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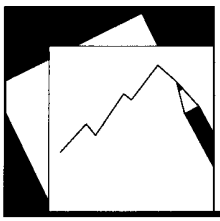

IMF Working Paper

Macroeconomic and Financial Soundness Indicators: An Empirical Investigation

Rita Babihuga

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Macroeconomic and Financial Soundness Indicators: An Empirical Investigation

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Abstract

This paper analyzes the relationship between selected macroeconomic and financial soundness indicators (FSIs) using a newly assembled panel dataset of FSIs for 96 countries covering the period 1998-2005. The analysis covers key macroeconomic indicators and FSIs of capital adequacy, asset quality and profitability. The paper finds that FSIs fluctuate strongly with both the business cycle and the inflation rate. Short term interest rates and the real exchange rate also emerge as important determinants. There is also a considerable degree of heterogeneity in the relationship between macroeconomic indicators and FSIs across the sample of countries. Several country and industry specific characteristics including country income levels, financial depth, market concentration, and the quality of regulatory supervision are found to be significant in explaining this cross country heterogeneity.

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I. INTRODUCTION

The financial crises of the late 1990s prompted the search for indicators of financial system soundness. Initial efforts were aimed at identifying a broad set of macroprudential indicators (MPIs), comprising aggregate prudential indicators, macroeconomic variables associated with financial system vulnerability, and market based indicators to support periodic financial system monitoring. Along these lines, a parsimonious and operationally useful set of "core" and "encouraged" financial soundness indicators (FSIs) was identified by the IMF (Sundararajan et al (2002).

Since the late 1990s, FSIs have been increasingly used in financial system surveillance. The International Monetary Fund (IMF) and World Bank have promoted the measurement and use of FSIs, particularly in the context of the Financial Sector Assessment Program (FSAP) as well as Article IV consultations and a Compilation Guide on FSIs (IMF, 2004) has been prepared and is currently under review. Many central banks and financial supervisory agencies around the world now routinely compile and disseminate information on FSIs. Despite their intrinsic information on the health of a financial system, FSIs themselves have not as yet been extensively analyzed empirically, given that as a relatively new body of economic statistics, consistent time series have been unavailable for a broad set of countries. Recent efforts to improve FSIs have mainly focused on strengthening compilation practices and data quality. Empirical analysis of FSIs at this juncture is important for supporting cross country comparisons of financial sector health, particularly as regional surveillance of financial systems becomes increasingly important.

Due to their wide coverage, FSIs are able to capture a range of factors that may pose risks to the financial system as a whole (Sundararajan et al., 2002). They provide vital firsthand information on the performance and fragility of the banking industry, on the condition of financial and real estate markets, the non-bank financial sector, and corporations and households. FSIs are potentially useful tools for cross country comparisons of financial systems and FSAPs often analyze a country's FSIs in relation to other comparator countries. Nonetheless, casual evidence (Section II) suggests that FSIs are strongly correlated to the business cycle. To the extent that the business cycle emerges as an important determinant of FSIs, any meaningful direct comparisons of FSIs within country across time, and between countries should, in principle, take into account the phase of the business cycle.

This paper is concerned with the connection between macroeconomic variables and FSIs. The paper empirically tests the relationship between key macroeconomic variables and the following core FSIs: capital adequacy (measured by the ratios of capital to assets and capital to risk weighted asset), asset quality (measured by the ratio of non-performing loans to total loans) and profitability (measured by return on assets). The choice of FSIs is determined by their

availability for the largest set of countries over the longest time period[2]. Furthermore, capital adequacy, asset quality and profitability are all important indicators of bank performance and fragility. The paper tests the links between individual FSIs and the business cycle, inflation, the real exchange rate, and short-term interest rates to capture the stance of monetary policy. The paper also controls for individual country characteristics related to the financial sector such as the regulatory environment, the level of financial development, and the level of concentration of the financial sector**.**

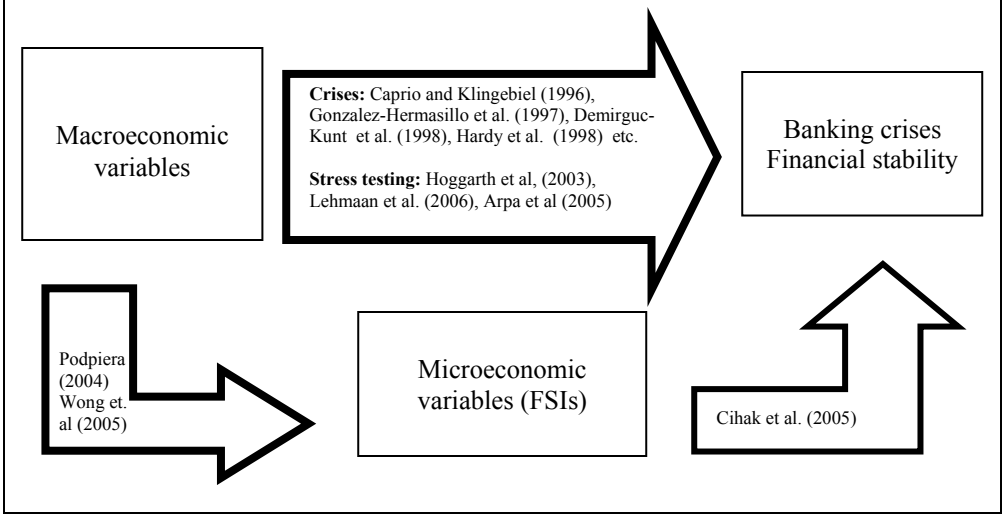
The body of literature examining the endogenous relationship between macroeconomic indicators and the financial sector has largely focused on analyzing the determinants of banking crises. Another strand empirical work has sought to analyze the relationship between macroeconomic variables and indicators of financial stability over a sample of countries and period of time including, but not necessarily limited to, episodes of banking crises. This study belongs to the latter category.

Caprio and Klingebiel (1996), Gonzalez-Hermasillo, Pazarbasioglu and Billings (1997), Demirguc-Kunt and Detragiache (1998), Eichengreen and Rose (1998), Hardy and Pazarbasioglu (1998) and Kaminsky (1999) focus on the role of macroeconomic variables in explaining specific episodes of banking crises. Conversely, a number of studies investigating the causes of the 1997-98 Asian financial crisis, notably Radelet and Sachs (1998), Chang and Velasco (1998) focus on the adverse consequences for macroeconomic stabilization of a weak financial sector. More recently, Cihak and Schaek (2005) incorporate FSIs in an early warning model of banking crises to assess what, if any, role FSIs may play in predicting banking crises—they conclude that on their own, FSIs have limited use as early warning indicators.

A separate stream of studies derives from the stress testing approach formalized by the FSAP, and analyzes the relationship between macroeconomic indicators and financial stability. Stress testing is usually country-specific and aimed at calibrating potential financial system risks from macroeconomic shocks. Notable studies in this area include stress tests of UK banks (Hoggarth, Logan and Zicchino 2003 UK FSR), Swiss banks (Lehmann and Manz, 2006), and Austrian banks (Arpa, Giulini, Ittner and Pauer, 2005).

[2] Slack (2003) shows that capital adequacy, asset quality (of lending institutions) and profit and competitiveness FSIs have the highest percentage of data collection relative to other FSIs.

Figure 1. Studies of Macro-financial sector linkages



This study focuses on the macroeconomic variable-FSI link, which has to-date received little empirical attention. Podpiera (2004) implicitly studied, on a cross country basis, the effects of macroeconomic conditions on some FSIs (non performing loans and net interest margins), but that study is primarily concerned with the effects of the quality of regulation and supervision (measured by compliance with the Basel core principles) on banking sector performance (measured by asset quality and profitability). Podpiera also controls for macroeconomic and structural factors, as well as the level of development of the economy and the financial system. A number of country-specific studies have investigated the determinants of specific FSIs, for example asset quality and profitability and more recently capital adequacy in Hong Kong (Wong et al., 2005), provisioning in the OECD (Bikker and Metzemakers, 2002), profitability in Italy (Quagliariello, 2003), but the analysis in these studies relies on bank level panel data.

This study is the first to analyze the determinants of aggregated FSI data for a large panel, and hence is able to exploit the advantages of panel data. The study uses a newly assembled dataset of FSIs for 96 countries covering the period 1998-2004. These data are perhaps the largest panel dataset available on FSIs.[3]

On average, we find that the business cycle—measured as the cycle component of real GDP, obtained using the Hodrick-Prescott filter (1980)—has a robust, negative relationship with capital adequacy, and non-performing loans (NPL) FSIs, and a robust, positive relationship with profitability (ROA) FSIs. Furthermore, inflation, the real effective exchange rate, and real interest rates also emerge to different degrees as important determinants of FSIs. Cross country

[3] These data have been gathered by the IMF through Article IV consultations and FSAPs.

differences in income, size of the financial sector, the quality of banking supervision, and market concentration robustly explain cross country differences in the cyclicality of FSIs. The structure of the paper is as follows. Section II discusses data issues. Section III describes the empirical methodology, the estimation methods and discusses the results, and Section IV concludes.

