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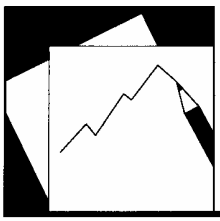

IMF Working Paper

Quality of Financial Policies and Financial System Stress

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Richard Podpiera, and Dmitriy Rozhkov

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Quality of Financial Policies and Financial System Stress

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Abstract

In this paper, we develop multi-country indices of financial system stress and quality of financial policies and use them in regression analysis of the determinants of financial stress. We find that countries with higher quality of financial policies are better able to contain the effects of macroeconomic pressures on the overall level of stress in the financial system. They are also in a better position to ensure sustainable development of the financial system.

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I. INTRODUCTION

The financial crises of the late 1990s underlined the importance of sound financial systems for countries' macroeconomic stability. Financial crises tend to have substantial macroeconomic costs, with possible negative effects on growth, reduction in policy effectiveness, and contagion effects. Weaknesses in financial systems lead to inefficient intermediation of savings, make monetary transmission less reliable, and may have serious fiscal consequences.

From the financial sector policymakers' point of view, the quality of domestic financial policies[2] is seen as key for achieving and maintaining financial stability (FSF, 2000; Mishkin, 2001). In contrast, the empirical economic literature is ambivalent as to the strength of the link. Early studies by Sundararajan, Marston, and Basu (2001) and Barth, Caprio, and Levine (2001) found that the quality of banking supervision policies, proxied by different instruments, does not have a statistically significant direct effect on bank soundness at the aggregate level and on the probability of a crisis. On the other hand, more recent studies by Das, Quintyn, and Chenard (2004) and Podpiera (2004), using bigger samples and more appropriate econometric specifications, provide some evidence of the existence of a positive link between the quality of supervision and bank soundness at the aggregate level.

This paper attempts to improve the understanding of the relationship between financial policies and financial stress. This is achieved by developing more robust measures of the quality of different aspects of financial policies, and by extending the analysis to sectors of the financial system other than banking and the foreign exchange market. We construct an index of financial stress and analyze its determinants[3] using longitudinal data-estimation techniques that control for time-invariant unobserved heterogeneity of the sample countries. We find that countries with higher quality of financial policies are better able to contain the effects of government deficits and inflationary pressures, stemming from terms-of-trade improvements, on the overall level of stress in the financial system. They are also in a better position to ensure sustainable development of the financial system.

II. OVERVIEW OF THE LITERATURE ON FINANCIAL CRISES AND STRESS

The modern analysis of financial crises developed in response to the Great Depression of the 1930s. It was brought into the mainstream of economics by John Maynard Keynes in *The General Theory of Employment, Interest and Money*. The economic literature on financial

[2] "Financial policies refers to policies related to the regulation, supervision, and oversight of the financial and payment systems, including markets and institutions, with the view to promoting financial stability, market efficiency, and client-asset and consumer protection" (IMF, 1999).

[3] Our goal in constructing the index is to create a measure of the severity of stress rather than to develop an indicator predicting financial crises.

crises has since evolved through classic descriptive analyses, such as Kindleberger (1978), to the modern theoretical models, surveyed by Breuer (2004).[4]

Kindleberger (1978) examined historic episodes of financial crises and identified commonalities in financial system developments in the course of the build up, immediately prior, and during crises. He concluded that all crises are preceded by manias or bubbles, characterized by irrationality on the part of market participants, followed by the emergence of financial distress, which manifests in balance sheet vulnerabilities that eventually culminate in a crash and/or panic. Since then, the financial crises literature has developed a number of mathematical models that uphold agents' rationality.

On the empirical side, efforts have been targeted at testing the validity of different models and identifying the factors that affect crisis incidence (e.g., Eichengreen, Rose, and Wyplosz, 1996; Rossi, 1999; etc.). One distinctive sub-branch of the literature on financial crises has focused on the identification of symptoms of financial distress with the goal of anticipating crises before they occur. On the theoretical side, these efforts have led to the development of the concept of "systemic risk," defined as "...the likelihood of a sudden, usually unexpected, collapse of the confidence in a significant portion of the banking or financial system with potentially large real economic effects" (Bartholomew and Whalen, 1995). On the empirical side, the search for variables that signal the occurrence of financial distress has given birth to the "early warning system/indicators" literature (IMF, 1998; Kaminsky and Reinhart, 1999). A related strand of operational research (IMF, 2001a; IMF, 2001b; IMF, 2003) has striven to identify financial soundness indicators to be used for continuous surveillance of financial system's vulnerability to shocks and capacity to absorb losses.

There is now virtual consensus regarding the defining characteristic of a financial crisis—a disruption in one or more sectors of the financial system that has a sizable negative impact on the real economy (Group of Ten, 2001; IMF, 1998). The definition of the financial system relevant for the analysis of financial crises potentially encompasses all financial institutions, financial markets, and the financial infrastructure (Houben, Kakes, and Schinasi, 2004). In practice, however, most financial crises emanate in and propagate through the banking sector, and the foreign exchange, debt, and equity markets (Bordo and Schwartz, 2000). Symptoms of financial system disruption include: (i) falling asset prices (Eichengreen and Portes, 1987; Patel and Sarkar, 1998; Bordo and Schwartz, 2000); (ii) exchange rate depreciation and/or losses of official foreign reserves (Sachs, Tornell, and Velasco, 1995; Eichengreen, Rose, and Wyplosz, 1996); (iii) insolvency of market participants (De Bandt and Hartmann, 2000; Breuer, 2004); (iv) defaults of debtors, including sovereign defaults (Bordo, Dueker, and Wheelock, 2000; Catao and Sutton, 2002); (v) rising interest rates (Kaminsky and Reinhart, 2001; IMF, 1998); and (vi) increased volatility of financial markets returns (Illing and Liu, 2003; De Bandt and Hartmann, 2000).

There are two, not mutually exclusive, approaches for identifying financial crises, known as the systemic and macroprudential views. The systemic approach uses as a yardstick the

[4] An extensive compilation of the literature on financial crises can be found at www.internationaleconomics.net/crisis.html.

degree to which the financial disturbance spreads within and/or across the different components of the financial system and the severity of its effect on the solvency of financial intermediaries (De Bandt and Hartmann, 2000). The macroprudential approach uses as a yardstick the severity of the negative effect of the financial disruption on the real economy (Houben, Kakes, and Schinasi, 2004).

