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The Cost of Doubling Bank Capital in ASEAN-5

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Abstract

This paper quantifies the effect of doubling bank capital in ASEAN-5. This means doubling the percent of equity of total assets from just below 10 percent to 20 percent, or halving the leverage ratio from just above 10 to 5. As equity is more expensive than debt, increasing bank capital increases the cost of doing business which decreases investment and which decreases aggregate output. Hence, the main cost of doubling bank capital is it decreases aggregate output. The question is whether the cost is worthy of spending and the usual answer depends on the benefit. Where benefit is the expected loss that the economy avoids from financial crises and where there is absence in historical data, estimation of benefit is not possible. Still, comparing the cost of doubling capital with one's confidence of financial crisis not happening in a determined number of years can give one the idea whether the cost is worthy of spending.

Keywords*: Bank, Capital, Leverage Ratio, Cost, Financial Crisis*

Introduction:

The recent US and European financial crises have highlighted the role of banks as root cause of past and recent financial crises (Blyth, 2013, Rogoff and Reinhart, 2011, and Schularik and Taylor, 2012). Consequently, proposals have been made so that history does not repeat itself. Such proposals include not bailing out banks so that the consequence of banks' failure is not passed on to government (Blyth, 2013), making examples of those responsible of the crisis by punishment, by limiting bank activities otherwise known as narrow banking, and by making banks stronger by macro prudential financial regulation for example by raising bank capital. The proposal that this paper focuses on is raising capital to the tune of 20 percent equity of total assets or to the tune of a leverage ratio (total asset/equity) of 5 as proposed by Admati and Hellwig (2013). Considering that the general level of capital in the ASEAN-5 is close to 10 percent equity of total assets or a leverage ratio of 10, raising capital to 20 percent equity of total assets amounts to doubling bank capital.

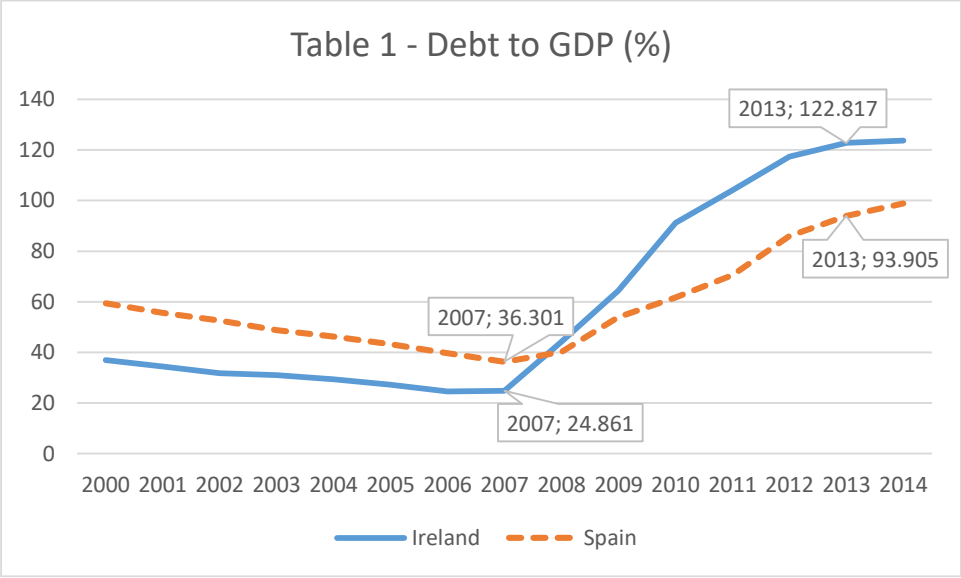
Equity being more expensive than debt will increase banks' cost of doing business which consequently decreases investment and which consequently decreases aggregate output. Hence, the main cost of doubling capital is decreasing aggregate output. This paper estimates the cost of doubling capital in ASEAN-5 mostly using Miles et al (2012) methodology. To make more meaning of the cost usually requires its comparison with benefit. Where benefit is the expected loss the economy avoids from financial crises and where there is absence in historical data on ASEAN-5, estimation of benefit is not possible. To give meaning to the cost in terms of its worthiness, the annual decrease in aggregate output is accumulated to determine the number of years the accumulated loss would match the loss from the 1998 Asian Financial Crisis. The confidence that another Asian Financial Crisis not happening in the determined number of years gives an idea whether the cost of doubling capital is worthy of spending.

The rest of the paper is ordered as follows. Section I (Events and Literature) sets the premise that recent financial crises are rooted from bank failures. The premise sets the motivation to find solutions. The solution of main interest is raising capital, hence a brief review of literature regarding raising capital is provided. Section II (Methodology) explains how the cost of raising capital is estimated. The methodology basically follows the cost side of the cost-benefit analysis that Miles et al (2012) implemented. Section III (Data and Results) implements the methodology explained in the previous section. Each step acknowledges the source of data and shows the result. It puts meaning to the result by expressing that the cost of raising capital is worthy of doing or otherwise depending on the expected frequency of future financial crises. This paper closes with a conclusion.