II. DATA: FINANCIAL SOUNDNESS INDICATORS

The FSI data used in this study are drawn from published Article IV and available FSAP reports which the respective national authorities have compiled and reported. In general, compilers are encouraged to follow the guidelines laid out in the *Compilation Guide on Financial Soundness Indicators* (IMF, 2004), which provides specific guidance on definitions and concepts. Nonetheless, given that the guide is a relatively new tool and there is some degree of flexibility with regard to its application, users of FSI data must contend with a certain amount of noise in the data. Appendix II provides definitions and sources of these and other explanatory data used in the study.

FSI data are a relatively new set of economic statistics and therefore have their important limitations. First, given that FSI metadata is sourced from national prudential and commercial measurement frameworks, compilation practices may vary across countries limiting cross-country comparability. However, while differing prudential standards may limit strict cross-country comparison of the data, they do not limit econometric analyses of the kind carried out in this study, especially since panel estimation techniques allow for these cross country compilation differences to be treated as unobserved time invariant characteristics. Thus, the specific measurement error generated in the response variable will not cause bias in the regression coefficients, although it may reduce the overall efficiency of estimates. When FSIs enter the model as explanatory variables, instruments may be used to preserve consistency of the estimators.

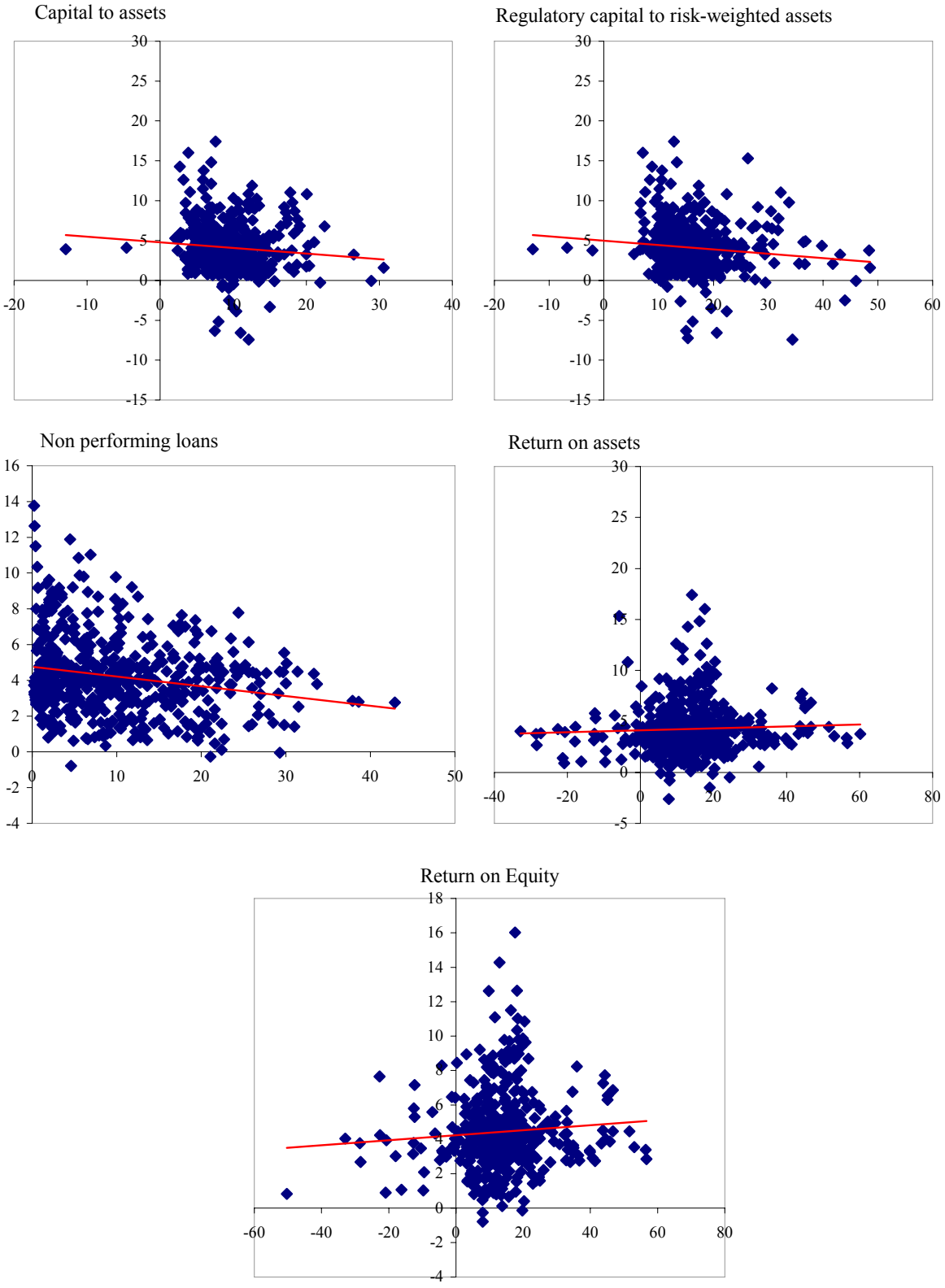
Second, the time series in FSIs is still quite limited. FSI data for most countries start in 1998, reflecting the fact that many countries began collecting FSI data in the context of the FSAP, which began in 1999. Despite the short time dimension of the dataset (1998-2005), the sample size (96 countries) is large enough to allow for consistent estimators by taking into account the asymptotic properties (of the larger sample of countries).

Figure 2 illustrates the relationship between FSIs and the business cycle. The data indicate that, as expected, FSIs vary with the business cycle, although this relationship appears stronger in some cases (return on assets and non performing loans) than in others (capital to assets and return on equity). Indicators of profitability and asset quality (ROA and NPLs) have a clear (positive/negative) relationship with the business cycle, although the relationship between capital adequacy indicators and the business cycle is more ambiguous. Moreover, there is an important degree of heterogeneity across the sample of countries. To further illustrate this

heterogeneity, Appendix figures 1-3 present the results of simple contemporaneous correlations where the relationship between FSIs and the business cycles is observed to vary across different income groups and levels of financial depth.

Figure 3 illustrates regional differences in the cyclicality of FSIs. Capital to assets appears to be countercyclical in every region except Asia and Sub-Saharan Africa, where it is procyclical. NPLs appear to behave counter cyclically as expected, except in Western European and Sub-Saharan African countries where the relationship appears flat. The relationship between profitability FSIs and the business cycle is flat in Emerging European countries, contrary to that in other regions where profitability measures are procyclical as would be expected. These preliminary findings imply that meaningful comparisons of FSIs across countries and regions require taking into account the phase of the business cycle. Furthermore, the evidence on the relationship between FSIs and the business cycle constructed assuming homogeneity of the relationship may be seriously misleading.