The analysis presented in this paper falls in the realm of the mainstream literature on financial crises. In the rest of this section, therefore, we survey only the mainstream theoretical models and empirical studies of financial crises. Literature on systemic risk, early warning systems, and financial soundness indicators is covered, respectively, in the surveys by Bartholomew and Whalen (2000), Berg, Borensztein, and Pattillo (2004), and IMF (2003).

A. Theoretical Models of Financial Crises

Existing literature has traditionally concentrated on defining and explaining the episodes of financial crises, primarily currency and banking crises. The two types of crises often occur simultaneously (Eichengreen and Bordo, 2002), and involve an actual or potential depreciation in the value of claims (Kaufman, 2000). The emphasis on currency and banking crises is not surprising, since they are both associated with serious negative effects for the real economy, including recession and unemployment, banking and business failures, inflation, reductions in investments, and losses in wealth (Breuer, 2004). Many studies found that the loss in output and recovery time for banking crises is worse than those for currency crises (Kaufman, 2000, and Bordo and Schwartz, 2000).

Breuer (2004) notes that models of currency and banking crises share a parallel development, and identify four generations of such models.[5] The models of the first generation (Salant and Henderson, 1978, Mishkin, 1978, Krugman, 1979, Flood and Garber, 1984) were developed in response to the sovereign debt crisis of Latin America of the 1980s, and were based on macroeconomic fundamentals and speculation. Second-generation models (Diamond and Dybvig, 1983, Obstfeld, 1994, Calvo, 1995, Eichengreen et al., 1996) developed in response to the European Exchange Rate Mechanism (ERM) crisis of 1992–93 and the Mexican crisis of 1994–95. They introduced speculation based on self-fulfilling expectations that need not be tied to fundamentals. The models of the third generation (Calvo 1995, Miller 1996, Sachs et al. 1995, Kiyotaki and Moore 1997) responded to the Asian crisis of 1997–98. They emphasized incentives and opportunities that invite lending and borrowing for overly risky or unproductive projects, and considered 'twin crises' as opposed to currency or banking crises independently.

The latest models of financial crises (fourth-generation models in Breuer 2004 terminology) consider the role of institutional factors. Quality of the institutional infrastructure for financial intermediation has been shown to affect the level of financial development, depositor trust in the financial system, and the level of credit risk (Bonin and Wachtel, 2003; De Nicolo, Geadah, and Rozhkov, 2003). In the fourth-generation models (Agenor and

[5] Similar classification of currency crises that stops at the third generation identified above is presented in Frankel and Wei (2004).

Aizenman, 1999; Hall and Jones, 1999; Alesina et al., 2002; Barth, Caprio, and Levine, 2001; Das, Quintyn, and Chenard, 2004), explanatory variables include factors like politics, rule of law, trust, ethnic tensions, culture, property rights, legal origin, types of governance, and quality of financial policies. The idea is that these variables are important because they have an impact on information, uncertainty, and transactions costs and can affect the efficiency of decision-making.

Good and transparent financial policies enhance the efficiency of financial system and the real sector by anchoring market expectations and alleviating the problems of adverse selection and moral hazard in the relationship between financial firms and their clients. Nontransparent policy formulation, and weak and inconsistent financial policies that fail to weed poorly-managed and undercapitalized participants out of the marketplace and ensure the credibility of regulatory filings, result in frequent revisions of private agents' expectations of losses in financial sectors/markets. This raises the variability of asset prices, consumption, and investment, thereby increasing the riskiness of investments in financial and physical assets. The latter translates into higher risk-premiums demanded on investments. The possibility for adverse selection and moral hazard in the relationship between supervised entities and their clients also results in higher risk-premiums and interest rates that prevent firms from pursuing otherwise economically viable investment projects (Sundararajan, Das, and Yossifov, 2003).

B. Financial Stress

Traditionally, the concept of financial stress has been used in the financial crises literature in reference to the incidence and magnitude of different symptoms of financial system disruption in the panic/crash phase of crises. For example, BIS (1999) lists under the rubric of financial stress the widening of yield spreads in the bond markets, the fall of stock market indices, the increase in nominal 1-day volatility of financial prices, etc. in periods of financial crises.

In a seminal study of the Canadian financial system, Illing and Liu (2003) extended the definition of financial stress to include the intertemporal dynamics of the variables serving as indicators of financial system disruption. They defined stress as "the force exerted on economic agents by uncertainty and changing expectations of loss in financial markets and institutions…. If financial stress is systemic, economic behavior can be altered sufficiently to have adverse effects on the real economy…. Therefore, financial stress is a continuous variable with a spectrum of values, where extreme values are called a crisis."

Looking at the level of financial stress instead of incidences of financial crises allows for continuous surveillance of the financial system. At the same time, however, analyses of financial crises and stress are closely related, as crises are signaled by extreme realizations of financial stress.

C. Empirical Studies of Fourth-Generation Models of Financial Crises

Early studies on the subject have yielded little evidence in support of the importance of the quality of financial policies for financial stability. Looking only at the banking sector, Sundararajan, Marston, and Basu (2001) and Barth, Caprio, and Levine (2001) find that the quality of banking supervision, proxied by different instruments, does not have a statistically

significant direct effect on bank soundness at the aggregate level and on the probability of a crisis. Sundararajan, Marston, and Basu (2001) do, however, report some evidence that higher noncompliance with internationally-accepted good practices of banking supervision results in higher nonperforming loans ratio "…by accentuating the marginal effect on credit risks associated with low loan growth." The relevance of these early studies to the debate is, however, limited by the small sample size in Sundararajan, Marston, and Basu (2001), and the failure to control for a number of fundamentals and institutions in Barth, Caprio, and Levine (2001).

