) use a loan pricing formula to investigate the cost impact of the Basel III rules on economic growth in the U.S., Europe, and Japan. Their study mainly focuses on the long-term outcomes, rather than transitional costs, and does not attempt to measure the economic benefits arising from the implementation of the new Basel III rules.

2. Basel standards: background and data

The augmented financial turmoil[5] in the early 1970s was enough to rattle major currency markets. The macro events in systemic nature triggered a surge in commodity prices and disrupted the world trade as a consequence. In response, the central bank Governors of G-10 were prompted to harmonize existing disparate capital standards within G-10 as internationally active banks had constant tendency to invent innovative loopholes to circumvent regulation and banking supervision. The upshot of the immediate cooperation and financial collaboration among G-10 governors gave birth to the establishment of the Basel Committee on Banking Supervision in 1974. Basel Committee's first landmark consultative document (known as Basel I) *International Convergence of Capital*

[5] The President Nixon decided to take the U.S. off the gold standard (1971), The collapse of the Bretton Woods system of fixed exchange rate regime (1973), the Arab-Israeli conflict – Yom Kippur War and the subsequent oil crisis (1973), OPEC's embargo to the U.S caused the price of oil to quadruple in less than six months (skyrocketed from $2.90 a barrel in October 1973 to $11.60 in March 1974), and the forced liquidation of Germany's Cologne-based Bankhaus Herstatt due to significant exposure to foreign exchange risk (1974).

Measurement and Capital Standards was approved by the G-10 Governors and released to banks in July 1988. Basel I, first major international banking regulation (in force by 1992), spurred a widespread adoption by more than 100 countries worldwide. The underlying objectives of Basel I are twofold: "...to strengthen the soundness and stability of the international banking system" and "...to reduce competitive inequalities" (BCBS, 1988).

Since its inception, Basel I has been subject to significant opposition on numerous grounds; the most forceful criticism relates to arbitrary risk categories (OECD and non-OECD origination) and corresponding simplistic risk buckets (0%, 10%, 20%, 50%, and 100%). The U.S. Federal Reserve Vice Chairman Ferguson (2003) elaborated in a speech that "Basel I Accord is too simplistic to adequately address the activities of our most complex banking institutions". Moreover, the insensitiveness of Basel I to credit risk caused significant distortions in cross-border lending (BCBS, 2004). According to Rodríguez (2002) and Elizalde (2007), Basel I encouraged greater risk-taking and enabled banks to accumulate more capital via disintermediation that caused credit squeeze in the 1990s. Basel I allows banks to move higher-risk-weight assets between on-balance and off-balance sheet through securitization (Blundell-Wignall et al., 2014). Jackson et al. (1999) assert that the total capital requirement of 8% risk-weighted assets (RWAs) is a form of another regulatory taxation imposed on banks. Economists believe that Basel I makes inaccurate risk assessments as risk models do not take into account the endogeneity nature of risk, especially in volatile markets. With the endorsement of the Basel Committee's *1996 market risk amendment* (i.e. BCBS, 1996), VaR became a mainstay but, this too is blind to certain risks under extreme market conditions (Danielsson, 2000).

Deficiencies of Basel I plus the mounting pressure from the industry participants prompted Basel Committee to introduce a *Revised Framework* known as Basel II in June 2004 (effective by 2006).[6] Basel II is often criticized for amplifying cyclical lending, in turn reducing capital inflows to developing and emerging market economies. Saurina and Trucharte (2007) point out that Basel II is expected to increase procyclicality, exacerbate boom-bust cycles, lead to deleveraging, and result in increased defaults due to contagion and counterparty risk. Gordy (2003) argues that a single global risk factor of Basel II to capture firm defaults increases the likelihood of large capital shortfalls. Blundell-Wignall and Atkinson (2010) assert that Basel II raises procyclicality. The moral dilemma is that regulatory distortions under Basel I and II give *too-big-to-fail* banks incentives to move assets off their balance sheets. These unconventional on-and-off balance sheet moves created another nonfinancial intermediary referred to as *shadow banking*. Heavy reliance on ratings given by the external credit assessment institutions (ECAIs) under Basel II played a crisis-intensifier role during the GFC. The use of external ratings created three adverse incentives for banks; (1) banks felt no real urgency to develop their own internal risk-assessment frameworks; (2) ECAIs misused the rating process to issue artificially-inflated ratings to clients from whom they earned lucrative service fees; (3) banks' overreliance on ECAIs resulted in a *cliff* effect in capital requirements (BCBS, 2004).

In the immediate aftermath of the worst financial crisis in human history (i.e. GFC), Basel Committee endorsed *Basel III: A global regulatory framework for more resilient banks and banking systems*; since 2009, the adoption and implementation of the new Basel III standard among ASEAN-5 has gained momentum.

Table 1
Adoption status of Basel III[7]

Elements	Indonesia		Malaysia		Philippine		Singapore		Thailand		27 EU nations	
Liquidity cov. ratio (LCR)	1	2014	3	2015	2	2015	1	2014	1	2014	3	16
Definition of Capital	4	2014	4	2013	4	2014	4	2010	4	2013	4	27
Risk coverage	1	2013	1	NA	2	2013	4	2010	4	2013	4	27
Capital conservation	1	2014	1	2015	4	2014	3	2012	3	2012	4	27
Counter cyclical capital	1	2014	1	2015	5	NA*	3	2012	3	2012	3	11
Leverage ratio	2	2014	1	TBA	2	2014	4	2010	1	*	3	12
D-SIBs capital charge	2	2013	1	TBA	3	2013	1	2016	1	*	3	10
G-SIBs capital charge	2	2013	1	NA	5	NA	4	2014	5	NA	3	10

This table reports the adoption status of Basel III among ASEAN-5 and EU countries. Data for the 27 member jurisdictions is as of 2014. D-SIB: Domestic systemically important banks; G-SIB: Global systemically important banks. Status indicators: 1 = draft regulation not published; 2 = draft regulation published; 3 = final rule published; 4 = final rule in force; 5 = not considered; NA = not applicable; * developments are still being monitored.

[6] See BCBS (2004) for all the revisions from Basel I to Basel II as well as new approaches introduced in Basel II.
[7] FSI (2015), Bank for International Settlements (BIS)

Financial sectors (excluding Singapore) of ASEAN-5 are not deep enough and some parts of the financial system are still in infancy stages such as insurance, derivatives, and bonds; therefore, securitization risks are insignificant and re-securitization structures do not exist. As a result, both speed and effectiveness of the Basel II implementation has been disparate and largely varied (only completed during 2006-2010). The Financial Stability Institute report (FSI, 2015) indicates that as of 2014, 94 non-Basel / non-EU jurisdictions and 27 EU jurisdictions have either implemented or in the process of implementation Basel II (for Basel III, 89 and 27 respectively).

Table 2
Basel III phase-in arrangements (*Shading indicates transition periods – all dates are as of January 1st*)[8]

	2013	2014	2015	2016	2017	2018	2019
Leverage ratio	Parallel run 2013 – 2017 Disclosure starts 2015					Migration to Pillar 1 (2018)	
Minimum CET1 ratio	3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital conservation buffer				0.625%	1.25%	1.825%	2.5%
Minimum common equity plus capital buffer	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
Phase-in of deductions from CET1		20%	40%	60%	80%	100%	100%
Minimum Tier 1 capital	4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum total capital	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum total capital plus conservation buffer	8.0%	8.0%	8.0%	8.625%	9.25%	9.875%	10.5%
Capital instruments that no longer Tier 1 or Tier 2	Phased out over 10-year horizon beginning 2013						
Liquidity coverage ratio LCR > 100	Observation Begins 2011		Introduce minimum standard by 2015				
Net stable funding ratio NSFR > 100	Observation Begins 2011		Introduce minimum Standard by 2018				

This table shows the Basel III phase-in arrangements. Common equity Tier 1 (CET1) increases from 2% to 4.5%; two new liquidity standards are introduced to promote resiliency over short-term (i.e. liquidity coverage ratio - LCR is introduced by January 1 2015) and over long-term (i.e. net stable funding ratio – NSFR is introduced by January 1 2018); the parallel run of a 3% leverage ratio is during 2013-2017 and its migration to pillar 1 is in January 1 2018; minimum total capital ratio remains at 8%, but increases to 10.5% with the addition of a 2.5% capital conservation buffer by January 2019.

Basel III promises to correct all of the deficiencies under Basel I and II; in that regard, Basel Committee has introduced a series of measures since 2009 to enhance risk coverage and strengthen the global banking resilience. For instance, going forward, it is mandatory for banks to use stressed value-at-risk (VaR) inputs to compute capital requirements for counterparty credit risk and market risk. A credit valuation adjustment (CVA) capital charge is introduced to address mark-to-market losses. The derivatives markets were outside of the traditional banking and therefore subject to hardly any regulation. In order to strengthen market infrastructures, regulate OTC derivatives markets, and mitigate the buildup of systemic risk, the Basel Committee is supporting initiatives that will establish Committee on Payments and Settlement Systems (CPSS), International Organization of Securities Commissions (IOSCO), and Central Counterparties (CCPs). The overreliance on external ratings by the ECAIs under Basel II caused *cliff effects* in capital requirements; to eliminate them, banks are required to perform their own assessments of externally rated securitization exposures. The excessive on- and off-balance sheet leverage in the banking sector played a crisis-intensifier role at the peak of the GFC. Basel Committee feels that excessive leverage in the banking sector has to be constrained to prevent the deleveraging process from becoming a destabilizing factor; as a result, a supplemental 3% non-risk leverage ratio (LR) is introduced as a backstop, but Norton (2013) contends that 3% is large enough. We have to wait till the next big crisis to see whether Basel III Has been successful or not.