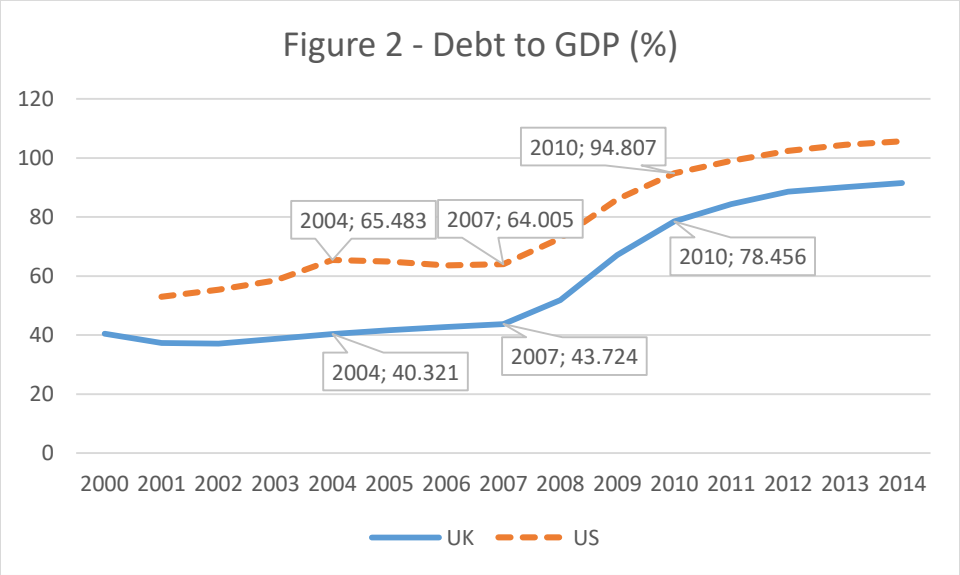
Events and Literature:

In the early 2000s, the European Central Bank's close to zero interest helped funded banks' real estate ventures in Ireland and Spain (Blyth, 2013, p. 66). Consequently, the three biggest Irish banks combined assets reached equivalent to 400 percent of Ireland's GDP, and Spanish *cajas de ahorros* or the regional savings banks akin to credit union had extended their loans to equivalent to 200 percent of Spain's GDP. When the credit crunch came, the respective governments treated

the said institutions as too big to fail and bailed them out (Blyth, 2013, p. 66). In Figure 1, the debt to GDP ratio taken from the IMF are shown. From 2000 to 2007, the GDP ratios of Ireland and Spain healthily decreased to 25 percent and 36 percent respectively. With governments borrowing to finance the bailouts, from 2008 or the beginning of the global financial crisis to 2013, the said ratios increased to 123 and 94 percent respectively.



It must be emphasized that what happened to Ireland and Spain were just microcosm of events happening in the biggest financial centers. In Figure 2, the debt to GDP ratio of the US and the UK taken from the IMF are shown. From 2004 to 2007, the debt to GDP ratios were not as healthy as those of Ireland and Spain though steady. As in Ireland and Spain, the ratios in the UK and the US turned weaker beginning in 2008. The financial crisis started the increase of Portugal-Ireland-Italy-Greece-Spain's (PIIGS) debt when they bailed out the banks, lost revenue due to recession and spent to stimulate their economies (Blyth, 2013, p. 46). Rogoff and Reinhart's (2011) concurs that the recent public debt explosions occurred immediately after the banking crises. Generalizing not just on the recent crises, Schularick and Taylor (2012) shows that sovereign-debt crises are almost always "credit booms gone bust;" that is private sector credit crisis causes sovereign debt crisis.



Blyth (2013, p. 46) argues that the reference to recent "sovereign debt crisis" on its own is a misnomer and that the more accurate description is "banking crisis first and sovereign debt crisis second." So Blyth proposes that if banking crisis hits, governments do not bail out banks so that banking crisis does not become a sovereign debt crisis. Blyth examples the case of Iceland. However, Chan (2015) argues that this cannot be the solution to too big to fail banks on a global scale. While allowing too big to fail banks in Iceland would be devastating to the national economy, doing the same for "US or UK banks would have been devastating for the rest of the world." What is clear is that whether of national or global scale, not bailing too big to fail banks would be devastating.

So what defines a too big to fail bank? A reasonable definition is any bank having total assets equivalent to 2 percent of GDP. The failure of Bear Stearns in March 2008 was the harbinger to the 2008 US financial crisis. Bear Stearns with its approximate asset of just *over* $300 billion was equivalent to 2 percent of the US GDP, and the Federal Reserve Bank of New York (FRB-NY) ended bailing it out on the basis of too big to fail argument. In September 2008, the failure of Lehman Brothers became apparent. Lehman Brothers with its approximate asset of just *under* $300 billion was also equivalent to 2 percent of the US GDP, yet the federal government did not bailout the bank. Still Geithner (2014) who was then governor of the FRB-NY in his memoir claimed to have tried but failed to bailout Lehman Brothers. More importantly, everything after, the US government started treating any failure of a bank close to the size of Lehman's assets as too big to fail.

Table 1 – Biggest Banks in ASEAN-5

Bank	Asset to GDP (%)	Equity to Asset (%)	Bank	Asset to GDP (%)	Equity to Asset (%)
Indonesia			Philippines		
Bank Mandiri	8.1	12.0	BDO Unibank Group	14.7	9.6
Bank Rakyat	7.6	12.1	MetroBank	12.7	9.4
Bank Central Asia	5.2	14.1	BPI	11.5	10.1
Bank Negara	4.0	14.6	Land Bank of the Ph.	7.4	9.7
Malaysia			PNB	4.9	15.8
Maybank	57.8	8.5	Dev't Bank of the Ph.	3.7	9.5
CIMB Group Holdings	37.4	9.3	China Bank	3.7	12.0
Public Bank	31.2	8.4	RCBC	3.6	11.6
RHB Capital	19.8	8.6	Union Bank	3.5	12.5
Hong Leong Fin. Grp.	15.4	8.5	Security Bank	3.1	12.1
AMMB Holdings	12.0	10.6	Singapore		
United Ov. Of My.	8.5	7.6	Dev't Bank of Sing.	113.1	9.1
OCBC Bank	8.3	6.6	OCBC Group	103.0	8.5
Bank Rakyat	8.1	14.3	United Ov. Bank Sing.	78.7	9.7
HSBC Bank	7.5	8.4	Thailand		
Affin Holdings	5.4	8.7	Bangkok Bank	20.9	11.7
Std Chartered Bank	4.9	7.8	Krung Thai Bank	20.8	8.5
Alliance Fin. Grp.	4.3	8.7	Siam Commercial	20.5	10.6
Bank Islam	4.1	8.1	Kasikorn Bank	18.1	11.7
Citibank	3.3	11.5	Bank of Ayudhya	9.2	10.8
Bank Simpanan	3.0	7.2	Thanachart Bank	7.8	10.2
			TMB Bank	6.1	8.6

An aggressive definition is any bank having total assets equivalent to 0.3 percent of GDP. The Dodd-Frank Wall Street Reform and Consumer Protection Act uses $50 billion of total assets as a threshold for systemic importance and $50 billion is approximately 0.3 percent of the US GDP. A conservative definition of a too big to fail bank is one with total assets equivalent to 3 percent of GDP. In Table 1, the list of banks in ASEAN-5 with asset to GDP ratio of at least 3 percent are shown. While asset to GDP ratio is probably not the only and exclusive indicator of a too big to fail institution, the 3 percent conservative threshold hints that these banks are big enough to be considered of systemic importance.

