CENTRAL BANK FINANCIAL STRENGTH AND ITS IMPACT ON ECONOMIC OUTCOMES

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Abstract

The discussion on central bank financial strength has been disregarded for a long period as it has been considered that central banks do not require financial strength. However, theoretical and empirical literature argues that even central banks require sufficient level of financial strength in order to perform their functions effectively and hence, achieve stipulated objectives. This study examines the relationship between central bank financial strength and key economic outcomes. While providing evidence for a group of advanced and emerging countries, this study further focuses on the South Asian perspective, particularly on two countries: India and Sri Lanka. Key measures of economic outcomes namely price stability, output growth, real interest rate variability and nominal exchange rate variability are modeled with measures of central bank financial strength. Although results are not consistent across sub samples of countries and for proxies of economic outcomes, it is observed that price stability is broadly related to central bank financial strength. It is also observed that, real interest rate variability in emerging countries can be explained using the changes in central bank finances. At the same time, it is noted that capital based measures remain the appropriate measures for central bank financial strength rather than profitability based measures. These results and observations have important implications for policy makers, particularly for central bankers.

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Key Words: Central Bank Capital, Net Worth, Financial Strength, Economic Outcomes, South Asia

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1. Introduction

Over the years, macroeconomic performance has been improved in both industrialised and emerging countries and monetary policy remains the driving force behind the improved performance (Cecchetti, Flores-Lagunes, and Krause 2006; Krause and Rioja 2006). Accordingly, in most countries, monetary policy conduct has become the key responsibility of central banks replacing the traditional roles played by them with regard to growth and development objectives. As a result, the independence of central banks to pursue their goals has also increased substantially (Woodford 2001). To that end, with the increased recognition of the role of monetary policy and also due to the responsibilities vested with them, central banks have become more powerful amongst policy making authorities (Blinder, Ehrmann, Fratzscher, de Haan and Jansen 2008).[2]

The performance of monetary policy conduct is reflected in macroeconomic outcomes, particularly in terms of monetary and price stability that enables the conducive environment for growth and stability of the economy. However, such outcomes do not explicitly reflect the behaviour of the central bank or the costs incurred by the central bank when performing its functions. The behaviour of central banks can be examined based on different attributes and concepts as well as practices of central banking. As such, during last few decades, the discussion on central bank behaviour has been centered on different issues such as central bank preferences, inflation targeting, central bank independence, transparency, etc. However, issues of central bank ability, i.e. capability of central banks to achieve their objectives, and also the central bank finances have been largely omitted and hence, academic research remains scant (Klüh and Stella 2008; Sweidan 2008).

The central banks' ability and finances can broadly be examined in the context of their balance sheets. However, conventional economic policy models focus only on selected elements of the central bank balance sheet, in particular, monetary liabilities and foreign reserves (Stella and Lonnberg 2008). To that end, the analysis of central bank balance sheet conditions in the context of economic outcomes has been disregarded for a long period of time. Such investigation was regarded as less important mainly due to the perception that central banks have unlimited costless ability to create the means to pay their financial obligations using domestic fiat money and hence, they do not require financial strength (Stella 2005). At the same time, given their key mandates and created by special legal statutes, it was thought that centrals are fundamentally different from private enterprises (Stella 1997). However, such perceptions have been changed over time and hence, an interest is observed on central

[2] However, in contrast, some studies questions the ability of monetary policy. For example, based on a theoretical explanation, Sweidan (2011b) argues that many central banks fail to reduce inflation variability despite having the desire proving that central bank's preferences are a necessary condition but not sufficient to guarantee lower inflation variability. Hence, the structure of the economy and the types of the shocks are also considered as significant factors.

bank finances due to the concerns of independent central banks about their balance sheets and the levels of capital (Jeanne and Svensson 2007).[3]

Particularly, a central bank might need to pay attention beyond the traditional balance sheet focus as its performance (in terms of policy outcomes) significantly relates to balance sheet conditions (Klüh and Stella 2008; Stella and Lonnberg 2008). This is due to a combination of reasons, which is relevant in the context of policy outcomes. On one hand, Sims (2008) and Stella and Lonnberg (2008) argue that even an independent central bank could be constrained in achieving policy objectives by its own balance sheet problems. Particularly, financial weaknesses of central banks may constrain policy outcomes and may also limit policy options available to them (Cargill 2005). On the other hand, a loss-making central bank is likely to become the object of increased oversight from the government and also could experience its independence eroded over time (Jeanne and Svensson 2007). Also, as Stella (2005) argues, a central bank, which is entrusted with the objective of price stability, cannot print an unlimited quantities of money without losing or damaging its credibility. Hence, in order to credibly attain policy objectives, a central bank requires a certain degree of financial strength (Berriel and Bhattarai 2009). In particular, although central banks can approach respective treasuries for financial difficulties, having own financial strength is considered as vital (Ize 2005; Stella and Lonnberg 2008).

During last few decades, central banks across the globe have been facing financial difficulties due to substantial losses causing deteriorations in balance sheets.[4] Particularly, such financial difficulties have raised the issue whether a central bank is able to conduct monetary policy successfully amidst negative level of capital (Cincibuch, Holub and Hurník 2008).In this context, financial strength of central banks and its relation to policy outcomes have recently been recognised as an important policy issue. However, as already indicated, this area is largely under-researched.[5] Particularly, although some case study evidence indicates that weak central bank finances can hamper effective policy implementation, the relationship between policy outcomes and central bank financial strength is subject to controversy. This is partly due to the lack of econometric evidence (Klüh and Stella 2008). Therefore, the lacuna of research on central bank financial strength and policy outcomes mainly motivates the present study.

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[3] Many studies use central bank capital to refer its financial strength (for example: Bindseil, Manzanares and Weller 2004; Ize 2005; Stella 2005). Klüh and Stella (2008) suggest four different indicators to measure the central bank financial strength based on central bank capital, profits and losses and assets. These concepts and measures will be further discussed in Section 2.

[4] In Latin America, Asia, Africa and Eastern and Central Europe, central banks faced considerable financial distress owing to delayed impact of quasi-fiscal operations, particularly due to the provision of credit during systemic banking crises (Stella and Lonnberg 2008).

[5] Jeanne and Svensson (2007) argue that although real world central bankers do seem to care about the central bank finances, these concerns have not been much analysed in the academic literature.

Some important observations can be made with regard to the existing academic literature. First, the relationship between central bank financial strength and economic outcomes has been empirically addressed for pooled samples of countries, i.e. in the context of panel data analyses (for example, Klüh and Stella 2008). Hence, empirical evidence on the relationship between central bank financial strength and macroeconomic outcomes does not explicitly focus the cross-country setting. To that end, alternative approaches such as time series techniques focusing on individual country context may provide different insight to the discussion. Klüh and Stella (2008) also suggest further investigations using time series approach as it would help to recognise changes in capitalisation, etc.

Second, a lack of focus on emerging country context is observed. Although, emerging countries are included in pooled samples, generalised results based on those samples do not address the unique economic and financial circumstances in emerging countries.[6] This is particularly important as central bank balance sheet vulnerabilities are largely prevalent and persistent in emerging countries (Leone 1994). However, such issues have not been examined extensively and explicitly for emerging countries. This study intends to address this gap while providing evidence for a pool of advanced and emerging countries. This study also focuses on two major South Asian countries (India and Sri Lanka) as a reliable and representative context for emerging/developing country setting. Since monetary authorities in these countries largely engage in quasi-fiscal operations and reserve accumulation, it would be an appropriate context to investigate the relationship between central bank finance and economic performance. The selection of a sample of South Asian countries is also motivated by the need for conducting empirical research extensively in the context of regional setting given the lack of research in monetary policy and central banking.

Third, existing studies attempt to model the relationship between central bank financial strength and policy performance mainly using the price stability as the primary proxy to measure the policy performance (for example: Klüh and Stella 2008). However, the relationship between central bank financial strength and broad range of economic outcomes has not been examined to date. Moving beyond, this study intends to provide a comprehensive investigation by modeling the relationship between central bank financial strength and other important variables such as output growth, interest rate stability and exchange rate stability. At the same time, the relationship between central bank financial strength and price stability is also modeled including most important determinants such as money growth ignored by previous research.

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[6] It is widely accepted that emerging/developing countries require separate modeling as these economies have unique and fundamental problems such as weak fiscal institutions, weak financial institutions, low credibility of monetary institutions and poor record with regard to monetary policy conduct, vulnerability for shocks in capital flows, etc. (Calvo and Mishkin 2003; Frankel 2010; Sweidan 2010). It is also argued that emerging/developing countries are not subject to all theories applied to advanced countries due to the privacy of problems in those countries (Sweidan and Widner 2008). These arguments point to the importance of having separate models for emerging countries.

To that end, this study would make several contributions to the existing literature of balance sheet concerns of central banks. Particularly, this contributes to the limited available literature of central bank financial strength and its implications for policy outcomes. Results and policy implications would be useful for relevant authorities in general, and South Asian countries in particular, in the process of better calibrating monetary policy conduct and central banking in the pursuit of achieving and maintaining price stability. As this study investigates the relationship between central bank financial strength and main financial variable, i.e. interest rate, which is the prime variable that monetary policy operates through and results will be particularly important in the context of evaluating monetary policy performance.

The remainder of the paper is structured in the following manner: Section 2 provides a conceptual framework for central bank finance while Section 3 reviews relevant theoretical underpinnings and empirical evidence. Section 4 presents the empirical analysis. This section includes analyses for both a group of advanced and emerging countries and South Asian countries as well. Section 5 briefly discusses policy implications and then, concludes.

2. Conceptualising Central Bank Finance and Financial Strength

2.1 Discussion on Central Bank Finance

Generally, commercial banks require financial strength in terms of maintaining adequate level of capital to absorb losses while meeting financial obligations.[7] However, the need for central bank financial strength is not clear and well defined. Particularly, for a long period of time, the issue of central bank finance has been disregarded causing negative economic consequences and also affecting the effectiveness of central banking and monetary policy (Sweidan 2011a). Several factors had led to the view that central bank finance can be ignored particularly in developed countries as they are either macro-economically insignificant, properly analysed within the consolidated public sector accounts or there is no risk of insolvency. More importantly, financial strength is considered as irrelevant for central banks due to the central banks' unlimited costless ability to create money to pay their obligations in full and on time using domestic fiat money.[8] Reflecting this ability, central banks have

[7] For commercial banks, capital serves for three purposes: i) buffer against shocks, ii) financing of asset holdings, and iii) represents the exposure of the owners of the bank (Heenan 2005).

[8] For example, Greenspan (1997) indicates that a central bank with the nation's currency franchise does not need to hold capital (Meyer 2000, p.7). Similarly, Goodhart (1999) argues that central bank balance sheet does not matter in a fiat environment.

been traditionally profitable.[9]Also, in the case of financial difficulties, it was believed that treasury will always stand behind the central bank with its statutory power to tax (Stella and Lonnberg 2008). Moreover, central banks in these countries carry out strictly monetary functions and operate under stable macroeconomic conditions with sound financial institutions and there are distinct rules determining the relationship between fiscal and monetary policies (Sweidan and Widner 2008; Sweidan 2011a). To that end, financial problems, particularly in developed country central banks, have not been a fundamental issue.

However, practically, these views may not be valid due to several reasons. First, although central banks are privileged to print money to meet their financial obligations, from a macroeconomic perspective, it may not be plausible do unlimitedly as excessive liquidity would lead to several macroeconomic ailments. Hence, printing money to finance losses conflicts with the goals of monetary policy (Sweidan 2011a). To that end, central banks cannot both attain its nominal policy objective and create an unlimited amount of fiat money and hence, require a degree of financial strength to credibly commit to a given nominal policy objective (Stella 2005). Second, treasury support is not an appropriate and reliable solution. On one hand, Stella and Lonnberg (2008) argue that treasuries do not intervene frequently, or at least not on a timely basis. Stella (2008) argues that historically, governments have not provided financial aid to central banks as and when they needed the support. The reason is central bank distress is associated with fiscal distress and also, the root cause of the central bank problems is often linked to quasi-fiscal operations imposed by treasuries (Stella 2008). On the other hand, government support by way of recapitalisation may not be appropriate as it involves transferring real resources to the central bank (Stella 1997). Therefore, although a central bank is a non-profit institution, it cannot accrue continuous losses affecting the efficiency and the continuity of central bank policy (Sweidan 2011a). It would also lead policy outcomes to deteriorate (Stella 2008). This is proven practically as central bank financial problems have been prominent for decades in some countries both in advanced and emerging countries (Stella and Lonnberg 2008).[10]

[9] Mostly, the profit is assured by the structure of the central bank balance sheet, for example: balance sheet of central banks of United States, Canada and European Union (Stella 1997; 2005; 2008). US Federal Reserve System has made profit every year since 1915 and in 1990, Fed's profit exceeded income before taxes and extraordinary items for all U.S. banks combined (Stella 2005).

[10] Central banks have been unable to meet their basic functions owing to financial distress requiring them to change policy in order to reduce losses (Stella and Lonnberg 2008). As an extreme case, The Central Bank of Philippines has been placed into liquidation. Also, Fry (1993) shows that in many developing countries, central banks are no longer profitable despite high inflation leading to many problems. Sweidan (2011a) also argues that losses have reached significant levels in developing countries hindering the conduct of monetary policy and eroding the reputation of the central banks.

During last few decades, the issue of central bank finance has become prominent and it has gained much attention in policy discussions.[11] This is due to several important reasons. From a broader perspective, increased financial integration, worldwide trend in lower inflation, large scale foreign reserve accumulation, particularly in emerging countries, the recent financial crisis[12] and also the adoption of more transparent accounting standards by central banks have led the attention on central bank finances (Klüh and Stella 2008). While many economic and financial factors are influential, from the governance perspective, central bank transparency can also be pointed as a key reason. In particular, in the past, central banks may have kept revaluation losses and/or accumulated losses in opaque asset accounts. However, with the changing accounting standards and also due to the improved corporate governance practices, central banks now divulge these losses in profit and loss accounts and in equity (Stella and Lonnberg 2008). At the same time, as more and more central banks become independent, it has become vital to understand the channels by which the balance sheet concerns and monetary policy influence each other (Jeanne and Svensson 2007). This is also connected to the increased transparency. For example, Bindseil et al (2004) argue that greater independence for central banks to implement monetary policy requires greater transparency of accounting practices. To that end, central bank balance sheets and capital structure in the context of legal independence, transparency and also the flexibility to pursue price stability have increasingly been recognised as important issues in the optimal design of central banks and vital considerations of modern central banking (Cargill 2005).

2.2 Concept of Central Bank Finance

In early literature, central bank finance has been discussed in the context of central bank independence. Particularly, it is argued that financial independence (the required quantity and composition of capitalisation) makes a central bank more credible and enables the effective conduct of policy. However, Beckerman (1997) claims that regardless the independence of its officials, a central bank may perform better if it possesses the financial means to absorb money rapidly. Hence, the implication is that central bank finance plays a special role and, as already indicated, it needs to be analysed carefully.

First, it is important to distinguish the conceptual differences with regard to central bank finance. Different terms have been used in the literature to refer various aspects of central bank finances. From

[11] For example, chairman of the US Fed, Ben Bernanke remarks "although, in principle, balance sheet considerations should not seriously constrain central bank policies, in practice they do" (Berriel and Bhattarai 2009).

[12] Serious financial distresses require strong central banks with healthy balance sheets. Existence of serious operational losses and negative capital may restrict the ability of central banks to respond to the various shocks including macroeconomic vulnerabilities (Sweidan 2010; 2011a).

a broader perspective, some studies use the term 'central bank finance' (for example: Jeanne and Svensson 2007; Stella and Lonnberg 2008). At the same time, based on the balance sheet of the central bank, i.e. by following the net worth approach, some studies use the term 'central bank financial position' (for example: Montanjees 1995; Beckerman 1997; Ize 2005; 2007). Also, some studies adopts the term 'financial strength' to refer the central bank finance (for example: Stella 2005; Martinez 2004; Cargill 2005; Klüh and Stella 2008) while some studies use the term 'central bank financial soundness' (for example: Fukui 2003) or financial health (for example: Ize and Oulidi 2009). Moreover, recent studies use the term 'central bank ability/inability' based on central bank losses (for example: Sweidan 2008; Sweidan 2010). The present study uses the term 'central bank financial strength' (CBFS, hereafter), previously used by Klüh and Stella (2008) and Stella (2008).[13]

Conventional measures of private enterprise financial strength, i.e. profitability and capital – can be misleading when directly applied to central banks and hence, those may not be primary considerations for a central bank (Stella 2008).[14] Stella (2008) argues that central banks' performance consideration is the obverse of the performance consideration of private enterprises. This is because, central banks' performance is assessed fundamentally on the performance with regard to objectives explicitly stated in legal statute. Hence, the primary benchmark for central bank is how well it creates conducive conditions to ensure favourable macroeconomic outcomes such as output growth, price stability, etc. A secondary benchmark is how efficiently the central bank achieves such outcomes, or in other words, internal efficiency with which it minimises the costs of attaining objectives (Stella 2008).

In that sense, central bank financial accounts may provide useful information on the cost of achieving policy outcomes – price stability, low output volatility, sustainable exchange rate, and financial stability. However, it is required drill into that information in order to depict a clear relation between CBFS and economic outcomes. To that end, it is important to discuss some of the issues and concepts related to central bank finance, particularly capital, net worth, profits/losses and CBFS.

Technically, capital may be defined as the amount directly invested by shareholders plus accumulated retained earnings minus losses (Stella 1997).[15] However, Stella (2008) argues that measured capital is a poor and also a misleading summary statistic for CBFS due to several reasons.

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[13] The term financial strength describes the extent to which an entity is constrained by its financial situation in pursuing its strategic goals or policies. An entity is financially strong when it is relatively unconstrained and weak when financial constraints are binding on policy choices (Stella 2008).

[14] The primary benchmark of private enterprise performance is profitability. Second is the enterprise book value or capital (direct reflection of accumulated past earnings). Third is market capitalisation. However, neither profitability nor marker capitalisation are primary considerations for a central bank (Stella 2008).