[8] Basel Committee on Banking Supervision (BCBS, 2010)

2.1 Data and descriptive statistics

We study cost impact of Basel III higher capital and liquidity requirements on bank capital, lending spreads, and steady state output. We also investigate the effects of the new Basel III rules on gain in steady state output. Our sample contains aggregated bank data for eight years covering the period of 2011 to 2019, during which the phase-in arrangements began (2011) and completed by no later than January 1st 2019. Bank-specific balance sheet and income statement data are collected from various sources such as Bankscope, banks' own websites and central banks. The analyses in this section mainly focus on ASEAN-5 banks excluding non-financial intermediaries. A total of 108 banks from Indonesia (104 private commercial and 4 state-controlled commercial banks), 56 banks from Malaysia (43 private commercial banks and 13 investment banks), 19 banks from Philippines (17 private and 2 state-controlled commercial banks), 6 banks from Singapore (5 private commercial banks and one foreign subsidiary); and 16 private commercial banks from Thailand.[9] The data for Group 1 banks (71 banks plus 30 G-SIBs) and Group 2 banks (109) is in the aggregate form. Group 1 banks consist of 14 banks from Japan, 13 from the U.S., 8 from Germany, 6 from China, 6 from Canada, 5 from the UK, 5 from France, 5 from India, 5 from Korea, 4 from Australia, 4 from Sweden, 3 from Singapore, and 2 from Indonesia (Group 2 banks).[10]

Table 3
Descriptive statistics of capital adequacy ratio (CAR)

In per cent (%)		IN	MY	PH	SG	TH	ASEAN5	Group 1	Group 2	G-SIB
N	Valid	5	5	5	5	5	5	71	109	30
	Missing	0	0	0	0	0	0	0	0	0
Mean		18.160	15.858	17.098	16.462	15.780	16.674	14.892	15.020	14.752
Median		18.450	15.410	16.890	16.430	15.670	16.650	14.790	15.100	14.750
Mode		16.08	14.57	16.18	15.88	15.35	16.42	14.01	14.35	13.85
Std. Dev.		1.4068	1.2166	.90071	.45130	.44385	.24704	.65431	.55520	.60210
Range		3.69	2.78	1.93	1.09	1.08	.64	1.79	1.45	1.65

This table reports descriptive statistics for the analysis of capital adequacy ratio (CAR). The data for ASEAN-5 is from the IMF's Financial Soundness Indicators (FSI). The results indicate that the average mean CAR of ASEAN-5 (M = 16.67, SD = .25) is significantly different than those of Group 1 banks (M = 14.89, SD = .65), Group 2 banks (M = 15.02, SD = .55) and G-SIB (M = 14.75, SD = .60). Indonesia has the highest mean of CAR, Malaysia and Thailand have lower means than the ASEAN-5 average.
IN: Indonesia; MY: Malaysia; PH: Philippines; SG: Singapore; TH: Thailand

Table 4
Descriptive statistics of Tier 1 capital ratio

In per cent (%)		IN	MY	PH	SG	TH	ASEAN5	Group 1	Group 2	G-SIB
N	Valid	5	5	5	5	5	5	71	109	30
	Missing	0	0	0	0	0	0	0	0	0
Mean		16.832	13.140	14.244	13.846	11.980	14.008	12.300	12.090	12.190
Median		17.000	13.210	14.010	13.770	11.830	14.270	12.200	12.000	12.200
Mode		15.29	12.68	13.46	13.69	10.87	13.37	11.45	11.20	12.20
Std. Deviation		1.19636	.27102	.90710	.17286	.91940	.45323	.63344	.81425	.57489
Range		2.80	.71	2.27	.38	2.32	1.03	1.75	2.10	1.60

This table reports descriptive statistics for the analysis of Tier 1 capital. The results indicate that the average mean Tier 1 capital ratio of ASEAN-5 (M = 14.00, SD = .45) is significantly different than those of Group 1 banks (M = 12.30, SD = .63), Group 2 banks (M = 12.09, SD = .81) and G-SIBs (M = 12.19, SD = .57). Indonesia has the highest average mean while Thailand's average is even lower than those of Group 1 and 2 banks.
IN: Indonesia; MY: Malaysia; PH: Philippines; SG: Singapore; TH: Thailand.

[9] We have used the following capital definitions: common equity Tier 1 (CET1) ratio = common equity Tier 1 capital / RWAs = 4.5%; Tier 1 capital ratio = total Tier 1 capital / RWAs = 6.0%; total capital ratio = (Tier 1 capital + Tier 2 capital) / RWAs = 8.0%; leverage ratio = Tier 1 capital / total exposure = ≥3%; net stable funding ratio (NSFR) = available stable funding / required stable funding = ≥100; liquidity coverage ratio (LCR) = HQLAs / net liquidity outflows over 30-day period = ≥100; HQLA: high quality liquid assets (see BCBS, 2010).
[10] Except Singapore, the remaining members of ASEAN-5 has no group 1 G-SIB.

3. Empirical setup and main results

3.1 Cost impact of Basel III on bank capital

To assess to what extent higher capital requirements result in key capital ratios dropping below the regulatory minima, we measure capital adequacy ratio (CAR) and Tier 1 capital ratio that are key capital indicators to measure bank solvency and to prevent the economy from entering a recession or a financial crisis. For the past three decades (since 1988), the regulatory capital minimum imposed on banks has progressively and substantially increased. Although Modigliani and Miller (1958), under strict conditions and casual assumptions, argue that a bank's capital structure is irrelevant to its weighted average cost of capital (also irrelevant to the bank's market value); but in the real world, markets are imperfect surrounded by distortions favoring debt finance over equity finance (i.e. tax shield), plus a host of implicit and explicit government guarantees exist.

The new Basel III rules raise minimum capital requirements significantly; effective as of January 1 2015, the CET1 ratio is increased from 2% to 4.5% and Tier 1 capital ratio from 4% to 6% of RWAs. By January 2019, the minimum capital requirement becomes 7% (4.5% CET1 plus 2.5% capital buffer) and the total capital requirement can increase from currently 8% to 15.5% including a conservation buffer of 2.5% (see Table 5), a G-SIB surcharge of 2.5% and a countercyclical buffer of 2.5%. We adopt the capital definitions under Basel III, according to which a bank's capital structure consists of Tier 1 and Tier 2 capital (Tier 3 capital in Basel II is eliminated), and CET1 (i.e. losses stemming from a financial crisis are deducted from CET1). When a bank's CET1 falls below the regulatory minimum of 4.5% due to deductions, the bank must raise fresh capital to bring its CET1 in line with the required level or face insolvency (i.e. overtaken or shut down). In the event of liquidation or bankruptcy, equity holders (as the risk bearer) do not get any money before creditors and preference share owners are settled.

Table 5
Individual bank minimum capital conservation standards

Common equity Tier 1 (CET1)	Minimum capital conservation ratios (expressed as a percentage of earnings)
4.5% - 5.125%	100
5.125% - 5.75%	80
5.75% - 6.375%	60
6.375% - 7.0%	40
> 7.0%	0

Source: BCBS (2010)

$$\text{Common equity Tier 1 (CET1)} = \frac{\text{Common equity Tier 1 capital}}{\text{CR RWA} + \text{MR RWA} + \text{OR RWA}} \geq 4.5\%$$

$$\text{Tier 1 capital ratio} = \frac{\text{Tier 1 capital}}{\text{CR RWA} + \text{MR RWA} + \text{OR RWA}} \geq 6.0\%$$

$$\text{Total capital (CAR)} = \frac{\text{Total capital}}{\text{CR RWA} + \text{MR RWA} + \text{OR RWA}} \geq 8.0\%$$

Where CR: credit risk, MR: market risk, OR: operational risk, and RWA: risk-weighted asset. Risk weighted assets is calculated as; RWA = K (capital requirement) x 12.5 x EAD (exposure at default).

The main results of our analysis of the cost impact of Basel III higher capital ratios on bank capital indicate that each banking sector of ASEAN-5 is well capitalized. Within ASEAN-5, only Indonesia and Philippines have higher CAR and Tier 1 capital ratios than the ASEAN-5 average (16.67% of CAR and 14.01% of Tier 1). These capital ratios in the aggregate are at least two percentage points higher than those of Group 1 banks (71), Group 2 banks (109), and G-SIBs (30 banks), and no member of ASEAN-5 needs recapitalization by 2015 or 2019. On the contrary, key results of the 2009 Supervisory Capital Assessment Program (SCAP), first stress testing conducted by the Federal Reserve in the U.S., indicates a cumulative capital shortfall of $185 billion, but the net final figure is only $75 billion after taking into account asset sales, preferred shares-to-common stock conversions, and other capital raising measures. Out of the ten BHCs with a capital deficit, only GMAC (the name is changed to *Ally*

Financial after the SCAP) used the backstop (temporary financial relief provided by the U.S. Treasury).[11] In stark contrast to the U.S., Europe bungled with its first two EU-wide stress tests. In the adverse scenario (EBA, 2014), 24 banks fall below the hurdle Tier 1 capital ratio of 5.5% resulting in a combined capital shortfall of €24.6 billion, it was €26.8 billion in the EBA (2011) exercise. After banks' capital raising actions, the capital shortfall is reduced to €9.5 billion (as opposed to €2.5 billion in the 2011 stress test) which belongs to 14 banks.[12]

Table 6
CAR and Tier 1 capital ratios of banking sectors across ASEAN-5

	Bank capital percent of RWAs					Average	Raise capital by 2015	Raise capital by 2019
	2011	2012	2013	2014	2015			
CAR	16.08	17.58	18.45	18.92	19.77	18.16	0	0
Tier 1	15.29	15.96	17.00	17.82	18.09	16.83	0	0
CAR	16.93	17.35	14.57	15.03	15.41	15.86	0	0
Tier 1	12.68	13.16	13.21	13.26	13.39	13.14	0	0
CAR	16.89	17.97	18.11	16.34	16.18	17.10	0	0
Tier 1	13.46	14.40	15.73	14.01	13.62	14.24	0	0
CAR	16.84	16.97	16.43	16.19	15.88	16.46	0	0
Tier 1	13.99	14.07	13.77	13.69	13.71	13.85	0	0
CAR	15.35	15.44	15.67	16.01	16.43	15.78	0	0
Tier 1	11.43	10.87	11.83	12.58	13.19	11.98	0	0

This table reports cost impact analysis of the Basel III higher capital regulation on bank capital across ASEAN-5. The data used here is submitted by national authorities to the IMF following the Financial Soundness Indicators (FSI) Compilation Guide and for dissemination through FSIs website. Deviations from FSI compilation Guide and complementary explanations are indicated in country's metadata. We omitted from the data *Non FSI Reporters: Data for this indicator may not follow the FSI Compilation Guide.