More recent studies by Das, Quintyn, and Chenard (2004) and Podpiera (2004), using bigger samples and more appropriate econometric specifications, provide evidence of the existence of a positive link between the quality of different aspects of banking supervision and bank soundness at the aggregate level. By constructing indices of financial system soundness and regulatory governance, based on country data collected from the Financial Sector Assessment Program (FSAP), these papers showed that financial system soundness is affected by regulatory governance, along with variables reflecting macroeconomic conditions, the structure of the banking system, and the quality of political institutions and public sector governance.

Existing empirical studies tend to focus on one or two financial sectors, instead of taking a system-wide approach to the analysis of financial crises. Despite the fact that in most cases financial crises affect more than one financial sector/market, empirical studies focus on one sector, or the combination of currency and banking crises that has come to be known as twin crises.[6]

III. Measures of Financial System Stress and Quality of Financial Policies

We construct indices of quality of financial policies and financial system stress for the 68 countries or economies with completed FSAP at the time this paper was written (Appendix Table 2). The FSAP is the main vehicle for systematically assessing countries' financial policies, which we use as a primary source of information on institutional quality. Given that our main goal is to explore the link between the quality of financial policies and the level of stress in the financial system, we analyze the latter only in countries, for which we have assessment data on the quality of financial policies.

A. Overall Indices of Financial Stress

In this paper, we adopt the definition of financial stress proposed by Illing and Liu (2003). As noted above, Illing and Liu (2003) conceptually view financial stress as a continuous variable, the extreme realizations of which occur in the panic/crash phase of crises. In practice, they construct indices of financial stress from variables that reflect the presence (or

[6] For a review of the empirical studies of financial crises, see Breuer (2004) and references therein. Influential examples include: (1) currency crises: Eichengreen, Rose, and Wyplosz (1996); (2) banking crises: Demirguc-Kunt and Detragiache (1997); (3) sovereign debt crises: Christofides, Mulder, and Tiffin (2003); (4) stock market crashes: Herrera and Perry (2001); and (5) twin banking and currency crises: Kaminsky and Reinhart (1999).

lack) and magnitude of financial system disruptions. As seen from the overview of the literature on financial crises, symptoms of financial system disruption include: (1) falling asset prices; (2) exchange rate depreciation and/or losses of official foreign reserves; (3) insolvency of market participants; (4) defaults of debtors, including sovereign defaults; (5) rising interest rates; and (6) increased volatility of financial markets returns.

We adopt a system-wide approach to the analysis of financial stress that takes into account developments in the key components of the financial system: the banking sector, the foreign exchange and equity markets, and the domestic and external government debt markets.[7] To construct an index of financial stress for the financial system as a whole, we first create sector-wise indices of financial stress, and then combine them in an overall index. Given data availability, basing the overall index of financial stress on all five sectors results in valid observations for just 22 economies (Appendix Table 1). As this is not sufficient to ensure robustness of the follow-up regression analysis, we construct an alternative overall index of financial stress, based on the three sectors of the financial system, for which we have data for most countries—the banking sector, and the foreign exchange and equity markets. In the construction of the overall financial system stress indices, each sector-wise index of financial stress is weighted by the size of the respective financial sector/market relative to the combined size of the financial sectors/markets encompassed by the particular overall index.[8]

Sector-wise indices of financial stress[9]

In the construction of sector-wise indices of financial stress, we use primarily variables that measure the first and, whenever possible, the second moments of price data from the respective sectors/markets, suitably transformed to allow meaningful cross-country comparisons. Data on these variables are readily available at high frequencies (up to daily), and they reflect directly the presence (or lack) and magnitude of financial system disruptions. In our choice of variables, we follow closely the existing literature, except in the case of the banking sector. A novel feature of our multi-country financial stress indices is the use of volatility measures alongside real price variables and spreads. As seen from the overview of the financial crises literature, the panic/crash phase of crises is often characterized not only by falling real asset prices, but also by heightened uncertainty about the nominal value of investments in the markets under considerations. Following Illing and Liu (2003, p. 17), we model the conditional variance of one-day nominal returns in the stock and foreign exchange

[7] Our initial intention was to include the insurance sector in the analysis of financial stress. However, we were unable to find suitable indicators of financial stress in this sector for a large enough sample of countries. Other components of the financial sector, including pension funds and hedge funds, are important only for a small number of countries.

[8] The variables used to measure the size of each sector of the financial system relative to the size of the domestic economy are commonly used in the literature: (1) banking sector—total assets of deposit money banks to GDP ratio; (2) stock market—stock market capitalization to GDP ratio; (3) foreign exchange market—total imports and exports of goods and services to GDP ratio; (4) external government debt market—ratio of external government debt to GDP; and (5) domestic government debt market—ratio of domestic government debt to GDP.

[9] See Appendix I for details on variables, transformations, and weighting schemes.

markets as GARCH(1,1) processes, and use period-average values of the estimated conditional variances in the construction of the financial stress indices.

The indicators of financial stress in each segment of the financial system are combined in a sector-wise index by first transforming the values of each variable across all countries and time periods in percentiles and then averaging the values of the transformed series for each country in each time period. For a given country in a given time period, the score on a financial stress index, based on the percentiles transformation method, shows the average[10] percent of country-time period measurements of financial stress in the full sample that fall below the level of stress measured in the time period and country under consideration.

Banking sector

All existing empirical studies of banking crises and bank soundness (in the context of financial stability) rely on aggregate balance-sheet indicators of weaknesses and vulnerabilities of financial intermediaries (e.g., share of nonperforming loans (NPL) in banks' total loans, etc.)—either explicitly, as indicators of bank soundness (Sundararajan, Marston, and Basu, 2001; Das, Quintyn, and Chenard, 2004), or implicitly, by using Demirguc-Kunt and Detragiache (1997) and Caprio (2003) dating of banking crises, which uses the NPL ratio as one of the quantitative factors for determining crises periods (Breuer, 2004, p. 307).

There are two reasons why we choose not to rely on aggregate balance-sheet indicators to measure stress in the banking sector. On the one hand, the availability, timeliness, and reliability of the data on these indicators are inadequate for our goal to develop high-frequency indices for continuous surveillance of the financial system. Publicly available data of good quality on aggregate bank balance-sheet indicators for a large number of countries has only recently become publicly available in the IMF's *Global Financial Stability Reports*. The time span of the published data is, however, limited to the post-1998 period, the frequency of the data is annual, and it is being published with a considerable delay in the case of many countries. On the other hand, as noted by Illing and Liu (2003) "stress is the product of a vulnerable structure and some exogenous shock." The aggregate balance sheet of financial intermediaries can be beset by weaknesses and vulnerabilities for a long time, before some exogenous shock triggers extreme realizations of the indicators of the magnitude of financial system disruptions.