[15] Central banks would require capital for three reasons: i) many central banks evolved from private banks (for example; Bank of England, Reserve Bank of Australia) and/or clearing house institutions requiring a strong capital base to be credible issuers of promise to pay, ii) financial resources supported to central banks to cover startup costs and to institutionalise a functional separation between the central bank and the government, iii) central banks need to earn a net income to finance operation and buildup a surplus to cover possible losses of future operations (Cargill 2005).

First, capital (which is the accumulation of accounting profits not distributed plus the original endowment) depends on the accounting and profit distribution rules of central banks, which is significantly different amongst central banks. Second, there exist significant amounts of off-balance sheet liabilities and assets. Third, profits may not have stated properly (Stella 1997; 2008).[16] To that end, capital is a weak measure of CBFS in the presence of contingent liabilities (Cargill 2006). Also, those simple accounting measures of CBFS may generate adverse policy outcomes. Therefore, it is considered that central banks do not need capital but they do need a financial strength to meet policy commitments (Cargill 2005).

Net worth is considered as much more useful indicator of potential profitability and financial independence of central banks since it takes into account the central bank's franchise value (value of its special legal status of being able to print money and impose reserve requirements on commercial banks) and also central bank's off-balance sheet rights and obligations (Bindseil et al 2004). Broadly, net worth is defined as the price of a fully informed risk neutral investor would pay to purchase the bank under normal conditions (Stella 1997). In the case of central banks, net worth includes period's net cash flows and accrued income and expenses, capital gains (losses) occurring as a consequence of changes in the market prices of assets and liabilities and valuation adjustments resulting from changes in exchange rates of currencies included in its holdings of foreign assets and in outstanding foreign liabilities (Leone 1993; Montanjees 1995). Although, the concept of central bank net worth is not very relevant, it actually provides a useful benchmark to examine the central bank balance sheet as it is considered as superior for predicting central bank profitability than capital. Hence, great divergences persist between capital and net worth (Stella 1997).[17]

A negative net worth signals that central bank losses have completely eroded the central bank's capital (Dalton and Dziobek 2005). To that end, although profitability is not a primary consideration, central bank profit/losses are important in explaining the net worth of a central bank. Particularly, central bank losses denote negative net worth (Sweidan and Widner 2008), or accumulation of past losses (either of a cash flow reflected in the profit and loss account or of a capital nature reflected in

[16] There is no agreement on the level of central bank capital. For example, Ize (2005) suggests a core level of capital, which considers projected profits as well. Stella (1997) identifies four different ways that central banks have used to determine their own level of capital: i) an absolute nominal value of capital, ii) a target ratio of capital to another central bank balance sheet item, iii) a target ratio of capital to a macroeconomic variable, and iv) according to the perceived risk to the solvency of the bank (Bindseil et al 2004).

[17] There are two broad reasons why net worth and capital could differ: i) application of improper accounting principles distorting past profitability, ii) differences of generally accepted accounting principles (GAAP), which might be applied by a well-informed investor. Particularly, central bank capital and net worth differ owing to off-balance sheet assets and liabilities. Hence, the net-worth of the central bank, unconstrained by quasi-fiscal operations, is far in excess of conventionally defined capital (the original government contribution plus accumulated retained profit) (Stella 1997). However, in early studies, capital position of central banks has been treated synonymous with its net worth (for example; Beckerman 1997).

net worth, i.e. reserve account) may eventually move the central bank balance sheet to a position of negative net worth (Teijeiro 1989).[18]

2.3 Causes of Central Bank Financial Problems

In summary, central bank financial problems could be associated with an external shock or policy decision that disproportionately inflates its balance sheet (Klüh and Stella 2008). However, it is worthwhile to discuss this in detail.

Central bank losses can arise in two ways: (i) operating expenses exceed operating income resulting in net operating losses (operating cost includes mainly the interest rate paid on all accounts and instruments and operating income encompasses income from local and foreign investment); and (ii) net valuation losses arising from the revaluation of assets and liabilities (Dalton and Dziobek 2005; Sweidan and Kalaji 2005; Sweidan and Widner 2008). Or in other words, losses can be defined in two ways: (i) current losses due to imbalances in revenues and expenditures, and (ii) capital losses due to differential changes in the value of assets and liabilities (Vaez-Zadeh 1991).

Sources of central bank losses are connected to several practices of central banks. From a perspective of revenue, central banks make losses mainly due to the decline in inflation and resulting decline in inflation tax, i.e. decline in income earned by printing money (Klüh and Stella 2008; Stella and Lonnberg 2008; Sweidan 2011a). At the same time, central banks may incur large expenses when conducting monetary operations (open market operations) under extreme conditions, i.e. structural excess liquidity created by systemic instability (Dalton and Dziobek 2005; Klüh and Stella 2008), engaging foreign exchange operations with a view to manage exchange rates and build up excess levels of international reserves (Ize 2007; Klüh and Stella 2008), conducting monetary operations using central bank securities instead government securities (Sweidan and Maghyereh 2006; Sweidan 2011a),[19] purchasing large amounts of low yielding assets particularly during episodes of prolonged deflation and asset slumps (Klüh and Stella 2008) and also due to costs associated with financial restructuring (Dalton and Dziobek 2005). Amongst these factors, decline in seigniorage incomes due

[18] Accounting standards require net losses to be recorded in the income statement, charged against capital and any resulting negative net worth to be properly disclosed in the equity section of the balance sheet (Dalton and Dziobek 2005).

[19] If the financial market is underdeveloped and the central bank is unable to engage in standard open market operations, then it will have to engage in the primary market through establishing its own securities (Sweidan and Widner 2008; Sweidan 2010). This practice is prevalent in developing countries whose engage in monetary operations by using indirect controls and create their own instrument to conduct open market operations in underdeveloped financial markets (Sweidan and Kalaji 2005). Sweidan and Maghyereh (2006) provide evidence to prove that central banks in several developing countries suffered from losses because of issuing of central bank securities. Sweidan (2011a) examines central bank losses for the period 1997-2009 for a group of Asian countries, observes that in some countries major cause is open market operations and concludes that open market operations using central bank securities have a significant negative impact on central banks distorting monetary policy and also eroding the capital of central banks.

to decline in inflation and financial innovations and developments and also carrying costs of foreign exchange reserves considered as the most important drivers of central bank losses.[20]

Among several factors, 'fiscal abuse' seems to be the most common source of central bank losses.[21] To that end, fiscal dominance largely explains the financial health of central banks (Ize and Oulidi 2009). Generally, fiscal activities absorb part of the seigniorage revenue and thereby reduce central bank profits. The most influential fiscal impact is generated by the non-core fiscal activities or quasi-fiscal nature (Dalton and Dziobek 2005; Heenan 2005).[22] Heenan (2005) also shows that excessive profit transfers to the government erode the financial resources of central banks.

Quasi-fiscal operations (QFO) can be defined as operations undertaken for public policy reasons by units outside the definition of the government (Montanjees 1995). Markiewicz (2001) discusses two types of QFOs: i) operations related to the financial system – subsidised lending; administered lending rates; loan guarantees; under-remunerated reserve requirements; credit ceilings; rescue operations, and, ii) operations related to the exchange system – multiple exchange rates, import deposits, exchange rate guarantees, subsidised exchange risk insurance, etc. Teijeiro (1989) argues that most common source of losses is lending to the nonfinancial public sector at zero or very low interest rates. At the same time, subsidy payments and prioritised , development or subsidised lending pose a significant impact on central bank finances (Beckerman 1997; Dalton and Dziobek 2005).[23] These QFOs lead excessive risk taking by central banks and also negative cash-flows of central bank operations resulting changes in balance sheet structure and limiting monetary operations (Markiewicz2001).[24]

As already outlined, central bank profit and losses seem to be important determinants of the net worth of the central bank, which are important when analysing CBFS. For example, Cargill (2006) argues that a central bank can be regarded as financially strong if it can conduct operations in the

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[20] Sweidan (2011a) shows that if central banks accumulate large foreign reserves, the safety of their balance sheet may be affected through two main channels: i) large exchange rate fluctuations may lead to revaluation losses, ii) purchasing foreign assets by sterilising intervention will mean that central bank is sacrificing government bond for the reserves to keep the monetary base unchanged. Sweidan (2011a) examines central bank losses for the period 1997-2009 for a group of Asian countries and observes that one of major causes has been revaluation losses.

[21] Fry (1993) reviews fiscal activities undertaken by central banks in a group of developing countries and classifies them into four categories: i) collecting seigniorage, ii) imposing financial restrictions - implementing selective or sectoral credit policies, iii) undertaking foreign exchange operations at non-market clearing prices, and iv) recapitalising insolvent financial institutions. As a result of undertaking these operations, Fry finds that a large number of central banks are no longer profitable despite high rates of inflation. Fry also observes that many central bank balance sheets have been impaired through interest-free or subsidised loans to the government.

[22] Klüh and Stella (2008) examines central bank losses for Latin American countries during the period of 1987-2005 and based on the same, Stella and Lonnberg (2008) observe that such losses as being the result of prolonged impact of QFOs.

[23] From the macroeconomic perspective, QFOs may change the allocation of resources (generating crowding-out effects), distort financial markets, and decrease the credibility of macroeconomic policy (Fry 1993; Markiewicz 2001). At the same time, there can be some beneficial impacts of QFOs. For example, QFOs conducted by central banks may allow delay in fiscal adjustment, which could earn additional time for reforms. Also, it can be useful when the tax system is complicated (Markiewicz 2001).

[24] Sweidan (2011a) argues that QFOs influence the central bank balance sheet by making liabilities plus net worth greater than assets and hence, change the structure of central bank balance sheet.

present and future without incurring operating losses. Also, Ize (2007) classifies central banks into weak or strong categories depending on their structural profitability.[25]

Hence, the discussion so far supports to conclude that profits and losses of central bank are vital to strengthen the net worth, which is crucial to conceptualise its financial strength. The financial strength in terms of positive net worth is expected to support the central bank, particularly, to conduct operations and hence, achieve its stated objectives successfully. As Ize (2005) argues, in order to preserve the inflation credibility (particularly important under an inflation targeting regime), the present value of the central bank (real) profit (that is, its net worth) should be nonnegative.

2.4 Measuring Central Bank Financial Strength

Financial strength of a central bank is difficult to measure since it depends on the asset structure of the central bank, the cost of providing monetary services, and the macroeconomic events influencing operating profits (Cargill 2006). However, as outlined in the previous section, CBFS can be discussed using the net worth approach by carefully selecting relevant proxies. On one hand, Klüh and Stella (2008) argue that theories of CBFS do not provide clear guidance as to which of the potential measures or proxies should be used to assess the central bank financial conditions (and also their relationship with macroeconomic outcomes). On the other hand, it is noted that accounting capital is only a very imperfect proxy for net worth. Also, CBFS cannot be measured using conventional balance sheet ratios as the focus on ratios may generate adverse policy outcomes (Cargill 2006). In this context, a careful analysis is required to determine the financial strength of a central bank based on the balance sheet information along with economic environment, and also the accounting and profit transfer rules and the bank's institutional status within government (Stella 1997).

When defining CBFS, it is important considering central bank operations specifically stated in its opaque accounts. To that end, particularly, it is important to examine 'other items net (OIN)' component of the central bank balance sheet in order to understand the true situation of the balance sheet (Stella 2008).[26] OIN is the residual item after taking into account the asset items: foreign assets, claims on central bank government, claims on other levels of government, claims on financial institutions, and claims on the private sector, etc., and the liability items: reserve money, foreign liabilities, central government deposits, monetary authority securities, etc., which are explicitly identified. That is, OIN includes the revaluation account, net worth, original capital, reserves and physical assets. Hence, it contains accounts reflecting accumulated losses or 'hidden' reserves.

[25] However, conversely to conventional profits, Ize (2007) proposes a concept of structural profits, net of temporary valuation gains and losses, which are meaningful for economic analysis.

[26] This item is referred to as monetary authorities' 'other items net (OIN)' in International Financial Statistics (IFS) database of International Monetary Fund.

Therefore, as an approximation of net worth, mainly, the measure of OIN expressed as percentage of reserve money, can be applied. A negative OIN means that liabilities are higher than assets expressed as a percentage of reserve money and it would represent the fragility of the central bank financial position (Montanjees 1995). Moreover, Stella (2008) suggests a stock concept to measure financial strength of a central bank by considering both capital and OIN as a percentage of total assets of the central bank. If the sum of capital and OIN is largely negative, it would indicate that the respective central bank is financially weak (Stella 2008). Also, given the fact that stock concept might not fully capture the implications of CBFS, Klüh and Stella (2008) advise employing more than one measures based on different quantitative conceptualisations such as accumulated losses over a specified period as a percentage of GDP. The present study borrows the capital and OIN based measure and also alternative measures of CBFS, which would be discussed in Section 4.1.

3. Theoretical Underpinnings and Evidence

3.1 Theoretical Underpinnings

3.1.1 Linking Central Bank Financial Strength and Macroeconomic Outcomes

Theoretical linkage between CBFS and economic outcomes is subject to debate. As Klüh and Stella (2008) discuss, many argue that theoretically, links between financial conditions, monetary policy stance and macroeconomic outcomes are unlikely to emerge and hence, seem to be irrelevant assertions. However, such views seem to be invalid due to several reasons. In order to address this issue, Klüh and Stella (2008) use two approaches: (i) pragmatic approach, and (ii) theoretical considerations linking CBFS and policy performance.

Pragmatic approach emphasises that given the considerations of central bankers about the financial health of their institutions, financial constraints may have the potential to reduce the aggressiveness of anti-inflationary policy or may result in attempts to transfer the cost of mopping up excess liquidity to the financial system. Also, motives such as self-interested behaviour of central bank representatives in terms of reputation, personal prestigious and future employment opportunities and also, intentions to generate stable flow of seignorage revenues can lead to a tendency to factor CBFS in monetary policy decisions.

Moreover, a weak balance sheet has the potential to impair the relationship between monetary and other authorities, particularly impact the financial independence of central banks. This conception however leads to a hypothesise that a low degree of CBFS is a by-product of fiscal dominance. Hence, a weak balance sheet may be considered as an outcome or indication of a more fundamental problem,

i.e. the inability of the government to finance itself sustainably. In this context, Klüh and Stella (2008) argue that empirical relationships between CBFS and policy performance may be spurious as those would merely reflect the correlation between the actual reason for inflation and the financial strength of central bank.

To address this concern, Klüh and Stella (2008) provide theoretical considerations linking CBFS and policy performance. They first summarise the available alternatives that a loss-making central bank has at its disposal when the treasury does not provide for a capital injection, and also it does not engage in policies that would inflate debt portfolio of the central bank. In this situation, as the first option, a central bank can rely on measures intended to lower the cost of its monetary operations. In many cases, this can be done using the institution's ability to adjust minimum reserve requirements. However, the reliance on such options involves economic costs, in particular with respect to financial repression affecting the financial development.[27]

A second option for the central bank would be to use its ability to create money based on interest free liabilities in order to pay its obligations. However, if the resultant excess liquidity is not sterilised, money market rates will fall leading to additional inflationary pressures. If, in contrast, the central bank absorbs the resultant excess liquidity by issuing debt certificates, it will have to incur additional interest costs (Klüh and Stella 2008). Accordingly, financial constraints of a central bank will have the potential to reduce the aggressiveness of anti-inflationary policies and it would impair the financial independence of the central bank causing higher risk of interference with monetary policy. In sum, arguments of Klüh and Stella support the view that a weak central bank will have difficulties in implementing low-inflation equilibrium through conducting its monetary policy effectively. To that end, lack of CBFS can impede the pursuit of price stability.

The impact of central bank financial constraints on policy outcomes can be further explained in the context of optimal monetary policy, particularly, which focuses on the level of the interest rate that minimises a quadratic loss function (Cecchetti and Ehrmann 2000). As such, expanding the quadratic loss function by adding a third preference that minimises the fluctuations of central bank cost, Sweidan and Kalaji (2005) articulate how the central bank cost constraints are important for optimal policy making. The policy target is specified by Equation (1), and the objective is to minimise (1) subject to Equations (2) and (3) and also (4) below:

$$L = E[\alpha(\pi - \pi^*)^2 + \eta(y - y^*)^2 + (1 - \alpha - \eta)(c - c^*)^2] \qquad (1)$$

[27] This is similar to other financial repressive policies, such as compelling banks to hold central bank securities those do not reflect market yields.

$$y_t = \gamma ms_t + \gamma d_t + s_t \quad (2)$$

$$\pi = ms_t + d_t - \omega s_t \quad (3)$$

$$c_t = -\psi ms_t \quad (4)$$

Equation (1) is a general form of a quadratic loss function for one period. In this equation, E denotes the mathematical expectation and π^*, y^* and c^* denote the desired level of inflation, output and central bank cost of conducting monetary policy, respectively. The parameters α, η and $(1 - \alpha - \eta)$ are the respective weights of interest. According to Equation (4), cost, c_t has a negative relation with the money supply, ms_t meaning that issuing more securities (certificate of deposits), i.e. contractionay monetary policy would lead to higher value of interest payments on those securities. Equations (2) and (3) denote the dynamic structure of the economy, i.e. output and inflation whereas d_t and s_t are aggregate demand and supply shocks, respectively (Cecchetti and Ehrmann 2000).

Using the same Equations (1) to (3) of Cecchetti and Ehrmann (2000), and also replacing the interest rate by money supply in order to target the former by the later, Sweidan and Kalaji (2005) discuss how the monetary policy becomes ineffective in the presence of operating losses of the central bank. Accordingly, they argue that existence of a constraint in applying monetary policy, i.e. cost constraint, makes monetary policy incapable to offset completely an aggregate demand shock. Or, in other words, existence of cost constraint in performing monetary policy limits the ability of monetary policy to affect aggregate demand and under such constraints, adopting a tight monetary policy becomes costly. This theoretical preposition suggests the importance of CBFS, or in other words, non-constrained monetary policy conduct with regard to monetary policy outcomes. Though this discussion is limited to monetary policy and inflation, and it has implications on other economic outcomes, the following section would provide a further discussion on the impact of CBFS on other economic outcomes while reviewing relevant academic literature.