Our cost impact analysis of the Basel III higher capital regulation on bank capital across ASEAN-5 shows no recapitalization need in order to comply with the minimum regulatory capital of 7% in 2015 or 10.5% in 2019. This is true under normal market conditions, to see if the same conclusion applies under an adverse scenario in an acute stress, we construct a macro stress testing framework to assess the resilience of Malaysia's banking sector (stress testing of the remaining four banking sectors also produce similar results). The results of adverse scenario containing hypothetical shocks indicate that despite the strengthened capital ratios at the end of 2015 some smaller Islamic banks fall below the hurdle Tier 1 capital ratio of 6.0%. Credit risk (primary risk of default) and the resultant losses on residential mortgage loans as well as the increased cost of funding result in the largest impact on banks' capital ratios. Even though Malaysia's banking sector has higher post-stress test Tier 1 capital ratio than required by Basel III (i.e. 6%), the impact of adverse shocks reduces the level of Tier 1 capital ratio by 3.37% (Tier 1 capital ratio drops from 13.12% to 9.75%). The aggregate capital shortfall in the form of needed capital injection (cost to the government) is 1.55% of GDP (or $4.59 billion of capital injection based on 2015 GDP of $296.22 billion). The important outcome of the adverse scenario is that no bank fails (even Islamic banks) or faces a forced liquidation and suspension of license (losses could be smaller in Singapore but greater in Indonesia).

[11] The SCAP stress tested 19 Bank Holding Companies (BHC) with each a combined total assets of $100 billion or more at year-end 2008. The SCAP results are of great importance since this is the first macro stress testing used by the US Federal Reserve as a crisis management tool (for details see Fed, 2009). The results are also significant to central banks, supervisory authorities, bank executives, risk managers, and academia to understand various sources of financial losses, the majority of which resulted from mortgage-backed securities.

[12] In parallel to the U.S., the Committee of European Banking Supervisors (CEBS, 2010) conducted a stress testing exercise similar to the SCAP; 22 SIBs took part in the program. The results were not disclosed to the public, but a brief summary was published indicating that all 22 banks achieved 6% or higher post-stress threshold Tier 1 capital. CEBS was succeeded by the European Banking Authority (EBA), 91 banks participated in the EBA (2011) EU-wide stress test, the results of which revealed that 20 banks would fail meeting the benchmark CET1 ratio of 5% (4.5% in Basel III) and the resultant capital shortfall was €26.8 billion. After banks' capital raising actions taken into account, only eight banks were still below the CET1 of 5% and the capital shortfall was reduced to €2.5 billion, but one of the concerning outcomes of the exercise was that 16 banks' CET1 ratios were close to the border line between 5% and 6% (EBA, 2011).

Throughout this article, we use statistical methods to determine if our estimates involving the Basel III higher capital and liquidity rules are normally distributed. One of our underlying assumptions is that rejecting the null hypothesis will affirm that the difference in means between ASEAN-5 and other groups is statistically significant. It will also indicate that there is a positive relationship between regulatory tightening (higher capital and liquidity requirements) and financial stability. Conversely, retaining (or failing to reject) the hypothesis will mean exactly the opposite; as such, the difference between ASEAN-5 and other groups is not statistically significant, which may be interpreted as there is no strong evidence to suggest that the Basel III higher capital and liquidity requirements will promote banking resilience which in turn is expected to reduce the probability of future crisis.

Table 7
Paired samples *t*-test of CAR

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Diff.				
					Lower	Upper			
Pair 1	ASEAN-5 & Group 1 banks	1.78200	.63779	.28523	.99009	2.57391	6.248	4	.003
Pair 2	ASEAN-5 & Group 2 banks	1.65400	.59117	.26438	.91997	2.38803	6.256	4	.003
Pair 3	ASEAN-5 & G-SIB	1.92200	.57347	.25646	1.20994	2.63406	7.494	4	.002

This table reports summary statistics of paired samples test of CAR. Pair 1 (M = 1.78, SD = .6378, t (4) = 6.248, *p* (.003) < .05 (other results are reported the same way); we reject the null hypothesis and conclude that average CAR of ASEAN-5 is significantly higher than those of Group 1 banks, Group 2 banks, and G-SIBs.

Table 8
Paired samples *t*-test of Tier 1

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Diff.				
					Lower	Upper			
Pair 1	ASEAN-5 & Group 1 banks	1.70800	.35238	.15759	1.27047	2.14553	10.838	4	.000
Pair 2	ASEAN-5 & Group 2 banks	1.91800	.48422	.21655	1.31676	2.51924	8.857	4	.001
Pair 3	ASEAN-5 & G-SIB	1.81800	.30327	.13562	1.44145	2.19455	13.405	4	.000

This table reports summary statistics of paired samples test of Tier 1. Pair 1 (M = 1.71, SD = .3524, t (4) = 10.838, p (.000) < .05, (other results are reported the same way); we reject the null hypothesis and conclude that average Tier 1 capital of ASEAN-5 is significantly higher than those of Group 1 banks, Group 2 banks, and G-SIBs.

We perform a paired samples test to analyze how significantly the average means of both CAR and Tier 1 ratio of banks across ASEAN-5 differ from those of 210 banks across 27 countries. The *t* statistic (see Table 7 & 8) for pair 1 in CAR (ASEAN-5 & Group 1 banks), $t = 6.248$, and $p = 0.003 < 0.05$ show that the probability of this outcome occurring by chance is very small under the null hypothesis of no difference. The null hypothesis is rejected and concluded that the average means of CAR between ASEAN-5 and Group 1 banks are significantly and statistically different. The other results are reported in the same way since all *p* values are less than the priori alpha ($\propto = .05$). With the *p* values of significance < 0.05, there is a strong evidence that the average means in CAR and Tier 1 capital ratio of ASEAN-5 and 210 banks across 27 countries are significantly different.

The aggregate sample for CAR and Tier 1 capital ratio of ASEAN-5 banks has a normal distribution when the results are compared with 71 Group 1 banks, 109 Group 2 banks, and 30 G-SIBs. However when the results of CAR and Tier 1 capital ratio of ASEAN-5are compared with those of 118 countries, the results of the

Kolmogorov-Smirnov (K-S) test indicate that the first assumption of normality is violated, Sig. p (.036) < α = 0.05, the hypothesis of no difference is rejected and concluded that the difference in the means of CAR and Tier 1 between ASEAN-5 banks and those of 118 countries are significant, so a non-parametric test must be used.

The Mann-Whitney U test is performed to see if the mean ranks of CAR and Tier 1 capital ratio of ASEAN-5 banking sectors differ statistically and significantly from those of 118 countries. ASEAN-5 banking sectors have an average rank of 112.40 in CAR and 106.80 in Tier 1 capital ratio, while banking sectors across 118 countries have 59.86 and 60.10 respectively. The test results are in the expected direction and significant, z = -3.241 (CAR) and -2.869 (Tier 1), p (.001 and .004 respectively). Because Sig. p values are < α = 0.05, the null hypothesis is rejected and concluded that the groups' mean ranks are significantly different.

Table 9
Mann-Whitney U test ranks of CAR and Tier 1

	Group	N	Mean Rank	Sum of Ranks
CAR	ASEAN-5	5	112.40	562.00
	The World	118	59.86	7064.00
	Total	123		
Tier 1	ASEAN-5	5	106.80	534.00
	The World	118	60.10	7092.00
	Total	123		

This table reports summary statistics of Mann-Whitney U test ranks of CAR and Tier 1. The results indicate that the mean rank of CAR for ASEAN-5 112.40 (N=5) is significantly higher than the world's 59.86 (N= 118). The mean rank of Tier 1 for ASEAN-5 106.80 (N = 5) is also significantly higher than the world's 60.10 (N = 118).

Table 10
Mann-Whitney U test statistics of CAR and Tier 1

	CAR	Tier 1
Mann-Whitney U	43.000	71.000
Wilcoxon W	7064.000	7092.000
Z	-3.241	-2.869
Asymp. Sig. (2-tailed)	.001	.004

This table reports summary statistics of Mann-Whitney U test. The test results are strong evidence to reject the null hypothesis, and conclude that the difference in CAR (M.W. = 43.000, p = .001 < .05) and Tier 1 (M.W. = 71.000, p = .004 < .05) between ASEAN-5 and 118 countries is statistically significant.

3.2 Cost impact of Basel III on lending spreads

In this section, the analysis involves estimating the cost impact of the Basel III higher capital ratios on lending spreads across the banking sectors of ASEAN-5. As the basis of the analysis, the underlying assumption is that banks adjust accordingly by passing a portion of the increased funding costs to customers in terms of higher rates on new loans generated and/or higher fees for services provided. We adopt the approach developed by Slovik and Cournède (2011) to estimate the cost impact of Basel III higher capital rules on lending spreads. The underlying assumption in the analysis is that banks are assumed to react to increases in increments of one percentage point (pp) in bank capital relative to risk-weighted assets. Aggregated balance sheets of ASEAN-5 banking sectors are used. Input data from two categories of balance sheet items are utilized to show that banks' funding costs are equal to their returns on assets, which are directly influenced by the cost of liabilities and equity. Bank lending assets (AL) stored on banking books and other bank assets (AO) held on trading books (i.e. bonds) are used.