To measure financial stress in the banking sector, we use overnight interbank rates and the amounts of central bank credit to banks. When banks experience difficulties meeting their obligations out of their current earnings, due to a bank run, exposure to other participants in the payments system that fail to meet their obligations etc., they can turn to either the interbank market or the central bank to raise quickly additional funds. Problem banks would face progressively higher risk-premia on the interbank market, as other market participants become aware of the extent of their balance-sheet weaknesses. Central bank lending would be their last resort, should the access to interbank funds is completely shut off. Therefore,

[10] Across different indicators of the severity of financial stress.

overnight interbank rates and the amounts of central bank credit to banks are our preferred measures of financial stress in the banking sector.[11] To ensure that country rankings on the final index capture cross-country differences in the severity of stress in the banking sector, we use the real overnight interbank rate (to account for differences in the rate of inflation across countries) and the ratio of central bank credit to total bank assets (to remove the scale effect due to the different sizes of the economies in our sample).

Foreign exchange market

The construction of the financial stress index for the foreign exchange market is informed by the widely accepted procedure for constructing foreign exchange market pressure indices (e.g., Sachs, Tornell, Velasco, 1995; Eichengreen, Rose, and Wyplosz, 1996; Kaminsky and Reinhart, 1999; etc.), from which we deviate in three respects. First, we add a volatility measure to capture the time-varying uncertainty associated with the nominal value of open positions on the foreign exchange market. Second, to ensure that country rankings on the final index capture cross-country differences in the severity of foreign exchange market pressures, we use the real effective exchange rate instead of the nominal exchange rate,[12] and the ratio of net international reserves to imports in place of the level of net international reserves (to remove the scale effect due to the different sizes of the economies in our sample). Finally, we use the above-mentioned variables in levels instead of percentage changes over an arbitrary period, as is common in the literature, because as noted by Borio and Lowe (2002) "vulnerabilities are generally built up over an extended period, rather than in a single year."

Stock market

There is surprisingly little research on non-U.S. stock market crises (see Patel and Sarkar, 1998 for a survey and an important contribution). Existing studies follow the lead of Patel and Sarkar (1998) in using the CMAX method for identifying crises periods. The CMAX indicator is a "hybrid volatility-loss measure" (Illing and Liu, 2003), defined as the ratio of the level of the stock market index to its maximum realization in the time span between the sample's start date and the period, for which the CMAX value is calculated.[13] In this paper, we decouple the standard volatility-loss measure in two separate variables—one

[11] We do not use a volatility measure in the construction of the financial stress index for the banking sector, because of the poor quality of published daily interbank interest rate data. The series, which we obtained from Bloomberg and the CEIC Daily Database contained a very large number of missing values.

[12] Kaminsky and Reinhart (1999) also use the real effective exchange rate in their analysis of cross-country differences in severity of currency crises.

[13] In Patel and Sarkar's original formulation, all country indices were expressed in nominal dollar terms, although the authors note that in future research they would like to use the indices either in real U.S. dollar or real local currency terms. Herrera and Perry (2001) carry out this research agenda, by estimating CMAX indicators, based on real stock market indices, for a number of Latin American countries.

measuring the level of real stock market indices, and the second capturing the volatility of nominal stock market returns.

Government debt markets

Following the consensus in the literature, we measure financial stress in the external government debt market by the spread between the return on countries' foreign debt (for countries that issue U.S. dollar-denominated debt) or the hedged return in U.S. dollars of domestic government debt (for countries with fully convertible currencies that do not issue U.S. dollar-denominated debt), and the return on U.S. government securities with comparable maturity (Sy, 2003; Merrick, 2004). Due to lack of published daily data on domestic government bond yields for the majority of countries in our sample, we measure financial stress in the domestic government debt market by the quarterly values of the real treasury bill rate.

B. Index of Quality of Financial Policies

To assess countries' progress in adopting good and effective financial policies, there is a need for guideposts to judge what has been achieved and what remains to be done. As indicated earlier, the term "financial policies" in the paper refers to policies related to the regulation, supervision, and oversight of the financial and payment systems. The international community has accepted certain minimum elements of such type of financial polices. These have been codified as an international standard in the areas of supervisory polices,[14] transparency policies,[15] and market integrity polices.[16] Since, 1999, the FSAP has become the main vehicle for assessing countries' observance with these financial polices, providing the most comprehensive and consistent cross-country dataset on the quality of domestic financial policies.

For our analysis, we use the principle-by-principle assessments of countries' observance of the Basel Core Principles for Effective Banking Supervision (BCP) and the IOSCO Objectives and Principles of Securities Regulation (OPSR) to construct indices of the quality of financial policies in the banking sector, securities market, and a combined index of quality of financial policies (one observation per country for the whole sample). To construct a combined index of quality of financial policies, we first create sector-wise indices of quality of financial policies in the banking sector and securities market, and then combine them into one index. Each sector-wise index is weighted by the size of the respective financial

[14] Basel Core Principles for Effective Banking Supervision; IOSCO Objectives and Principles of Securities Regulation; IAIS Insurance Core Principles; CPSS Core Principles for Systemically Important Payment Systems; and CPSS-IOSCO Recommendations for Securities Settlement Systems.

[15] IMF's Special Data Dissemination Standard and General Data Dissemination System; IMF's Code of Good Practices on Fiscal Transparency; and IMF's Code of Good Practices on Transparency in Monetary and Financial Policies.

[16] OECD Principles of Corporate Governance; Anti-Money Laundering and Combating the Financing of Terrorism.

sector/market relative to the combined size of the financial sectors/markets encompassed by the combined index.[17] Given the importance of banks and securities markets in most countries' and their key role in crises, the combined index can be considered a good proxy for the overall financial sector policies. Identification problems (caused by the fact that there is only one observation of the index per country for the whole sample) are solved by using it only in interaction with other variables (Section IV).