3.1.2 Consequences of Central Bank Financial Strength

Although marginal changes or transient movements in central bank finance are immaterial, severe financial problems, i.e. weak CBFS may degrade the policy capacity and its outcomes (Stella 1997; 2008). As indicated in the previous section, on one hand, central bank financial problems may create a serious problem in designing and performing monetary policy as it would pose severe constraints (Leone 1993; Sweidan and Widner 2008). Under problematic circumstances, the ability of the central bank to conduct monetary policy would be affected and also it will have to be dependent on the

treasury support and hence, its control (Stella 1997). As a result, a central bank may have to abandon its primary goal, price stability and to compromise its operational independence and also to impose inefficient restrictions on the financial system to suppress inflation (Stella 1997). On the other hand, even though the central bank is not dependent on the treasury, monetary policy will be still ineffective when it operates with significant financial problems (Sweidan and Kalaji 2005). To that end, financial distress is a self-restraint on central banks affecting the adoption of monetary policy measures (Martinez- Resano 2004). Moreover, losses may influence the central bank to change its loss function to guarantee survival and to change the operations of central banking and the conduct of monetary policy itself (Sweidan 2011a). Hence, in sum, CBFS appears to be positively associated with good policy performance, or in other words, financially weak central banks would undermine the macroeconomic stability (Stella 2008). As Sweidan (2011a) argues that broadly, weak central bank finances may have negative implications on economic outcomes and also the central bank itself.

In order to signify the impact on economic outcomes, it is worthwhile to review some of the previous discussions in that regard. For example, Vaez-Zadeh (1991) argues that central bank losses influence economic aggregates both directly, and through the impact on monetary management, particularly by way of missing monetary targets and causing fluctuations in interest rates.[28] According to Vaez-Zadeh, losses of the central bank, especially if they are large relative to the monetary base, could erode the ability of the central bank to conduct monetary management efficiently, thereby compounding the adverse macroeconomic effects. In sum, central bank losses would resent a transfer of real resources, cause monetary expansion, erode central bank capital and also generate higher inflation rate. Vaez-Zadeh also argues that the impact of central bank losses is similar to that of the monetisation of growing fiscal deficits as they can undermine monetary management, slow down financial development and limit the ability to attain macro objectives such as price stability and economic growth. Montanjees (1995) also argues that central bank losses could endanger the attainment of monetary targets[29] and also generate further consequences if they are financed through creation of additional losses or through inflation. In order to lower the losses, central banks may tempted to temporarily manipulate the interest rate, growth of the monetary base or valuation of assets leading to distorted interest rate structure, inflation and depletion of foreign reserves. According to Montanjees, net worth affects long-run inflation performance and hence, more specifically, weak central bank financial position affects monetary and exchange rate stability.

[28] Vicious circle of rising losses, and rising remunerated liabilities would be accompanied by increases in interest rates in each around.

[29] Losses either lead to an injection of reserve money causing immediate impact on domestic liquidity or influence expectations about future monetary growth (Stella 1997).

Similarly, Stella (1997) argues that seriously deteriorated balance sheets would generate chronic losses eventually interfering with price stability. Particularly, such situation would tend to abandon of price stability as a goal, finance losses by money creation, resort to financial repression and also to obtain frequent transfers from the treasury. From a practical view point, Beckerman (1997) also observes that central bank recapitalisation has occasionally generated macroeconomic turbulence, for example, in Argentina and Chile. Beckerman also argues that central bank finance is important not only to ensure that it can honour payment obligations, but also to ensure its capability to sustain the value of the monetary unit.

Zhu (2004) argues that large capital losses and resultant negative net worth imply a possible loss of control over inflation. When central bank is worried about its net worth, monetary activism, which is embedded in the Taylor Rule, cannot be applied to its full extent. As a result, an active interest rate rule combined with a passive fiscal policy, which ensures the desired steady state equilibrium, could be reversed. Heenan (2005) also argues that shortfalls in financial resources of central bank may tend to increase the seignorage and reduce sterilization affecting policy objectives and hence, allowing for higher inflation, exchange rate instability, lower reserves accumulation, and financial repression. Similarly, Stella (2005) states that losses, which are financed through financial repression, would impair financial development or would explode reserve money creation affecting the price stability or would induce debt issuance leading to expectations of future monetary growth.[30]

Cargill (2006) also observes that financially weak central bank would generate losses requiring monetary expansion to cover expenses, require abandonment or modification of a policy objective to eliminate losses, reduce the ability of the central bank to function as a fiscal agent for the government, loose the credibility and shift from the formal to informal payment system. Similarly, Cuckierman (2008) argues that weak central bank conditions might limit policy options. Moreover, Stella (2008) indicates that if the central bank is required to maintain price or exchange rate stability, losses and deterioration of its balance sheet cannot continue indefinitely. On the same lines, Stella and Lonnberg (2008) argue that weak central bank finance may affect the expectations of public and hence, adversely affect the effectiveness of macroeconomic stabilisation efforts. Sweidan (2010) argues that central bank financial strength is important during times of financial distress given the capability of central bank to respond directly to offset unfavorable fluctuations of macroeconomic variables. In a recent contribution, Sweidan (2011b) argues that central bank losses result in higher actual and expected inflation rates, higher money supply growth, greater fluctuation in real GDP, deviations between central bank's announced objectives and macroeconomic indicators. When synthesising these

[30] If the money injection is with in targets and consistent with exchange rates, then it would not create any instability, however, if there is a deviation from targets, then there is risk of macroeconomic imbalance.

arguments, it is possible to hypothesise that CBFS is related to most of the economic outcomes, for example, price stability (represented by lower level of inflation or inflation variability), output performance (output growth or stability in terms of lower variability), interest rate stability (measured by lower variability) and also for exchange rate stability (measured by lower variability).

From the perspective of central banks, financial strength is important to maintain the independence and credibility. To that end, Montanjees (1995) argues that accumulated losses and negative net worth may compromise independence of central banks and interfere with monetary policy goals. Similarly, Heenan (2005) argues that recapitalisation by the government would reduce the independence due to usual time-inconsistency arguments and also tend to reduce operating costs leading to a reduction in services plus loss in credibility influencing the expectations. Similarly, Stella (1997) and Sweidan and Maghyereh (2006) argue that losses would erode central bank independence even if it is legally independent and hence, change the priorities of the central bank. In addition, large losses and balance sheet problems may draw unwanted attention and criticisms from the public (Zhu 2004). Moreover, Stella and Lonnberg (2008) argue that continuous losses of central banks will make central banks technically insolvent. All these arguments point to the importance of CBFS with regard to both macroeconomic outcomes and central bank performance.

3.2 Previous Research

Although it is evident that central banks need a certain level of financial strength in order to achieve policy objectives, the discussion on the causation and exact nature of the relationship have often remained vague and the underlying assumptions have not been much analysed (Bindseil et al 2004). At the same time, existing literature in this regard provides mixed and inconclusive evidence, which would be presented in the following section.

Prior research on CBFS focuses on both theoretical and empirical perspectives. For example, building a theoretical model, Bindseil et al (2004) argue that low (or even a negative) level of capital does not pose harmful effects on the ability of central bank to achieve its monetary policy target. Particularly, a temporary shock, which may create negative capital and loss making situation, is always reversed in the long-run. They argue that although losses may easily accumulate over a long period of time, and lead to a negative capital, there is no reason to affect the central banks' ability to control interest rates. They also argue that some other factors would need to be included in order to explain the negative correlation between inflation performance and CBFS. At the same time, Zhu (2004) provides a theoretical foundation arguing that central bank balance sheet concerns may hinder monetary policy activism, which is required to achieve aggregate stability. The argument is based on the conventional Taylor rule with net worth targeting and Zhu shows that central bank balance sheet

concerns built into the economic system have a tendency towards structural inability impacting to deviate from targeted steady state even under an active interest rate rule. Similarly, Sims (2005) illustrates that central bank concerns about the level of its capital can lead to self-fulfilling hyper-inflationary equlibria. That is, low level capital may prevent the central bank in avoiding a self-fulfilling hyper-inflationary equlibria. Sweidan and Kalaji (2005) mathematically show that the existence of constraints on the conduct of monetary policy leads to inability of monetary policy to completely offset an aggregate shock. Similarly, Sweidan and Maghyereh (2006) develop a model to illustrate how macroeconomic variables such as change in money supply and inflation rate are biased towards higher levels in an environment of central bank losses.

Jeanen and Svensson (2007) show how it is possible for independent central bankers to manage their capital so as to create an incentive not to appreciate currency ex-post. Cincibuch et al (2008) develop a framework to evaluate the ability of central bank to keep its balance sheets sustainable without having to default its policy objectives. Sweidan (2008) theoretically models the central bank ability in the central bank loss function and finds chronic central bank losses would reduce the ability of the central bank to control the economy, particularly to manage money supply and inflation rate. Sweidan and Widner (2008) further argue that cost constraints of conducting monetary policy, central bank losses, in both transparency and opacity alike are significant and affect positively the error of the private sector expected inflation rate and the output gap. Introducing a fiscally independent central bank with balance sheet concerns in the new Keynesian model, Berriel and Bhattarai (2009) find that when central bank targets its real capital, optimal monetary policy is substantially different from the standard case. They observe that inflation responds less than the standard case, and the variation in inflation decreases at the expense of higher variation in output gap. Based on a developing country perspective, Sweidan (2010) indicates that existence of serious operational losses and negative capital restricts the ability of central banks to respond to the various macroeconomic shocks. Sweidan further argues that central bank inability plays a crucial role to boost up expected future inflation rate and also leads to explode expected future nominal interest rate. Accordingly, Sweidan argues that central bank inability decreases both expected future real interest rate and the expected future real output.

Although theoretical arguments and practical examples point to a relationship between CBFS and economic and monetary performance, empirical evidence in this regard remains scant, mixed and also inconclusive. For example, Fukui (2003) opines that central banks with low or negative capital may experience difficulties in conducting monetary policy. Similarly, Hawkins (2003) argues that approaching the government frequently for capital support would compromise central bank independence, and may even reduce confidence on currency. According to Ize (2005), it is unlikely that the rate of inflation can be brought below double digits on a sustainable basis without significant

strengthening of the balance sheet of the central bank. Detecting a strong negative relationship between CBFS and inflation outcomes, Klüh and Stella (2008) conclude that financially strong central banks tend to facilitate lower inflation. In contrast, Cincibuch et al (2008) prove that accumulated losses of the central bank would not damage monetary policy credibility.

Based on the above theoretical and also empirical implications, several hypotheses can be formulated to investigate the relationship between CBFS and economic outcomes. Accordingly, the following hypotheses are formed:

H1: Inflation is negatively associated with CBFS.

H2: Output growth is positively associated with CBFS.

H3: Real interest rate variability is negatively associated with CBFS.

H4: Nominal exchange rate variability is negatively associated with CBFS.

Although several other macroeconomic outcomes such as inflation variability, output variability, etc. can be modeled, the analysis in this study is limited to examine key economic outcomes highlighted in the above hypotheses. This indicates that there remains a wide research scope with regard to CBFS.

4. Empirical Analysis

4.1 Basic Evidence

Before moving to the empirical investigation employing econometric techniques in order to examine the validity of above stated hypotheses, it is worthwhile to focus on basic evidence. The basic evidence is presented by following the approach of Alesina and Summers (1993), Cukierman, Kalaitzidakis, Summers and Webb (1993), Romer (1993), Crosby (1998) and also Chrigui, Boujelbene and Mhamdi (2011) examining the relationships between central bank independence and macroeconomic variables.

Accordingly, using data over the period 1996-2008 and employing the descriptive method, evidence for the relationship between CBFS and economic outcomes is presented for a group of selected countries.[31] The selected group of countries includes selected advanced countries (Australia, Germany, New Zealand, Singapore, South Korea, and the United Kingdom), selected emerging

[31] The selection of the period and countries depends on the availability of comparable data. 2009 was excluded purposely in order to avoid the undue changes in trends in variables due to the impact of global financial and economic crisis.

countries of Latin America (Argentina, Brazil, Chile and Mexico), East Asia (Indonesia, Malaysia, Philippines and Thailand) and also South Asia (India, Nepal, Pakistan and Sri Lanka).

Initially, four different measures of CBFS suggested by Klüh and Stella (2008) are examined. First, as an explicit measure of CBFS, central bank's return on average assets (ROAA) available for most of the countries in the Bankscope database is considered. ROAA measure of CBFS ($CBFS_{1,t}$) appears to be a representative measure; however, only for average values (period averages of ROAA and period averages of economic outcomes). Hence, the following three measures of CBFS are also considered:

$$CBFS_{2,t} = (CBC_t + OIN_t)/TA_t \quad (5)$$

where $CBFS_{2,t}$ is the stock measure of CBFS, expressed as the sum of central bank capital (CBC_t) and other items net (OIN_t) scaled by central bank total assets (TA_t).[32] The other measure of CBFS, i.e. $CBFS_{3,t}$ is defined based on central bank profit and losses ($CBPL_t$) as a percentage of GDP (GDP_t) as given in Equation 6.

$$CBFS_{3,t} = CBPL_t/GDP_t \quad (6)$$

The last measure is an extension of $CBFS_{3,t}$ calculated using accumulated profits or losses over a specified period of time (for example, profits and losses of preceding three years). Accordingly, $CBFS_{4,t}$ is defined as follows:

$$CBFS_{4,t} = \sum_{t=1}^{t-3} CBPL_t/GDP_t \quad (7)$$

Appendix A presents plots for movements in different measures of CBFS. The issue of reverse causality is also recognised in selecting appropriate measures of CBFS. Since inflationary pressures themselves can cause financial weaknesses by forcing the central bank to carryout costly stabilisation operations, it is imperative to account for potential reverse causality (Klüh and Stella 2008). Hence, in order to address the reverse causality, one year lagged measures (t-1) of CBFS are considered. The use of lagged measures also recognises the fact that CBFS may not impact the economy during the same period, but, impact during the subsequent periods. Initial examinations proved that all the measures of CBFS do not explicitly indicate any relationship with economic outcomes. Only $CBFS_{2,t}$ and its

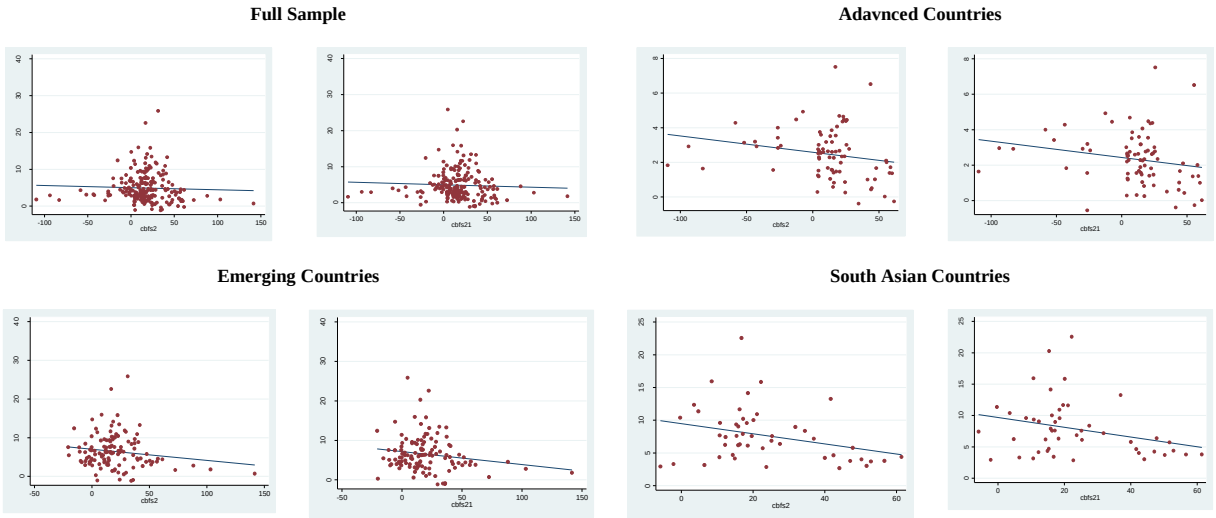
[32] Countries in which the ratio of central bank capital and OIN to total assets exceeds 20 per cent are defined as those with high CBFS (Klüh and Stella 2008). This measure is based on standardised data of IFS and hence, comparable across countries.

lagged measure appear to be the most representative measures. These measures can be linked with economic outcomes.

Figures 1 to 4 present two-way scatter plots with fitted lines exploring the relationship between $CBFS_{2,t}$ or its lagged measure ($CBFS_{2,t-1}$) and different economic outcomes.[33] These economic outcomes include price stability (as represented by actual inflation rate), output performance (as represented by real economic growth), interest rate stability (as measured by real interest rate variability) and exchange rate stability (as measured by nominal exchange rate variability). However, as the use of actual inflation rates may result in heteroscedastic error terms due to the presence of hyperinflationary outliers. Hence, previous empirical research introduces a rescaled measure for inflation, i.e. $d=\frac{\pi_t}{(1+\pi_t)}$, which ranges from 0 to 1, and can be interpreted as the rate of depreciation of purchasing power (for example: Cukierman et al 1992; Klüh and Stella 2008; Chrigui et al 2011). The rescaled inflation rate is also examined, however, a significant deviation is not observed with actual inflation rates.

Figure 1

Inflation and Central Bank Financial Strength



[33] In scatter plots, $CBFS_{2,t}$ is represented by $CBFS_2$ and the lagged measure is represented by $CBFS_{21}$.