The analysis involves three steps, all figures are in percentages unless indicated otherwise. In the first step, it is shown how return on assets was equal to cost of funding: The left side of the equation implies the return on assets: $r_t^{AL} * AL + r_t^{AO} * AO = r_t^{L} * L + r_t^{E} * E$. the return on lending assets (r_t^{AL}) is computed and multiplied by lending assets (AL), added return on other assets (r_t^{AO}) and multiplied it by other assets to total assets ratio (AO). On the right side of the equation, the cost of borrowing (r_t^{L}) is computed and multiplied by liabilities to total assets ratio (L), added cost of equity (r_t^{E}), and multiplied that by common equity to total assets ratio (E).

Second step incorporated the effect of a one pp increase in capital ratios relative to RWAs. As expected, this negatively affected the bank financing structures, in turn funding costs. The left side of the equation in step one remains unchanged, but in the right side, a one percentage rise was added in capital: $r_t^{AL} * AL + r_t^{AO} * AO = r_t^{L} * \left(L - \frac{RWA}{100}\right) + r_t^{E} * \left(E + \frac{RWA}{100}\right)$. In the third and final step of the analysis, the results indicated that a one percentage increase in the ratio of bank capital to RWAs pushed lending spreads higher. Increases in bank lending spreads generated additional return on lending assets for banks ($r_{t+1}^{AL} - r_t^{AL}$). The additional return on lending assets is equal to cost of equity minus cost of borrowing, divided by the ratio of lending assets to total assets relative to RWAs: $\left(r_{t+1}^{AL} - r_t^{AL}\right) = (r_t^{E} - r_t^{L})/AL * \frac{RWA}{100}$.

Table 11
Impact of 1% increase in bank capital on lending spreads

	$r_t^E - r_t^L$	AL	RWA	$r_{t+1}^{AL} - r_t^{AL}$
	2012	2013	2014	2015
	basis points-bps	percentage %	percentage %	basis points-bps
Indonesia	32.53	66.56	70.73	34.52
Malaysia	24.82	57.64	63.84	27.55
Philippines	21.65	49.17	64.92	28.68
Singapore	24.41	59.52	60.95	24.91
Thailand	38.54	76.75	71.37	35.84
Average	27.36	61.93	66.36	30.30

This table reports results of the impact analysis of 1% increase in CET1 on lending spreads: To meet the minimum target capital requirement of 7% by 2015, ASEAN-5 banks are estimated to increase lending spreads by 30.30 bps (7.5 bps per annum). Slovik and Cournède (2011) estimate that lending spreads increase 14.4 bps on average across the three main OECD economies; the U.S. (20.5), Euro area (14.3), and Japan (8.4).

Table 12
Basel III impact on lending spreads (bps)

Country	2015	2016	2017	2018	2019	+ 25% liquidity
Indonesia	34.52	42.46	53.29	62.51	72.46	99.28
Malaysia	27.55	35.42	44.27	55.78	66.52	91.64
Philippines	28.68	34.75	43.42	54.44	69.85	94.37
Singapore	24.91	31.87	39.64	46.45	54.63	82.48
Thailand	35.84	46.43	57.56	66.93	77.84	104.19
Average	30.30	38.19	47.64	57.22	68.26	94.39

This table reports the results of Basel III impact on lending spreads. To meet the minimum capital requirement of 10.5% (i.e. 8% of total capital plus 2.5% of capital conservation buffer) enforced by the January 2019 deadline, ASEAN-5 banks will have to increase the lending spreads by 68.26 bps on average (17.07 a year).

Gradual integration of ASEAN-5 into major financial markets and international trading hubs has made them become ever more susceptible to monetary policy decisions (i.e. tightening or expansive) by the U.S., EU, and Japan. The results of our analysis obtained through the use of analytical and statistical models demonstrate that the cost impact of Basel III higher capital and liquidity requirements on lending spreads is more than twofold of the estimates found in other studies (see Table 13). Excluding the IIF (2011) report, our average estimate of 68.26 bps for ASEAN-5 after a four-year implementation is broadly consistent with the estimates of Slovik and Cournède (51.1 bps after a five-year implementation) and Basel Committee (52 bps). In addition to one percentage point rise in CET1, we add a 25% liquidity requirement to the analysis which results in a significant jump in the level of average impact on lending spreads across ASEAN-5 (94.39 bps). The results of our analysis in this section shows that each member of ASEAN-5 is still not immune to exogenous shocks originated in the U.S., EU, and Japan. Our estimates of Basel III impact on lending spreads are substantially higher than those found in studies published since the introduction of the new Basel III capital and liquidity rules in December 2010. In spite of noticeable differences in banking structures, nature of intermediation, capital levels, and capitalization needs; our estimates of the Basel III regulatory tightening on lending spreads are within a close range.

Table 13
Studies on impact of regulatory tightening on lending spreads

Study	Method	Increase in Lending Spread (bps)
Our Study	1 pp rise in capital ratios 25% liquidity requirement	68 bps 26 bps (94 bps as combined)
MAG (2010)	1 pp rise in capital ratios 25% liquidity requirement	15 bps 14 – 25 bps
BIS (2010)	1 pp rise in capital ratios Capital and liquidity regulation	52 bps (U.S.) and 52 bps (Euro area) 66 bps (U.S.) and 66 bps (Euro area)
IIF (2011)	2 pp rise in Tier 1, total capital No monetary policy response	468 bps (U.S.), 291 bps (Euro area), and 202 bps (Japan) in 2011-2015
Angelini et al. (2011)	2 pp rise in the CET1 ratio 25 % liquidity requirement	26 bps 14 bps (40 bps as combined)
Slovik and Cournède (2011)	1 pp rise in capital ratios After a 5-year implementation	64 bps (U.S.), 54 bps (Euro area), and 35 bps (Japan)
Elliott et al. (2012)	1 pp rise in the CET1 ratio	28 bps (U.S.), 18 bps (Euro area), and 8 bps (Japan)
Miles et al. (2012)	2 pp rise in capital ratios Large M-M effect is assumed	18 bps

This table reports summary results of studies on cost impact of the new Basel III higher capital and liquidity rules on lending spreads. M-M theorem is developed by Modigliani & Miller (1958); pp: percentage point; bps: basis points.

In the Levene's test (Table 14), the F value of lending spreads between ASEAN-5 and three OECD economies in 2015 is; F (.636), Sig. p = .455 > .05 (other years are reported the same way). The Sig. (p) values are greater than the priori α = .05, the data is normally distributed and the assumption of equal variances is met. Based on these results, the analysis fails to reject the null hypothesis and concludes that the difference in lending spreads between groups is not statistically significant. Given no violation of Levene's test for homogeneity of variances, *Equal Variances Assumed* must be used and the *t*-test not assuming homogeneous variances is not calculated. If a violation of Levene's test for homogeneity of variances occurs, *Equal Variances Not Assumed* is used; and a *t*-test not assuming homogeneous variances is calculated. The report of results are written as; t (6) = 5.316, Sig. p = .003 < .05; d = 3.88. The effect size calculated for this analysis (d = 3.88) exceeds Cohen's 1988 for a large effect (.80).

Table 14
Independent samples test of lending spreads

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
2015	E. V. A	.636	.455	4.989	6	.002	15.400	3.087	7.847	22.953
	E. V. NA			5.316	5.215	.003	15.400	2.897	8.044	22.756
2016	E. V. A	1.555	.259	3.724	6	.010	14.333	3.849	4.915	23.752
	E. V. NA			4.113	5.663	.007	14.333	3.485	5.682	22.985
2017	E. V. A	.024	.881	2.420	6	.052	13.600	5.619	-.149	27.349
	E. V. NA			2.387	4.159	.073	13.600	5.697	-1.983	29.183
2018	E. V. A	.557	.484	2.119	6	.078	14.333	6.764	-2.217	30.884
	E. V. NA			1.917	3.222	.145	14.333	7.477	-8.562	37.229
2019	E. V. A	1.167	.321	2.140	6	.076	17.200	8.038	-2.468	36.868
	E. V. NA			1.844	2.833	.168	17.200	9.326	-13.491	47.891

This table reports summary statistics of independent samples test for lending spreads. Based on the results (all p values > .05), the analysis fails to reject the null hypothesis. There is strong eveidence to suggest that higher lending spreads charged on new loans adversely affect financial stability across ASEAN-5.

One-way Analysis of Variance (ANOVA) is performed to evaluate increases in lending spreads between and within groups. One-way ANOVA is used to compare the mean differences between ASEAN-5 banking sectors and those of the advanced economies; the output results are set out in Table 15. The level of increases differ among the two groups in 2015 and 2016; F (1, 6) = 24.889, p (.002) < .05 and F (1, 6) = 13.867, p (.010) < .05 respectively. The null hypothesis is rejected and concluded that the difference the groups' means were statistically significant. The fails to reject the null hypothesis in 2017, 2018, and 2019 as the *p* values > .05; F (1, 6) = 5,858, p (.052) > .05; F (1, 6) = 4.491, p (.078) > .05 and F (1, 6) = 4.579, p (.076) > .05 respectively, and concluded that there is no strong evidence to reject the null hypothesis that the population means are all equal.

Table 15
One-way ANOVA of lending spreads

		Sum of Squares	df	Mean Square	F	Sig.
2015	Between Groups	444.675	1	444.675	24.889	.002
	Within Groups	107.200	6	17.867		
	Total	551.875	7			
2016	Between Groups	385.208	1	385.208	13.867	.010
	Within Groups	166.667	6	27.778		
	Total	551.875	7			
2017	Between Groups	346.800	1	346.800	5.858	.052
	Within Groups	355.200	6	59.200		
	Total	702.000	7			
2018	Between Groups	385.208	1	385.208	4.491	.078
	Within Groups	514.667	6	85.778		
	Total	899.875	7			
2019	Between Groups	554.700	1	554.700	4.579	.076
	Within Groups	726.800	6	121.133		
	Total	1281.500	7			

This table reports summary statistics for one-way ANOVA used to compare the mean differences between ASEAN-5 and three main OECD economies; the difference in means between groups is statistically significant in 2015 and 2016.