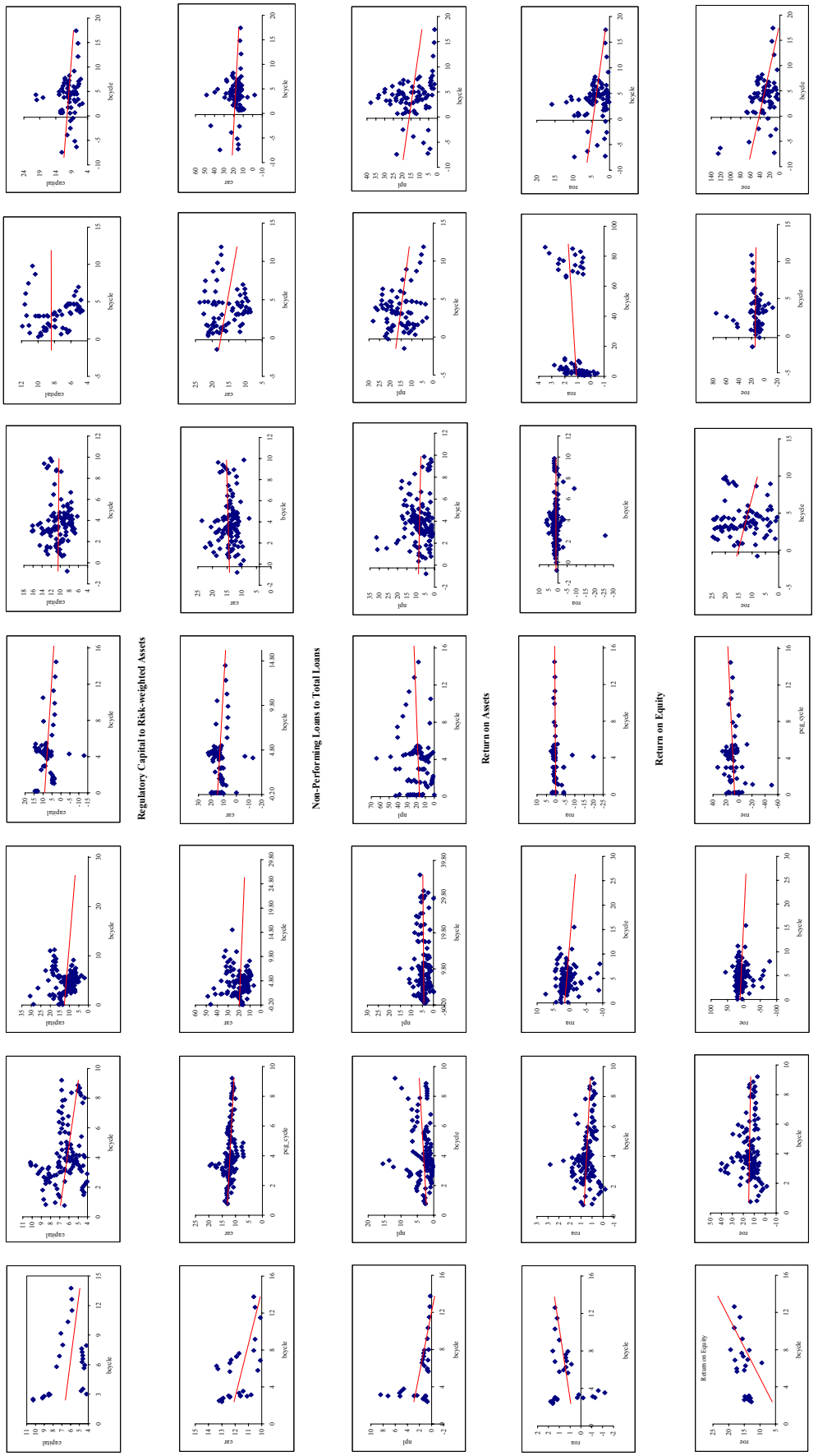
Figure 2. FSIs and the Business Cycle, 1998-2005 1/



Source: Financial Soundness Indicators (IMF), World Economic Outlook (WEO)

1/ Business cycle proxied by the cyclical component of real GDP, generated using the Hodrik-Prescott filter, and measured on the y-axis.

Figure 3. Variation Across Regions: Cyclicality of FSIs, 1998–2005



Source: Author's calculations. Note: Regional classifications consistent with Global Financial Stability Report (IMF).

III. EMPIRICAL METHODOLOGY

The general form of the panel data model adopted for analyzing the determinants of financial soundness indicators is defined as follows:

$$FSI_{i,t} = f(bank\ specific_{i,t}, macro_{i,t}, structural_{i,t},) \quad (1)$$

where subscripts *i* and *t* denote country and time respectively. FSIs are modeled as a function of bank specific variables, macroeconomic and structural variables. The bank specific control variables included in the model have been shown in a number of studies to be instrumental in explaining the respective indicators, and when aggregated, are essentially other financial soundness indicators. We control for variables that capture the macroeconomic environment in which banks operate and for structural variables related to the financial sector which may differ from one country to the next, such as the quality of banking supervision.

As previously noted, the relationship between macroeconomic variables and FSIs appears to vary across countries (see Figure 3). In order to explain this heterogeneity, we introduce interaction terms between the business cycle and dummy variables controlling for cross-country differences in income, financial depth, market concentration, and the quality of regulatory supervision (proxied by a measure of compliance with the Basel Core Principles) over the sample period[4]. Interaction terms are useful tools for inferring how the effect of the business cycle on FSIs might depend on the magnitude of other variables, in particular differentiating characteristics across countries. In general, three dummy variables are defined for each characteristic (e.g, low income (D1), middle income (D2) and high income (D3) countries), with D3 as the control group in each equation where these terms are included. Significant interaction terms confirm the hypothesis that the specific differentiating country characteristic (e.g., country income levels) influences the general relationship which we are testing (between FSIs and the business cycle), explaining why this relationship may vary across different countries in our sample. Results are only reported and discussed where the interaction terms are significant.

A. Capital Adequacy

We model the change in the capital ratio as a function of lagged capital, the business cycle, changes in the inflation rate, the real effective exchange rate, interest rates to capture the impact of monetary policy[5]. We also control for the depth of the financial system. Our model specification is as follows:

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[4] Other cross country differences, including financial dollarization, banking system capitalization and portfolio risk, are also tested but not found significant.

[5] The underlying conceptual model explaining bank capital, following Shrieves and Dahl (1992) is outlined in the appendix.

$$\Delta capital_{i,t} = \alpha_1 + \beta_1 capital_{i,t-1} + \beta_2 bcycle_{i,t} + \beta_3 inflation_{i,t} + \beta_4 reer_{i,t} + \beta_5 int\_r_{i,t} + \beta_6 size_{i,t} + \varepsilon_{i,t} \quad (2)$$

for panel data i = 1,...., 96 and t = 1998,....,2005.

Variable	Description	Expected Effect	Explanation
$capital_{t-1}$	One period lagged capital, implying the cost of raising capital or adjustment cost.	+	A higher cost of adjusting capital implies that banks will hold a capital buffer.
bcycle	The cycle component (hp-filtered series) of real GDP growth	-	In downturns: (1) banks take precautionary measures by holding more capital; (2) banks relying on credit ratings to gain access to capital will increase capital.
inflation	The annual change in the inflation rate	ambiguous	The effect on bank capital ratios depends on what happens to bank income under high inflation conditions.
Reer	The annual change in the real effective exchange rate	ambiguous	The effect on bank capital ratios depends on the share of banking system assets held abroad.
int_r	The annual change in real interest rates	ambiguous	Depends on the dominating effect – pass through to deposit rates or pass through to lending rates, which will determine higher bank profits
size	Ratio of total assets of the financial system to GDP	-	Larger banks may hold less capital. *(Using our dataset, a simple correlation between average financial system size and average capital ratio shows a negative relationship).*

We estimate a dynamic specification of equation (2) given that capital at time *t*, is likely to be related to its level in previous periods. Estimating the determinants of bank performance variables using a dynamic panel data model is generally relevant because it allows for regressors which are lagged dependent variables to be endogenous.

However, using dynamic panel data models introduces two econometric issues which render OLS, between, fixed and random effects estimators (typically used in panel data estimations) biased and inconsistent. The potential bias in the estimates arises first from correlation between X_{it} (where X_{it} is the vector of explanatory variables), in this case the lagged endogenous variable ($capital_{t-1}$) and autoregressive terms in the error term. The second main issue is whether X_{it} is exogenous weakly, strictly or contemporaneously.

Therefore, estimating equation 2 requires an instrumental variable approach in order to correctly control for the problem of endogeneity. As instruments, we choose the second lag of capital ($capital_{t-2}$) and the change in capital ($\Delta capital_{t-2}$), assuming no second order autocorrelation in the errors. This approach has been generalized by Arellano and Bond (1991) whose idea is to build up as many moment restrictions within a generalized method of moments (GMM) framework. Their approach is based on the fact that as *t* increases, the number of admissible instruments is also increasing. The GMM allows us to optimally exploit the orthoganality conditions between the lagged dependent variables and the disturbances.

Tables 1-2 report the results of 4 specifications of equation 2 using as dependent variables the capital to assets and the capital to risk weighted assets ratios respectively. We report the

results for the following models: pooled OLS (OLS on levels); within groups; first-differenced GMM; and System-GMM[6]. The coefficients of the explanatory variables show the dynamic short term relationship between the capital ratio and its determinants.

The business cycle has a strong negative correlation with the capital adequacy ratio, and this relationship is robust across all specifications. Our analysis indicates that on average, banking systems tend to have higher capital ratios in economic downturns, but lower capital ratios in upturns (either by holding more capital, or less assets). This result is consistent with findings in other studies, notably Wong, Choi and Fong (2005) who analyze the determinants of capital levels in Hong Kong. During economic downturns, the quality of banks' assets will generally deteriorate, thus increasing risk exposure and capital in turn. Banks take precautionary measures to insure themselves during downturns by holding more capital in anticipation of possible increases in write-offs and provisions. According to this theory, banks will adjust the numerator in the capital adequacy ratio. Separately, in economic downturns, banks may also increase their capital adequacy ratios by adjusting the denominator (reducing their asset portfolio) in order to try and maintain regulatory requirements.[7]

Higher inflation has a negative effect on capital adequacy ratios, possibly through the negative effect (of inflationary conditions) on profits. Interest rates and the real effective exchange rate have a negative effect on affect capital ratios – their coefficients are statistically significant across all specifications. However, the coefficient on *size*, a variable proxying the size of the banking system (measured by the ratio of total assets to GDP) is negative, statistically significant and robust across all specifications. This implies that on average, smaller financial systems will tend to hold more capital. Consistent with other studies, the coefficient on lagged capital is positive and statistically significant confirming the existence of adjustment costs and that full adjustment (of capital to the target capital) does not occur instantaneously.