Figure 2

GDP Growth and Central Bank Financial Strength

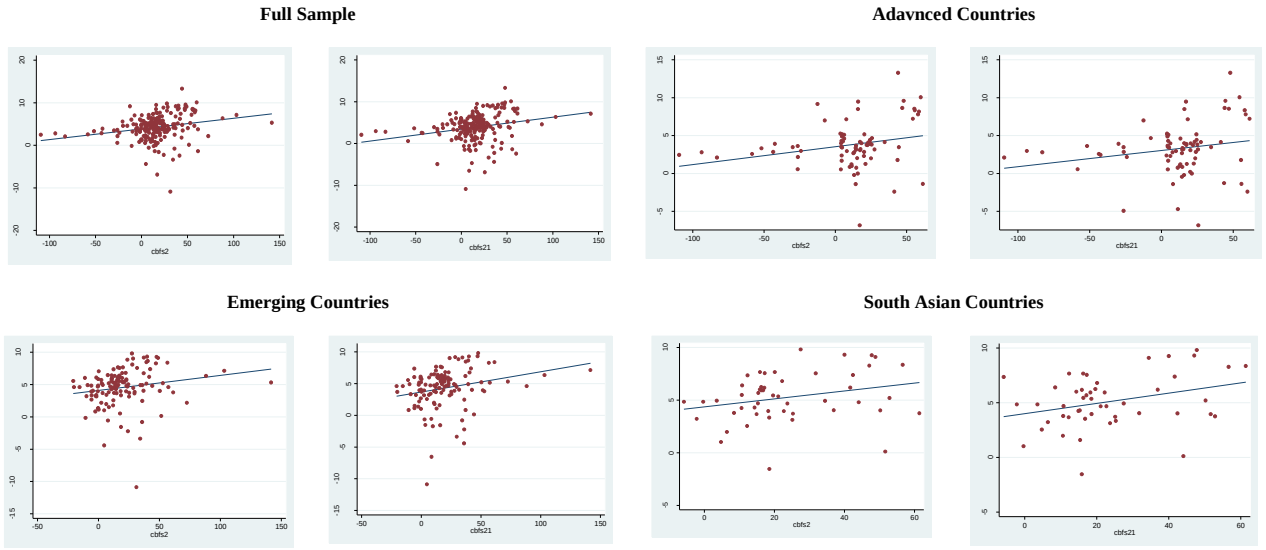


Figure 3

Real Interest Rate Variability and Central Bank Financial Strength

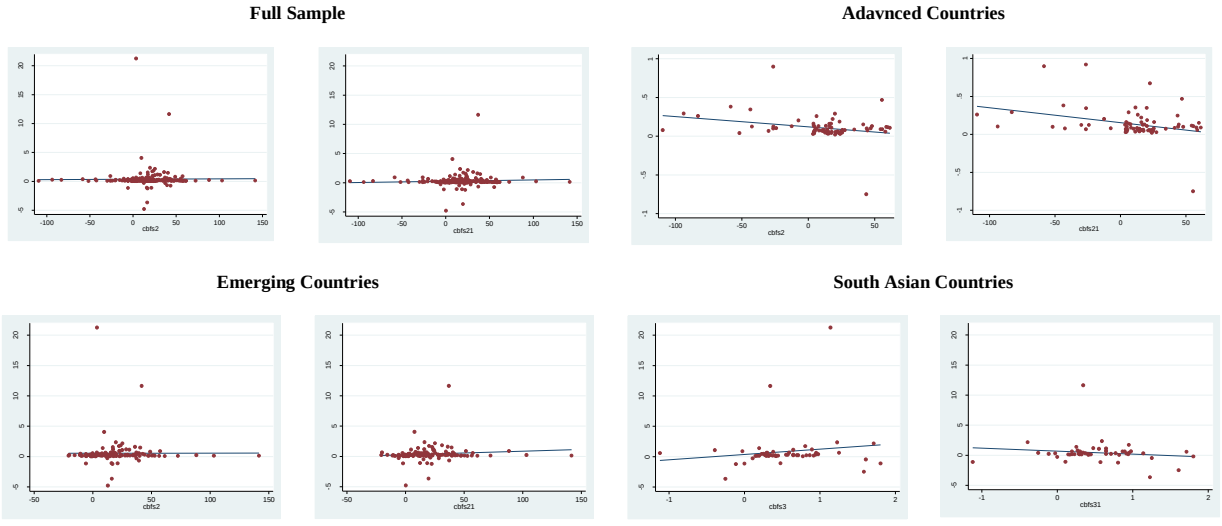
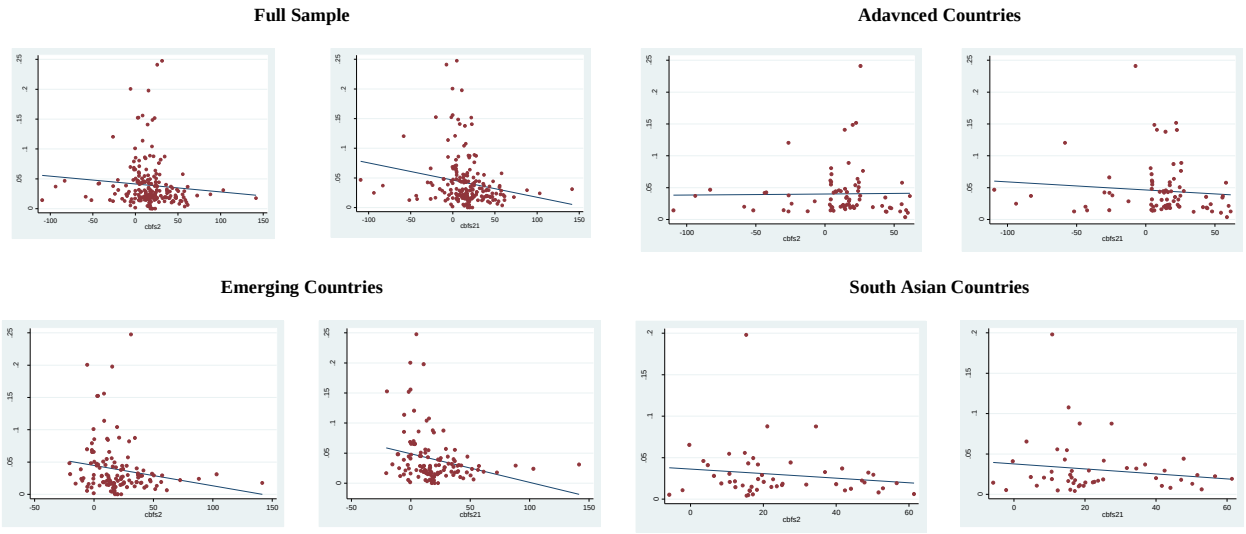


Figure 4

Nominal Exchange Rate Variability and Central Bank Financial Strength



According the scatter plots, it is observed that most of the results are consistent with the expectations. First, the expected negative relationship is observed between CBFS and the level of inflation (Figure 1). This indicates that CBFS may lead to a significant bias in inflation.[34] Figure 2 presents evidence for the expected positive relationship between CBFS and output growth.[35] More importantly, the expected negative relationship is observed for real interest rate variability for advanced countries and also, for nominal exchange rate variability for majority of samples (Figure 3 and 4). These observations are broadly consistent with theoretical implications and hence, support hypotheses. The above investigation is based on a panel setting and the same is conducted on annual basis. Appendix B presents the respective graphs, and it is observed that the majority of the observed evidence is consistent with panel graphs.

Next, the validity of basic evidence is investigated within the empirical setting. The empirical approach allows considering additional variables that would explain the relationships between CBFS and economic outcomes. As already highlighted, the existing evidence for the relationship between macroeconomic outcomes and CBFS (for example, Klüh and Stella 2008) is based only on pooled samples of countries providing results and policy inferences without accounting for heterogeneity of individual country characteristics. Particularly, these studies do not specifically detangle the emerging country context, which experience significant financial problems in central banks due to high exposure

[34] The relationship between CBFS and inflation variability was also examined though scatter plots are not presented. However, a clear negative relationship between inflation variability and CBFS was not observed.

[35] Although scatter plots are not presented, a clear positive relationship is observed for CBFS and per capita income growth.

of quasi-fiscal activities. Also, these studies do not attempt to examine other important factors affecting inflation such as monetary growth.[36] Moreover, many studies do not focus the time series approach, which is important to account for changes in policies and resultant outcomes. The empirical analysis of this study is designed to address these aspects.

4.2 Sample, Data and Methodology

4.2.1 Sample and Data

First, the empirical analysis is conducted for the entire group selected for basic evidence. Accordingly, evidence is presented for the entire sample of countries based on the pooled data and panel data setting and then, at disaggregated levels, i.e. advanced countries, emerging countries and South Asian countries. Second, given the specific interest with regard to South Asian countries, the empirical investigation is conducted for two South Asian countries (India and Sri Lanka) based on the time series setting.[37] The selection of these countries is motivated by the ease of access to central bank balance sheet data. At the same time, being a leading economic powerhouse, it is worthwhile to focus on the Indian context and also, being a key emerging economy in the South Asian region, it is also imperative to focus on the Sri Lankan context. At the same time, for a long period of time, these two countries have been engaging in quasi-fiscal operations including interventions in the foreign exchange market posing implications on the balance sheets of respective central banks. Moreover, one could argue that fiscal abuse has been significant in these countries, particularly during 1980s and 1990s (for example, Fry 1993). Hence, these two countries provide an appropriate context to examine the relationship between CBFS and economic outcomes in emerging country setting.

Accordingly, the sample examined for the empirical analysis of this study consists of macroeconomic data for a group of selected countries (introduced in Section 4.1) over the period 1996-2008, and for India and Sri Lanka over the period 1980 – 2008. The required data was retrieved from various sources such as International Financial Statistics (IFS) of International Monetary Fund, World Development Indictors of World Bank, Bankscope database and also from the respective central banks, particularly, Central Bank of Sri Lanka (CBSL) and Reserve Bank of India (RBI).

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[36] For example, Klüh and Stella (2008) use a large set of explanatory variables such as world inflation, central bank independence, institutional quality, GDP per capita, openness, etc., however disregard money despite its importance.

[37] South Asian countries namely Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka jointly form a regional initiative called South Asian Association for Regional Corporation (SAARC). In terms of output contribution (based on GDP, PPP current international dollar terms of World Development Indicators), India and Sri Lanka account for 84 per cent of the regional output.

4.2.2 Variable Selection

Broadly, four dependent variables: a measure for price stability (proxied by inflation), a measure of output performance (proxied by real GDP growth), a measure of interest rate variability (measured by the standard deviation of real interest rates) and also a measure of nominal exchange rate variability (measured by the standard deviation of nominal exchange rate) are identified. These dependent variables are modeled separately with measures of CBFS in order to examine the relationship between different economic outcomes and central bank finances. Though $CBFS_{2,t}$ and its lagged measure appear to be the representative measure, a pilot analysis was conducted using alternative measures of CBFS interchangeably as the main explanatory variable. It was reconfirmed that $CBFS_{2,t}$ and its lagged measure remain the most representative measures, which can be used to model the relationship with economic outcomes.

At the same time, by following the previous empirical literature of both CBFS as well as central bank independence, a set of explanatory variables is included in extended models. Prior to selecting these additional explanatory variables, a plethora of previous studies, which examines the relationships between certain macroeconomic variables and also defines determinants of key macroeconomic outcomes, was summarised. For example, in prior literature, inflation has been regressed using a broad range of explanatory variables including broad money, per capita income, budget deficit, output gap, nominal interest rates, nominal exchange rates, economic openness, import prices, world inflation, oil and/or commodity prices, expected inflation, central bank independence, political stability, etc. and also incorporating dummies to capture various external factors (for example: Cuckierman, Webb and Neyapti 1992; Romer 1993; Moser 1995; Roberts 1995; Lane 1997; de Brouwer and Ericson 1998; Kuijs 1998; Dwyer and Leong 2001; Hendry 2006; Chrigui et al 2011). Similarly, empirical research of growth theory finds a list of explanatory variables affecting output or per capita income. These variables include government consumption, public and private investment, terms of trade movements, labour force, economic openness, financial development, productivity and also some socio-economic and institutional variables such as fertility, population, education, democracy, rule of law, central bank independence, etc. (for example: Kormendi and Meguire 1985; Jorgenson 1991; Roubini and Sala-i-Martin 1992; Cuckierman et al 1993; Barro 1996 and 2003; Chen and Feng 2000; Ranis, Stewart and Ramirez 2000; Yanikkaya 2003; Bhattacharyya 2004). At the same time, interest rates have been examined employing relevant determinants such as economic performance, monetary growth, inflation or expected inflation, risk, central bank independence, etc. (for example: Tatom 1984 and 1985; Cuckierman et al 1993; Berument and Malatyali 1999). Meanwhile, exchange rates have been examined using capital mobility, openness, degree of economic development, trade diversification,

interest rate differential, etc. (for example: Holden, Holden and Suss 1979; Bailey and Tavlas 1991; Lane and Milesi-Ferretti 2002).

Although it is possible to examine the relationship between CBFS and economic outcomes in the presence a set of explanatory variables, a wide range of variables is not utilised in empirical models in this study in order to avoid or minimise the potential endogeniety problem and also to keep models less complex. However, several alternative models were tested employing a range of explanatory variables interchangeably, and then, carefully selected a set of appropriate variables to include in regression models. At the same time, the step-wise regression method was used to justify the selection of most appropriate variables that can be included in regression models.[38] The final set of variables of concern is listed in Table C.1 in Appendix C with relevant definitions and measure/s along with the source. Table C.2 presents descriptive statistics.

4.2.3 Models and Estimation Method

As covered in the theoretical and empirical discussion in Section 2, four hypotheses are developed. In order to test these hypotheses, first, benchmark regression models, and then, extended models including a host of explanatory variables are specified. A set of equations (Equations 8 through to 15) is specified for basic and extended models of CBFS and economic outcomes and each equation is presented in relevant table of empirical results.

Following Cuckierman et al (1992 and 1993); Klüh and Stella (2008) and Chrigui et al (2011), ordinary least squares (OLS) method is used to estimate the models. Particularly, in order to estimate models for the selected group of countries (baseline estimations) pooled OLS method is used with robust standard errors to correct for heteroskedasticity of unknown type and first order serial correlation (Wooldridge 2002; 2006). The baseline regression models adopt CBFS as the only explanatory variable. The extended models, which include additional explanatory variables, are also estimated using pooled OLS method.

However, given the possibility of biased and inconsistent results of pooled OLS estimates, further analysis is conducted using advanced panel data estimation methods, and hence, robustness checks for baseline pooled OLS estimates are conducted.[39] Accordingly, regression models (Equation 8-15) are re-estimated using Generalised Least Square (GLS) Random Effect (RE) technique following Baltagi

[38] Stepwise regression allows some or all of the variables in a standard linear multivariate regression to be chosen automatically, using various statistical criteria, from a set of variables (Derksen and Keselman 1992).

[39] In order to pooled OLS method to produce a consistent estimator of β, it is required to assume that the unobserved effect, a_i, is uncorrelated with x_{it}. Hence, even if it is assumed that the idiosyncratic error u_{it} is uncorrelated with x_{it}, pooled OLS is biased and inconsistent if a_i and x_{it} are correlated. The resulting bias in pooled OLS is sometimes called heterogeneity bias, in the presence of such bias, using pooled OLS on the many years of data results in biased and inconsistent estimates (Wooldridge 2006).

and Wu (1999) procedure.[40] The Hausman test also suggests that RE should be used; however Hausman test results are not reported here.

Thereafter, time series regression models (Equations 16 to 22) are estimated using OLS method for India and Sri Lanka. Different diagnostic tests are performed and models are adjusted accordingly to correct any misspecification. At the same time, considering the possibility of having non-stationary properties (and also proved by Augmented Dicky-Fuller unit root tests), some of the variables are adjusted to spurious estimates bias.

4.3 Empirical Results

First, results are presented for pooled OLS and GLS-RE estimates for baseline (simple) regression models for CBFS and economic outcomes without controlling for additional explanatory variables. Table 1 presents results for both pooled OLS and GLS-RE results for the relationship between CBFS and price stability (measured using the movements in actual inflation rate). It is expected that greater financial strength of central banks would lead to lower level of inflation. As per expectations, empirical results point to a significant negative relationship between CBFS and inflation, particularly for emerging countries as results are significant and robust across both pooled OLS and GLS-RE estimates.

Though GLS – RE estimates are not significant except for emerging country sub-sample, pooled OLS estimates point to a significant relationship between CBFS and inflation across sub-samples. Particularly, a significant negative relationship is observed for advanced, emerging and South Asian samples. Despite some GLS – RE models are not significant, expected coefficients are observed for both estimates. Hence, these results are broadly in line with those of Klüh and Stella (2008) arguing for a negative relationship between CBFS and inflation outcomes.

The same models are re-estimated for transformed inflation rates. However, a significant difference is not observed between results for actual inflation rates and transformed inflation rates, hence, further analysis is based on actual inflation rates. Also, the same regression models are estimated for inflation variability and CBFS. Similar to the relationship between CBFS and inflation, it is expected that greater CBFS would lead to lower inflation variability. However, similar to basic evidence in scatter plots, a clear relationship is not observed for inflation variability and CBFS.

[40] The random effects estimator (error components model) is attractive when the unobserved effect is uncorrelated with all the explanatory variables (Wooldridge 2006). At the same time, it is also appropriate for randomly selected samples (Hill, Griffiths and Lim 2008).

Table 1

Inflation and Central Bank Financial Strength

This table presents the results of the pooled OLS and GLS-RE regression model,

$$CPI\_INF_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \varepsilon_{i,t} \qquad (8)$$

Subscripts i denote individual countries and t time period. $CPI\_INF_{i,t}$ is the measure of inflation, i.e. year-on-year change of consumer price index, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$ and ε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: CPI Inflation (CPI_INF)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	4.95***	5.15***	2.51***	2.53***	6.96***	7.37***	9.25***	9.76***
$CBFS_{2,t}$	(-)	-0.004		-0.009*		-0.028*		-0.077*	
$CBFS_{2,t-1}$	(-)		-0.008		-0.010*		-0.034**		-0.080***
R^2		0.007	0.003	0.042	0.521	0.021	0.034	0.081	0.088
F-Statistic		0.21	0.87	3.45*	3.64*	5.45*	8.93**	4.73*	8.60***
No. of Observations		193	184	74	72	119	112	46	45
Panel B: GLS-RE Estimates									
Constant	?	5.11***	5.40***	2.42***	2.46***	6.85***	7.33***	9.28***	9.49*
$CBFS_{2,t}$	(-)	-0.014		-0.001		-0.030*		-0.079	
$CBFS_{2,t-1}$	(-)		-0.021		-0.005		-0.043**		-0.072
R^2									
Within		0.003	0.016	0.018	0.001	0.012	0.038	0.039	0.018
Between		0.002	0.002	0.266	0.290	0.055	0.060	0.178	0.370
Overall		0.001	0.003	0.042	0.053	0.021	0.034	0.081	0.088
Wald chi-Statistic		0.40	1.44	0.05	1.53	3.45*	6.76***	2.01	1.97
No. of Observations		193	184	74	72	119	112	46	45

Next, the relationship between CBFS and output performance is examined and Table 2 presents results. As per the expectation, a positive relationship is observed between CBFS and output growth except for $CBFS_{2,t-1}$ in advanced countries. In order to confirm these result, the same regression models are estimated replacing the GDP growth variable with per capita growth variable (results are not reported). Again, significant positive relationships are observed. Though it is not much clear about the direct relationship between CBFS and growth, one could infer a relationship between CBFS and output performance based on the discussions on resource misallocation, impact on financial

development and macroeconomic stability. Particularly, it may be argued that CBFS would help to minimise the resource misallocation while facilitating the financial sector developments vital for output performance.