In the construction of indices of quality of financial policies, we assign equal weights to countries' performance in the four areas of financial policies that are of particular relevance for financial soundness and stability— governance; regulatory practices; prudential framework; and financial integrity and safety net arrangements (Appendix II).[18] The constituent principles of the main financial policy standards are grouped under the above four headings and countries' average degree of observance of principles in each group is calculated. Countries' final scores on the sector-wise indices of quality of financial policies are then obtained by taking simple averages of the four scores obtained in the preceding step.

IV. Analysis of the Link Between Quality of Financial Policies and Financial System Stress

We use panel data at annual frequency over the period 1998–2003. The relatively small sample of economies, for which we are able to construct overall financial stress indices (22 or 65, depending on the coverage of sectors/markets, Appendix Table 1), all but precludes the use of cross-sectional regression specifications. Panel data, besides increasing the degrees of freedom and hence the efficiency of parameter estimates, has the added advantage of substantially reducing estimation biases that plague cross-sectional regressions, including omitted variables bias, and bias caused by measurement errors. We choose annual frequency, as data on some of the explanatory variables are available only annually. Even when available, the usefulness of higher frequency data is undermined by peculiarities in data collection and methodologies in some countries that tend to average out at lower frequency of reporting. We limit the time-span of the sample to a six-year period beginning in 1998, mainly because all principle-by-principle assessments of countries' observance of financial policies, on which we base our index of quality of financial policies, have been conducted from 1999 onwards.

A. Preliminary Look at the Data

Over the period 1998–2003, the average level of financial stress has decreased in both the full-sample of countries and in the country groups with above and below-average quality of

[17] The variables used to measure the relative sizes of the banking sector and securities market are, respectively, the total assets of deposit money banks to GDP ratio and the stock market capitalization to GDP ratio.

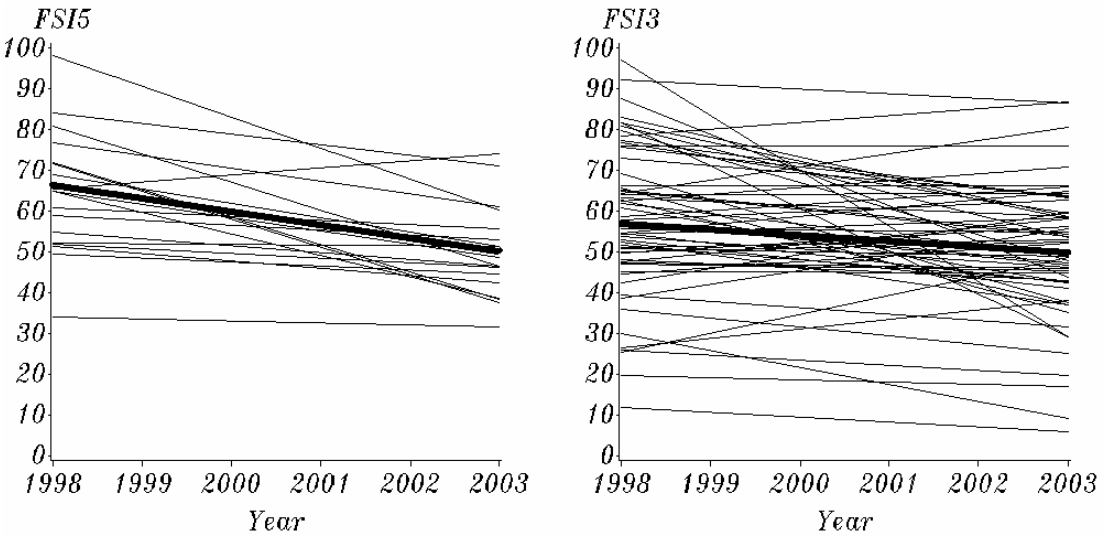
[18] The rationale for this classification of regulatory polices across different components of the financial system can be found in *Financial Sector Regulation: Issues and Gaps,* http://www.imf.org/external/np/sec/pn/2004/pn04131.htm, October, (Washington: International Monetary Fund).

financial policies (Figure 1). This reflects the abundant liquidity in the major financial centers throughout most of the period that has spilled over to emerging markets and developing countries, leading to rich valuations in the bond and equity markets and lower market volatility. In the beginning of the period, the average level of financial stress was higher in countries with below-average quality of financial policies, but has since declined at a faster rate. As a result, the average values of the overall index of financial stress in countries with above- and below-average quality of financial policies were roughly the same in 2003. The observed convergence of the average levels of financial system stress in the two groups of countries may reflect the willingness of investors from mature markets to accept narrower risk-spreads, relative to historic valuations, on their overseas investments, in their quest for higher returns than afforded by domestic investments (IMF, *Global Financial Stability Report*, various issues).

Taken as a group, countries with above-average quality of financial policies have been more financially stable than countries that lag on this indicator. Throughout the whole period, the difference between the maximum country scores on the overall index of financial stress and its average values remained narrower and falling among countries with above-average quality of financial policies. At the same time, the heterogeneity in financial stress outcomes among countries with below-average quality of financial policies remained largely unchanged.