3.3 Economic cost of Basel III on steady state output

On one hand, Basel III higher capital and liquidity requirements are projected to increase bank cost of funding in the short-term; on the other hand, the regulatory tightening is expected to strengthen the resilience vulnerability to both endogenous and exogenous shocks under highly adverse market conditions. The intuition behind this logic of thinking is that a shift from debt (lower cost financing option) to equity (higher cost financing option) capital structure not only will contribute positively to the soundness of banks, but also reduce the probability of financial crisis occurring in the future. However, there is a widespread concern that more equity financing negatively affects banks' ROEs, this in turn could force banks to respond submissively by raising lending spreads, and consequently all of these developments may cause a shrinkage in the level of steady state output (e.g. King, 2010).

The analysis in this section follows models developed by Yan et al. (2011), Caggiano and Calice (2011), and Angelini et al. (2011) who have estimated the effects of Basel III higher capital and liquidity regulation (i.e. NSFR) on steady state output (i.e. GDP). Yan et al. (2011) use a binary-state model and the vector error correction model to estimate the impact of the Basel III reforms on the UK economy. Caggiano and Calice (2011) investigate the impact of tighter capital and liquidity rules on a panel of 53 African economies using a combination of binary-state and multivariate logit models. Angelini et al. (2011) assess the long-term economic impact of Basel III using DSGE models. The findings of the former two studies provide empirical evidence that higher capital ratios together with the NSFR will result in a net benefit in the UK and African economies under study. The latter study projects a reduction in the steady state output in the range of 0.08-0.15%.

First, the explanatory variables to be used are determined in the binary state model because the calculation of probability of a banking crisis occurring depends on interaction of each explanatory variable; mathematically, $\mathrm{Pr}_t = \Phi(\alpha_i \mathrm{CET1/RWA}_t + \beta_i \mathrm{NSFR}_t + \gamma_i Z_{it})$, where NFSR denotes the net stable funding ratio, CET1/RWA is

the common equity Tier 1 capital ratio, Z_t represents macroeconomic variables such as RPI_t as the real estate price inflation and CA_t as the current account balance ratio. These variables are in the log-form. As in standard probit models, Φ is used and P_r denotes the likelihood of a crisis materializing.

The Augmented Dickey Fuller (ADF) test (e.g. Yan et al., 2011) shows that there could be four cointegrating relationships; namely, CET1/RWA (CAR is used in the simulations), NSFR (long-term liquidity), and the average 3-month lending rates charged by banks for new generated loans. Next, Johansen's trace test is applied to variables, where α is an $n * r$ matrix of loading coefficients and β is an $n * r$ cointegrating vectors. The test results indicate that the determinants of a financial crisis across ASEAN-5 might have long-term interactions.

Table 16
Johansen cointegration trace test

	test	α = 0.10 (10%)	α = 0.05 (5%)	α = 0.01 (1%)
r ≤ 6	8.25	8.42	10.33	13.79
r ≤ 5	12.48	14.25	14.97	19.80
r ≤ 4	22.38	20.68	23.40	28.60
r ≤ 3	29.20	26.10	29.24	32.81
r ≤ 2	32.85	30.95	35.26	41.74
r ≤ 1	41.95	38.25	41.60	47.32
r ≤ 0	59.81	44.64	48.29	54.45

This table reports summary statistics for Johansen comintegration trace test.

We expand the binary state model of Caggiano and Calice (2011) and include the capital adequacy ratio (λ), year-over-year GDP growth rate (δ), real GDP per capita (ξ), private credit growth (ψ), private credit as a ratio of GDP (φ), foreign exchange reserve (ϱ), change in trade (τ), current account balance (Ω) to nominal GDP, real estate price inflation rate adjusted by the GDP deflator (Γ), real interest rate (r), and currency depreciation (d).

Table 17
The indicators of a banking crisis

	Model 6	Model 5	Model 4	Model 3	Model 2	Model 1
λ	-0.678***	-0.453**	-0.585**	-0.570**	-0.646**	-0.438**
φ	0.027*	0.026*	0.032*	0.036*	0.029*	0.016
δ	-0.167***	-0.156***	-0.173***	-0.178***	-0.191***	-0.157***
r	0.261***	0.274***	0.277***	0.221**	0.224**	0.226**
τ	0.031*	0.032*	0.036*	0.034*	0.034*	0.028
Ω	0.128**	0.157***	0.168***	0.177***	0.179***	0.154***
ψ		0.221	0.385	0.395	0.399	0.512
ϱ			-0.263	-0.277	-0.296	-0.241
Γ				0.030	0.028	0.033
ξ					-0.001	-0.001
d						0.004
R^2	0.171	0.173	0.178	0.186	0.186	0.164

Notes: Data extracted from IMF Data Warehouse: www.elibrary.imf.org
* ** *** denote significance levels of 10%, 5%, and 1% respectively.

As the first step in the general model, some of the explanatory variables have been progressively reduced to a list of fewer variables via general-to-specific approach that are statistically significant at 0.10 (10%) level (see Table 17). As in Caggiano and Calice (2011), at the conclusion of the variable reduction process, three specific categories of variables are obtained which form three sets of indicators; real economy (i.e. GDP growth and interest rate), macro factors (i.e. current account and exports), and financial indicators (i.e. capital adequacy ratio and credit growth). The probit estimation results are set out in Table 17, the negative sign of the estimated coefficient on CAR implies that tighter capital and liquidity regulation can contribute positively to the bank's ability to prevent

a banking and/or financial crisis in the magnitude of the GFC or worse. Conversely, the positive sign on inflation and the real interest rates suggests that higher interest rates can trigger a rise in the probability of a crisis.

The results are in the expected direction, CAR (λ) is the most critical determinant of a banking crisis among ASEAN-5 banking sectors. The central banks of ASEAN-5 (stricter on the CAR rule than Basel Committee) require banks to meet a higher CAR ratio than mandatory under Basel III; therefore, banks across ASEAN-5 have at least two percentage point higher CARs than banks in the U.S., Europe, and Japan. The second most important indicator is the level of private credit as percent of GDP (φ); in an acute financial stress, excessive corporate leverage can lead to a cascade of defaults as observed during the Asian crisis in the late 1990s and repeated in the GFC exactly a decade later. GDP growth (δ) is in top three of a crisis' determinants; when growth shrinks relative to the baseline, it could be a sign of warning in some segments of the economy, adversely affecting consumption which in turn may cause a contraction in the economic activity. The last two indicators are changes in real interest rate and exports volume; a majority of ASEAN-5 transformed from export dependent to domestic consumption.

To see the effects of higher capital ratios, the marginal effect of a change was calculated in an explanatory variable via $\partial E(y_i|x_i,\beta)/\partial x_{ij} = f(-x_i'\beta)\beta_j$ where x_j is the j-th explanatory variable in vector of regressor and y_i is the dependent variable, $E(y_i|.)$ is the conditional expected value of y_i, β is the vector of parameters, and f(.) is the logistic function. Next, a simple OLS regression was run for the mapping of Tier 1 ratio to RWAs.

Similar to Angelini et al. (2011), MAG (2010), and BIS (2010); we investigate the cost impact of Basel III under three scenarios; first, we calculate the impact of a one percentage increase in the CET1/RWA ratio without liquidity tightening on GDP; second, we add a 25% increase in the liquidity requirement; and third, we increase the liquidity requirement to 50%. The main results (Table 4.25) suggest almost a linear correlation between the regulatory tightening under Basel III and increases in the level of steady state output. For a one percentage point increase in CET1/RWA without liquidity tightening, we estimate the average impact on steady state output across ASEAN-5 to be -0.33% (0.085% per annum). When we add a 25% liquidity requirement, fall in output increases by 33.3% to -0.44%. A 50% increase in liquidity leads to a bigger reduction of -0.54% in GDP growth which is more than 50% of the loss in output in the first scenario where no liquidity tightening is considered.

Table 18
Steady state output loss due to regulatory tightening

Increase in CET1/RWA	Rise in liquidity	Indonesia	Malaysia	Philippines	Singapore	Thailand	Average
%	%	(percentage deviation from baseline after a 4-year implementation)					
1	0	0.34	0.32	0.35	0.29	0.36	0.33
2	0	0.46	0.40	0.49	0.34	0.48	0.43
3	0	0.58	0.50	0.60	0.42	0.62	0.54
4	0	0.69	0.62	0.73	0.51	0.75	0.66
5	0	0.85	0.76	0.90	0.68	0.92	0.82
6	0	1.01	0.90	1.04	0.85	1.08	0.98
Median loss in output		0.64	0.56	0.67	0.47	0.69	0.61
1	25	0.45	0.42	0.46	0.38	0.47	0.44
2	25	0.56	0.51	0.58	0.46	0.55	0.53
3	25	0.74	0.68	0.81	0.63	0.76	0.72
4	25	0.93	0.82	0.98	0.77	1.00	0.90
5	25	1.05	0.98	1.11	0.92	1.15	1.04
6	25	1.22	1.14	1.29	1.08	1.30	1.21
Median loss in output		0.84	0.75	0.90	0.70	0.88	0.81
1	50	0.54	0.51	0.56	0.47	0.62	0.54
2	50	0.72	0.66	0.75	0.60	0.75	0.70
3	50	0.88	0.79	0.93	0.74	0.90	0.85
4	50	1.05	0.96	1.10	0.88	1.13	1.02
5	50	1.24	1.10	1.28	1.06	1.32	1.20
6	50	1.38	1.36	1.45	1.26	1.50	1.39
Median loss in output		0.97	0.88	1.02	0.81	1.02	0.94

This table reports summary results for the economic cost impact analysis of regulatory tightening on steady state output. The largest output loss (i.e. shrinkage in GDP growth) across ASEAN-5 is projected when the CET1 ratio is increased by 6 pp combined with an additional 50% liquidity requirement.