The interaction terms *income*bcycle* and *fs_size*bcycle* are negative and significant, implying that the negative relationship between the business cycle and capital adequacy ratios is larger the lower a country's income, and the lower the level of financial development. The term *bcp*bcycle* is positive and significant, implying that the negative relationship between the business cycle and capital adequacy ratios is smaller in countries with a higher quality of supervision.

[6] See appendix for an explanation of different econometric models.

[7] Without access to the metadata from which FSIs are calculated, we are unable to test for individual effects of the business cycle on the numerator or the denominator of capital adequacy ratios.

B. Asset Quality

We model the determinants of asset quality following an approach adopted by DemirgucKunt and Huizinga (1999, 2000). We estimate a parsimonious model, with the share of non-performing loans in total loans as a function of macroeconomic variables including unemployment, changes in inflation, and real interest rates in previous years, the business cycle, and exchange rates). We also control for the quality of banking supervision and other industry characteristics including income and financial depth. The basic specification is as follows:

$$npl_{i,t} = \alpha_1 + \beta_1 bcycle_{i,t} + \beta_2 inflation_{i,t} + \beta_3 reer_{i,t} + \beta_4 int\_r_{i,t} + \beta_5 unrate_{i,t} + \beta_6 t\_trade + \beta_7 bcp_{i,t} + \beta_8 bcp*cycle_{i,t} + \varepsilon_{i,t} \quad (3)$$

for panel data i = 1,...., 96 and t = 1998,....,2005.

Variable	Description	Expected Effect	Explanation
bcycle	The cycle component (hp-filtered series) of real GDP growth	-	Asset quality will improve in economic booms
inflation	The annual change in the inflation rate	ambiguous	Depends on whether inflation is anticipated or not, whether it coincides with general economic instability
reer	The annual change in the real effective exchange rate	ambiguous	Depends on the composition of outstanding credit and the impact on borrowers
int_r	The average change in real lending rates over the previous two years	+	Asset quality will worsen with an increase in real interest rates would make loan repayment difficult
$unrate_{t-1}$	The unemployment rate at time *t-1*	+	Higher unemployment affects borrowers ability to repay thereby affecting asset quality negatively.
t_trade	Terms of trade index – the ratio of the price deflator for exports of goods and services to the price deflator for imports of goods and services.	ambiguous	Depends on the impact on borrowing sectors
bcp	The quality of banking supervision measured by an index of compliance with the Basel Core Principles	-	A higher quality of supervision is associated with lower NPLs
bcp.cycle	The interaction term between bcp and bcycle	ambiguous	Tests for heterogeneity across the sample of countries in the relationship between asset quality and the business cycle

The choice of explanatory macroeconomic variables in the model reflects the evidence provided by the large empirical literature showing that a collapse in borrowers' credit worthiness and the subsequent deterioration in the value of collateral are the main transmission mechanisms of a macroeconomic shock to banks' portfolios. Thus during periods of financial distress, credit quality emerges as an important source of vulnerability and non-performing loans deteriorate quickly before bank failures. Therefore in order to assess the impact of macroeconomic conditions on asset quality, we focus on macroeconomic variables that potentially affect borrowers' credit worthiness.

Summary statistics point, as in the case of capital FSIs, to cross country differences in the impact of macroeconomic variables on asset quality FSIs. In order to account for this

heterogeneity, we allow for interaction between the different explanatory variables. For example, to test whether the impact varies systematically across countries on the basis of the level of financial system depth, we include an interaction term between, on one hand the macroeconomic variables, and on the other, the ratio of bank deposits to GDP, the variable capturing the depth of the financial system.

The variable *bcp* presents a potential endogeneity problem since the quality of bank regulation and supervision can be influenced by the extent to which banks are fragile (i.e., have high non-performing loans). We correct for this problem by using instrumental variables, which to be effective must correlate strongly with the explanatory variable in question, but not with the error term. We find two governance indices from the Kaufmann, Kraay, and Mastruzzi (2006)[8] database, to be highly correlated with the *bcp* variable –an index of government effectiveness and an index measuring the rule of law. The government effectiveness index measures the competence of the bureaucracy and the quality of public service delivery, while the rule of law index measures the quality of contract enforcement, the police, and the courts.

Table 3 reports the results of 4 specifications of equation 3: pooled OLS, within groups or fixed effects, random effects, and the Anderson-Hsiao 2SLS models. The Hausman test tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. Given the insignificant p-value, we use the random effects results. The 2SLS model reports the results of the tests for heterogeneity in order to account for the endogeneity generated by the *bcp* variable.

The coefficient on the business cycle variable is negative, significant and robust across all specifications, implying that economic booms are associated with improvements in asset quality. However, the interaction terms indicate that this relationship is not uniform across countries. In particular, the coefficients on the terms *income*bcycle* and *Fs_size*bcycle*, are significant. This implies on one hand that the positive effect of the cycle on asset quality is dampened in low income countries. On the other hand, the positive effect of the business cycle on asset quality appears to be larger in countries with a relatively lower level of financial development.

Higher inflation, interest rates and unemployment worsen asset quality (increasing NPLs). An improvement in the terms of trade index appears to have a positive effect on asset quality. Nonetheless, a real depreciation in the exchange rate appears to have a negative effect on asset quality. Thus, the overall impact for exporters and producers of tradable goods, to which the banking system is exposed, will depend on which effect dominates, whether the

[8] The choice of instruments follows Podpiera (2004), although we find the rule of law index to correlate more strongly with the *bcp* index compared to the index for the control of corruption.

positive impact of improving terms of trade outweighs the negative impact of the depreciation on asset quality due to unhedged positions.

As expected, the quality of regulatory supervision has a positive impact on asset quality. This finding is consistent with Podpiera (2004). The interaction term *bcp*bcycle* is positive and significant implying that differences in the quality of supervision may also help to explain cross country differences in the cyclicality of non-performing loans.

C. Profitability

To model the determinants of profitability we adopt a framework developed by Demirgüç-Kunt and Huizinga (1999) and Abreu and Mendes (2002). We control for several bank specific determinants including equity capital, operating cost and credit risk, as well as macroeconomic variables, including the business cycle, inflation, real interest rates and the real effective exchange rate. The equation to be estimated is as follows:

$$profit_{i,t} = \alpha_1 + \beta_1 capital_{i,t} + \beta_2 npl_{i,t} + \beta_3 bcycle_{i,t} + \beta_4 inflation_{i,t} + \beta_5 reer_{i,t-1} + \beta_6 int\_r_{i,t} + \beta_7 ovr\_head_{i,t} + \beta_8 conc_{i,t} + \varepsilon_{i,t} \quad (4)$$

for panel data i = 1,...., 96 and t = 1998,....,2005.

Variable	Description	Expected Effect	Explanation
capital	The ratio of equity capital to assets	+	Banks with higher capital face lower funding costs and higher net interest margins and profits
npl	Asset quality - the ratio of non performing loans to total loans and is a proxy for credit risk	-	Higher exposure to risk is associated with lower profitability
bcycle	The cycle component (hp-filtered series) of real GDP growth	-	Economic booms are associated with higher bank profitability
inflation	The annual change in the inflation rate	ambiguous	Inflation is potentially associated with higher realized interest margins and greater profitability. Inflation brings higher costs-more transactions and generally more extensive branch networks-and also more income from bank float. Bank income can increase more with inflation than bank costs do
reer	The annual change in the real effective exchange rate	ambiguous	Depends on the financial system's share of assets held abroad
int_r	The average change in short term interest rates over the previous two years	+	Depends on the dominating effect, pass through to deposit rates or to lending rates which will determine higher bank profits or not
ovr_head	The overhead cost - equals the accounting value of a banks' overhead costs as a share of total assets	-	Banks with higher costs will have lower profits
conc	Concentration measured by ratio of the assets of the 4 largest banks to total assets	-	Increased competition lowers banks' profits

Widely used FSIs of bank profitability include two common operating ratios: return on assets (ROA) and return on equity (ROE), both defined in Appendix II. Sundararajan et al. (2002) point out that an analysis of profitability based on ROE disregards the greater risks normally

associated with high leverage. Given that banks' leverage is often determined by regulation, ROA emerges as the more crucial FSI for measuring bank profitability.

Table 4 reports the results of 3 specifications of equation 4, using return on assets (ROA) as the measure of profitability. We report the results for the following models: pooled OLS (OLS on levels); within groups or fixed effects; and random effects. A Hausman test generates an insignificant p-value, so we discuss the random effects results.