The alternative solution to no bailout is in the first place to avoid future banking crisis from happening. One way to do so is to make examples of those responsible in the past e.g. by making incompetent, negligent or reckless bankers and even economists accountable of past crises. While this paper does not go into accusing any individual or group for some accountability, one such

outlet that calls for some accountability is the 2010 documentary picture *Inside Job* directed by Charles H. Ferguson which won the 2010 *Academy Award* for Best Documentary Feature. Another way to avoid future banking crisis is to apply what is generically referred to as *narrow banking* where regulators restrict banks' market activities. For example in September 2008, the US Securities and Exchange Commission banned abusive naked short selling or selling of assets without actually having them in possession (SEC, 2009). Another example is Stiglitz' (*Bloomberg*, 2009) proposal to outlaw large banks from dealing in financial derivatives. In narrow banking, if banks are not allowed to participate in certain market activities, they cannot use such market activities to cause bad but also cannot use such to cause good. Still, Beltratti and Stulz (2012) find that banks under the jurisdiction of stricter regulation on bank activities such as securities market activities is associated with better stock returns.

Another way to avoid future banking crisis is through macro prudential financial regulation. Hanson et al (2011) propose several ways to do this but the one which this paper focuses on is for requiring banks to raise capital. Admati and Hellwig (2013) provide an academic work for general public reading that champions for requiring banks to raise capital. Martynova (2015) provides an informative survey of literature on this particular issue. Related to jurisdictions with depositors' insurance like the Philippines, depositors do not price banks' assets' fully and banks do not internalize asset losses fully which distorts the incentive making banks take more risk; thus, requiring banks to raise capital increases banks stake which in effect corrects the incentive making banks take less risk (Rochet, 1992; and Furlong and Keeley, 1989). Banks with higher capital have significantly lower market risk and stock return volatility (Kashyap et al, 2010), have less financial fragility (Diamond and Rajan, 2000), are "better able to withstand extremely diverse conditions" (De Jonghe, 2010, p. 387), and suffer less from the debt overhang problem (Myers, 1977).

Admati and Hellwig (2013) even argue that when banks with insufficient capital are in trouble, the insufficiency creates an incentive for the said banks to "gamble for resurrection" (Myerson, 2104, p. 201). In addition, by raising capital "the probability of investment losses large enough to affect the depositors becomes smaller" (Myerson, 2014, p. 199). The reason is that higher capital increases the buffer from adverse shocks. When an adverse shock causes the value of assets to decrease, it takes a greater decrease in asset value before the shock threatens to decrease the value of liability (Admati and Hellwig; and Dewatripont and Tirole, 1994). Consequently, those with higher capital in 2006 performed better in terms of stock returns in the 2008 global financial crisis (Beltratti and Stulz, 2012).

How much capital is enough to avoid future banking crisis? Miles et al (2012) use cost-benefit analysis and finds that the optimal bank capital should be around 20 percent of risk weighted assets (RWA). "If RWAs are between one half and one third of total assets" (p. 30), then this translates to 6.67 to 10 percent equity of total assets. Note that this finding assumes away catastrophic events like war and major political turmoil that are probably unreasonable to expect in a G-20 country. While it is probably unreasonable to factor in war in ASEAN-5 in the next 50 years, it is not unreasonable to factor in political turmoil. Miles et al find that the optimal bank capital should catastrophic events be included in the analysis is 45 percent of RWA which translates to 15 to 22.5 percent equity of total assets. Finally, Miles et al define that "generalized banking crisis is as large as their equity capital" which they claim conservative "as the early failure of less-capitalized institutions would be likely to freeze funding markets well before the sector as

a whole falls negative into equity" (p. 24) which makes their founded optimal bank capital conservative.

Hanson et al (2011) propose a time-varying capital requirement. Here, regulation requires banks to maintain higher capital in good times than in bad times. This way, banks are given leniency in bad times lessening the pressure for them to downsize its assets and giving them time to recapitalize. In Hanson et al citing the IMF (2010), cumulative credit losses of US banks from 2007 to 2010 were in the order of 7 percent of total assets. If the market standard for capital in bad times is 8 percent equity of total assets, they suggest that requiring capital of 15 percent equity of total assets in good times would be reasonable.

Admati and Hellwig (2013) also cited in Myerson (2014) propose between 20 and 30 percent equity of total assets. The basis of the proposal is historical when banks typically had equity worth 25 percent of total assets in the early twentieth century when there were still no deposit insurance. The reason is that 25 percent equity was the market determined equity had there been no distortion brought about by deposit insurance to banks' and depositors' preference over risk. Note: it is not to suggest to eliminate deposit insurance for Diamond and Dybvig (1983) and Bryant (1980) have shown that deposit insurance have the effect of reducing bank runs. However, the extent to which deposit insurance transfers the loss from depositors to government in times of solvency distorts bankers' and depositors' preference over risk. Cases in point, Beltratti and Stulz (2012) find that banks in countries with deposit insurance have higher idiosyncratic risk and Demirguc-Kunt and Detragiache (2002) finds that explicit deposit insurance is associated with less bank stability. Hence, the goal of raising capital is the same as the goal of a generalized capital regulation which is to "force banks to internalize losses, thereby protecting the deposit insurance fund and mitigating moral hazard" (Hanson et al, 2011, p. 4).