Table 2

Output Growth and Central Bank Financial Strength

This table presents the results of the pooled OLS and GLS-RE regression model,

$$D\_GDP_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \varepsilon_{i,t} \qquad (9)$$

Subscripts i denote individual countries and t time period. $D\_GDP_{i,t}$ is year-on-year growth of real gross domestic product, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$ and ε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: Real GDP Growth (D_GDP)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	3.78***	3.82***	3.39***	3.44***	4.09***	4.07***	4.28***	4.05***
$CBFS_{2,t}$	(+)	0.025***		0.023*		0.022**		0.035	
$CBFS_{2,t-1}$	(+)		0.027***		-0.010*		0.028***		0.042*
R^2		0.055	0.064	0.064	0.054	0.033	0.054	0.060	0.090
F-Statistic		17.26***	19.40***	5.74**	4.31**	6.28**	11.44***	2.35	3.57*
No. of Observations		193	184	74	72	119	112	46	45
Panel B: GLS-RE Estimates									
Constant	?	3.81***	3.83***	3.41***	3.47***	4.088***	4.08***	4.92***	4.46*
$CBFS_{2,t}$	(+)	0.022***		0.015		0.022*		0.004	
$CBFS_{2,t-1}$	(+)		0.025***		0.010		0.028**		0.019
R^2									
Within		0.001	0.007	0.003	0.007	0.004	0.039	0.012	0.004
Between		0.284	0.256	0.306	0.300	0.210	0.167	0.354	0.300
Overall		0.055	0.063	0.064	0.054	0.033	0.054	0.060	0.090
Wald chi-Statistic		11.57***	14.45***	1.23	1.17	4.20**	6.15**	0.01	0.37
No. of Observations		193	184	74	72	119	112	46	45

Next, the relationship between CBFS and interest rate variability is examined. Though central bankers are interested in nominal interest rates due to their ability to manipulate, given the importance of real interest rates in terms of influencing the economy through monetary policy actions, it would be imperative to focus on real interest rates (Walsh 2010).

Table 3

Real Interest Rate Variability and Central Bank Financial Strength

This table presents the results of the pooled OLS and GLS-RE regression model,

$$RINT\_VAR_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \varepsilon_{i,t} \qquad (10)$$

Subscripts i denote individual countries and t time period. $RINT\_VAR_t$ is the standard deviation of ex-post real interest rate derived using lending rate and inflation rate, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$ and ε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: Standard Deviation of Ex-Post Real Lending Rate (RINT_VAR)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	1.36***	1.38***	0.121***	0.128***	2.07***	2.10***	2.09***	2.19***
$CBFS_{2,t}$	(-)	0.005		-0.013**		-0.003**		-0.012	
$CBFS_{2,t-1}$	(-)		0.004		-0.002*		-0.003		-0.014*
R^2		0.004	0.003	0.079	0.032	0.001	0.001	0.029	0.040
F-Statistic		1.92	1.32	4.13**	4.77**	0.018	0.200	1.69	2.85*
No. of Observations		193	184	74	72	119	112	46	45
Panel B: GLS-RE Estimates									
Constant	?	1.55***	1.60***	0.507***	0.519***	2.23***	2.32***	2.22***	2.23***
$CBFS_{2,t}$	(-)	-0.007		0.002***		-0.015*		-0.018*	
$CBFS_{2,t-1}$	(-)		-0.009***		0.002***		-0.019*		-0.017
R^2									
Within		0.017	0.028	0.003	0.001	0.030	0.051	0.036	0.026
Between		0.264	0.304	0.445	0.406	0.004	0.008	0.027	0.088
Overall		0.004	0.003	0.059	0.045	0.001	0.001	0.029	0.040
Wald chi-Statistic		0.92	1.22	76.08***	39.03***	2.87*	3.02*	2.87*	1.64
No. of Observations		193	184	74	72	119	112	46	45

As per hypothesis predicts, a significant negative relationship is expected between CBFS and real interest rate variability. Table 3 presents results for pooled OLS regression models for the relationship between ex-post real interest rate variability and CBFS. Given the findings for inflation, it is reasonable to expect a clear negative relationship between CBFS and the variability of ex-post real interest rates. In line with these expectations, a significant negative relationship is observed for majority of models. Hence, it is reasonable to conclude that real interest rate variability can be partly explained using the financial strength of the central bank. This finding corresponds with cases of

central bank independence and its impact on real interest rates. For example, Alesina and Summers (1993) do not observe clear relations between central bank independence and average ex-post real interest rates arguing that while expansionary monetary policy may influence real interest rates in the short-run, it does not affect real interest rates over a longer period. However, they also observe a significant negative relationship between real interest rate variability and central bank independence. The same finding is observed by Cuckierman et al (1993).

The relationship between CBFS and nominal exchange rate variability is examined using regression models and results are presented in Table 4.

Table 4

Exchange Rate Variability and Central Bank Financial Strength

This table presents the results of the pooled OLS and GLS-RE regression model,

$$EXR\_VAR_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \varepsilon_{i,t} \qquad (11)$$

Subscripts i denote individual countries and t time period. $EXR_VAR_t$is the standard deviation of nominal exchange rate, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$ and ε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: Standard Deviation of Nominal Exchange Rate (EXR_VAR)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	22.75***	21.57***	10.31***	11.66***	0.044***	0.047***	2.21***	2.42***
$CBFS_{2,t}$	(-)	0.159		0.79		-0.003***		-0.021*	
$CBFS_{2,t-1}$	(-)		0.011		-0.027		-0.004**		-0.024*
R^2		0.002	0.001	0.005	0.006	0.032	0.005	0.032	0.040
F-Statistic		1.94	0.20	1.73	0.15**	7.72***	8.34***	3.33**	3.33*
No. of Observations		193	184	74	72	119	112	46	45
Panel B: GLS-RE Estimates									
Constant	?	0.040***	0.045***	0.039***	0.043***	0.044***	0.049***	0.035***	0.035***
$CBFS_{2,t}$	(-)	-0.001		0.001		-0.002*		-0.001*	
$CBFS_{2,t-1}$	(-)		-0.003**		-0.002		-0.001*		-0.003*
R^2									
Within		0.006	0.034	0.050	0.013	0.004	0.053	0.061	0.038
Between		0.113	0.135	0.025	0.051	0.204	0.217	0.019	0.853
Overall		0.009	0.039	0.001	0.015	0.032	0.068	0.019	0.025
Wald chi-Statistic		0.33	4.10**	0.53	1.15	2.84*	3.78*	3.02*	3.31*
No. of Observations		193	184	74	72	119	112	46	45

Although results are mixed across samples, it is possible to observe a negative relationship between CBFS and nominal exchange rate variability mainly for emerging country samples. This observation is consistent with the fact that many emerging central banks engage in foreign exchange operations with a view to stabilise the exchange rate. In other words, when the financial position is strong, central banks can intervene in foreign exchange markets to stabilise exchange rates and absorb resultant losses, *ceteris paribus*.

Broadly, it is reasonable to conclude that key economic outcomes can be partly explained using CBFS. In other words, CBFS impacts on key economic outcomes. However, it is not reasonable to arrive at a final conclusion, as these economic outcomes can be determined or affected by several other factors. The lower 'R^2' values in Tables 1- 4 also indicate that these economic outcomes are not well explained by CBFS alone. Hence, in order to ascertain the robustness of these findings, it is essential to examine whether such relationships hold in the presence of a set of other variables. Accordingly, in order to confirm baseline regression results, next, the same models are estimated controlling for a set of explanatory variables and results are presented in Tables 5 to 8. No correlation is observed between explanatory variables (hence, no multi collinearity) as the highest average variance inflation factor (VIF) is only 2.91 for all estimates.

First, Table 5 presents results for pooled OLS and GLS-RE models for CBFS and inflation. Confirming the results of Klüh and Stella (2008) and also baseline regression results presented in Table 1, negative coefficients are observed for CBFS and inflation models in the presence of a host of control variables. These observations are also consistent with theoretical considerations and hence, support hypothesis H1. At the same time, as expected, a significant negative relationship is evident between per capita income and inflation. Being a proxy for the level of economic development, the negative relationship indicates that inflation is dependent on the level of economic development. This is re-confirmed in the context of developed countries where inflation is relatively low compared to emerging countries. In addition, it is noteworthy that inflation in advanced countries remains a leading indicator of global inflation and also acts as a forerunner for inflation in emerging countries. Empirical observations also prove that inflation in emerging countries generally follow the trend in advanced country inflation (for example, Perera 2010). This has been proven in this study as the variable for advanced (OECD) country inflation, i.e. CPI_OECD_t is significantly positive for all the models. CPI_OECD_t is included in advanced country model as well since it would have a mutual impact on those countries. Moreover, as theory predicts, a significant positive relationship is noted between money growth and inflation. Although the coefficient is not significant, a positive relationship is observed for South Asian countries as well.

Table 5

Inflation and Central Bank Financial Strength (Extended Models)

This table presents the results of the pooled OLS and GLS-RE regression model,

$$CPI\_INF_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \beta_2 L\_PER\_CAP_{i,t} + \beta_3 L\_CPI\_OECD_{i,t} + \beta_4 \Delta BM_t + \beta_5 CB\_IND_{i,t} + \varepsilon_{i,t} \quad (12)$$

Subscripts i denote individual countries and t time period. $CPI\_INF_{i,t}$ is the measure of inflation, i.e. year-on-year change of consumer price index, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$, PER_CAP_{i,t_t} is natural logarithm of per capita income, $L_CPI_OECD_{i,t}$is natural logarithm of average inflation for advanced countries, ΔBM_t is broad money growth, $CB\_IND_{i,t}$ is real central bank independence based on the turnover rate andε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. The average variance inflation factor (VIF) shows the degree of collinearity among the regressors. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: CPI Inflation (CPI_INF)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	-23.39***	-24.80***	-20.98***	-20.55*	-14.80	-14.71	-6.49	-40.77
$CBFS_{2,t}$	(-)	-0.022***		-0.010**		-0.037***		-0.035	
$CBFS_{2,t-1}$	(-)		-0.023**		-0.010**		-0.035**		-0.058*
L_PER_CAP	(-)	-1.28***	-1.30***	-1.84**	-1.47**	-0.924**	-751	4.27**	4.19**
L_CPI_OECD	(+)	8.36***	8.64**	8.33***	8.21***	5.94	5.45	-2.89	5.33
ΔBM	(+)	0.083**	0.123***	0.055*	0.050	0.089**	0.176***	0.047	0.066
CB_IND (TOR)	(+)	1.745	1.671	-0.030	0.080	2.60	2.33	-0.662	-1.37
Average VIF		1.06	1.08	1.25	1.27	1.11	1.19	1.18	1.17
R^2		0.363	0.391	0.281	0.275	0.203*	0.241	0.335	0.343
F-Statistic		22.60***	29.84***	5.53***	6.09***	6.59***	12.33***	7.15***	5.27***
No. of Observations		193	184	74	72	119	112	46	45
Panel B: GLS-RE Estimates									
Constant	?	-27.69**	-28.79**	-20.98***	-20.55***	-29.07	-28.31	-6.49	-40.77
$CBFS_{2,t}$	(-)	-0.020*		-0.010***		-0.038**		-0.035	
$CBFS_{2,t-1}$	(-)		-0.025**		-0.010***		-0.039**		-0.058
L_PER_CAP	(-)	-1.42***	-1.38***	-1.48***	-1.47***	-1.56**	-1.15**	4.27**	4.19**
L_CPI_OECD	(+)	9.57***	9.69***	8.333***	8.21***	10.13	9.13*	-2.89	5.33
ΔBM	(+)	0.074*	0.115*	0.055***	0.050***	0.083	0.159**	0.47	0.066
CB_IND (TOR)	(+)	1.65	1.52	-0.03	0.080	2.33	2.10*	-0.662	-1.37
R^2									
Within		0.172	0.187	0.116	0.116	0.212	0.228	0.179	0.219
Between		0.566	0.625	0.806	0.786	0.229	0.338	0.701	0.819
Overall		0.361	0.389	0.280	0.275	0.189	0.235	0.335	0.343
Wald chi-Statistic		28.78***	58.31***	337.91***	723.90***	34.51***	48.75***	20.22***	20.93***
No. of Observations		193	184	74	72	119	112	46	45

Previous empirical research establishes a relationship between central bank independence and inflation (for example: Alesina and Summers 1993; Cuckierman et al 1992; Chrigui et al 2011). Majority of these research points to a significant negative relationship between central bank independence and inflation. Based on this observation, regression model specified by Equation (12) includes a measure of central bank independence. However, traditional measures of central bank independence like indices of overall or legal independence are not used in this study. Instead, a measure of real independence based on the turnover rates of central bank chief executive officers (TOR) constructed by Dreher, Sturm and De Haan (2008), which is also used by Chrigui et al (2011), is employed. Higher TOR would mean frequent changes of the chief executive of the central bank (lower independence), and it would have a positive impact on inflation. In this model, the positive coefficient indicates that higher TOR (lower independence) leads to higher inflation (in other words, lower independence has a negative impact on inflation). Accordingly, despite coefficients are not significant for some models, a positive relationship is noted between CB_IND_t and inflation.

Next, by following the previous empirical literature of determinants of output, models for output performance and CBFS are re-estimated including a set of explanatory variables.

Table 6 presents results for regression models establishing the relationship between CBFS and output growth controlling for a set of explanatory variables. Despite having the expected positive coefficients, almost all the models do not yield significant results. Hence, hypothesis H2 is not supported.

In addition to variables of CBFS, other explanatory variables too provide some interesting results. It is a standard finding that physical capital formation and also, human capital formation as proxied by primary school enrolment have a positive impact on output (for example, Barro 1993 and 2003). The same finding is confirmed by these results. At the same, consistent with theoretical and empirical proposition (for example, Edwards 1997; Yanikkaya 2003), a significant positive relationship is observed between economic openness and output growth. Hence, it leads to conclude that external trade remains as an important determinant of output performance. It is also noteworthy that TOR (proxy for central bank independence) has negative implications on output performance. In other words, higher central bank independence has a positive impact on output performance.

Table 6

Output Growth and Central Bank Financial Strength (Extended Models)

This table presents the results of the pooled OLS and GLS-RE regression model,

$$D\_GDP_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \beta_2 CAP\_FORM_{i,t} + \beta_3 TRADE\_GDP_{i,t} + \beta_4 L\_SC_{i,t} + \beta_5 CB\_IND_{i,t} + \varepsilon_{i,t} \quad (13)$$

Subscripts i denote individual countries and t time period. $D\_GDP_{i,t}$ is year-on-year growth of real gross domestic product, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$, $CAP\_FORM_{i,t}$ is gross capital formation as a percentage of GDP, $TRADE\_GDP_{i,t}$ is external trade as a percentage of GDP (measure of economic openness), $L\_SC_{i,t}$ is natural logarithm of total number of pupils enrolled at primary level in public and private schools (measure of human capital), $CB\_IND_{i,t}$ is real central bank independence based on the turnover rate and ε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. The average variance inflation factor (VIF) shows the degree of collinearity among the regressors. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: Real GDP Growth (D_GDP)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	-9.75***	-10.11***	-2.68	-2.21	-8.11**	-9.29***	-10.33	-11.24**
$CBFS_{2,t}$	(+)	0.003		-0.006		-0.001		-0.033	
$CBFS_{2,t-1}$	(+)		0.002		-0.010		-0.001		-0.026
CAP_FORM	(+)	0.171***	0.174***	0.161**	0.172**	0.206***	0.205***	0.229**	0.223**
TRADE_GDP	(+)	0.010***	0.011**	0.010***	0.010**	0.006	0.010**	0.009	0.017
L_SC	(+)	0.611***	0.628***	0.101	0.050	0.054***	0.0558***	0.630*	0.065*
CB_IND (TOR)	(-)	-1.21***	-1.16**	-0.056	0.092	-1.61**	-1.57***	-2.69	-0.200
Average VIF		1.24	1.25	1.45	1.44	1.20	1.22	2.87	2.91
R^2		0.231	0.245	.0178	0.183	0.267	0.289	0.388	0.371
F-Statistic		10.96***	11.25***	2.74**	2.74**	8.23***	8.64***	5.09***	4.73***
No. of Observations		179	179	69	67	119	112	46	45
Panel B: GLS-RE Estimates									
Constant	?	-9.89***	-10.11**	-2.68	-2.21	-8.93***	-9.29***	-10.34	-11.25*
$CBFS_{2,t}$	(+)	0.002		-0.006		-0.001		-0.033	
$CBFS_{2,t-1}$	(+)		0.002		-0.010		-0.001		-0.026
CAP_FORM	(+)	0.174***	0.174***	0.161**	0.171**	0.207***	0.205***	0.229***	0.223***
TRADE_GDP	(+)	0.010***	0.011***	0.010***	0.010***	0.006**	0.010**	0.009	0.017
L_SC	(+)	0.615***	0.628***	0.101	0.050	0.547***	0.558***	0.630**	0.655*
CB_IND (TOR)	(-)	-1.21**	-1.16**	-0.056	0.092	-1.61***	-1.57***	-2.69	-0.203
R^2									
Within		0.131	0.130	0.010	0.016	0.231	0.231	0.238	0.198
Between		0.678	0.711	0.873	0.882	0.547	0.640	0.833	0.847
Overall		0.231	0.245	0.178	0.183	0.267	0.289	0.388	0.371
Wald chi-Statistic		52.10***	56.27***	13.70**	13.70***	41.16***	43.21***	25.46***	23.63***
No. of Observations		179	179	69	67	119	112	46	45

As per hypothesis predicts, a significant negative relationship is expected between CBFS and real interest rate variability.