The coefficient on the business cycle variable is positive, significant and robust across all specifications, implying that economic booms are associated with higher bank profitability. The interaction term, *conc*bcycle*, is positive and significant, implying that the positive impact of the business cycle on profitability is larger in less concentrated financial systems.

The coefficients on inflation and interest rates are positive and significant, indicating that on average, the banking system is able to benefit from inflationary conditions and higher interest rates, with pass-through to lending rates exceeding pass-through to deposit rates.

As expected, the coefficient on *capital* is positive, implying that banks with higher capital face lower funding costs and higher profits. Higher NPLs (a variable proxying risk exposure of the banking system) are on average associated with lower profitability of the system.

Table 1. Capital Adequacy

Dependent variable: Regulatory capital to assets ratio	Pooled OLS	Within Groups	GMM Differenced	GMM System	GMM System 2/
c	2.84	7.93			
	(0.46)***	(1.84)***			
capitalt-1	-0.23	-0.59	-0.66	0.14	
	(0.03)***	(0.13)***	(0.21)**	(0.05)**	
bcycle	-0.14	-0.29	-0.45	-0.18	
	(0.05)**	(0.15)*	-0.22**	(0.06)**	
inflation	0.03	0.01	0.01	0.02	
	(0.01)***	(0.00)	(0.00)*	(0.00)**	
reer	-0.04	-0.04	-0.02	-0.02	
	(0.01)**	(0.01)**	(0.00)**	(0.00)**	
int_r	-0.09	-0.04	-0.02	-0.04	
	(0.02)***	(0.02)*	(0.00)**	(0.01)**	
size	-0.01	-0.02	-0.01	-0.01	
	-0.01**	(0.01)*	(0.01)	(0.00)*	
income*bcycle 1/					-0.88
					(0.21)***
fs_size*bcycle 1/					-1.39
					(0.36)**
bcp*bcycle 1/					0.07
					(0.05)*
m1			-2.8	-1.7	
m2			1.5	1.9	
Sargan			33	47	

Standard errors in parentheses; *significant at 10%; **significant at 5%; ***significant at 1%

1/ Income is the income level, measured by average real GDPper capita, 1998-2005.
Fs_size is the average size of the financial sector measured by bank deposits to GDP, 1998-2005
BCP, the quality of bank supervision, is measured by an index of compliance with the Basel Core Principles for Banking Supervision.

2/ Full results for these individual models not reported.

Table 2. Capital Adequacy

Dependent variable: Regulatory capital to risk weighted assets ratio					
	Pooled OLS	Within Groups	GMM Differenced	GMM System	GMM System
c	7.09	12.5			
	(0.75)***	(1.66)***			
capitalt-1	-0.45	-0.68	-0.97	-1.05	
	(0.03)***	(0.04)***	(0.05)***	(0.07)***	
bcycle	-0.11	-0.11	-0.15	-0.26	
	(0.09)	(0.12)	-0.12	(0.12)**	
inflation	-0.05	-0.02	-0.01	-0.07	
	(0.01)***	(0.01)*	(0.01)	(0.01)***	
reer	-0.10	-0.11	-0.09	-0.04	
	(0.02)**	(0.02)***	(0.00)***	(0.02)*	
int_r	-0.11	-0.10	-0.11	-0.12	
	(0.03)***	(0.02)**	(0.02)***	(0.04)**	
size	-0.01	-0.02	-0.02	-0.03	
	-0.01**	(0.03)	(0.02)	(0.00)**	
income*bcycle 1/ 2/					-0.40
					(0.50)
fs_size*bcycle 1/2/					-0.39
					(0.48)
bcp*bcycle 1/2/					1.67
					(1.00)*
m1			3.2	2.4	
m2			-0.3	-0.4	
Sargan			34	27	

Standard errors in parentheses; *significant at 10%; **significant at 5%; ***significant at 1%

1/ Income is the income level, measured by average real GDPper capita, 1998-2005.

Fs_size is the average size of the financial sector measured by bank deposits to GDP, 1998-2005

BCP, the quality of bank supervision, is measured by an index of compliance with the Basel Core Principles for Banking Supervision.

2/ Full results for these individual models not reported.

Table 3. Asset Quality

Dependent variable: Non performing loans to total loans						
	Pooled OLS	Within Groups	Random Effects	2SLS Differenced	2SLS Differenced	2SLS Differenced
constant	58.72	11.88	50.06	28.26	26.91	21.07
	(7.61)***	(1.35)***	(8.54)***	(13.81)**	(13.68)*	(10.77)**
bcycle	-8.88	-6.34	-7.09	-5.94	-5.54	-2.24
	(1.72)***	(1.77)***	(1.60)***	(2.24)**	(2.37)*	(1.04)*
inflation	0.17	0.27	0.26	-0.39	-0.44	-0.29
	(0.05)***	(0.04)***	(0.04)***	(0.35)	(0.36)	(0.32)
reer	-0.04	-0.04	-0.04	-0.29	-0.36	-0.37
	(0.02)**	(0.02)**	(0.02)**	(0.01)**	(0.05)**	(0.03)*
int_r	0.14	0.13	0.13	0.27	0.26	0.42
	(0.06)**	(0.04)***	(0.03)***	(0.15)*	(0.15)*	(0.21)*
t_trade	0.25	0.21	0.21	0.49	0.32	0.42
	(0.11)**	(0.07)***	(0.07)***	(0.32)	(0.31)	(0.33)
un_rate	0.84	0.62	0.62	-0.20	-0.32	-0.53
	(0.35)**	(0.23)***	(0.22)***	(1.05)	(0.99)	(1.2)
bcp_index 1/	-0.48	…	-0.39	-2.64	-2.49	-3.06
	(0.07)***	…	(0.09)***	(1.27)**	(1.32)*	(1.50)**
bcp_bcycle	0.08	0.05	0.06	54.94	0.51	0.61
	(0.02)***	(0.02)***	(0.02)***	(27.24)**	(0.27)*	(0.31)*
Income1*bcycle 2/					2.83	
					(1.09)**	
Income2*bcycle 2/					-0.01	
					-0.87	
Fs_size1*bcycle						1.44
						-2.45
Fs_size2*bcycle						-6.26
						(3.76)*

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

1/ The variables government effectiveness and rule of law, Kraay and Mastruzzi (2006) used as instruments for BCP index.

2/ Dummy variable Income, measuring level of development, is divided into three categories: Low, Middle and High Income

3/ Dummy variable Fs_size, measuring financial sector depth, is divided into three categories: Low, Middle and High

Table 4. Profitability

Dependent variable: Return on assets (ROA) to total assets ratio				
	Pooled OLS	Within Groups	Random Effects	Random Effects
Constant	-1.31	-1.03	-1.36	-2.00
	(0.33)***	(0.92)	(0.54)**	(0.69)***
capital	0.18	0.38	0.27	0.28
	(0.02)***	(0.04)***	(0.03)***	(0.03)***
npl	-0.06	-0.05	-0.05	-0.05
	(0.02)***	(0.02)***	(0.02)***	(0.02)***
bcycle	0.06	0.22	0.11	0.09
	(0.03)*	(0.06)***	(0.04)***	(0.05)*
inflation	-0.02	-0.01	-0.01	-0.01
	(0.00)***	0.00	(0.00)***	(0.00)***
reer	-0.02	-0.02	-0.02	-0.02
	(0.01)**	(0.01)***	(0.01)***	(0.01)***
int_r	0.01	0.03	0.02	0.02
	(0.01)	(0.01)***	(0.01)***	(0.01)**
overhead	-0.30	-0.65	-0.27	-0.21
	(0.08)**	(0.36)*	(0.15)*	(0.11)*
concentration	0.73	-3.66	-0.67	-2.11
	(0.40)*	(1.13)***	(0.25)**	(0.83)**
conc1*bcycle				0.18
				(0.10)*
conc2*bcycle				0.03
				(0.07)

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

1/ Dummy variable conc, measuring market concentration, is divided into three categories: Low, Medium and High.

IV. CONCLUSION

This paper is the first attempt to explore the macroeconomic determinants of FSIs using a large panel dataset. The compilation of FSI data has evolved since the inception of the FSAP in 1998. Despite limitations inherent in the data, its analysis can provide useful insights and enhance the future use and refinement of FSIs. The stylized facts relating the business cycle and capital adequacy ratios, nonperforming loans and profitability variables indicate a correlation and degree of heterogeneity across countries and regions. We sought to econometrically test this relationship, and to explain the degree of heterogeneity observed.