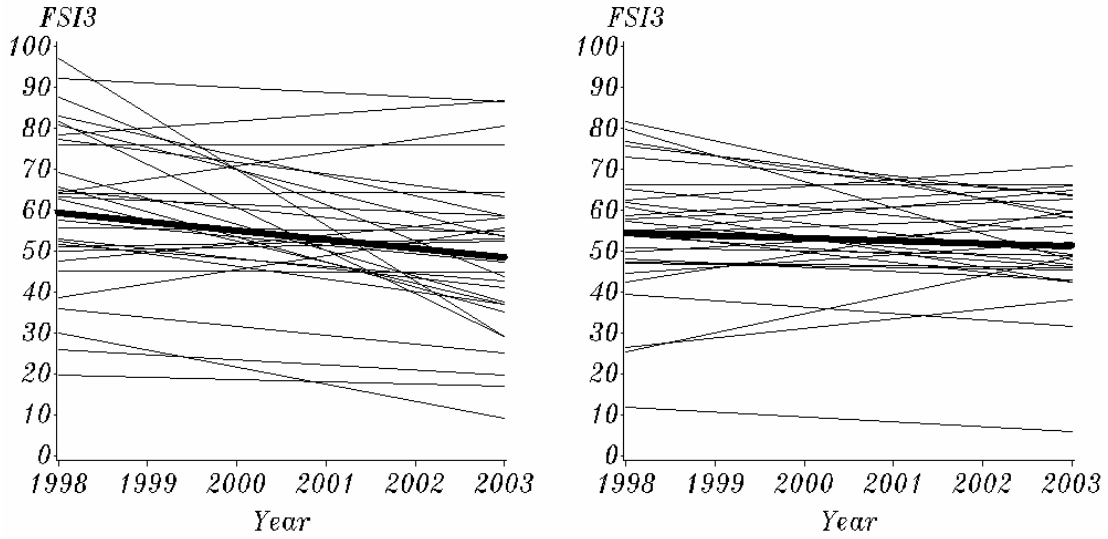
Figure 1. Intertemporal Dynamics of the Overall Indices of Financial Stress (FSI5[1/] and FSI3[2/]) in the Full Sample and in Country Groups by Quality of Financial Policies

A. Full Sample



B. Countries with scores on the combined index of quality of financial policies *below the average* for all countries

C. Countries with scores on the combined index of quality of financial policies *equal or above the average* for all countries



Notes: Each panel presents fitted OLS change trajectories by country and an average change trajectory (bold line) for the entire group of countries.

[1/] Encompassing the banking sector, the foreign exchange and equity markets, and the domestic and external government debt markets.

[2/] Encompassing the banking sector, and the foreign exchange and equity markets.

B. Regression Analysis

Regression model

The four generations of theoretical models of financial crises (Section II) identify three broad sets of variables as potential determinants of crisis incidence and, by extension, of the severity of stress in the financial system—weak macroeconomic fundamentals, cross-border contagion, and weak institutions. In practice, no real-world financial crisis can be unequivocally categorized in one of the four theoretical types of crises (Frankel and Wei, 2004, p. 10). Macroeconomic fundamentals, cross-border contagion, and quality of institutions all play a role in determining the level of stress in the financial system.

The specification of the panel data regression model should also reflect the fact that, typically, there is only one observation per country on most measures of institutional quality. The index of quality of financial policies, developed in this paper, is no exception. This is not as restrictive as it appears at first glance, because institutions are shaped by complex socio-economic forces over long periods of time, and it is, therefore, reasonable to assume that they remain relatively unchanged in the short run.

With the above considerations in mind, we propose a regression model that views financial system stress as being determined by macroeconomic fundamentals, cross-border spillovers of financial stress, and interactions between institutions, on the one hand, and fundamentals and exogenous shocks, on the other:

$$FSI_{it} = \alpha_i + (\sum_n \delta^n F_{it}^n + \sum_k \xi^k C_{it}^k)(1 + \sum_j \beta^j I_i^j) + \varepsilon_{it} \qquad (1)$$

FSI_{it} — value of the overall index of stress in the financial system for country i in period t;
α_i — country-specific constant;
F_{it}^n — value of macroeconomic fundamental n for country i in period t;
C_{it}^k — cross-border spill-over of financial stress, captured by the level of contagion measure k for country i in period t;
I_i^j — value of indicator j of quality of institutions in country i.

In (1), macroeconomic fundamentals and exogenous shocks affect the level of financial stress directly, with their impact differing across countries due to differences in institutions. In other words, institutions play the role of a medium for impact propagation. The model is an adaptation of Blanchard and Wolfers (1999) analysis of the rise of European unemployment, which provides a general framework for examining the effect of infrequently changing (and measured) characteristics of the economy on economic outcomes over time. The Blanchard and Wolfers (1999) approach bears significant similarities with Illing and Liu (2003) informal discussion of the determinants of financial system stress:

> "Our review of facts makes clear why it is tempting to look for explanations of the rise of European unemployment based on the interaction of shocks and institutions: Adverse shocks can potentially explain the general increase in

> unemployment. Differences in institutions can potentially explain differences in outcomes across countries." Blanchard and Wolfers (1999, p. 16).
>
> "Stress is the product of a vulnerable structure and some exogenous shock…. A shock is more likely to result in stress (in the extreme, a crisis) when financial conditions are weak; …. Shocks may also propagate through weakness in the structure of the financial system..." (Illing and Liu, 2003).

The dependent variable in our model is the overall index of financial stress that encompasses three segments of the financial system—the banking sector, and the foreign exchange and equity markets (Section III). The index is calculated at quarterly frequency. To convert it to annual frequency, we take the maximum quarterly realization of the index in each year in our sample.[19] The small number of countries, for which we are able to construct an overall financial stress index encompassing all five financial sectors/markets, prevents us from using it in regression analysis, as the implemented estimation techniques use a lot of degrees of freedom.

Our measure of institutional quality is the index of quality of financial policies, based on countries' observance of international financial sector standards (Section III). In the economic literature, similar indices have been used as measures of institutional quality by Sundararajan, Marston, and Basu (2001), Das, Quintyn, and Chenard (2004), and Podpiera (2004). Some empirical studies of financial crises have also utilized indicators of institutions that provide information on regulatory preconditions (i.e., the general policy and environmental conditions and institutional infrastructure essential for regulation), which are not evaluated as part of the regulatory standards assessments.[20] The large number of interaction terms in (1) that would have been needed to test simultaneously the effects of different measures of institutional quality on financial system stress, prevent us from considering complimentary measures of institutional quality in the regression analysis. This is an area in which further research is needed.

The definition and selection of macroeconomic fundamentals variables follow the consensus in the empirical literature on financial crises (Appendix IV). We construct measures of contagion via international trade, that affects primarily the foreign exchange market, and measures of financial flow contagion that propagate through the banking sector, the stock market and the external government debt market (Appendix III). In the case of the foreign exchange market and the banking sector, we construct measures of cross-border spillovers of financial stress via both the direct and indirect contagion channels, whereas in the case of the stock and external government debt markets we are able to measure spillovers of financial

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[19] Regression results are robust to the method of converting quarterly financial stress data to annual frequency. We have used both the maximum and average of quarterly realizations and the results were not substantially different.