The key results of the impact analysis of economic cost due to regulatory tightening are set out in Table 18; according to which, the fall in steady state output increases considerably responding to each percentage point rise in the CET1 ratio. The cost of the Basel III capital regulation peaks at a 6 pp rise in regulatory capital, but the cost impact is more significant with an additional liquidity requirement of 25%. After four years of implementation, the results reveal that the economic cost of higher capital ratios to ASEAN-5 is a -0.33% shrinkage in GDP growth (or -0.09% per annum), but the size of loss in output compared to the baseline triples for a 6 pp rise in capital ratio. A 0.09% decline in GDP for annual basis is more than twice the estimate of a 0.04% fall in output found by Slovik and Cournède (2011) and MAG (2010). In the former study, the steady state output shrinks by -0.20% after five years of implementation; whereas in the later study, the horizon was four and a half years and the fall in output is estimated to be -0.19%. The cost of the new Basel III reforms are varied and disparate across ASEAN-5.

3.4 Economic benefit of Basel III on steady state output

The assessment of economic benefit is a bipartite analysis; first, we quantify the economic benefit resulting from a higher CET1 ratio (incremental increase of 1%) combined with reduced probability of crisis[13] (RPC); the result is expressed as a gain in steady state output. A 1 pp rise in the CET1 ratio with a 4.65% reduced probability of crisis (RPC) results in an average gain of 0.18% in output (i.e. GDP) after a four-year implementation; further, the gain in steady state output increases to 0.63% at 6 pp increase in CET1 in conjunction with a 2.5% RPC. The second analysis estimates the economic benefit due to the addition of NSFR as part of liquidity tightening[14]; the steady state output expands by 0.25% at 1 pp with 95% NSFR, which peaks at 1.09% at 6 pp with 100% NSFR. To determine the net economic benefit, the final analysis in this section takes into account all three assumptions; as such, higher CET1 (from 1% increase to 6%), RPC (from 4.65% worst scenario to 2.5% best scenario), and NSFR (rom 95% to 100%). We estimate net economic benefits across ASEAN-5 to be 0.49% at 1 pp rise in CET1 with 4.65% RPC and 95% NSFR; the gain in output reaches 1.74% at 6 pp with 2.5% RPC and 100% NSFR.

Table 19
Economic benefits due to reduced probability of crisis

Increase in CET1/RWA	Probability of crisis	Indonesia	Malaysia	Philippines	Singapore	Thailand	Average
%	%	(expected gain as % of GDP after a 4-year implementation)					
1	4.65	0.19	0.17	0.16	0.18	0.21	0.18
2	4.15	0.26	0.27	0.25	0.23	0.29	0.26
3	3.60	0.37	0.41	0.32	0.32	0.36	0.36
4	3.10	0.49	0.52	0.40	0.40	0.43	0.45
5	2.75	0.60	0.58	0.49	0.53	0.51	0.54
6	2.50	0.69	0.67	0.58	0.60	0.63	0.63
Median benefit		0.43	0.47	0.36	0.36	0.40	0.40

This table reports summary results for the analysis of economic benefits due to reduced probability of crisis. Economic benefits of higher capital and liquidity requirements under Basel III are calculated based on the assumption that the regulatory tightening reduces the probability of financial crisis because banks with strong capital positions will be better enabled to deal with the first several panic days in the event of a crisis, this is also expected to prevent funding freeze.

As illustrated in Table 19, we see that economic benefit due to higher capital ratios and liquidity regulation are larger than that of higher capital ratios and the resultant reduced probability of crisis. A 1 pp rise in the CET1 capital ratio along with 4.65 RPC result in an average gain of 0.18% in steady state output after four years of implementation, which is about 40% higher than the average gain of 0.25% in output generated by a 1 pp rise in the CET1 ratio in conjunction with 95% NFSR ratio. We estimate that the economic benefit across ASEAN-5 for a 6 pp rise in CET1 together with 2.5% RPC more than triples, a 0.63% gain in output as opposed to 0.18% at 1 pp rise in CET1 along with 2.5% RPC. The positive contribution of NSFR to the gain in output is larger than that

[13] We use 4.65% as the starting probability of a crisis to occur which is an approximate average of 5% (BIS, 2010), 5.2% (Reinhart and Rogoff, 2009), and 4.1% (Laeven and Valencia, 2008).
[14] Regulatory tightening refers to Liquidity Coverage Ratio (LCR) ≥ 100% and Net Stable Funding Ratio (NSFR) ≥ 100%

of PRC; for instance, when we increase CET1 ratio by two percentage points along with 4.15% PRC, the gain in steady state output increases from 0.18% to 0.26% (an increase of 44.4%); whereas, the steady state output expands by 0.39% at 2 pp rise in CET1 combined with 96% NSFR (an increase of 56%, from 0.25% to 0.39%).

Table 20
Economic benefits due to liquidity tightening

Increase in CET1/RWA	NSFR	Indonesia	Malaysia	Philippines	Singapore	Thailand	Average
%	%	(expected gain as % of GDP after a 4-year implementation)					
1	95.0	0.26	0.23	0.26	0.24	0.28	0.25
2	96.0	0.40	0.36	0.39	0.35	0.44	0.39
3	97.0	0.60	0.55	0.57	0.49	0.63	0.57
4	98.0	0.82	0.73	0.70	0.60	0.87	0.74
5	99.0	0.94	0.89	0.92	0.78	1.02	0.91
6	100.0	1.13	1.05	1.09	0.97	1.19	1.09
Median benefit		0.71	0.64	0.63	0.55	0.75	0.66

This table reports summary results for the analysis of economic benefits due to liquidity tightening. Short-term (LCR) and long-term (NSFR) liquidity standards are introduced to strengthen banks' ability to manage risk exposures related to counterparty default. Basel III requires banks to have sufficient amount of stable funding to take care of required stable funding over 1-year horizon, this is also expected to alleviate maturity mismatches.

Our estimate of gain in steady state output is considerably larger in the analysis that combines three scenarios as opposed to individual analysis of the economic benefits of RPC and NSFR. The economic benefit peaks at 6 pp rise in CET1 with 2.50% RPC, 6 pp with 100% NSFR, and 6 pp with 2.5% RPC and 100% NSFR which we call this the combined scenario (0.63%, 1.09%, 1.74% respectively).

Table 21
Economic benefits due to regulatory tightening

Increase in CET1/RWA	Probability of crisis	NSFR	Indonesia	Malaysia	Philippines	Singapore	Thailand	Average
%	%	%	(expected gain as % of GDP after a 4-year implementation)					
1	4.65	95.0	0.51	0.47	0.49	0.44	0.53	0.49
2	4.15	96.0	0.82	0.78	0.72	0.63	0.75	0.74
3	3.60	97.0	1.13	1.03	0.94	0.79	1.07	0.99
4	3.10	98.0	1.45	1.34	1.19	1.03	1.38	1.28
5	2.75	99.0	1.64	1.53	1.44	1.26	1.64	1.50
6	2.50	100.0	1.82	1.70	1.74	1.54	1.89	1.74
Median benefit			1.29	1.19	1.07	0.91	1.23	1.14

This table reports summary results for the combined analysis of economic benefits due to regulatory tightening. The analysis takes into account the three assumptions; higher CET1 ratio, RPC, and NSFR. Economic benefits due to regulatory tightening across ASEAN-5 are the highest at 6 pp increase in CET1 along with 2.5% PRC and 100% NSFR.

The main results of the net benefits analysis (see Table 22) show that both costs and benefits due to regulatory tightening increase in proportion to the increments of increases in the regulatory capital and liquidity requirements. After a four-year implementation, the fall in steady state output due to a 1 pp rise in the CET1 is 0.33% on average and the benefit in terms of a gain in output during the same period is 0.49%; as a result, the net benefit is 0.16% (or 0.04% per annum). The annual net benefit nearly doubles (0.08%) for a 2 pp rise in the CET1 ratio. The amount of net benefits is reduced substantially when we add a 25% liquidity requirement in addition to a 1 pp rise in the CET1 ratio results in even a bigger loss in steady state output (0.39%) which reduces the net benefit to 0.10%. A 50% liquidity requirement causes a further reduction in the net benefit which is reduced to 0.02% after deducting a 0.47% cost. The results of the analysis shows that there is a positive correlation and almost a linear relationship between regulatory tightening and economic performance underpinned by reduced probability of crisis and NSFR.

Both levels of costs and benefits increase in proportion to rising capital and liquidity levels. The net benefit peaks at 6 pp increase in the CET1 ratio, at which level, the average cost impact of Basel III on output is 0.98% and the benefit is 1.74%; bringing the final net benefit figure to 0.76%. These estimates may not reflect the actual events.

Table 22
Net economic benefits due to regulatory tightening

CET1 RWA	benefit* cost**	Indonesia	Malaysia	Philippines	Singapore	Thailand	Average	Net benefit
		(Net benefit as % of GDP after 4-year implementation)					%	%
1	benefit	0.51	0.47	0.49	0.44	0.53	0.49	0.16
	cost	0.34	0.32	0.35	0.29	0.36	0.33	
2	benefit	0.82	0.78	0.72	0.63	0.75	0.74	0.31
	cost	0.46	0.40	0.49	0.34	0.48	0.43	
3	benefit	1.13	1.03	0.94	0.79	1.07	0.99	0.45
	cost	0.58	0.50	0.60	0.42	0.62	0.54	
4	benefit	1.45	1.34	1.19	1.03	1.38	1.28	0.62
	cost	0.69	0.62	0.73	0.51	0.75	0.66	
5	benefit	1.64	1.53	1.44	1.26	1.66	1.51	0.68
	cost	0.85	0.76	0.90	0.68	0.92	0.82	
6	benefit	1.82	1.70	1.74	1.54	1.89	1.74	0.76
	cost	1.01	0.90	1.04	0.85	1.08	0.98	

This table reports summary results for the analysis of net economic benefits due to regulatory tightening, computed by subtracting economic costs from economic benefits. * Benefit calculations include a reduced probability of crisis and NSFR conditions. ** The cost is the output loss due to higher capital requirements without tighter liquidity rules.