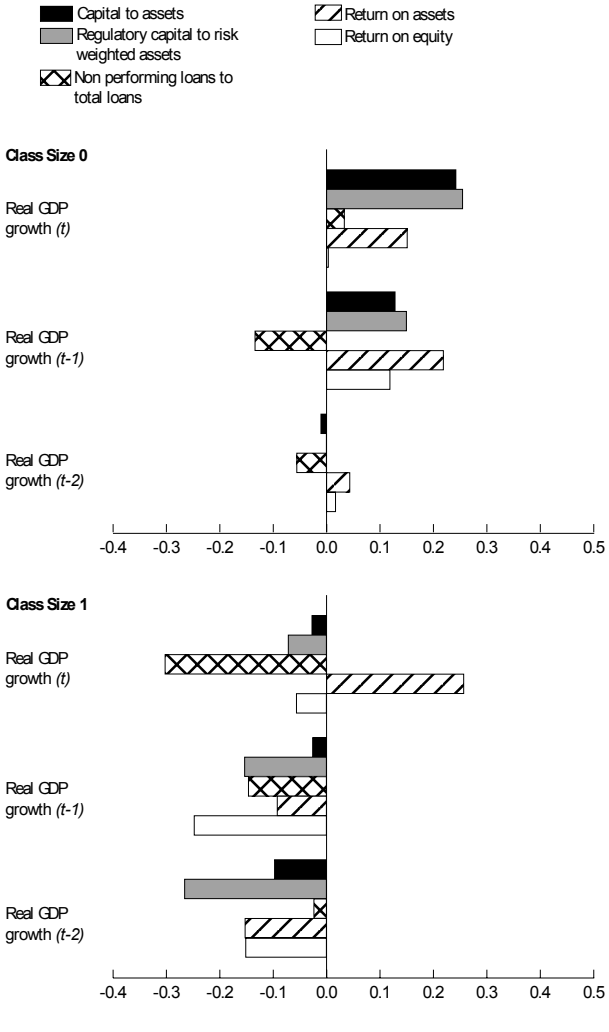
The results showed that FSIs fluctuate strongly with the business cycle and the inflation rate. Short-term interest rates and the real exchange rate also emerge to different degrees as important determinants. There is also an important degree of heterogeneity across the sample of countries in the relationship between macroeconomic indicators and FSIs, which can be explained by several country specific characteristics. Country income levels, financial sector size, market concentration, and the quality of regulatory supervision are found to be significant in explaining this cross country heterogeneity.

The interaction terms between the business cycle and various country and industry specific characteristics provide some interesting results, and point to several extensions of this study. For instance, the negative correlation between the business cycle and capital adequacy ratio differs across countries depending on their level of income and depth of the financial system. The lower a country's income and the less developed its financial system, the higher capital ratios are during economic downturns, relative to higher-income countries. Though providing an explanation for the degree of heterogeneity in the macroeconomic-FSI relationship, these results also raise a number of questions which are outside the scope of this study. To what extent do country specific factors lead to asymmetry in how financial systems weather the business cycle? Are certain factors, for instance quality of supervision, financial sector depth and income, more important than others?

Given the degree of correlation between the business cycle and FSIs, the results of this study suggest that cross-country comparisons would be more useful if they are carried out within certain clusters. Furthermore, direct comparisons of FSIs within country across time and across countries at a specific point in time may be misleading if FSIs are not corrected to account for the phase of the business cycle. Evidence on the relationship between FSIs and the macroeconomy constructed assuming homogeneity of this relationship may also be seriously misleading. Thus, in order to enhance the use of FSIs in financial system surveillance, future work could usefully focus on cyclically adjusted indicators, filtering out the effects of the business cycle. Nonetheless, FSI analysis should be one element in the financial soundness assessment, which should be complemented with other analyses and indicators (including forward looking market indicators).

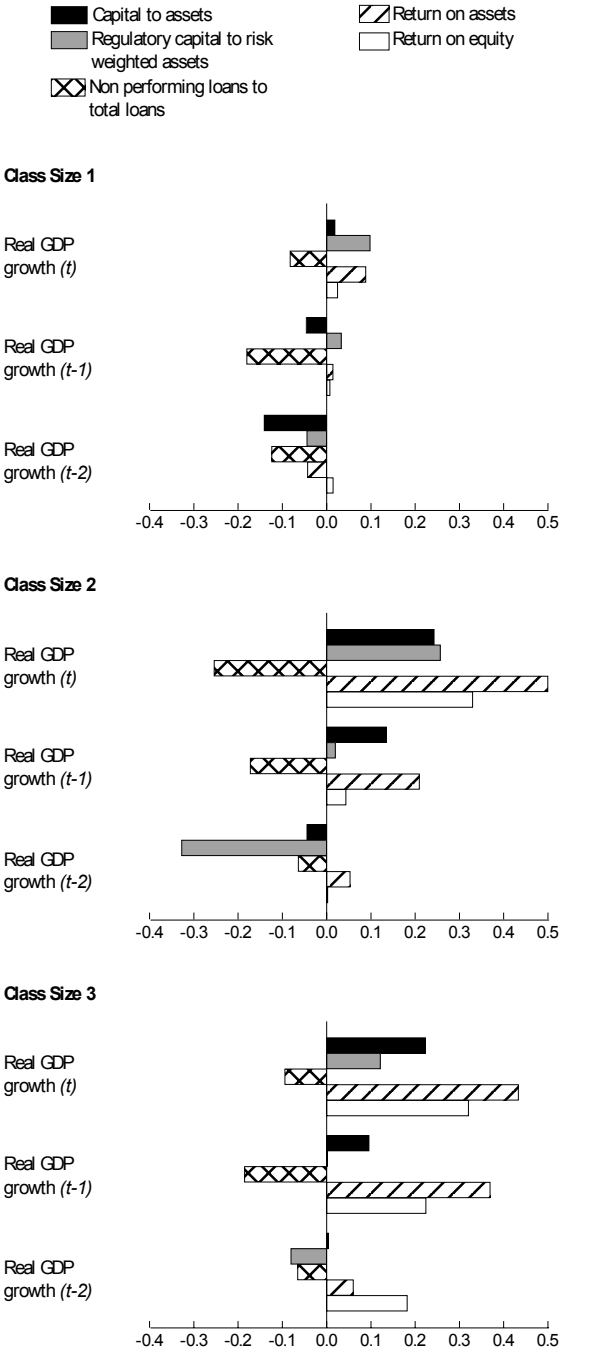
APPENDIX I: CONTEMPORANEOUS CORRELATIONS (FSIS AND REAL GDP GROWTH)

Figure 1a. Contemporaneous Correlations Between Selected FSIs and Real GDP Growth, 1998–2005
(Percent; group classification according to real GDP growth) [1]



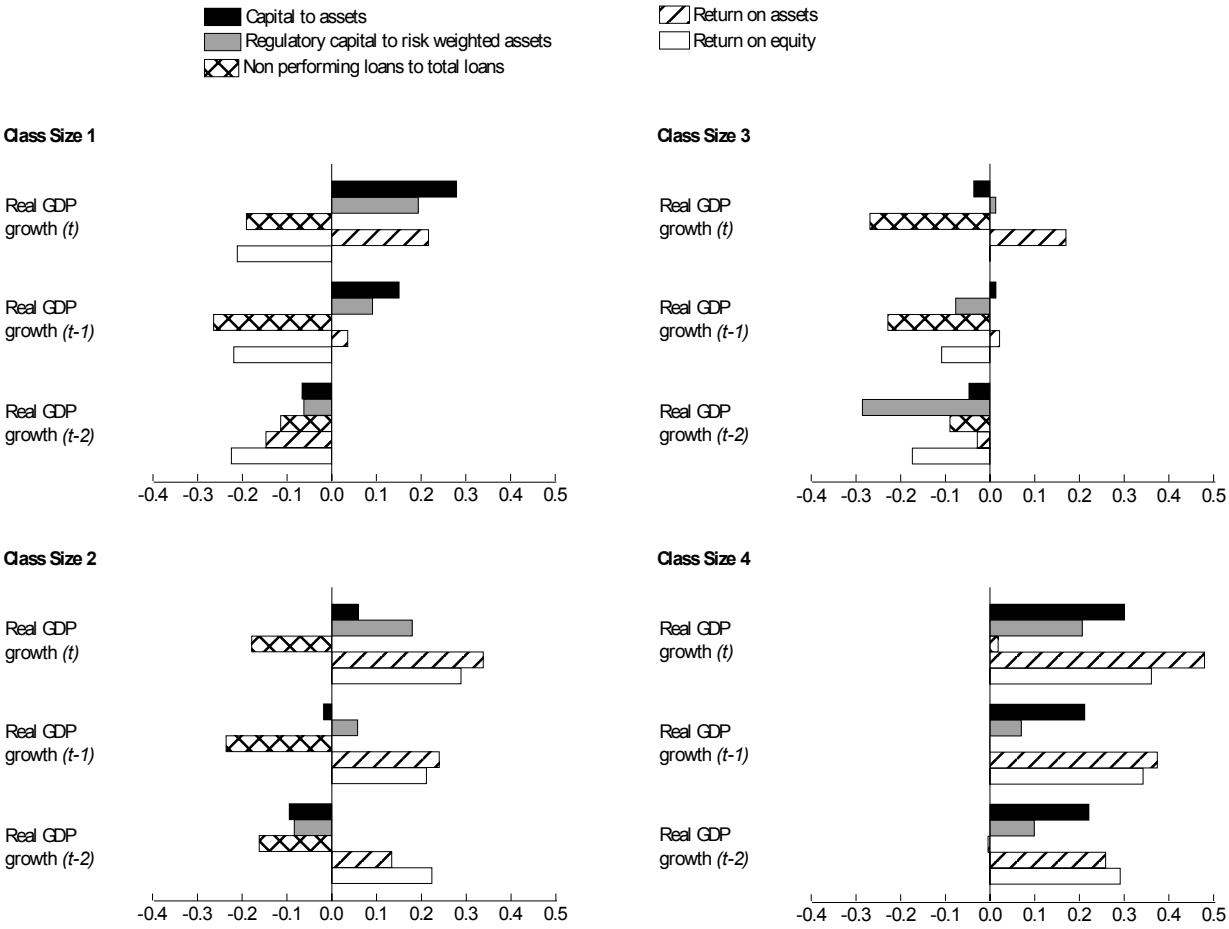
Source: IMF staff calculations.
[1]Class size = 0 for countries whose average real GDP growth during the sample period exceeds the entire group average. Class size = 1 for countries whose average real GDP growth during the sample period is less than the entire group average.