Table 7

Real Interest Rate Variability and Central Bank Financial Strength (Extended Models)

This table presents the results of the pooled OLS and GLS-RE regression model,

$$RINT\_VAR_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \beta_2 INF\_VAR_{i,t} + \beta_3 L\_BDEF_{i,t} + \beta_4 CB\_IND_{i,t} + \varepsilon_{i,t} \quad (14)$$

Subscripts i denote individual countries and t time period. $RINT\_VAR_{i,t}$ is the standard deviation of ex-post real interest rate derived using lending rate and inflation rate, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$, $CINF\_VAR_{i,t}$ is standard deviation of consumer price inflation, $L\_BDEF_{i,t}$ is natural logarithm of central government budget deficit, $CB\_IND_{i,t}$ is real central bank independence based on the turnover rate and ε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. The average variance inflation factor (VIF) shows the degree of collinearity among the regressors. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: Standard Deviation of Ex-Post Real Lending Rate (RINT_VAR)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	-0.270***	-0.273***	-0.205**	-0.177**	0.306***	0.265	0.342	0.291*
$CBFS_{2,t}$	(-)	0.001		-0.0002		-0.006		-0.0002	
$CBFS_{2,t-1}$	(-)		0.0004		-0.001*		-0.007*		0.001
INF_VAR	(+)	0.383 ***	0.382 ***	0.079	0.087	0.869**	0.865***	0.864***	0.809***
L_BDEF	(+)	0.007	0.007	0.010***	0.009***	0.021	0.019	0.008	0.027
CB_IND (TOR)	(+)	-0.079	-0.080	0.004	0.008	0.887	0.916	-0.433*	-0.405
Average VIF		1.06	1.08	1.05	1.07	1.13	1.12	1.21	1.18
R^2		0.424	0.423	0.098	0.111	0.793	0.825	0.822	0.826
F-Statistic		4.37***	4.15***	5.86***	6.10***	9.17***	9.87***	40.56***	42.91***
No. of Observations		152	148	47	47	87	85	40	39
Panel B: GLS-RE Estimates									
Constant	?	-0.270**	-0.273***	-0.205***	-0.177**	0.248	0.266	0.342	0.291
$CBFS_{2,t}$	(-)	0.001		-0.0002***		-0.004		-0.0002	
$CBFS_{2,t-1}$	(-)		0.0004		-0.001***		-0.007		0.001
INF_VAR	(+)	0.382**	0.382**	0.079***	0.087***	0.866***	0.865***	0.864***	0.809***
L_BDEF	(+)	0.007	0.007	0.010***	0.009***	0.035	0.021	0.008	0.027
CB_IND (TOR)	(+)	-0.079	-0.081	0.004	0.008	0.877	0.915	-0.433*	-0.405*
R^2									
Within		0.289	0.282	0.021	0.033	0.637	0.679	0.721	0.765
Between		0.801	0.814	0.966	0.966	0.971	0.982	0.918	0.878
Overall		0.424	0.423	0.098	0.111	0.793	0.825	0.822	0.826
Wald chi-Statistic		27.32***	29.67***	1204.58***	8101.77***	2169.84***	3425.27***	162.23**	171.66***
No. of Observations		152	148	47	47	87	85	40	39

According to Table 7, it is possible to observe a negative relationship for some models, particularly for advanced country and emerging market samples although it is not proved for the entire sample. As expected, a significant positive relationship is observed between inflation variability and real interest rate variability. Though budget deficits do not have significant impact on emerging market countries, it is found to be significant for advanced countries. This indicates that long held argument for the impact of budget deficit on real interest rate variability (for example, Orr, Edey and Kennedy 1995) is not valid for emerging countries.

Table 8 presents empirical results for CBFS and nominal exchange rate variability.

Table 8

Exchange Rate Variability and Central Bank Financial Strength (Extended Models)

This table presents the results of the pooled OLS and GLS-RE regression model,

$$EXR\_VAR_{i,t} = \alpha + \beta_1 CBFS_{i,t/t-1} + \beta_2 TRADE\_GDP_{i,t} + \beta_3 INT\_DIFF_{i,t} + \beta_4 OIL_{i,t} + \beta_5 CB\_IND_{i,t} + \varepsilon_{i,t} \quad (15)$$

Subscripts i denote individual countries and t time period. $EXR\_VAR_{i,t}$ is the standard deviation of nominal exchange rate, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time t or $t-1$, $TRADE\_GDP_{i,t}$ is external trade as a percentage of GDP (measure of economic openness), $INT\_DIFF_{i,t}$ is interest rate differential, $OIL_{i,t}$ is international oil price, $CB\_IND_{i,t}$ is real central bank independence based on the turnover rate and ε_{it} is idiosyncratic error term. All variables are defined in Table C.1 in Appendix C. Each pooled OLS model and GLS-RE models are tested for heteroskedasticity using White (1980) alternative test for heteroskedasticity providing Lagrange Multiplier (LM) statistic and for first-order serial correlation using Wooldridge (2006) alternative procedure providing F-statistic. Any heteroskedasticity and first-order serial correlation is corrected for robust standard error (clustered observations by countries) method and corrected results are reported. The average variance inflation factor (VIF) shows the degree of collinearity among the regressors. Panel A presents results for pooled OLS estimates and Panel B presents results for GLS-RE estimates. Columns 1 and 2 present results for the full sample and columns 3 and 4 present results for advanced countries. Columns 5 and 6 present results for emerging countries and 7 and 8 present results South Asian countries. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1996 to 2008.

Dependent Variable: Standard Deviation of Nominal Exchange Rate (EXR_VAR)

		Full Sample		**Advanced Countries**		**Emerging Countries**		**South Asian Countries**	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Panel A: Pooled OLS Estimates									
Constant	?	0.014*	0.014*	0.009	0.004	0.004	0.003	0.025*	0.019
$CBFS_{2,t}$	(-)	-0.0001		0.0002*		-0.0001		-0.0002	
$CBFS_{2,t-1}$	(-)		-0.0002*		0.0002		-0.0001		-0.0001
TRADE_GDP	(+)	-0.0001	-0.0006	-0.0001	0.0007	0.0001	0.0004	0.0002	-0.0001
INT_DIFF	(+)	0.002***	0.002***	0.009***	0.010***	0.003***	0.003***	-0.0004	0.001
OIL	(+)	0.0003**	0.0003**	0.001***	0.001**	0.0002	0.0003*	-0.0001	0.0002
CB_IND (TOR)	(+)	0.010	0.011	-0.011	-0.015*	0.0017*	0.018***	0.008	0.004
Average VIF		1.10	1.11	1.32	1.33	1.14	1.13	1.98	1.72
R^2		0.212	0.225	0.334	0.332	0.338	0.348	0.041	0.059
F-Statistic		9.68***	9.94***	5.91***	5.95***	6.72***	5.95***	0.84	1.08
No. of Observations		186	177	69	67	117	110	46	45

Panel B: GLS-RE Estimates									
Constant	?	0.006	0.008	0.009	0.004	0.003	0.002	0.653	0.149
$CBFS_{2,t}$	(-)	0.0008		0.0002*		-0.0001		-0.015	
$CBFS_{2,t-1}$	(-)		-0.0002*		0.0002		-0.0001		-0.007
TRADE_GDP	(+)	-0.0003	0.0001	-0.0001	0.0007	0.0006	0.0001	0.033	0.004
INT_DIFF	(+)	0.004***	0.003***	0.009***	0.010***	0.003***	0.003***	-0.035	0.111
OIL	(+)	0.0003**	0.0003**	0.001***	0.001***	0.0002	0.0003*	0.0002	0.021
CB_IND (TOR)	(+)	0.008	0.008	-0.011*	-0.015**	0.0168*	0.017**	0.418	0.182
R^2									
Within		0.251	0.271	0.260	0.264	0.295	0.315	0.048	0.098
Between		0.347	0.404	0.872	0.842	0.585	0.641	0.901	0.712
Overall		0.205	0.222	0.334	0.332	0.338	0.348	0.125	0.137
Wald chi-Statistic		102.78***	54.81***	14654.39***	243.47***	60.81***	45.82***	5.75	6.38
No. of Observations		186	184	69	67	117	110	46	45

As per Table 8, it is observed that there is no significant relationship between CBFS and nominal exchange rate variability despite having the expected coefficients and the overall sample results are consistent with the expectation. Thus, H4 is supported only in the context of the overall sample. At the same time, majority of other control variables explains the variability of nominal exchange rate except for the proxy for real independence of central bank despite having the expected positive coefficients for many cases. At the same time, economic openness does not have a significant impact on nominal exchange variability.

Table 9 summarises empirical results of pooled OLS and GLS-RE estimates.

Table 9

Economic Outcomes and Central Bank Financial Strength (Summary)

This table summarises results presented in Table 1 to 8 on the relationships between economic outcomes and $CBFS_{2,t}$ or its lagged measure of $CBFS_{2,t}$ ($CBFS_{2,t-1}$). 'YES' represents the expected significant results while 'NO' denotes the absence of the expected significant relationship. Superscripts * indicates the instances of expected relationship despite statistical significance.

Economic Outcome	**Expected Sign**	**Without Controls**				**With Controls**			
		Full Sample	**Advanced Countries**	**Emerging Countries**	**South Asian Countries**	**Full Sample**	**Advanced Countries**	**Emerging Countries**	**South Asian Countries**
Panel A: Pooled OLS Estimates									
Inflation	(-)	NO*	YES	YES	YES	YES	YES	YES	YES
Economic Growth	(+)	YES	YES	YES	YES	NO*	NO*	NO*	NO*
Interest Rate Variability	(-)	NO	YES	YES	YES	NO	YES	YES	NO*
Exchange Rate Variability	(-)	NO	NO*	YES	YES	YES	NO	NO*	NO*
Panel B: GLS-RE Estimates									
Inflation	(-)	NO*	NO*	YES*	NO*	YES	YES	YES	NO*
Economic Growth	(+)	YES	NO*	YES*	NO*	NO*	NO	NO	NO
Interest Rate Variability	(-)	YES	YES	YES	NO*	NO	YES*	NO*	NO*
Exchange Rate Variability	(-)	YES	NO*	YES	YES	YES	NO	NO*	NO*

Summary observations lead to conclude that CBFS mainly impacts on inflation, and to some extent, real interest rate variability. Although primary considerations point to a significant impact of CBFS on other macroeconomic outcomes such as economic growth and nominal exchange rate variability, this study leads to conclude that the impact is not substantial and significant as consistent and robust results are not observed across extended models despite observing the expected coefficients.

Next, given the specific interest on the South Asian context, the same discussion is extended to examine the impact of CBFS on economic outcomes in South Asian countries. As it is intended to conduct the investigation for individual South Asian countries, the sample period is extended cover the period 1980 – 2008. The selection of a long time series would address the issue of degrees of freedom and would treat the dynamism and developments in these countries. However, the attempt to examine the South Asian countries is largely constrained by the availability of comparable data, particularly for CBFS measures. Hence, the discussion is limited to two major South Asian economies, i.e. India and Sri Lanka.

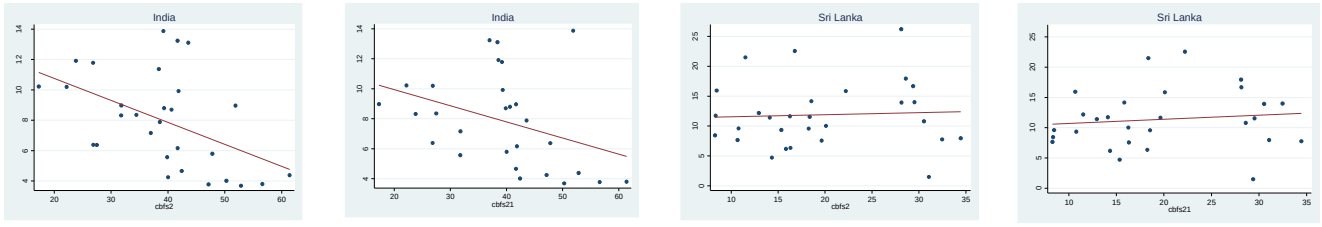
Initial investigations confirm that capital and OIN based measure of CBFS and its lagged measure, i.e. $CBFS_{2,t}$ and $CBFS_{2,t-1}$ remain the most representative measures for these two countries as well (Appendix D presents plots for CBFS). Accordingly, first, prior to the empirical analysis, basic evidence is provided using these CBFS measures. Figure 5 presents panel of two way scatter plots for India and Sri Lanka. In addition to economic outcomes used so far, nominal interest rate variability is also considered in this analysis.

Based on Figure 5, the following can be observed: First, a negative relationship between CBFS and inflation is observed only for India. Second, the expected positive relationship in not observed between CBFS and output growth for both India and Sri Lanka. Third, the expected negative relationships between nominal/real interest rate variability and CBFS is observed for both countries. Fourth, negative relationship is observed between CBFS and nominal exchange rare variability for both countries. These results indicate that economic outcomes in these two countries can be explained using the financial position of their central banks.

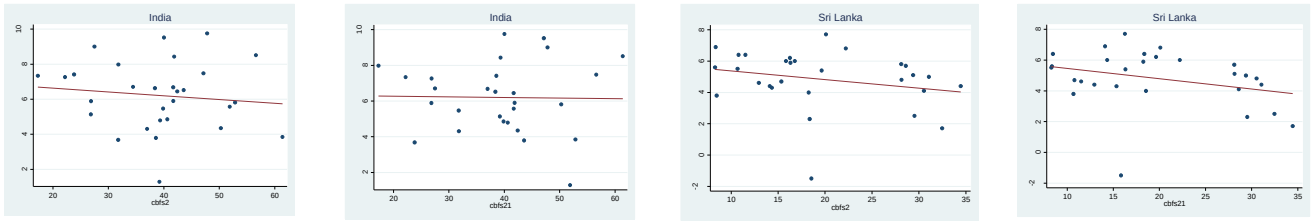
Figure 5

Economic Outcomes and Central Bank Financial Strength: India and Sri Lanka

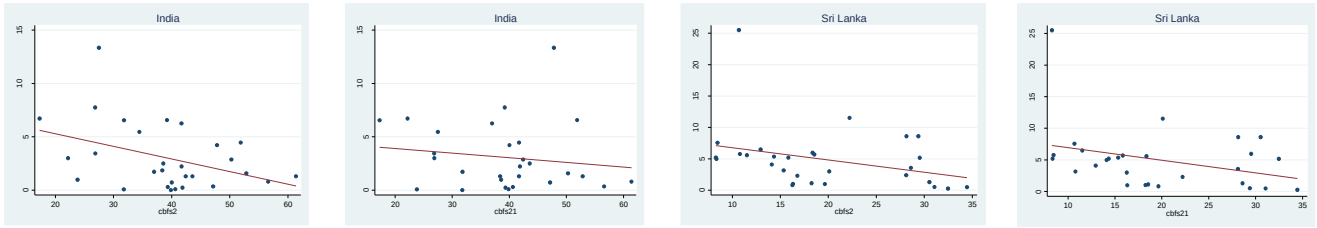
Inflation



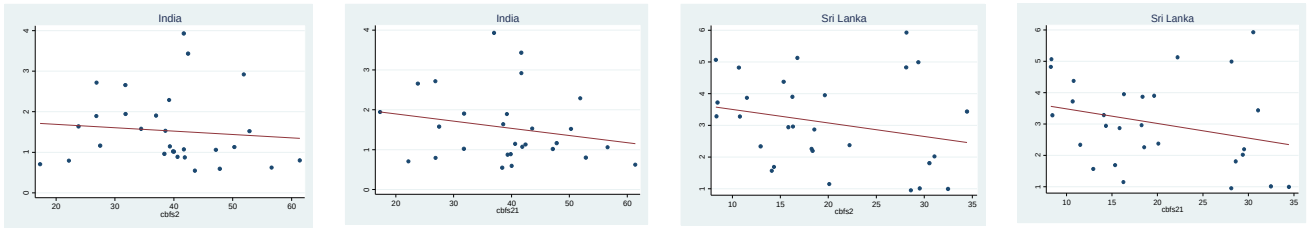
Real GDP Growth



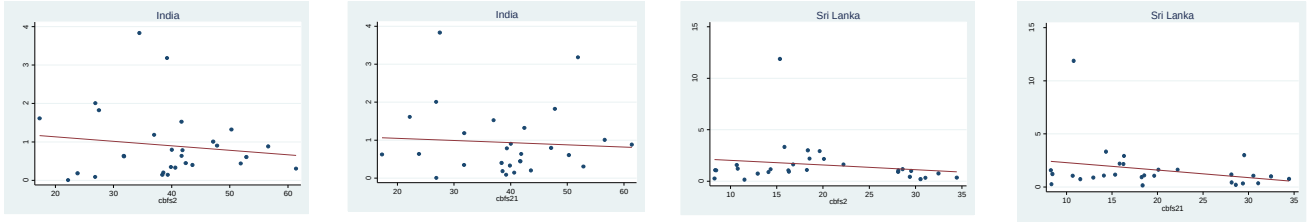
Nominal Interest Rate Variability



Real Interest Rate Variability



Nominal Exchange Rate Variability



Next, OLS regression models are estimated to empirically establish the expected relationships. Similar to the pooled OLS and GLS-RE model estimates, first, time series baseline OLS models are specified. Accordingly, the dependent variable (for each economic outcome) is regressed on the explanatory variable, CBFS and the empirical results are summarised in Table 10.

Table 10

Economic Outcomes and Central Bank Financial Strength: India and Sri Lanka

This table presents the results of the OLS regression model,

$$D_t = \alpha + \beta_1 CBFS_{i,\,t/t-1} + \varepsilon_t \qquad (16)$$

D_t is the dependent variable (CPI_INF_t: measure of inflation, i.e. year-on-year change of consumer price index; D_GDP_t : year-on-year growth of real gross domestic product; $SRINT\_VAR_t$: standard deviation of money market rate; $RINT\_VAR_t$: standard deviation of ex-post real interest rate derived using lending rate and inflation rate; EXR_VAR_t : standard deviation of nominal exchange rate), $CBFS_{i,\,t/t-1}$ is the measure of central bank financial strength at time *t* or *t-1* and ε_t is error term. All variables are defined in Table C.1 in Appendix C. Models are tested for normality (based on Jarque-Bera Statistic), serial correlation (based on Breusch-Godfrey Serial Correlation LM Test), heteroskedasticity (based on White Heteroskedasticity Test) and omitted variables and functional form (based on Ramsey RESET Test). Panel A presents results for India and Panel B presents results for Sri Lanka. Columns 1 and 2 present results for CPI_INF_t, columns 3 and 4 present results for D_GDP_t, columns 5 and 6 present results for $SRINT\_VAR_t$, columns 7 and 8 present result for $RINT\_VAR_t$ and columns 9 and 10 present results for EXR_VAR_t. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1980 to 2008.