How much capital does international standards require? Basel III prescribes equity equivalent to 3 percent of total assets. How much capital do banks actually have? The value of total assets and equity are taken from banks' independent auditors' balance sheet reports. In Table 1, capital expressed in terms of equity as a percentage of total assets are shown. The data shows that the average equity of banks is close to 10 percent. To the credit of ASEAN-5 banks and financial regulators, banks' capital more than doubles Basel III prescription. The rest of this paper measure the cost of doubling capital to 20 percent equity of total assets following Admati and Hellwig's (2013) proposal.

Of course the most used argument against raising capital is that equity is more expensive than debt. Hence, raising equity will raise costs of banks and hence will reduce banking activities. However, Admati and Hellwig (2013) among others counter argue that equity is expensive only because banks are more financially distressed due to their low level of capital e.g. high debt-equity ratio or high leverage ratio. The subsequent section uses Miles et al (2012) to formally show Admati and Hellwig's point. Still it cannot be denied that raising capital to 20 percent equity of total assets will raise the cost of capital, which consequently decreases investment and which consequently decreases aggregate output. As to how much aggregate output decreases depends on the elasticity of substitution between capital and labor which the subsequent section discusses.

Methodology:

The methodology for estimating the cost uses that used by Miles et al (2012). Where β is the market risk or beta, A is asset, E is equity and D is debt, the market risk of the bank's asset is

$$1. \quad \beta_A = \beta_E \frac{E}{D+E} + \beta_D \frac{D}{D+E}.$$

Suppose that all bank debt is mostly due to depositors' with interest payment. With interest on demand deposits relatively constant, then

$$2. \quad \beta_A = \beta_E \frac{E}{D+E} + (0)\frac{D}{D+E}.$$

$$3. \quad \beta_E = \beta_A \frac{D+E}{E}.$$

Rearranging equation 2 results to equation 3. Equation 3 states that the bank's beta on equity is a positive function of the leverage ratio [$(D+E)/E$]. If there is no debt, then the bank's beta on equity is its beta on total assets. As debt increases, the bank's beta on equity increases. Hence, lowering market risk requires lowering the leverage ratio. In estimating β_E the stochastic equation to regress is

$$4. \quad \beta_E = \hat{a} + \hat{b}\frac{D+E}{E} + e, \quad \hat{b} > 0 \quad \& \quad e \sim N(0, \sigma_\beta^2).$$

Where r is rate of return and F refers to risk free asset, the Capital Asset Pricing Model (CAPM) states that

$$5. \quad r_E = r_F + \beta_E (r_M - r_F).$$

Inserting equation 4 gives

$$6. \quad r_E = r_F + \left(\hat{b}\frac{D+E}{E}\right)(r_M - r_F) \quad \& \quad \hat{a} = 0.$$

The above equation explains why equity financing is expensive. It is because banks have high leverage ratio from the start. Note that the above assumes that $\hat{a}$=0 which will subsequently be shown to be a statistical fact. Inserting the actual market rate of return and the risk free rate of return give us the estimated cost of equity.

The banks' cost of funding business is measured in terms of the weighted average cost of capital or WACC used in corporate finance theory. It is expressed as [1]

$$7. \quad WACC = r_E \frac{E}{D+E} + r_D \frac{D}{D+E}, \quad r_E > r_D.$$

Miles et al (2012) assume that debt has zero beta so that the cost of debt should be similar to the risk free rate of return. In the case of the ASEAN-5, debts primarily come from retail depositors whose interest payment is stable, close to constant and close to zero. So it is more realistic to assume that debt has zero beta. Hence, equation 7 can be expressed as

[1] Notice that the WACC formula used does not take tax into consideration. As in Miles et al (2012), cost to individual institutions is distinguished from cost to the overall economy. The former takes tax into consideration because tax takes away from the institution. The latter does not take tax into consideration because tax is only a transfer from private to public within the overall economy.

8. $$WACC = r_E \frac{E}{D+E} + r_F \frac{D}{D+E}.$$

The estimated r_E using actual numbers inserted in equation 6 and the risk free rate of return taken from hard data can now be inserted. The actual proportions of debt and equity are then inserted into $E/(D+E)$ and $D/(D+E)$. The resulting WACC becomes the estimated banks' cost of funding *before* raising capital. The proportions of debt and equity of 0.8 and 0.2 are then inserted so that the resulting WACC becomes the banks' estimated cost of funding *after* raising capital to 20 percent equity of total assets (leverage ratio of 5).

The increase from *before* to *after* represents the estimated additional cost of capital to banks. It is the cost that banks are expected to pass on to investor-borrowers. With additional cost, investors will decrease their investment which in turn will decrease the level of aggregate output. Where P_K is the level of cost of capital, α is the elasticity of output with respect to capital, σ is the elasticity of substitution between capital and labor and $\alpha/(\alpha\text{-}1)$ is the elasticity of relative price with respect to output, a 1 percent increase in the cost of capital will decrease aggregate output by the succeeding formula whose derivation is presented in the Appendix.

9. $$\frac{dY}{dP_K}\frac{P_K}{Y} = \alpha\sigma\frac{1}{\alpha-1} = \frac{\alpha}{\alpha-1}\sigma.$$

The standard contribution that goes to capital is a third and to labor is two-thirds so that gives $\alpha/(\alpha\text{-}1)$=-0.5. Miles et al quote Barnes (2008) and Smith (2008) stating that the elasticity of substitution between capital and labor in the UK is 0.5. In cross country research, Restuccia and Urritia (2001) assume that the total factor productivity (TFP) across countries is the same and estimate σ as close to 1. Collins and Williamson (2001) take into account of cross country differences in relative price of capital good reflected in productivity levels and skill endowments, use data from 11 OECDs dating from 1870 to 1950, and estimate σ as close to 0.7 for capital goods and 0.5 for equipment. Pessoa et al (2005) assume that the TFP across countries vary, use data from 113 countries dating from 1960 to 1996, and estimate σ as close to 0.7. Assuming that σ=0.7 which is the median among those cited estimates, a 1 percent increase in the cost of capital will decrease aggregate output by 0.5×0.7=0.35 percent.