Figure 1b. Contemporaneous Correlations Between Selected FSIs and Real GDP Growth, 1998–2005
(Percent; group classification according to financial sector size proxied by bank deposits to GDP) [1]



Source: IMF staff calculations.
[1]Class size 1 = for countries where the ratio of bank deposits to GDP is < 0.28. Class size = 2 for countries where the ratio of bank deposits to GDP is between 0.28 and 0.61. Class size = 3 for countries where the ratio of bank deposits to GDP is > 0.61.

Figure 1c. Contemporaneous Correlations Between Selected FSIs and Real GDP Growth, 1998–2005
(Percent; group classification according to GDP per capita)[1]



Source: IMF staff calculations.
[1]Class size 1 = for countries where the ratio of bank deposits to GDP is < 0.28. Class size = 2 for countries where the ratio of bank deposits to GDP is between 0.28 and 0.61. Class size = 3 for countries where the ratio of bank deposits to GDP is > 0.61.

APPENDIX II: DATA DESCRIPTION

Variable	Source
Financial Soundness Indicators	
Capital to assets: Measures the capital adequacy or financial leverage of deposit taking institutions – the extent to which assets are funded by other than own funds. It is calculated by taking capital and reserves as the numerator and total assets as the denominator.	Article IV reports (IMF) FSAP reports (IMF)
Regulatory capital to risk-weighted assets: Measures the capital adequacy of deposit taking institutions and is calculated by dividing aggregated data on regulatory capital for all reporting banks by aggregated risk-weighted assets for all reporting banks. It is based on national practice in calculating regulatory capital and risk-weighted assets. Some industrial countries report ratios consistent with regulatory definitions of capital and risk-weighted assets developed by the Basel Committee on Banking Supervision.	
***Non performing loans to total loans (NPL)*:** Measures the asset quality in the loan portfolio. It is calculated by taking the value of NPLs as the numerator and the total value of the loan portfolio (including NPLs, and before the deduction of specific loan-loss provisions) as the denominator.	
Return on assets (ROA): Measures deposit takers' efficiency in using their assets. It is calculated by dividing net income (before taxes) by the average value of total assets over the same period.	
Return on equity (ROE): Measures deposit takers' efficiency in using their capital. It is calculated by dividing net income (gross income less gross expenses) by the average value of capital (capital and reserves) over the same period.	
Macroeconomic variables	
Real per capita GDP (constant 2000, in US dollars)	WDI (World Bank)
Real interest rate	..
Real GDP growth	IFS (IMF)
Consumer price index	..
Real lending rate	..
Real effective interest rate	..
Unemployment rate	..
Banking system claims on the private sector to GDP	..
Terms of trade (of goods and services)	WEO
Industry variables	
BCP index (measuring the quality of regulatory supervision)	FSAP reports (IMF)
Bank deposits to GDP (measuring size of the financial sector)	IFS (IMF)
Deposit money bank assets to GDP (Claims on domestic real nonfinancial sector by deposit money banks as a share of GDP) --measuring size of the financial sector.	IFS (IMF)
Concentration (Assets of three largest banks as a share of assets of all commercial banks)	Fitch's Bankscope database
Overhead (Accounting value of a bank's overhead costs as a share of its total assets)	Fitch's Bankscope database

Note. FSAP… Financial System Assessment Program (IMF/World Bank), IFS…International Finance Statistics (IMF), WDI…World Development Indicators (World Bank), WEO…World Economic Outlook (IMF)

Countries in sample

Asia
Bangladesh
China
Hong Kong SAR
India
Indonesia
Korea
Malaysia
Philippines
Singapore
Thailand

Emerging Europe
Armenia
Belarus
Bosnia&Herzegovina
Bulgaria
Croatia
Czech Republic
Estonia
Hungary
Israel
Kyrgyz Republic
Latvia
Lithuania
Moldova
Poland
Romania
Russia
Serbia&Montenegro
Slovak Republic
Slovenia
Turkey
Ukraine

Middle East and North Africa
Azerbaijan
Egypt
Jordan
Kazakhstan
Kuwait
Lebanon
Morocco
Pakistan
Saudi Arabia
Tunisia
United Arab Emirates

Sub-Saharan Africa
Angola
Botswana
Gabon
Ghana
Kenya
Madagascar
Mauritius
Mozambique
Nigeria
Senegal
Sierra Leone
South Africa
Uganda
Zambia
Zimbabwe

Other Industrial
Australia
Canada
Japan
United States

Latin America
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Dominican Republic
Ecuador
El Salvador
Honduras
Jamaica
Mexico
Nicaragua
Panama
Paraguay
Peru
Uruguay
Venezuela

Western Europe
Austria
Belgium
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Luxembourg
Netherlands
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom

APPENDIX III: ECONOMETRIC MODELS

Pooled OLS (OLS on levels): This model estimates OLS on the pooled sample, pooling across countries and time periods. The pooled OLS model gives more variation since individual data points are treated as separate observations. However, the model does not explore additional (within) country information, an important feature of panel data. By assuming that coefficients are common to all countries and time periods, OLS essentially discards all country specific effects into the error term, thus leading to omitted variable bias. Furthermore, in the presence of lagged dependent variables, the pooled OLS model does not address endogeneity.

Within Groups (or fixed effects): OLS estimators, which are biased and inconsistent in a panel, can be improved by transforming the model (thus deriving a simple AR(1) model). The within groups or fixed effects model estimates OLS on the "theta" differenced model (to eliminate the country specific unobservable fixed effects) producing unbiased and consistent estimators. The within groups model is associated with a loss of identification since the observed fixed effects are eliminated along with the unobserved country specific effects. In addition, the within groups estimator requires strict exogeneity and is thus inconsistent in the presence of lagged dependent variables (and endogeneity from any other explanatory variables).

2SLS (Anderson-Hsiao Two Stage Least Squares): In the absence of strict exogeneity, a popular class of estimators that are consistent as $N \rightarrow \infty$ with T fixed, first transform the model to eliminate the individual effects, and then apply instrumental variables. These instrumental variable (IV) estimators require much weaker assumptions about the initial conditions. Anderson and Hsiao (1981, 1982) proposed a basic first differenced Two Stage Least Squares estimator, with instruments specified in the second lags of levels. An important difference from the Within transformation is that first differencing does not eliminate all the country specific observable effects, hence there is no loss in identification, and the resulting 2SLS estimator is consistent as $N \rightarrow \infty$, for fixed T panels, but they are generally not efficient.

GMM(Differenced and System): The unique problem of dynamic panel data models (a particular moving average form of serial correlation and heteroskedasticity) has led to a widely used class of Generalized Method of Moments (GMM) estimators (Hansen (Econometrica, 1982), Holtz-Eakin, Newey and Rosen (Econometrica, 1988), Arellano and Bond (RES, 1991)). GMM formulates a set of moment conditions (orthogonality restrictions) related to an econometric model and finds parameter estimates that come as close to achieving these orthorgonality properties in the sample. The differenced-GMM model is specified in levels with first differences as instruments. Arellano and Bover (1995) argue that the instruments (differences) may suffer from weak correlation with the variables they are instrumenting, resulting in poor estimation precision. To counter this potential problem, the System-GMM model uses both levels (for equations in first differences) and differences (for equations in levels) as instruments.