[20] Mulder, Perrelli and Rocha (2002) utilize indices, developed by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998), on creditor's rights, shareholder's rights, ability to enforce contracts, accounting standards, and origin of the legal regime. Das, Quintyn, and Chenard (2004) use indicators from Kaufman, Kraay and Mastruzzi (KKM, 2003) on control of corruption, government effectiveness, voice and accountability, and regulatory quality.

stress via the indirect contagion channel only. The first type of contagion occurs when a realization of financial stress in one country has an impact on the level of financial stress in another country, with the two countries having strong bilateral trade or financial links. The second type of contagion occurs when a realization of financial stress in one country has an impact on the level of financial stress in another country, with the two countries having strong bilateral trade or financial links with a common third country. The indirect contagion channel is referred to as "competitive devaluation," when it occurs in the foreign exchange market (Dornbusch, Park and Claessens, 2000, p. 5), the "common lender channel,"[21] when it affects the banking sector, and the "portfolio rebalancing channel,"[22] when it hits the stock and external government debt markets (Schinasi and Smith, 2000).

Regression findings

At the initial stages of the analysis, we considered all macroeconomic variables and contagion measures (Appendices III and IV) as potential determinants of the level of financial system stress. Given the properties of model (1), we consider the primary explanatory variables only in pairs with their interaction terms with the index of quality of financial policies. We tested each regression specification for country-specific constants versus a common intercept.[23] In all cases, the variable intercept model outperformed the common constant specification. Because all macroeconomic fundamentals are endogenous, and, therefore, likely to be correlated with the white-noise error term in (1), and all explanatory variables are potentially correlated with the country-specific effects, we evaluate the regression using the Arellano and Bover (1995) and Blundell and Bond (1998) GMM-SYS estimator, as implemented by Roodman (2003) in a STATA module. The GMM-SYS estimator is consistent in dynamic models with variable intercepts, in which some of the explanatory variables are correlated with the idiosyncratic and white-noise errors.

The combined GMM-SYS estimator is based on two sets of instrument/moment conditions: one for the model in first-differences and one for the model in levels. In the case of the first set of moment conditions, second and longer lags of the dependent and endogenous variables in levels are used together with the contemporaneous first-differences of exogenous regressors as instruments. In the case of the second set of moment conditions, lagged first-differences of the dependent and endogenous variables are used together with the contemporaneous levels of exogenous regressors as instruments. To keep the number of instruments manageable, we use an option of the estimation routine that creates "…one

[21] If banks in a country have exposure to a number of emerging markets, high values of financial stress in the banking sector of one of these emerging markets may cause banks to call-off part of their loans not only to that country, but to other emerging markets too, in their bid to restore capital adequacy.

[22] If a country included in a global index of stocks or bonds experiences a high level of financial stress in the stock/bond market, foreign investors that practice index investing may liquidate some of their positions not only in that country, but in other countries included in the index.

[23] Estimations were carried out using STATA and PcGive software packages.

instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance" (Roodman, 2003). See Doornik, Arellano, and Bond (2002), and Roodman (2003) for more information on the GMM-SYS estimator.

Table 1 presents our preferred regression specification. Specification tests on the static version of the preferred regression model, evaluated by the GMM-SYS estimator, signal the presence of serial correlation in the disturbances (ε_{it}). We add a lagged dependent variable in the final regression specification to address this problem, because the GMM-SYS estimator assumes serially uncorrelated errors. The resultant partial adjustment model implies that the short run impact of each explanatory variable on financial system stress is smaller, in absolute value, than its effect in the long run. The model, presented in Table 1, shows the short run coefficients of explanatory variables. Their long run coefficients are obtained by dividing the values in Table 1 by one minus the coefficient of the lagged dependent variable (see notes to Table 1). The magnitude of this expression suggests a relatively slow pace of adjustment of the overall level of financial stress from one long run equilibrium to another, in the face of changes in macroeconomic fundamentals, cross-border spillovers of financial stress, and institutions. Approximately half of the remaining gap between the short run response of the level of financial system stress to such changes and its equilibrium response is closed each year.

The level of financial system stress is positively related to government budget deficits and the terms-of-trade index, with the strength of the association determined by the quality of countries' financial policies. Higher quality of financial policies reduces the impact of these variables on financial system stress (Table 2). The negative association between financial system stress and government budget balances is driven by the decrease in government borrowing requirements and hence interest rates and the quelling of aggregate demand and hence demand driven price increases (through the narrowing of the gap between government revenue, which is foregone expenditure by other sectors, and government expenditures), brought around by an improvement in government finances. The positive link between financial system stress and improvements in terms-of-trade stem from their inflationary consequences. Improvements in terms-of-trade are ushered by either higher prices of exports (in domestic currency units), lower prices of imports (in U.S. dollars), or appreciation of the nominal exchange rate (measured in domestic currency units per US$1). The first potential cause has a direct impact on the domestic price level, whereas the last two stimulate the demand for imports, giving sellers pricing power.

Countries with higher quality of financial policies are better able to contain the effects of government deficits and inflationary pressures, stemming from terms-of-trade improvements, on the overall level of stress in the financial system. The short run and long run effects of changes in the primary explanatory variables on financial system stress are higher in absolute terms, when evaluated at the 25th percentile of the index of quality of financial policies than when evaluated at its 75th percentile (Table 2).[24]

[24] Due to the presence of interaction terms, involving the value of the index of quality of financial policies, the effects of changes in the primary explanatory variables on financial

(continued…)