The MAG (2010) study assesses the macroeconomic impact of the regulatory tightening under Basel III and measures the cost that banks would have to incur making the transition to rigorous capital and liquidity standards. In the analysis, the impact of a 1 pp rise in the CET1 ratio and the resultant deviation from the baseline scenario is assessed over the four-year implementation period. The results indicate that economies are likely to incur transitional costs arising from regulatory tightening, but the negative impact is expected to alleviate in the long-run. The main findings of the study reveals the US Federal Reserve's FRB/US model results in the largest impact.

Table 23
Varying impact of Basel III due to modelling approach

	ECB MCM Model	ECB CMR Model	Federal Reserve FRB/US Model
Without monetary policy			
Increase in spreads only	-0.08%	-0.29%	-0.79%
Increase in spreads due to changes in lending standards	-0.19%	--------	-0.89%
With monetary policy	-0.16%	-0.25%	-0.31% to -0.36%

Source: MAG (2010)

This table reports summary statistics for three different modelling approaches. MCM model: Multi-country model with endogenous policy; CMR model: Medium-to-large DSGE model; FRB/US model with endogenous monetary policy. The cost impact of Basel III capital and liquidity regulation differed depending on what modelling approach was employed. The approach used by the Federal Reserve resulted in the largest impact.

We perform a K-S test to statistically analyze the estimates obtained from the analysis of output gain due to higher capital ratios and the assumed reduced probability of crisis. Each 1 pp rise in the CET1 ratio corresponds with a reduced probability rate of crisis; as such, RPC1pp denotes reduced probability of crisis at 1% rise in the CET1 with 4.65% reduced probability of crisis, RPC2pp: 4.15%, RPC3pp: 3.60%, RPC4pp: 3.10%, RPC5pp: 2.75%, and RPC6pp: 2.5%. The assumption of normality is met since all *p*-values are greater than the significance

alpha (i.e. p = 955 > 0.05). Therefore the analysis fails to reject the null hypothesis and concludes that the groups' means in output gain are not significantly different than normal (see Table 24).

Table 24
Kolmogorov-Smirnov test of reduced probability of crisis

		RPC1pp	RPC2pp	RPC3pp	RPC4pp	RPC5pp	RPC6pp
N		5	5	5	5	5	5
Normal Parameters	Mean	.1820	.3560	.2600	.4480	.5420	.6340
	Std. Dev.	.01924	.03782	.02236	.05450	.04658	.04615
Most Extreme Differences	Absolute	.141	.229	.127	.229	.202	.182
	Positive	.141	.229	.127	.229	.202	.169
	Negative	-.127	-.171	-.127	-.189	-.193	-.182
Kolmogorov-Smirnov Z		.316	.513	.285	.513	.451	.408
Asymp. Sig. (2-tailed)		1.000	.955	1.000	.955	.987	.996

This table reports summary statistics for the analysis of reduced probability of crisis using Kolmogorov-Smirnov test. The data of economic benefit due to Basel III higher capital and reduced probability of crisis is normally distributed, and the analysis fails to reject the null hypothesis as all the p values > .05.

We perform another K-S test to analyze the benefits of tighter liquidity regulation (i.e. NSFR) expressed as a gain in steady state output (see Table 25). Similar to the first K-S test, the net stable funding ratio (NSFR) corresponds with increments of a 1 pp rise in the CET1/RWA ratio. As such, NSFR1pp represents a 1 pp rise in the CET1 ratio at 95% NSFR, NSFR2pp: 2 pp at 96%, NSFR3pp: 3 pp at 97%, NSFR4pp: 4 pp at 98%, NSFR5pp: 5 pp at 99%, and NSFR6pp was 6 pp at 100%. The results of the K-S test indicates that all Sig. p values are greater than the alpha level (i.e. p = .968 > 0.05). The null hypothesis is retained and concluded that the difference in groups' means is not significant. The extent of the contribution of NSFR to output gain is higher than that of the RPC because the probability of a future crisis could be reduced to a degree, but never eliminated.

Table 25
Kolmogorov-Smirnov test of net stable funding

		NSFR1pp	NSFR2pp	NSFR3pp	NSFR4pp	NSFR5pp	NSFR6pp
N		5	5	5	5	5	5
Normal Parameters	Mean	.2540	.3880	.5680	.7440	.9100	1.0860
	Std. Dev.	.01949	.03564	.05310	.10550	.08718	.08295
Most Extreme Differences	Absolute	.221	.184	.167	.164	.209	.132
	Positive	.179	.184	.129	.153	.165	.119
	Negative	-.221	-.143	-.167	-.164	-.209	-.132
Kolmogorov-Smirnov Z		.494	.411	.374	.368	.468	.295
Asymp. Sig. (2-tailed)		.968	.996	.999	.999	.981	1.000

This table reports summary statistics for the analysis of net stable funding using Kolmogorov-Smirnov test. The first assumption of normality is met and the null hypothesis is retained. It is concluded that the difference in means of economic benefit across ASEAN-5 is not statistically significant. A parametric test such as paired samples test is conducted to further test the contribution of RPC and NSFR to economic benefit.

To investigate the nature of relations between higher CET1 ratio combined with RPC or NSFR, we perform paired samples t test. The paired samples correlations confirm that the economic benefit due to higher capital and liquidity tightening is more significant in pairs containing higher CET1 and NSFR. A negative correlation (-0.092) with a high Sig. p (.883 > 0.05) shows that the effect of 1 pp rise in the CET1 in conjunction with 95% NSFR and 4.65% RPC is substantially smaller than the scenario where CET1 ratio increases by 6 pp along with 100% NSFR and 2.50% RPC. The groups' means clearly illustrate that the contribution of reduced probability of crisis to economic benefit is less than that of NSFR, and the mean differences increase substantially after the initial 1 pp rise in the CET1. The economic benefit from a 6 pp rise in the CET1 ratio with 100% NSFR is the largest. Looking at the observed t-statistic in pair 1 (see Table 26), t = -9.798, and the Sig. p = .001; we conclude that the probability of this result occurring by chance is extremely small under the null hypothesis of no difference. Therefore, the null

hypothesis is rejected since all Sig. *p* values are greater than 0.05. In pair 6, the mean of negative -0.45200 and the t-statistic of negative -12.284 with $p = .000 < .05$ indicate that the size of economic benefit in terms of gain in output is substantially high for a 6 pp rise in the CET1 ratio combined with 100% NSFR (or higher).

Table 26
Paired samples test of economic benefit

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	RPC1pp & NSFR1pp	-.07200	.01643	.00735	-.09240	-.05160	-9.798	4	.001
Pair 2	RPC2pp & NSFR2pp	-.12800	.02387	.01068	-.15764	-.09836	-11.988	4	.000
Pair 3	RPC3pp & NSFR3pp	-.21200	.05495	.02458	-.28024	-.14376	-8.626	4	.001
Pair 4	RPC4pp & NSFR4pp	-.29600	.09813	.04389	-.41785	-.17415	-6.745	4	.003
Pair 5	RPC5pp & NSFR5pp	-.36800	.10257	.04587	-.49535	-.24065	-8.023	4	.001
Pair 6	RPC6pp & NSFR6pp	-.45200	.08228	.03680	-.55416	-.34984	-12.284	4	.000

This table reports summary statistics for the analysis of economic benefit using paired samples. The results indicate that the null hypothesis is rejected since all *p* values (.001, .000, .001, .003, .001, and .000) < .05; it is concluded that the difference in means is statistically significant. This means that the difference in means of contribution to economic benefit between RPC and NSFR is statistically significant.

5. Discussion

Basel Committee's endorsement of Basel III as a replacement for Basel II has induced a plethora of studies making attempts to forecast any potential long-term effects of Basel III higher capital and liquidity requirements on bank capital, lending spreads, and steady state output. Advances in theoretical knowledge in the field of Basel III have brusquely focused on advanced economies, ignoring developing nations and emerging markets including ASEAN-5. In that regard, the findings of this study should be of significant interest to various industry participants. Our estimates are broadly consistent with those found in recently published studies, nonetheless they may or may not reflect the actual developments or the views of Malaysia's central bank and/or supervisory authorities.

Two integral components of a financial system are stable banks and stable markets that are also prerequisites for a normal-functioning banking sector (i.e. Crockett, 1997), Borio (2003) calls this *twin stability*. Monetarists Friedman (1968), Bernanke (1995), and Eichengreen (2002) contend that prolonged expansive monetary policies promote financial stability. Kindleberger (1978) and Minsky (1977) warn about possible adverse effects of cyclical excess that has the ability to inflict financial instability. Basel II and III standards are a regulatory consequence following two major crises in systemic nature, the homegrown Asian crisis of 1997-98 and global financial crisis of 2007-08. The propagation of high-magnitude financial crises since the late 1990s has made the adoption and implementation of the Basel III standard a central focus across ASEAN-5. The latest unprecedented crisis (i.e. GFC), worst in financial history, has unmistakably proved that structural weaknesses can be extremely costly due to interconnectedness of banking sectors worldwide, thorough which financial instability can spread contagiously.