Dependent Variable: D (CPI_INF; D_GDP; SRINT_VAR; RINT_VAR; EXR_VAR)

Explanatory Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
	CPI_INF [Ex.Sign (-)]		**D_GDP [Ex.Sign (+)]**		**SRINT_VAR [Ex.Sign (-)]**		**RINT_VAR [Ex.Sign (-)]**		**EXR_VAR [Ex.Sign (-)]**	
Panel A: India										
Constant	12.74***	11.51***	25.29***	25.27***	8.19***	2.19	1.62**	2.30***	1.38**	1.28**
$CBFS_{2,t}$	-12.80**		0.130		-0.132**		-0.13		-1.06	
$CBFS_{2,t-1}$		-10.14**		0.141		2.19		-1.77		-0.77
R^2	0.222	0.143	0.953	0.971	0.312	0.181	0.162	0.173	0.022	0.014
F-Statistic	7.87***	4.42***	674.2***	605.2***	6.03***	2.85**	2.48*	2.71*	0.233	0.121
No. of Observations	29	28	29	28	29	28	29	28	29	28
Panel B: Sri Lanka										
Constant	13.20***	9.48***	20.40***	20.11	8.63***	8.63***	3.93***	3.91	2.50**	2.95**
$CBFS_{2,t}$	-9.87		0.131		-19.05*		-4.30		-4.66	
$CBFS_{2,t-1}$		5.21		-0.382		-19.35*		-4.52		-6.84
R^2	0.094	0.014	0.991	0.991	0.112	0.113	0.071	0.083	0.102	0.085
F-Statistic	1.29	0.49	1442.1***	1509.8***	3.01*	3.07*	2.72*	2.30*	0.863	1.95
No. of Observations	29	28	29	28	29	28	29	28	29	28

First two columns of Table 10 present empirical results for the relationship between CBFS and inflation. Confirming the basic evidence, a significant negative relationship is observed between CBFS and inflation for India. Although the expected negative relationship between $CBFS_{2,\,t}$ and inflation is observed for Sri Lanka, the relationship is not significant. The same model is re-estimated (results are not reported) using transformed inflation rates, however significant results are observed only for India. Similarly, although results are not presented, the same models are estimated for CBFS and inflation variability. In this case, a negative relationship between inflation variability and CBFS is observed

across two countries; however, significant only for Sri Lanka. This indicates that the variability of inflation in Sri Lanka is affected by CBFS whereas the level of inflation in India is affected by CBFS.

Columns 3 and 4 of Table 10 present results for the relationship between output growth and CBFS. Any significant relationship is not found between output growth and financial strength of the central bank. However, in order to confirm these result, the same regression models are estimated replacing the GDP growth variable with level variable and also with per capita growth variable (results are not reported). Again, significant positive relationships are not observed.

Next, the relationship between CBFS and interest rate variability is observed and columns 5-6 and 7-8, respectively, present results for nominal interest rate variability and real interest rate variability, respectively. A significant negative relationship is expected between CBFS with both nominal and real interest rate variability. According to Table 10, it is possible to observe a negative relationship for both countries, particularly for nominal interest rate variability models. However, unlike nominal interest rate variability, a significant negative relationship is not observed for real interest rate variability models despite some are providing expected coefficients. It is also noteworthy that models are not significant and hence, it is reasonable to conclude that real interest rate variability cannot be explained by the financial strength of the central banks in these countries. This is consistent with pooled estimates for South Asia. It is also attempted to model the relationship between CBFS and nominal exchange rate variability using baseline regression models and results are presented in columns 9 and 10 in Table 10. Although a negative relationship between CBFS and nominal exchange rate variability is hypothesised, regression results do not support for such relationship despite having the expected negative coefficients. It is also noteworthy that overall models are not significant. Again, observations are consistent with pooled estimates.

In order to make a sound conclusion, it is worthwhile to estimate the same models controlling for a set of possible explanatory factors. However, extended models are estimated only for inflation and nominal interest rate variability as baseline models for other economic outcomes, i.e. output growth, real interest rate variability and nominal exchange rate variability do not exhibit any significance.

Table 11 presents results for CBFS and inflation models including a set of relevant control variables.

Table 11

Inflation and Central Bank Financial Strength (Extended Model): India and Sri Lanka

This table presents the results of the OLS regression model,

$$CPI\_INF_t = \alpha + \beta_1 CBFS_{i,\,t/t-1} + \beta_2 L\_PER\_CAP_t + \beta_3 CPI\_OECD_t + \beta_4 \Delta BM_t + \beta_5 POL\_STAB_t + \beta_6 CB\_IND_t + \beta_7 DUM\_90_t + \varepsilon_t \quad (17)$$

where CPI_INF_t is the measure of inflation, i.e. year-on-year change of consumer price index, $CBFS_{i,\,t/t-1}$ is the measure of central bank financial strength at time *t* or *t-1*, $L\_PER\_CAP_t$ is the natural logarithm of per capita income, CPI_OECD_t is the average inflation for advanced countries, ΔBM_t is the broad money growth, POL_STAB_t is the measure for country's political stability, CB_IND_t is real central bank independence (TOR), DUM_90_t is the dummy variable for structural break for 1990s and ε_t is the error term. All variables are defined in Table B.1. Models are tested for normality (based on Jarque-Bera Statistic), serial correlation (based on Breusch-Godfrey Serial Correlation LM Test), heteroskedasticity (based on White Heteroskedasticity Test) and omitted variables and functional form (based on Ramsey RESET Test). Columns 1 and 2 present results for $CBFS_{2,t}$ and $CBFS_{2,t-1}$ models, respectively for India and columns 3 and 4 present for $CBFS_{2,t}$ and $CBFS_{2,t-1}$ models, respectively for Sri Lanka. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1980 to 2008.

Dependent Variable: CPI Inflation (CPI_INF)

		India		Sri Lanka	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**
Constant	?	21.03**	19.85**	50.54**	-10.42
$CBFS_{2,t}$	(-)	-7.44*		-32.84*	
$CBFS_{2,t-1}$	(-)		-7.82*		-3.52
L_PER_CAP	(-)	-2.17	-1.94	8.06**	2.89
CPI_OECD	(+)	0.44**	0.46**	1.41**	0.75*
ΔBM	(+)	0.25	0.22	0.01	0.09
POL_STAB	(-)	-7.40	-7.11	15.94	1.92
CB_IND (TOR)	(+)	0.63*	2.18**	1.08	0.89*
DUM_90	?	3.24	4.49*	8.80	10.78**
R^2		0.62	0.62	0.44	0.26
F-Statistic		4.96***	5.01***	2.38**	2.09*
No. of Observations		29	28	29	28

Negative coefficients are observed for CBFS for models despite $CBFS_{2,\,t-1}$ is not significant for Sri Lanka. In contrast to pooled and panel estimates, a significant relationship is not evident between per capita income and inflation. Moreover, as theory predicts, a significant relationship is noted between money growth and inflation. Interestingly, a negative relationship can be observed between a country's political stability and inflation though coefficients are not significant. One could argue that greater political stability leads to lower inflation and it is open for future research. A robust positive relationship is noted between CB_IND_t and inflation. This is consistent with most of the existing studies of inflation and central bank independence.

By following the same approach of inflation models, next, the same models are estimated for nominal interest rate variability including a set of explanatory variables. Results are presented in Table 12.

Table 12

Nominal Interest Rate Variability and Central Bank Financial Strength

This table presents the results of the OLS regression model,

$$SRINT\_VAR_t = \alpha + \beta_1 CBFS_{i,t/t-1} + \beta_2 CREDIT_t + \beta_3 CPI\_INF_t + \beta_4 DEBT_t + \beta_5 TOR_{t-1} + \varepsilon_t \quad (18)$$

where $SRINT\_VAR_t$ is the standard deviation of money market rate, $CBFS_{i,t/t-1}$ is the measure of central bank financial strength at time *t* or *t-1*, $CREDIT\_GDP_t$ is private sector credit as a percentage of GDP, CPI_INF_t is measure of inflation, i.e. year-on-year change of consumer price index, $DEBT_t$ is government debt as a percentage of GDP, CB_IND_t is real central bank independence (TOR) and ε_t is the error term. All variables are defined in Table C.1 in Appendix C. Models are tested for normality (based on Jarque-Bera Statistic), serial correlation (based on Breusch-Godfrey Serial Correlation LM Test), heteroskedasticity (based on White Heteroskedasticity Test) and omitted variables and functional form (based on Ramsey RESET Test). Columns 1 and 2 present results for $CBFS_{2,t}$ and $CBFS_{2,t-1}$ models, respectively for India and columns 3 and 4 present for $CBFS_{2,t}$ and $CBFS_{2,t-1}$ models, respectively for Sri Lanka. Superscripts *, **, *** indicate statistical significance at 10%, 5% and 1% levels, respectively. The sample period is from 1980 to 2008.

Dependent Variable: Standard Deviation of Nominal Call Money Rate (SRINT_VAR)

		India		Sri Lanka	
Explanatory Variables	**Expected Sign**	**(1)**	**(2)**	**(3)**	**(4)**
Constant	?	-11.90*	-13.17**	18.74*	10.99*
$CBFS_{2,t}$	(-)	-14.2**		-24.5**	
$CBFS_{2,t-1}$	(-)		-6.15		-20.4**
CREDIT_GDP	(+)	0.12	0.18**	0.05*	0.03*
CPI_INF	(+)	0.61**	0.70**	0.05*	0.21*
DEBT	(+)	0.18**	0.12	-0.13	-0.06
CB_IND (TOR)	(+)	0.86*	0.50	3.98*	3.38*
R^2		0.47	0.35	0.23	0.22
F-Statistic		4.13***	2.42**	2.71**	2.33**
No. of Observations		29	28	29	28

The expected negative relationship for CBFS and nominal interest rate variability is observed for majority of models. Such negativity is significant for $CBFS_{2,t}$ for India and for both $CBFS_{2,t}$ and $CBFS_{2,t-1}$ for Sri Lanka. Hence, generally, it is possible to conclude that financial strength of central banks affect the variability of short-term nominal interest rates.[41] This finding is similar to the apparent negative relationship between central bank independence and nominal interest rate variability. For example, Cuckierman et al (1993) observe that turnover (proxy for central bank independence) found to have a positive and significant effect on nominal interest rate variability. The same is confirmed by the results presented in Table 12. At the same time, it is observed that demand for private sector credit (as represented by the supply for private sector credit) has a positive and significant impact on nominal rate variability while inflation also has the same impact. However, government debt accumulation, i.e. *DEBT* (variable used instead of budget deficit) does not indicate significant relation with interest rate variability.

[41] A possible extension to this study is to explore the relationship between CBFS and different short-term and long-term interest rates as well as interest rate for different product categories.

As per empirical results of baseline and extended models, several observations can be made: first, when summarising models for inflation and nominal interest rate variability, it is evident that CBFS poses impacts on those economic outcomes. Second, output performance is not related to CBFS. Third, no significant relationship is observed with regard to real interest rate variability and nominal exchange rate variability. Fourth, $CBFS_{2,t}$ defined based on the capital and other items net as a percentage of central bank total assets and its lagged variable ($CBFS_{2,t-1}$) remain the most representative variable for CBFS.

5. Conclusions and Policy Implications

The predominant view is that central banks do not require financial strength or given the nature of their balance sheet structure, central banks should always be profitable entities. However, academic literature strongly argues that central banks could experience financial difficulties and weak financial conditions could have implications on the central bank itself as well as on the entire economy. To that end, central banks would need to be cautious about self-financial conditions when achieving its policy objectives. In other words, central banks may need to understand how they have created a conducive environment for better economic outcomes such as price stability, interest rate stability, and exchange rate stability while supporting the growth momentum by manipulating its own finances.

To that end, this study attempts to provide evidence towards establishing a relationship between central bank financial strength and economic outcomes. While examining basic evidence for a group of advanced and emerging countries, this study further focuses on the South Asian context. Based on group of countries and advanced and emerging country context, it is observed that price stability (measured by inflation) is broadly related to central bank financial strength. Also, real interest rate variability in emerging countries can be explained using the changes in central bank finances. Based on two major South Asian economies, this study also concludes that central bank financial strength is vital in the context of lowering inflation and also to maintain the stability in nominal interest rates. Both approaches lead to conclude that central bank financial strength is important for inflation and interest rates. This is particularly important in terms of modern central banking perspective, which emphasises the primary role of a central bank. On the other hand, this study indicates that central bank financial health may not be important for real economic performance, for example, to boost the output growth.

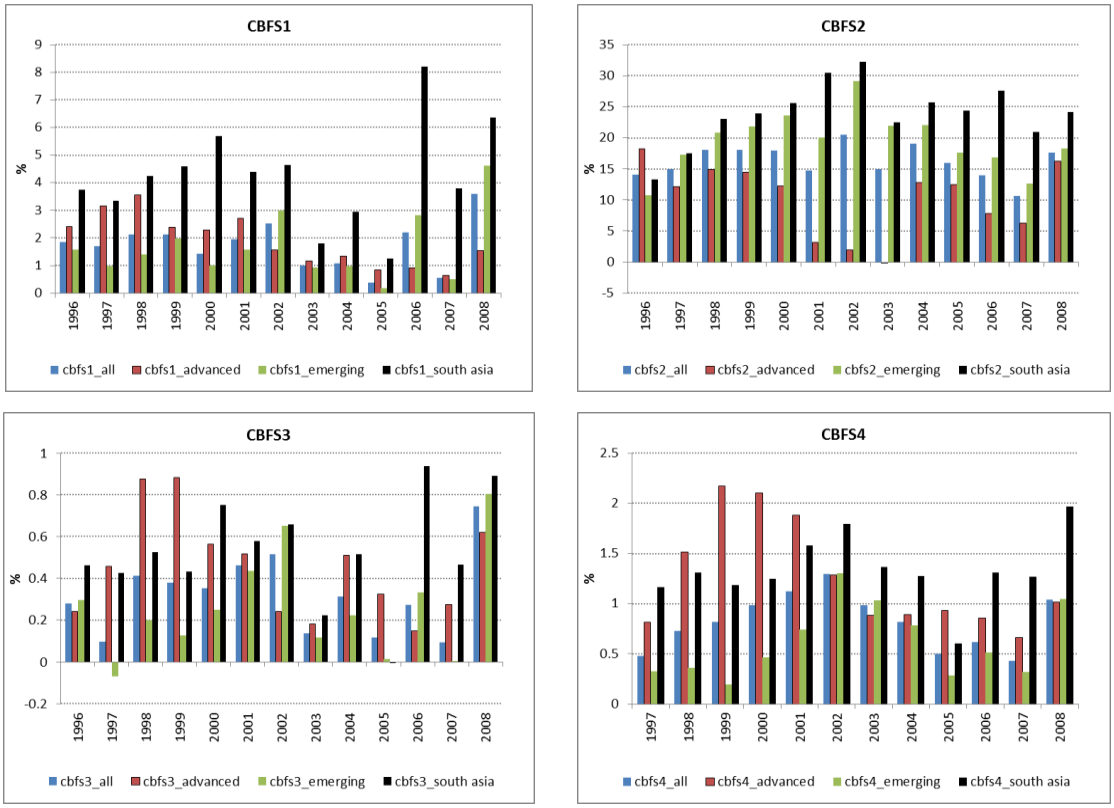
These observations have several policy implications. First, the priority of central banks should be focus on explicit primary objectives rather than attempting to achieve a broad range of nominal and/or real objectives. Second, central banks should concentrate and attempt to avoid losses by pursuing

appropriate policies with a view to maintain its balance sheet health and discipline while supporting to develop financial markets. Particularly, central banks would need to refrain undertaking massive scale quasi-fiscal operations and also need to allow greater exchange rate flexibility while deviating from the objective of excess reserve accumulation. Broadly, central banks would need to maintain their financial health in order to generate a downward bias in inflation and also maintain the stability of interest rates.

However, broader conclusions in this study rely only on a selected group of countries and hence, results may not be generalised for different economic and financial contexts. To that end, repeating the same study to include a large sample of countries would help to strengthen the conclusions drawn by this study. Going forward, further robustness tests of results using alternative specifications are also warranted.

Appendix A

Movements in Different Measures of CBFS



Source: Bankscope, IFS

Appendix B

Figures B.1 to B.4 present scatter plots for economic outcomes and CBFS on annual basis.