The cost of raising capital can now be expressed in terms of loss to aggregate output. How can one can make more meaning of this? One way is to compare the cost with some benefit. Miles et al (2012) uses cost-benefit analysis to estimate the optimal bank capital. Particularly, they measure the benefit as the product of the probability and the expected cost of a banking crisis where the probability is estimated using 200 years of aggregate growths of 31 countries. With a wealth of data equivalent to 4,500 observations, Miles et al still admit that estimating the probability is "hard to judge" (p. 18). Estimating the probability in this study is much harder if not impossible as none of the 31 countries in Miles et al include a single ASEAN-5 country, as this research has gathered data on GDP growths of only 22 years and as there has been only a single ASEAN-5 wide financial crisis i.e. the Asian Financial Crisis (AFC).

Alternatively, one can make more meaning to the cost of raising capital in terms of the number of years before this cost becomes not worthy. Assume that the estimated cost to the GDP growth is annual, the cumulative cost can be calculated through the years. The number of years

the cumulative cost exceed the cost of the AFC will give an estimate as to the number of years raising capital becomes worthy or otherwise. For example, if the number of years the cumulative cost exceed the cost of the AFC is 10 years, then raising capital is worthy if future AFC types of crises occur every less than 10 years and not worthy if they occur every more than 10 years.

The geometric average growth is taken to be the normal growth or loosely called the steady growth of an economy given status quo bank capital. The steady state growth less the annual cost of raising capital will be the annual growth when capital is raised to 20 equity percent of total assets. The cumulative difference between the two will be the estimated cumulative loss. The steady state growth less the GDP growth in 1998 in the midst of the AFC gives an estimate of the GDP cost of financial crisis.

Data and Results:

As a conservative classification of one being too big to fail, any bank with an asset of at least 3 percent of the GDP is included. The source of data on daily stock price and daily market price is the *Wall Street Journal* available online. The daily market prices are Composite Index (Indonesia), FBM KLCI (Malaysia)[2], Composite Index (Philippines), Straits Times Index (Singapore) and SET-50 (Thailand)[3].

Note that other ASEAN banks were originally considered but eventually are not included. One reason is that their banks' assets are relatively small or less than 3 percent of their GDP; for example, Vietnam's biggest bank Vietin Bank has an asset equivalent to 0.9 percent of GDP. Another reason is the rest which includes Brunei Darussalam, Cambodia, Lao and Myanmar do not have a major bourse where data can be obtained. As of the writing of this paper, the latest year where all financial reports are available is 2014 where 2014 and 2013 figures are shown. Hence stock prices and indices from 2013 and 2014 are considered and hence the data is a cross section of figures containing two years.

[2] Financial Times Straits Index (F) Bursa (B) Malaysia (M) Kuala Lumpur (KL) Composite Index (CI).

[3] Stock Exchange Thailand (SET) – 30.

Table 2 – Market Risk of Banks

Bank	Country	β_E 2014	β_E 2013
Bank Mandiri	Indonesia	1.60	1.48
Bank Rakyat	Indonesia	1.83	1.43
Bank Central Asia	Indonesia	1.11	1.18
Bank Negara	Indonesia	1.62	1.47
Maybank	Malaysia	0.98	1.13
CIMB Group	Malaysia	1.39	1.66
Public Bank	Malaysia	0.61	0.49
RHB Capital	Malaysia	0.68	0.94
Hong Leong Financial	Malaysia	1.25	1.44
AMMB Holding	Malaysia	0.72	0.97
Affin Holding	Malaysia	0.81	0.97
Alliance Financial Group	Malaysia	0.83	1.20
Banco de Oro	Philippines	0.92	1.12
Bank of the Philippine Islands	Philippines	1.00	0.88
Metropolitan Bank	Philippines	1.16	0.92
Philippine National Bank	Philippines	0.55	0.84
China Bank	Philippines	0.15	0.65
Rizal Commercial Banking Corp.	Philippines	0.33	0.81
Union Bank	Philippines	0.36	0.47
Security Bank	Philippines	0.67	0.83
Development Bank of Singapore	Singapore	1.03	0.95
Overseas Chinese Banking Corp.	Singapore	0.93	1.04
United Overseas Bank	Singapore	1.29	1.08
Bangkok Bank	Thailand	1.00	0.99
Krung Thai Bank	Thailand	1.16	1.41
Siam Commercial Bank	Thailand	1.22	1.29
Kasikorn Bank	Thailand	1.14	1.20
TMB Bank	Thailand	1.26	1.01
Thanachart Bank	Thailand	0.77	0.99
Bank of Ayudhya	Thailand	0.48	0.42

Note: China Bank (2014) has *p*-value of less than 5 percent. All the rest have *p*-value of less than 1 percent.

The first difference of the natural log of stock prices and indices are taken. The Dickey-Fuller test is implemented in each series to assure stationarity which indeed confirms stationarity of each. This allows us to proceed in estimating each bank's β_E. All get statistically significant beta; they are shown in Table 2. With leverage ratio calculated from banks' respective independent auditor's report available online and market risk data taken from Table 2, regression using equation 4 can now be implemented. The results are shown in Table 3.

The first run (1) simply uses equation 4, the second run (2) controls for the year 2013 and the third run (3) controls for the size of the bank expressed in terms of asset to GDP ratio. But the

first three runs do not fit the data and are overall insignificant. The fourth (4), fifth (5) and sixth (6) runs control for country effects that captures differences in financial reporting standards among others. Only Indonesian banks are shown to be statistically different from others. There is now "goodness of fit" and overall significance. However, heteroscedasticity is present. As heteroscedasticity does not make the results unbiased and does not destroy the consistency of the ordinary least squares, it is worth paying attention to the statistically significant relationship between market risk and leverage ratio. The indication is that raising capital to the tune of a unit decrease in leverage ratio is associated with 0.06 to 0.08 decrease in market risk. In a related empirical finding, Kashyap et al (2010) find that banks with lower leverage ratio have lower market risk.