Basel III promotes banking resilience by providing coverage in all aspects of a banking operation, the rules of which apply to both domestic and internationally active banks. A series of measures has been introduced under Basel III to correct fundamental deficiencies of the earlier Basel standards. Going forward, the assessment of credit and market risks are no longer based on simplistic historical statistical correlations. Therefore, Basel III addresses mark-to-market counterparty credit risk, credit valuation adjustments and wrong-way risk (see BCBS, 2010).

Estimates of the Basel III impact analysis found in the literature are comparatively varied due, in most part, to study-specific methodologies, diverse implementation horizons, and differing assumptions. This study consists of multiple analyses; first, we quantify the impact of Basel III on bank capital. Taking the capital increases since the Asian crisis of 1997-98 into account, we conclude that most ASEAN-5 banks are well capitalized and except smaller Islamic and rural banks there is no need for recapitalization (i.e. the central banks of ASEAN-5 require banks to meet at least two percentage point higher capital ratios than required by Basel III). Second, we estimate the impact of a one percentage point increase in the CET1 ratio on lending spreads. Our findings indicate that in order to meet the Basel III higher capital requirements effective as of 2015, ASEAN-5 banks will have to increase their lending spreads on average by 30 bps four years after the implementation (2015). The estimates presented in this study are twice the estimates by MAG (2010), Slovik and Cournède (2011); 15 bps and 14.4 bps respectively. The estimates of the IIF (2011) study are off the chart, markedly higher than the assessments found among recently published studies. The IIF's results show a rise in lending spreads on average of 320 bps four years after the implementation (i.e. 468 bps in the U.S., 291 bps in Europe, and 202 bps in Japan), this is by far the biggest impact estimate, and it is even more than 10 times as much as the estimate presented in this study.[15] To meet the Basel III enhanced requirements fully enforced as of 2019 ASEAN-5 banks will have to increase their lending spreads on average by 68 bps, this is also considerably higher than the Slovik and Cournède's assessment of 51 bps involving three main OECD economies (64 bps by the U.S., 54 bps by EU, and 35 bps by Japan).[16]

There is a widespread consensus among the industry participants that virtually all banks will be subject to a degree of adverse impact arising from the new Basel III rules, but the extent of its effects on the broader economy is unknown due to the amount of uncertainty surrounding the macroeconomic effects of the regulatory tightening for banks. The economic cost of Basel III on steady state output (i.e. annual GDP growth) presented in this study is in the range of -0.33% (-0.08% per annum) to -0.94% (-0.24% per annum) after four years and eight years of implementation compared to the baseline, which is 60% more than the estimates of -0.05% to -0.15% by Slovik and Cournède (2011), and about 3 to 5 times as much as the MAG's assessment of -0.03% to -0.05%. In terms of GDP effects, the estimates presented in the BIS and MAG studies are on the high conservative side. For instance, the BIS estimates that a 1% rise in the CET1 ratio results in on average -0.09% loss in steady state output across countries. On the other hand, the MAG study suggests that loss in long-run GDP peaks at -0.22% compared to the baseline three years after the start of implementation and improves to -0.13% after 12 years.

IIF (2011) argues that the capital and liquidity reforms under Basel III will reduce bank profits as banks going forward will be subject to higher cost of capital. Against this backdrop, banks are assumed to pass on a portion of their increased cost of funding to private sector by raising interest rates on credit or reducing credit volume. The confluence of bank actions along with monetary policy responses might lead to a contraction restraining growth. The IIF also asserts that increased liquidity (both in quality and quantity) in the form of capital conservation buffers (i.e. 2.5% of RWAs) will increase banking resilience and make banks be less prone to financial crises. According to Basel Committee (BCBS, 2010) stronger capital and liquidity requirements will enhance financial stability. Yan et al. (2011) estimate the temporary net benefit and permanent net benefit on the UK economy to be 0.34% and 14.32% of pre-crisis GDP respectively. The BIS (2010) study estimates that a three percentage point rise in the CET1 ratio (from 7% to 10%) will reduce the probability of future crises by 70%.

Despite that recent studies brusquely focus on the long-term effects of Basel III, we attempt to measure any potential economic benefits of these reforms expressed as gain in steady state output. The underlying basis of our Basel III economic benefits analysis is that Basel III higher capital and liquidity requirements in the long-run make the global banking system more resilient and less prone to costly financial crises with unthinkable disruptions to foregone output. Furthermore, higher capital ratios along with conservation buffers and tightened liquidity (NSFR) will lead to fewer output volatility, all of which and more is assumed to produce positive impact on welfare. This study's main results highlight that our estimated economic benefits in the combined scenario (i.e. higher capital, reduced probability of crisis, and tightened liquidity) outweigh economic costs across ASEAN-5.

[15] The IIF's impact estimates modestly improve on average to 251 bps eight years after implementation (i.e. 243 bps in the U.S., 328 bps in Europe, and 181 bps in Japan).

[16] The relationship between lending spreads and bank capital presented in this study is consistent with the estimates of other key studies. Elliot et al. (2012), using a simple loan pricing model, estimate lending spreads to increase on average by 18 bps (28 bps in the U.S., 18 bps in Europe, and 8 bps in Japan). These results are quite similar to the assessment of 14.4 bps on average found in the Slovik and Cournède study; 21 bps in the U.S., 14 bps in Euro area, and 8 bps in Japan. Miles et al. (2011) investigate the Basel III effects on the UK economy; instead of a 1 pp rise in the CET1 ratio, CET1 is increased by two percentage points and the authors estimate 18 bps rise in lending spreads.

In this final section of our analysis, the estimates of both costs and benefits due to regulatory tightening under Basel III tend to increase in proportion to increments of a one percentage point increases in the CET1 ratio alone with NSFR. After four years of implementation, we find that a 1 percentage point rise in the CET1 ratio results in a shrinkage in GDP growth of -0.33% on average below its baseline (-0.08% per annum); we also estimate that the benefit arising from the Basel III capital and liquidity rules plus reduced probability of crisis (RPC) is a gain of 0.49% pre-crisis GDP (0.12% a year); as a result, the net benefit is 0.16% pre-crisis GDP (or 0.04% per annum). The economic benefits nearly double (0.31%) when the CET1 ratio increases by 2 percentage points coupled with 96% NSFR and reduced probability crisis rate of 4.15%. The net benefit climaxes when CET1 rises by 6 pp plus 100% NSFR and 2.5% RPC; at which level, the decline on GDP growth on average reaches -0.98% below its baseline and the benefit in the same scenario is 1.74%, bringing the net benefit figure to 0.76% (0.19% per annum).

6. Conclusion

Financial crisis due to bank failures is nothing of new and won't be the last time. Contemporaneous crises in systemic nature have become increasingly costly, more damaging, and longer lasting. The latest crisis has proved that financial crises over four decades have succeeded themselves with depressing consistency and intensity. Basel III, same as the predecessors, is an anticipated reactionary response by the authorities because unprecedented crises require equal measures in order to restore confidence in the financial system and its components. This time and before, in the immediate aftermath of a major financial crisis promises from many sources thrown in the air, but when the panic recedes and the confidence is restored temporarily, people quickly forget until the next big crisis.[17]

There is plethora of studies focusing on the cost impact of Basel III, but estimates presented in these studies including ours are varied and disparate. Due to momentous uncertainty surrounding Basel III, we feel that the time will attest whether the Basel III standard, as stated by the Basel Committee, will promote global banking resilience or contribute to global banking frailty. The scorecard in this connection is poor; for example, the simplistic risk approach of Basel I encouraged greater risk-taking and its insensitiveness to credit risk caused distortions in cross-border lending. Basel I also paved the way for the creation of *shadow banking* as internationally active banks were allowed to move higher-risk-weight assets between on-and off-balance sheet via securitization. Basel II on the other hand had the primary objective of enhancing risk coverage; instead, it caused the amplification of cyclical lending, increased procyclicality, and exacerbated boom-and-bust cycles. Probably the most paramount deficiency of Basel II was that it made banks heavily rely on ratings given by the ECAIs which not only resulted in a *cliff effect* in capital requirements but played a major crisis-intensifier role during the GFC.

Although a great majority of industry participants pay enormous attention to the Basel III higher capital and liquidity requirements, Basel III is more than just these two rules. It is about creating a solid banking culture (*credit culture* in particular) where the management of risk is underpinned by prudent and consistent accounting practices. Another misperception among some bank executives is that financial ratios are a sufficient way of measuring risk and good supervision will prevent banks from inventing loopholes to circumvent regulation; on the contrary, the use of ratios is an imperfect measure of riskiness unless it is complemented by analytical tools such as stress testing and stressed VaR, plus even the best supervision is no substitute for an internally developed comprehensive risk management framework. The conclusion of this study is in line with that of Basel Committee; countercyclical capital buffer will reduce procyclicality and higher capital and liquidity requirements will help banks to absorb losses in an acute financial stress, this in turn will produce positive net benefits.

Even though the five founding members of ASEAN-5 have made remarkable strides in bringing respective domestic banking sectors in line with the international standards, they must continue with structural reforms because each member country is still at varying degrees not immune to exogenous shocks originated in the U.S., Europe, and Japan. In recent memory, the taper tantrum of May followed by the August rout in 2013 rattled the currency markets across ASEAN-5 causing their currencies to depreciate significantly against the U.S. dollar.

[17] 1970s: Energy crisis, OPEC oil price shock, and banking crisis in Europe led to the establishment of the Basel Committee in 1974. 1980s: Latin America debt crisis, Japanese asset price bubble, and US stock market crash (Black Monday of 1987) led to the introduction of Basel I in 1988. 1190s: Scandinavian banking crises, Mexican peso crisis, Asian currency crisis, Russian ruble crisis, and Argentina economic crisis led to the announcement of Basel II (Revised Framework). 2000s: Dot.com bubble (and its burst), US mortgage debacle, subprime global financial crisis (GFC), and European sovereign debt crisis led to the announcement of Basel III (fully effective by January 2019).

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