Figure B.1: Inflation and CBFS

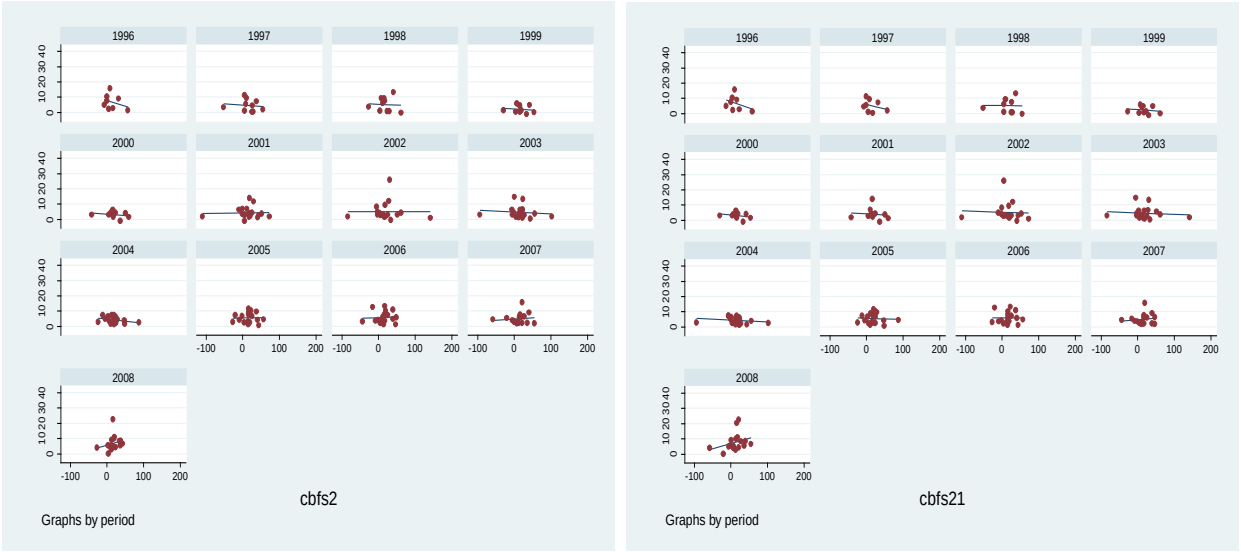


Figure B.2: Output Growth and CBFS

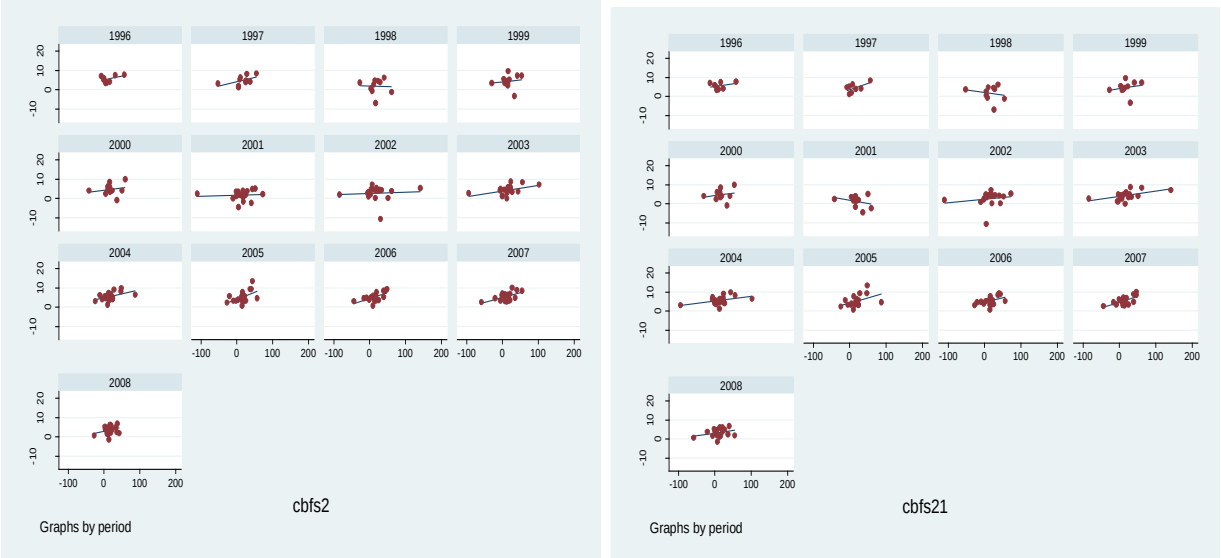


Figure B.3: Real Interest Rate Variability and CBFS

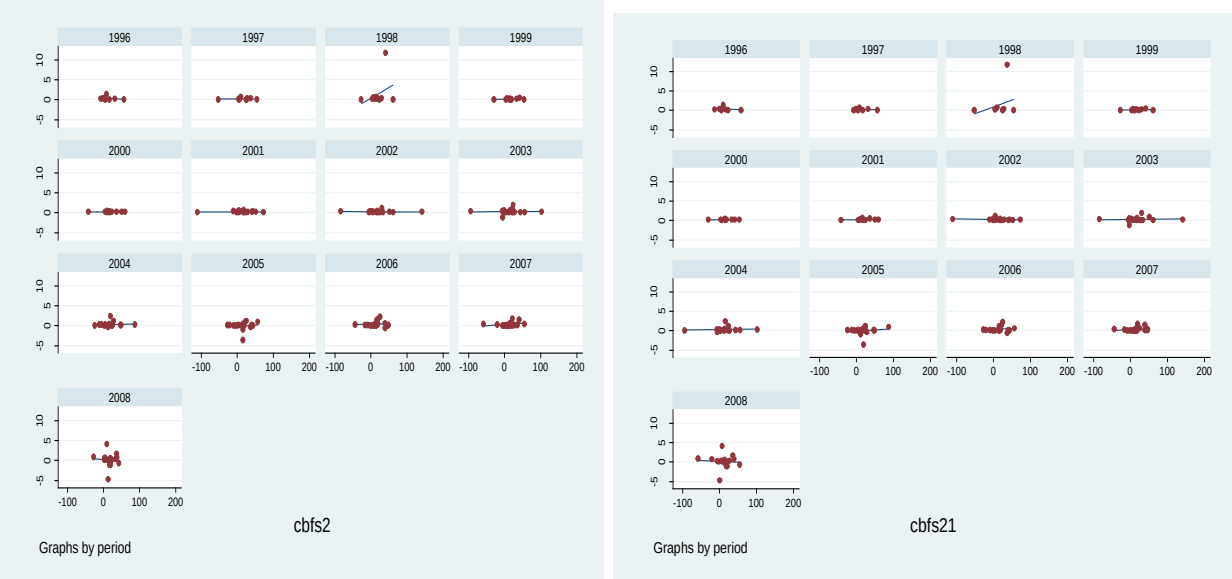
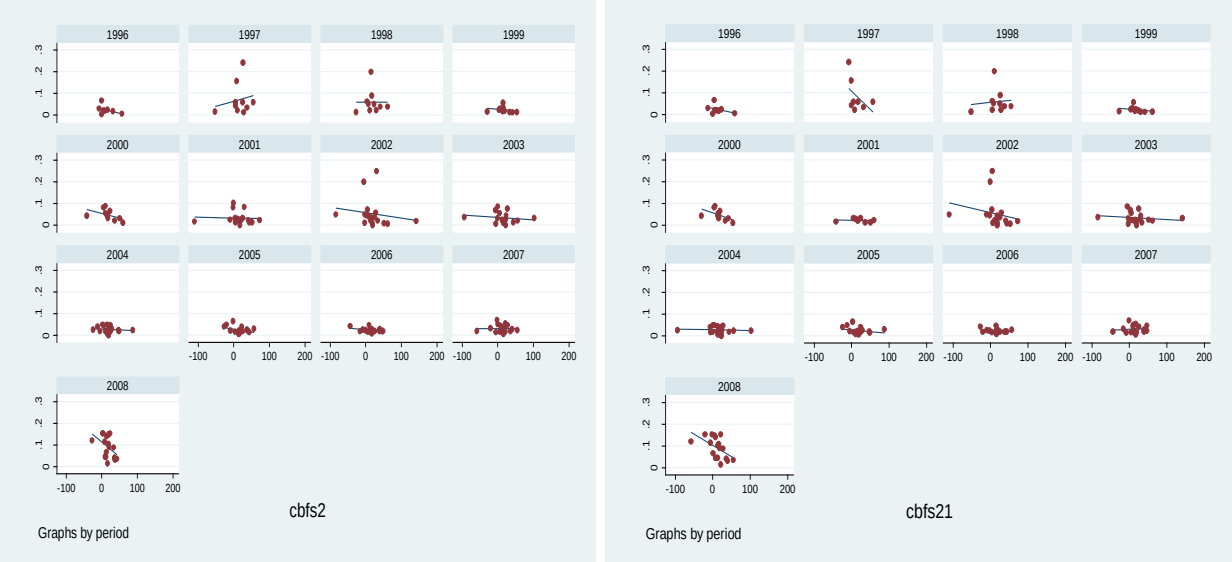


Figure B.4: Nominal Exchange Rate Variability and CBFS



Source: IFS, WDI

Appendix C

Table C.1: Definitions of Variables

Variables (Variable Name)	Measures/Definition	Source/s
Dependent Variables		
CPI inflation (CPI_INF)	Year-on-year change of consumer price index	WDI
Inflation variability (INF_VAR)	Standard deviation of CPI inflation	Calculated based on IFS
GDP growth (D_GDP)	Year-on-year growth of real gross domestic product	WDI
Nominal interest rate variability (SRINT_VAR)	Standard deviation of money market (short-term) rate	Calculated based on IFS
Real interest rate variability (RINT_VAR)	Standard deviation of ex-post real interest rate derived using lending rate and inflation rate	Calculated based on IFS
Nominal exchange rate variability (EXR_VAR)	Standard deviation of nominal exchange rate	Calculated based on IFS
CBFS Variables		
$CBFS_{2,\,t}$	CBFS expressed as the sum of central bank capital and other items net scaled by central bank total assets	IFS, Bankscope, CBSL, RBI
$CBFS_{2,\,t-1}$	One year lagged $CBFS_{2,\,t}$	IFS, Bankscope, CBSL, RBI
Other Explanatory Variables		
Inflation Model		
Per capita income (L_PER_CAP)	Natural logarithm of per capita income (US dollars)	WDI
Foreign inflation (L_CPI_OECD)	Natural logarithm of average CPI for advanced (OECD) countries	WDI
Broad money growth (ΔBM)	Year-on-year change in broad money (M2)	IFS
Output Model		
Capital formation (CAP_FORM)	Gross capital formation as percentage of GDP	WDI
School enrolment (L_SC)	Natural logarithm of total number of pupils enrolled at primary level in public and private schools	WDI
Interest Rates Model		
Credit demand (CREDIT_GDP)	Domestic credit to private sector as a percentage of GDP	WDI
Budget deficit (L_BDEF)	Natural logarithm of central government deficit	WDI
Public debt (DEBT)	Government debt as a percentage of GDP	CBSL, RBI
Exchange Rate Model		
Economic Openness (TRADE_GDP)	External trade as a percentage of GDP	WDI
Interest rate differential (INF_DIF)	Difference between 3-months US dollar LIBOR rate and domestic base interest rate	IFS, CBSL, RBI
Oil price (OIL)	International oil price	WDI
Other Control Variables		
Political stability (POL_STAB)	Majority of the legislature	WB
Central bank independence (CB_IND)	Real central bank independence as a dummy variable which equals 1 in the case of a change of a governor and 0 in the default case, i.e. turnover rate (TOR)	Dreher et al (2008)
Dummy Variables		
Structural break dummy (DUM_90)	Deregulation dummy variable which equals 1 for the year if liberalisation and 0 otherwise	
Correction dummy (DUM_O)	Dummy to correct the large outliers which equals to 1 in the case of large outliers and 0 otherwise	

Note: CBSL - Central Bank of Sri Lanka, IFS -International Financial Statistics, RBI - Reserve Bank of India, WB - World Bank, WDI - World Development Indicators

Table C.2: Descriptive Statistics

All Countries

Variable	Mean	Std. Dev.	Min	Max
$CBFS_{2,t}$	16.1	27.9	-109.6	141.7
CPI_INF	5.3	4.8	-1.2	34.4
D_GDP	4	3.3	-13.1	13.3
RINT_VAR	1.8	2.8	0.1	20.8
EXR_VAR	41.5	202.9	0	2384.8
L_PER_CAP	8.4	1.5	5.3	10.8
ΔBM	13.4	9.6	-19.4	82.6
L_CPI_OECD	4.5	0.1	4.4	4.7
CB_IND	0.2	0.4	0	3
CAP_FORM	23.1	5.5	11.4	43
TRADE_GDP	80.2	75.1	14.9	438.1
L_SC	15.3	1.4	12.5	18.8
INF_VAR	1.4	2.6	0.7	23.8
L_BDEF	25.3	3.2	21.1	30.9
INT_DIFF	5.1	7	-4.4	39.6
OIL	38.5	24.4	13.1	97.0

Advanced Countries

Variable	Mean	Std. Dev.	Min	Max
$CBFS_{2,t}$	9.7	33.0	-109.6	61.3
CPI_INF	2.4	1.4	-0.4	7.5
D_GDP	3.5	3.0	-6.9	13.3
RINT_VAR	0.5	0.3	0.1	1.5
EXR_VAR	10.5	36.1	0.0	237.7
L_PER_CAP	10.1	0.4	8.9	10.8
ΔBM	10.3	6.9	-2.0	30.2
L_CPI_OECD	4.5	0.1	4.4	4.7
CB_IND	0.2	0.4	0.0	1.0
CAP_FORM	23.4	5.6	16.0	38.9
TRADE_GDP	97.9	110.2	36.5	438.1
L_SC	14.2	1.2	12.5	15.5
INF_VAR	0.5	0.3	0.1	1.5
L_BDEF	24.9	3.3	21.2	30.9
INT_DIFF	1.1	2.4	-4.4	7.2
OIL	38.5	24.5	13.1	97.0

Emerging Countries

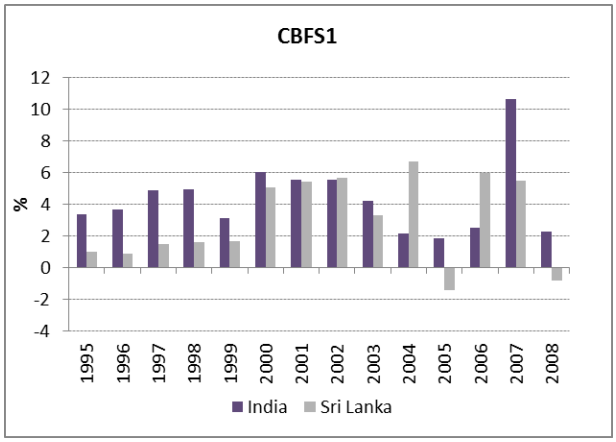
Variable	Mean	Std. Dev.	Min	Max
$CBFS_{2,t}$	20.1	23.4	-20.7	141.7
CPI_INF	6.7	5.2	-1.2	34.4
D_GDP	4.3	3.5	-13.1	10.0
RINT_VAR	2.4	3.2	0.2	20.8
EXR_VAR	57.0	246.0	0.0	2384.8
L_PER_CAP	7.5	1.1	5.3	9.2
ΔBM	15.0	10.4	-19.4	82.6
L_CPI_OECD	4.5	0.1	4.4	4.7
CB_IND	0.2	0.5	0.0	3.0
CAP_FORM	23.0	5.5	11.4	43.0
TRADE_GDP	71.9	49.4	14.9	220.4
L_SC	15.9	1.3	14.3	18.8
INF_VAR	1.9	3.1	0.2	23.8
L_BDEF	26.6	2.8	22.0	30.0
INT_DIFF	7.2	7.7	-1.7	39.6
OIL	38.5	24.4	13.1	97.0

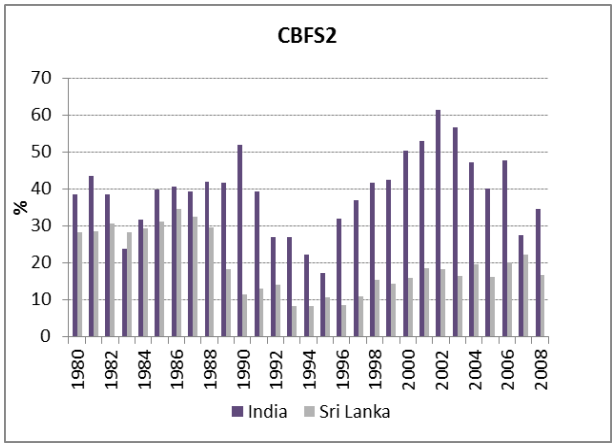
South Asian Countries

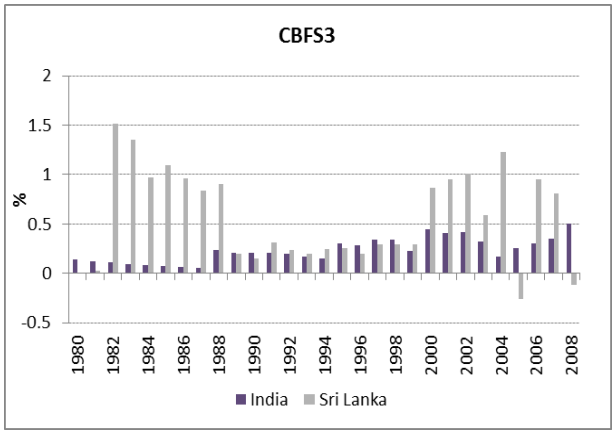
Variable	Mean	Std. Dev.	Min	Max
$CBFS_{2,t}$	24.3	16.4	-5.8	61.4
CPI_INF	7.7	4.4	2.5	22.6
D_GDP	5.0	2.3	-1.5	9.8
RINT_VAR	1.9	1.2	0.4	4.7
EXR_VAR	1.8	2.0	0.2	11.9
L_PER_CAP	6.3	0.6	5.3	7.6
ΔBM	15.9	5.8	2.7	38.9
L_CPI_OECD	4.5	0.1	4.4	4.7
CB_IND	0.2	0.4	0.0	1.0
CAP_FORM	24.4	5.1	15.6	38.1
TRADE_GDP	48.3	19.2	22.2	88.6
L_SC	16.2	1.6	14.3	18.8
INF_VAR	1.8	1.2	0.6	5.3
L_BDEF	26.6	2.8	22.0	30.0
INT_DIFF	6.7	4.6	0.7	18.5
OIL	38.5	24.6	13.1	97.0

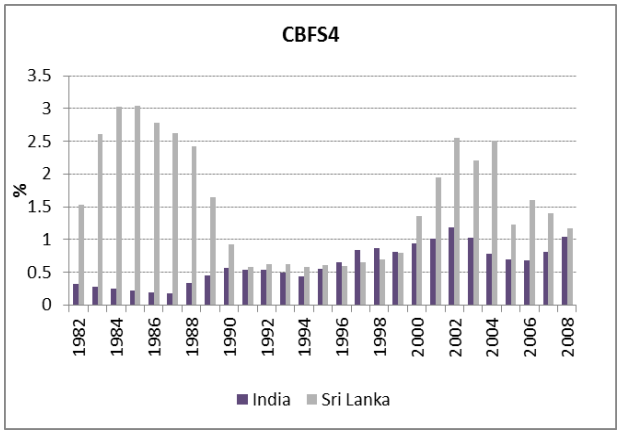
Appendix D

Trends in CBFS in India and Sri Lanka









Source: Bankscope, CBSL, IFS, RBI

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