Table 3 – Effect of Leverage Ratio on Market Risk

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	.91***	.91***	.96***	.18	.02	.08	-.23	.21
Leverage Ratio	.01	.01	.00	.06**	.08***	.08***	.12***	.07***
Asset-to-GDP Ratio			.14					
Indonesia				.81***	.78**	.74***	.81**	.71***
Malaysia				.13				
Singapore				.20				
Thailand				.22**	.14			
2013		.08						
R^2	.00	.01	.01	.44	.42	.39	.52	.32
F	0.1	0.4	0.3	8.5***	13.6***	18.5***	31.1***	13.1***
White Statistic	8.6**	12.1***	11.4**	16.5*	13.7**	12.6**		

Dependent variable: β_E. Level of significance: *** for 1%, ** for 5%, * for 10%.

In the seventh (7) and eighth (8) runs, the inefficiency of the regressions resulting from the presence of heteroscedasticity is eliminated. The (7) run employs the "heteroscedasticity corrected" option in the Gretl econometrics freeware where observations with higher residuals are given less weight and observations with lower residuals are given more weight. The (8) run is the weighted least square regression using the leverage ratio. The significance of partial regression coefficient, the goodness of fit and the overall significance indicate that raising capital to the tune of a unit decrease of leverage ratio decrease market risk by 0.12 in (7) and 0.07 in (8). With the median of partial regression coefficients of runs (4) to (8) being 0.08, what follows assumes that raising capital to the tune of a unit decrease of leverage ratio results in 0.08 decrease in market risk. Since the partial coefficient of regression for the constant or intercept in runs (4) to (8) are insignificant, the constant in equation 4 is interpreted as statistically zero.

The next step is to estimate the return on equity using equation 6. The annual market rate of return and risk free rate of return are banks' commercial lending rates and their respective government treasury-bill rates quoted from the *Bangko Sentral ng Pilipinas*. The source of data on debt, equity and asset is each banks' respective independent auditor's report available online. The data and the resulting estimated return on equity is shown in Table 4. The leverage ratio in each country is the asset weighted average leverage ratio. Note that those banks included in the weight include those not in the process of obtaining the beta; they are included in the calculation of the

leverage ratio because of their asset size of at least 3 percent of the GDP; but they are excluded in the calculation of beta as they are not listed in the local bourse. As thought experiment, the dollar converted bank assets are used to calculate the weighted average of interest rates and leverage ratio to calculate an ASEAN-5 level of aggregation. For the sake of example, take the case of ASEAN-5 and the answer to equation 6 is 1.72+0.08×9.7040×(5.39-1.72) = 4.57 shown on the last column.

The next step is to estimate the WACC given the actual percentage of equity of total assets, given the proposed 20 percent equity, and the change in the WACC by increasing capital from the actual to the proposed. The calculation uses equation 8. The risk free rate of return and the return on equity are those numbers shown in Table 4. The ratio of equity or $E/(D+E)$ is the inverse of the weighted average leverage ratio again also shown in Table 4 from which the ratio of debt is derived. The results are shown in Table 5. The change in the WACC varies to as high as 0.49 percent in the case of Singapore and to as low as 0.14 percent in the case of Malaysia. As for ASEAN-5, the change in WACC is 0.28 percent. In a similar work, Hanson et al (2011) suggests that raising equity by 10 percentage-point which is equal to the percentage-point experimented in this paper increase the WACC by 0.25 to 0.35 percent depending on the assumption. The main concern is the cost to aggregate income of raising capital to 20 percent equity of total assets. The answer to that is in the last column. For example is the case of the Philippines. Raising capital will increase the cost of capital by 0.37 percent. It has been mentioned that a 1 percent increase in the cost of capital will decrease aggregate output by 0.35 percent. Since 0.35 percent of 0.37 percent is 0.13 percent, aggregate output will decrease by 0.13 percent.

Table 4 – Return on Equity as Cost of Equity

	Treasury-Bill Rate	Commercial Lending Rate	Weighted Average Leverage Ratio	Estimated Return on Equity
Indonesia	8.80	12.60	7.7356	11.15
Malaysia	3.23	4.60	11.4964	4.49
Philippines	1.24	5.50	10.3793	4.78
Singapore	0.35	5.38	11.0559	4.82
Thailand	2.07	6.80	9.7040	5.74
ASEAN-5	1.72	5.39	9.7040	4.57

Indonesia risk free rate is time deposit rate.
Singapore commercial lending rate source is World Bank.

The final step is to give more meaning of the cost to GDP of raising capital. Annual real GDP growth rates from 1993 to 2014 of each ASEAN-5 country are taken from the IMF (2015). From that, the geometric average is calculated and is assumed to be the normal growth or loosely called the steady state growth. From the present to the future, the steady state growth is used to estimate the future of aggregate income. The steady state growth less the cost to GDP of raising capital is used to estimate the future of aggregate income if capital is raised. The difference between the two becomes the accumulated cost to GDP. The steady state growth less the GDP growth in 1998 in the midst of the AFC gives an estimate of GDP that could be avoided should an AFC-type of crisis hit.

Table 5 – Weighted Average Cost of Capital (WACC)

	Leverage Ratio			
	5	Actual	Change in WACC	Cost to GDP
Indonesia	9.27	9.10	0.17	0.06
Malaysia	3.48	3.34	0.14	0.05
Philippines	1.95	1.58	0.37	0.13
Singapore	1.24	0.75	0.49	0.17
Thailand	2.80	2.45	0.36	0.12
ASEAN-5	2.29	2.01	0.28	0.10

Table 6 shows the results. Take the case of Thailand. Since 1993, its GDP grew at an annual average of 3.71 percent. In the AFC, its GDP contracted by 10.51 percent which is 14.22 percent below its steady state growth. Its cost of raising capital is 0.12 percent of the GDP. If the loss is accumulated through the years, it will take 36 years for the accumulated loss to match its loss in the AFC. Further loose interpretations follow. The cost of raising capital is most expensive in the Philippines and Singapore. In other words, if each of the two is confident that there will be no financial crisis hitting their economies the next 19 years, then it is not worth for these countries to raise capital to 20 percent equity of total assets. The cost is least expensive in Indonesia. In other words, if Indonesia is confident that there will be no financial crisis hitting it the next 44 years, then it is not worth for Indonesia to raise capital to the same extent.