APPENDIX IV: MODEL FOR CAPITAL ADEQUACY

A partial adjustment framework and specification

In order to estimate the determinants of bank capital ratios, we extend the methodology adopted by many researchers[9] to a multi-country setting, controlling for the macroeconomic and regulatory environment. In the model, banks aim at a certain target capital ratio CAR^*. Observed changes in the bank capital ratio consist of two components, a discretionary adjustment toward the target capital ratio and factors exogenous to the bank:

$$\Delta CAR_{j,t} = \Delta^d CAR_{j,t} + \varepsilon_{j,t}; \qquad (1)$$

where $\Delta CAR_{j,t}$ is the observed change in the capital ratio for bank j in period t, $\Delta^d CAR_{j,t}$ is the discretionary change, and $\varepsilon_{j,t}$ is the exogenous random shock, for example, an unanticipated economic shock or an unanticipated change in earnings.

The discretionary changes in the capital ratio $\Delta^d CAR_{j,t}$ are modelled using a partial adjustment framework, thereby recognizing that banks may not be able to adjust their desired capital ratio and risk levels instantaneously.[10] Institutional inertia, high costs of rapid change, or a lack of information may prevent banks from reaching their capital ratio instantaneously. The discretionary changes in bank capital ratio is proportional to the difference between the target level and the level existing in period t-1:

$$\Delta^d CAR_{j,t} = \alpha(CAR^*_{j,t} - CAR_{j,t-1}) + \varepsilon_{j,t}; \qquad (2)$$

where α is the speed of adjustment (in the long run of CAR to the optimal CAR^*), and $CAR^*_{j,t}$ denotes the target capital ratio for bank j in period t, which is not directly observable.

Substituting equations (1) into equation (2), the observed changes in the bank capital ratio can be expressed as:

$$\Delta CAR_{j,t} = \alpha(CAR^*_{j,t} - CAR_{j,t-1}) + \varepsilon_{j,t}; \qquad (3)$$

This means that observed changes in the bank capital ratio in period t are a function of the target capital ratio, lagged capital and any random shocks. Although the target capital ratio of a bank $CAR^*_{j,t}$ is not observable, we assume this ratio to depend on a range of variables including individual bank characteristics as well as regulatory and macroeconomic factors.

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[9] Shrieves and Dahl (1992),

[10] Studies that have modeled the capital decision within a partial adjustment model include Peltzman (1970) and Marcus (1983).

REFERENCES

Anderson, T.W. and C. Hsiao, 1981, "Estimation of Dynamic Models with Error Components", *Journal of the American Statistical Association,* Vol. 76, pp. 598-606.

Anderson, T.W. and C. Hsiao, 1982, "Formulation and Estimation of Dynamic Models using Panel Data, *Journal of Econometrics,* Vol. 18, pp. 47-82.

Arellano, M., and S.R.Bond, 1991, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies,* Vol. 58, pp. 277-297.

Arellano, M., and O.Bover, 1995, "Another Look at the Instrumental Variable Estimation of Error-components Models," *Journal of Econometrics,* Vol. 68, pp. 29-52.

Arpa, M., I. Giulini, A. Ittner and F. Pauer, 2005, "The influence of macroeconomic developments on Austrian banks: Implications for banking supervision", BIS Paper No. 1. (Bank of International Settlements, Working Paper Series)

Bikker, J.A. and P.A.J. Metzemakers, 2002. "Bank provisioning behaviour and procyclicality", Bank of Netherlands Research Series Supervision no. 50.

Bond, S, 2002. "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice," *Portuguese Economic Journal,* Vol. 1, pp. 141-162. Also as an CEMMAP Working Paper No. 09/02. http://cemmap.ifs.org.uk/publications.php?publication_id=2661

Caprio, Jr. G. and D. Klingebiel, 2003, "Episodes of Systemic and Borderline Financial Crises," (Washington: World Bank), mimeo.

Demirguc-Kunt, A., and E. Detragiache, 1998a, "The Determinants of Banking Crises in Developing and Developed Countries," *Staff Papers*, International Monetary Fund, Vol. 45, No. 1, pp. 81-109.

Demirgüç-Kunt, A. and E. Detragiache, 1998b, "Financial Liberalization and Financial Fragility," IMF Working Paper 98/83, (Washington: International Monetary Fund).

Demirgüç-Kunt, A. and E. Detragiache, 1999, "Monitoring Banking Sector Fragility: A Multivariate Logit Approch". IMF Working Paper 99/147, (Washington: International Monetary Fund).

Demirgüç-Kunt, A. and E. Detragiache, 2005, "Cross-Country Empirical Studies of Systemic Bank Distress: A Survey". IMF Working Paper 05/96, (Washington: International Monetary Fund).

Gavin, M. and R. Hausmann, 1996, "The Roots of Banking Crises: The Macroeconomic Context". In: Hausmann, R. and L. Rojas-Suárez, (eds.) (1996) *Banking Crises in*

Latin America, (New York: Inter-American Development Bank), pp. 27 -75.

Hansen, L.P., 1982, "Large Sample Properties of Generalized Method of Moment Estimators", *Econometrica,* Vol. 50, pp. 1029-1054.

Hardy, D. and C. Pazarbaşioğlu, 1998, "Leading Indicators of Banking Crises: Was Asia Different?" IMF Working Paper 98/91, (Washington: International Monetary Fund).

Hermosillo-Gonzalez, Brenda, 1999, "Determinants of Ex-Ante Banking System Distress: A Macro-Micro Empirical Exploration of Some Recent Episodes", IMF Working Paper 99/33, (Washington: International Monetary Fund).

Hodrick, R.J. and E.C. Prescott, "Postwar U.S. Business Cycles: An Empirical Investigation," Carnegie-Mellon University Department of Economics Discussion Paper No. 451 (1980)

Holtz-Eakin, D., W. Newey and H.S. Rosen, 1988, "Estimating Vector Autoregressions with Panel Data, *Econometrica,* 56, 1371-1396.

Hoggarth, G, A. Logan, L. Zicchino, 2005, "Macro Stress Tests of UK Banks", BIS Paper No.22. (Bank of International Settlements, Working Paper Series)

International Monetary Fund, 2003, "Financial Soundness Indicators–Background Paper," http://www.imf.org/external/np/sta/fsi/eng/2003/051403b.htm (Washington: International Monetary Fund).

International Monetary Fund, 2004, *Compilation Guide on Financial Soundness Indicators,* http://www.imf.org/external/np/sta/fsi/eng/2004/guide/index.htm (Washington: International Monetary Fund).

International Monetary Fund, 2005, *Financial Sector Assessment: A Handbook,* (Washington: International Monetary Fund).

Kaufmann, D., A. Kraay, and M. Mastruzzi, 2005, "Governance Matters IV: Governance Indicators for 1996–2004" (Washington: World Bank; available via the Internet: http://www.worldbank.org).

Kaminsky, G., 1998, "Currency and Banking Crises: The Early Warnings of Distress," International Finance Discussion Paper No. 629, (Washington: Board of Governors of the Federal Reserve System)

Lehmann, H., and M. Manz, 2006, "The Exposure of Swiss Banks to Macroeconomic Shocks – An Empirical Investigation. Swiss National Bank Working Paper, (Zurich: Swiss National Bank)

Lindgren, C., Garcia, and M. Saal, 1996, "Bank Soundness and Macroeconomic Policy" International Monetary Fund

Modigliani, F. and M. Miller, 1958, "The Cost of Capital, Corporation Finance, and the Theory of Investment". *American Economic Review*, Vol. 48, pp. 261- 297.

Podpiera, R., 2004, "Does Compliance with Basel Core Principles Bring Any Measurable Benefits?" IMF Working Paper 04/204, (Washington: International Monetary Fund).

Quagliariello, M., 2003, "Banks Performance over the Business Cycle: A Panel Analysis on Italian Intermediaries," University of York Discussion Paper.

Roodman, D. 2005, xtabond2: Stata module to extend xtabond dynamic panel data estimator. Center for Global Development, Washington. http://econpapers.repec.org/software/bocbocode/s435901.htm

Santos, J.A., 2000, "Bank Capital Regulation in Contemporary Banking Theory: A Review of the Literature". *Basel Committee on Banking Supervision Working Papers No. 90*, (Basel: Bank for International Settlements).

Sundararajan, V., C. Enoch, A. San José, P. Hilbers, R. Krueger, M. Moretti, and G. Slack, 2002, "Financial Soundness Indicators: Analytical Aspects and Country Practices." IMF Occasional Paper No. 212, (Washington: International Monetary Fund).

Wong, J., K. Choi, and T. Fong, 2005, "Determinants of the capital level of banks in Hong Kong." Hong Kong Monetary Authority Quarterly Bulletin.