But stricter interpretation could also mean that having shorter threshold years does not make raising capital less urgent. Take the first example. The threshold years for the Philippines' 19 is close to only half of that of Thailand's 36 despite that the cost of raising capital in the Philippines and in Thailand are almost the same at 0.13 and 0.12 respectively. The reason for the extreme difference in the threshold years is that in the AFC the Philippines' 5.14 percent loss is only about a third of Thailand's 14.22 percent loss. Why did Thailand lose more? It is because the AFC happened to be the type of crisis that hit Thailand more. But with each financial crisis being unique, there is no reason to predict that Thailand will be hit more and as much compared to the Philippines and vice versa. Take the second example. The threshold years for Thailand's 36 is less than that of Malaysia's 38 despite that in the AFC Thailand's loss of 14.22 percent is greater than Malaysia's loss of 12.80 percent. The reason for the difference in the threshold years is that Thailand's 0.12 cost of raising capital is more than twice of Malaysia's 0.05 which could be exogenous of economics[4]. Hence, one should be cautious in being more complacent (or alarming) only because a country's threshold is shorter (or longer).

Table 6 – Threshold Years of Worthiness of Raising Capital

	Steady State (%)	GDP Growth (1998, %)	Loss from Crisis (%)	Cost of Capital (%)	Threshold Years

[4] The spread between the commercial lending and the Treasury-bill is 4.73 percent in Thailand and 1.37 percent in Malaysia. Hence, lowering the leverage ratio relatively marginally changes Malaysia's WACC and consequently reduces the cost of raising capital. `

Indonesia	4.64	-13.13	17.77	0.06	44
Malaysia	5.44	-7.36	12.80	0.05	38
Philippines	4.56	-0.58	5.14	0.13	19
Singapore	5.94	-2.23	8.17	0.17	19
Thailand	3.71	-10.51	14.22	0.12	36
GDPs are in domestic currencies.					

Giving more meaning of the cost to GDP of raising capital has been expressed in domestic income. The next gives meaning of the cost in terms of US dollar. Annual nominal GDP in US dollars from 1980 to 2014 of each ASEAN-5 country are taken from the IMF (2015). The US consumer price index also taken from the IMF is used to estimate the annual real GDP in US dollars. From that, the geometric average is calculated and is assumed to be the normal growth. The same steps implemented from above are repeated from this point on. Since the GDP numbers are all expressed in US dollars, all GDPs can be added to the aggregate income of ASEAN-5.

Table 7 – Threshold Years of Worthiness of Raising Capital (in US Dollar)

	Normal Growth (%)	GDP Growth (1998, %)	Loss from Crisis (%)	Cost of Capital (%)	Threshold Years
Indonesia	3.40	-56.43	59.83	0.06	78
Malaysia	4.50	-29.04	33.54	0.05	58
Philippines	3.02	-22.06	25.08	0.13	49
Singapore	6.63	-15.73	22.36	0.17	27
Thailand	4.32	-25.46	29.78	0.12	43
ASEAN-5	3.95	-35.57	39.52	0.10	54

Table 7 shows the results. From using domestic currencies to using the US dollar, some across the board differences are worth noting. First, normal growths are moderately lower because data in the 1980s are included when many economies in the first half of the said decade contracted. The effect would be to lessen the figures in the "Loss from Crisis" column. Second, the figures in the "Loss from Crisis" are greater because the GDP contractions in the AFC are enlarged by the major depreciation of ASEAN-5 currencies. The third difference is that the threshold years are dramatically longer. The least change is in Thailand's 20 percent increase in the number of years and the most change is in the Philippines' 160 percent increase. Note that the cost of raising capital is assumed the same.

Finally, imagine looking from the eyes of a non-ASEAN rational investor at these economies the past 35 years. First, they see investment with an average annual growth of 3.95 percent; that is almost quadrupling every dollar investment from 1980 to 2014. Second, they see that once in a while it can also lose value by an amount equivalent to a factor of 10 times its normal growth. They ask whether it is worth raising capital to 20 percent equity of total assets. Third, if they foresee with confidence that no financial crisis of the AFC-magnitude happening the next 54 years, then they would deem the status quo bank capital as appropriate. But if they foresee some possibility of the same the next 54 years, then they would prefer regulations raising bank capital.

Conclusion:

The recent US and European financial crises have highlighted the role of banks as root cause of past and recent financial crises and consequently proposals have been made so that history does not repeat itself. The proposal that this paper focuses on is raising capital in ASEAN-5 from the actual near 10 percent equity of total assets (or a leverage ratio of 10) to 20 percent equity of total assets (or a leverage ratio of 5). While the benefit of raising capital is to prevent history from repeating, equity being more expensive than debt will increase banks' cost of doing business which consequently decrease investment and which consequently decrease aggregate output. As to how much aggregate output will decrease is the main concern of this paper.

To estimate the cost, the effect of leverage ratio on banks' market risk is first estimated. Specifically, raising capital to the tune of a unit decrease in leverage ratio results in 0.08 decrease in market risk which complements Kashyap et al (2010) empirical finding that banks with less leverage have less market risk. The estimated return on equity is then estimated and it is found that equity is more expensive than debt because a bank is much indebted to begin with. From that, the WACC before raising capital and WACC after raising capital to the tune of 20 percent equity of total assets are estimated. The difference factoring in elasticity of output with respect to the cost of capital gives the cost to GDP of doubling capital. The range varies from as low as 0.05 percent (5 basis points) of GDP as in Malaysia to as high as 0.17 percent (17 basis points) of GDP as in Singapore. For ASEAN-5, doubling capital will cost the regional GDP 0.10 percent (10 basis points).

If capital is doubled to 20 percent equity of total assets, how many years before the accumulated loss would surpass the loss during the Asian Financial Crisis (AFC)? The shortest period is in the case of the Philippines and Singapore. Using domestic currency to measure aggregate output, it will take 19 years of accumulated loss from regulation before it surpasses the loss in the AFC. The longest period is 78 years in the case of Indonesia. Using US dollar to measure aggregate output, it will take 78 years of accumulated loss from regulation before it surpasses the loss in the AFC. The ASEAN-5-wide answer is 54 years. If one can confidently expect that no financial crisis of the AFC-magnitude will occur the next 54 years, then doubling capital is not worthy. But if otherwise, ASEAN-5 is better off requiring banks to double capital to the tune of 20 percent equity of total assets. The question is how reasonable or how optimistic is one to expect of no financial crisis happening in the next half century.

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Elasticity of Output with respect to the Cost of Capital (not for publication):

The following derives the elasticity of output with respect to the cost of capital used in Miles et al (2012). Consider the general production function

A. $Y = f(K, L).$

The change in output resulting from an increase in the cost of capital is

B. $$\frac{dY}{dP_K} = \frac{dY}{dK}\frac{dK}{dP}\frac{dP}{dP_K}, \quad Y'(K) > 0, \quad K'(P) < 0, \quad P = \frac{P_K}{P_L} \quad \& \quad P'(P_K) > 0.$$

Some manipulation gives

C.
$$\frac{dY}{dP_K}=\frac{dY}{dK}\frac{dK}{dP}\frac{dP}{dP_K}\left(\frac{K}{K}\frac{P}{P}\right)$$
$$=\left(\frac{dY}{dK}K\right)\left(\frac{dK}{dP}\frac{P}{K}\right)\left(\frac{dP}{dP_K}\frac{1}{P}\right).$$

The elasticity of output with respect to the cost of capital is

D.
$$\frac{dY}{dP_K}\frac{P_K}{Y}=\left(\frac{dY}{dK}K\right)\left(\frac{dK}{dP}\frac{P}{K}\right)\left(\frac{dP}{dP_K}\frac{1}{P}\right)\left(\frac{P_K}{Y}\right)=\left(\frac{dY}{dK}\frac{K}{Y}\right)\left(\frac{dK}{dP}\frac{P}{K}\right)\left(\frac{dP}{dP_K}\frac{P_K}{P}\right)$$
$$=\alpha(-\sigma)\left(\frac{dP}{dP_K}\frac{P_K}{P}\right),\quad \alpha=\frac{dY}{dK}\frac{K}{Y}\quad \&\quad -\sigma=\frac{dK}{dP}\frac{P}{K}.$$

Assume perfect competition, profit is

E. $Y=LP_L+KP_K$.

F. $LP_L=Y-KP_K$.

The second line of the above rearranges the first. Applying total differentiation gives

G.
$$LdP_L=\left(\frac{\partial Y}{\partial K}dK\right)-\left(P_K dK+KdP_K\right)$$
$$=\frac{\partial Y}{\partial K}dK-P_K dK-KdP_K.$$

Incorporating the Euler theorem where capital is paid exactly the marginal product of capital, then

H.
$$LdP_L=\left(P_K\right)dK-P_K dK-KdP_K,\quad \frac{\partial Y}{\partial K}=P_K$$
$$=-KdP_K.$$

Further manipulation gives

I.
$$dP_L=-\frac{K}{L}dP_K$$
$$=-\frac{K}{L}dP_K\left(\frac{P_K}{P_K}\right)=-\frac{K}{L}\frac{dP_K}{P_K}P_K.$$

J.
$$dP_L\left(\frac{1}{P_L}\right)=-\frac{K}{L}\frac{dP_K}{P_K}P_K\left(\frac{1}{P_L}\right)=-\frac{dP_K}{P_K}\frac{KP_K}{LP_L}$$
$$=-\frac{dP_K}{P_K}\frac{P_K K}{P_L L}\left(\frac{1/Y}{1/Y}\right)=-\frac{dP_K}{P_K}\frac{KP_K/Y}{LP_L/Y}.$$

The share of total output being paid on capital is α and that of labor is 1-α. Then

K. $$\frac{dP_L}{P_L}=-\frac{dP_K}{P_K}\frac{\alpha}{1-\alpha}.$$

The relative price of capital with respect to labor is stated in equation B. Its change is

L. $$dP = \frac{P_L dP_K - P_K dP_L}{P_L^2}.$$

Some manipulation gives

M. $$dP\left(\frac{1}{P}\right) = \frac{P_L dP_K - P_K dP_L}{P_L^2}\left(\frac{1}{P}\right) = \frac{P_L dP_K - P_K dP_L}{P_L^2}\left(\frac{1}{P_K / P_L}\right)$$
$$= \frac{dP_K}{P_K} - \frac{dP_L}{P_L}.$$

Inserting equation K and then rearranging give

N. $$\frac{dP}{P} = \frac{dP_K}{P_K} - \left(-\frac{dP_K}{P_K}\frac{\alpha}{1-\alpha}\right)$$
$$= \frac{dP_K}{P_K}\frac{1}{1-\alpha}.$$

O. $$\frac{dP}{dP_K}\frac{P_K}{P} = \frac{1}{1-\alpha}.$$

Inserting the above into the elasticity of output with respect to the cost of capital as expressed in equation D gives

P. $$\frac{dY}{dP_K}\frac{P_K}{Y} = \alpha(-\sigma)\left(\frac{1}{1-\alpha}\right) \quad \Rightarrow \quad \frac{dY}{dP_K}\frac{P_K}{Y} = \frac{\alpha}{\alpha-1}\sigma.$$

The above is equation 9 in the main text of this paper.