Table 1. Determinants of Financial System Stress

Explanatory variables/Overall index of financial stress (*FSI3*)	GMM-SYS Estimator
Lagged value of *FSI3*	0.52 **
	(0.11)
Constant	19.73 **
	(7.19)
General government balance as percent of GDP (*GovBal*)	-2.11 *
	(0.95)
Interaction term between the index of quality of financial policies (*QFPI*) and *GovBal (QFPI_x_GovBal)*	0.023 *
	(0.01)
Index of terms of trade in goods and services (*TOT*)	0.15 **
	(0.04)
Interaction term between *QFPI* and *TOT (QFPI_x_TOT)*	-0.002 **
	(0.0005)
Measure of contagion among constituents of the MSCI Emerging Markets Equity Index (*ContMSC*)	-27.25 **
	(9.91)
Interaction term between *QFPI* and *ContMSC (QFPI_x_ContMSC)*	0.37 **
	(0.13)
Time trend (*TIME*)	-4.39 **
	(1.10)
Interaction term between *QFPI* and *TIME (QFPI_x_TIME)*	0.059 **
	(0.01)
Overall R^2	0.62
Arellano-Bond test for AR(1) in first differences (StataCorp, 2003b)	-2.92 **
Arellano-Bond test for AR(2) in first differences	-1.6
Number of instruments	30
Sargan test of overidentifying restrictions (StataCorp, 2003b)	28.3
Number of countries	55
Number of observations	271

Notes: Robust standard errors in parentheses.
** – statistically significant at 99% level of confidence.
* – statistically significant at 95% level of confidence.
^ – Squared correlation between *FSI3* and its predictions from the model.

The static, long run solution of the partial adjustment model, presented in Table 1, is: [25]

$$FSI3 = 40.89 - 4.36\ GovBal + 0.05\ QFPI\_x\_GovBal + 0.32\ TOT - 0.003\ QFPI\_x\_TOT - \\ - 56.47\ ContMSC + 0.77\ QFPI\_x\_ContMSC - 9.11\ TIME + 0.12\ QFPI\_x\_TIME$$

system stress depend not only on their respective coefficients, but also on the coefficients of the interactive terms and the values of the index of quality of financial policies.

[25] "The static or long run solution of a dynamic, stochastic process denotes a hypothetical deterministic situation in which all change has ceased. For a stationary stochastic process..., the static solution corresponds to the expected value." (Hendry, 1995, pp. 212–13).

For the sample covering 1998–2003, we do not find evidence of the presence of portfolio rebalancing contagion channel among emerging markets. On the contrary, data seem to indicate that the direct effect of a higher realization of financial stress in the stock market of a country that is a member of the MSCI Emerging Markets Index is to decrease financial system stress in other member countries of the index (Table 1). This implies that international investors channel funds away from the troubled country into other emerging stock markets, rather than closing positions in all such markets. This finding may be explained by the willingness in recent years of investors from mature markets to accept narrower risk-spreads, relative to historic valuations, on their overseas investments, in their quest for higher returns than afforded by domestic investments (IMF, *Global Financial Stability Report*, various issues).

The overall negative effect of contagion-driven influx of foreign funds on financial system stress in emerging stock markets is more pronounced for low values of the index of quality of financial policies (Table 2). Whereas the immediate effect of a contagion-driven influx of foreign funds in emerging stock markets is to lower the level of financial system stress, this is not necessarily beneficial for recipient countries, as excess liquidity in the financial system can feed manias. Countries with higher quality of financial policies may be in a better position to fend off foreign capital looking for a temporary safe harbor to weather the storm in another emerging country. For values of the quality of financial policies index above the 55-th percentile, high realization of financial stress in a country, member of the MSCI Emerging Markets Index, leads to an increase of financial system stress in peer countries.

In the period 1998–2003, the average level of financial stress has exhibited a slight downward autonomous trend among countries that rank below the 55th percentile on the index of quality of financial policies, falling faster in countries with lower scores on the index. Over the same period, the average level of financial stress has exhibited a slight upward autonomous trend among countries that rank above the 55th percentile on the index of quality of financial policies, increasing faster in countries with higher scores on the index (Table 2). However, in all cases, the short run effects of passage of time, *ceteris paribus*, on the average level of financial system stress are small, with countries increasing or decreasing their scores on the overall financial system stress index by less than two basis points per year.

Our preferred regression specification has a good fit with a squared correlation between *FSI3* and its predictions from the model of 0.62.[26] Even though the short run and long run effects of changes in explanatory variables on the index of financial system stress appear small (Table 2), the heterogeneity in country realizations of explanatory variables (Figure 2) ensures the good fit of the model. All coefficients in our preferred regression specification are highly statistically significant, even with standard errors consistent in the presence of any pattern of heteroskedasticity and autocorrelation within panels.

The consistency of the GMM-SYS estimator depends on the validity of the underlying assumptions. The lack of serial correlation in the nonidiosyncratic residuals of the dynamic

[26] Squared correlations between observed and predicted dependent variable series are used in STATA as measures of goodness of fit in panel data models (StataCorp., 2003b, p. 195).

model can be established by testing for second-order correlation in the residuals in first-differences (Doornik, Arellano, and Bond, 2002). A more general test of the validity of the underlying assumptions of the GMM-SYS estimators is the Sargan test of overidentifying restrictions (Arellano, 2003). The results from both types of tests (Table 1) establish the validity of the assumptions behind the GMM-SYS estimator. There is no evidence of second-order correlation in the residuals in first-differences and the Sargan test statistic is also statistically insignificant at the 99 percent level of confidence.

Table 2. Short run and Long run Effects of Changes in Explanatory Variables on the Overall Index of Financial System Stress

(basis points of *FSI3*)

Scenarios	Change in predicted value of *FSI3* with					
	QFPI at sample mean (67.66)		*QFPI* at 25-th percentile (56.49)		*QFPI* at 75-th percentile (80.89)	
	Short run effect	Long run effect	Short run effect	Long run effect	Short run effect	Long run effect
GovBal falls below its sample mean by one percentage point (with *TOT, ContMSC,* and *TIME* at sample means)	0.52	1.08	0.78	1.62	0.21	0.43
TOT rises above its sample mean by ten points (with *GovBal, ContMSC,* and *TIME* at sample means)	0.42	0.88	0.61	1. 26	0.21	0.42
ContMSC doubles from its sample mean (with *GovBal, TOT,* and *TIME* at sample means)	-0.56	-1.16	-1.62	-3.36	0.69	1.43
TIME increments by one period from its sample mean (with *GovBal, TOT,* and *ContMSC* at sample means)	-0.40	-0.82	-1.06	-2.19	0.38	0.80

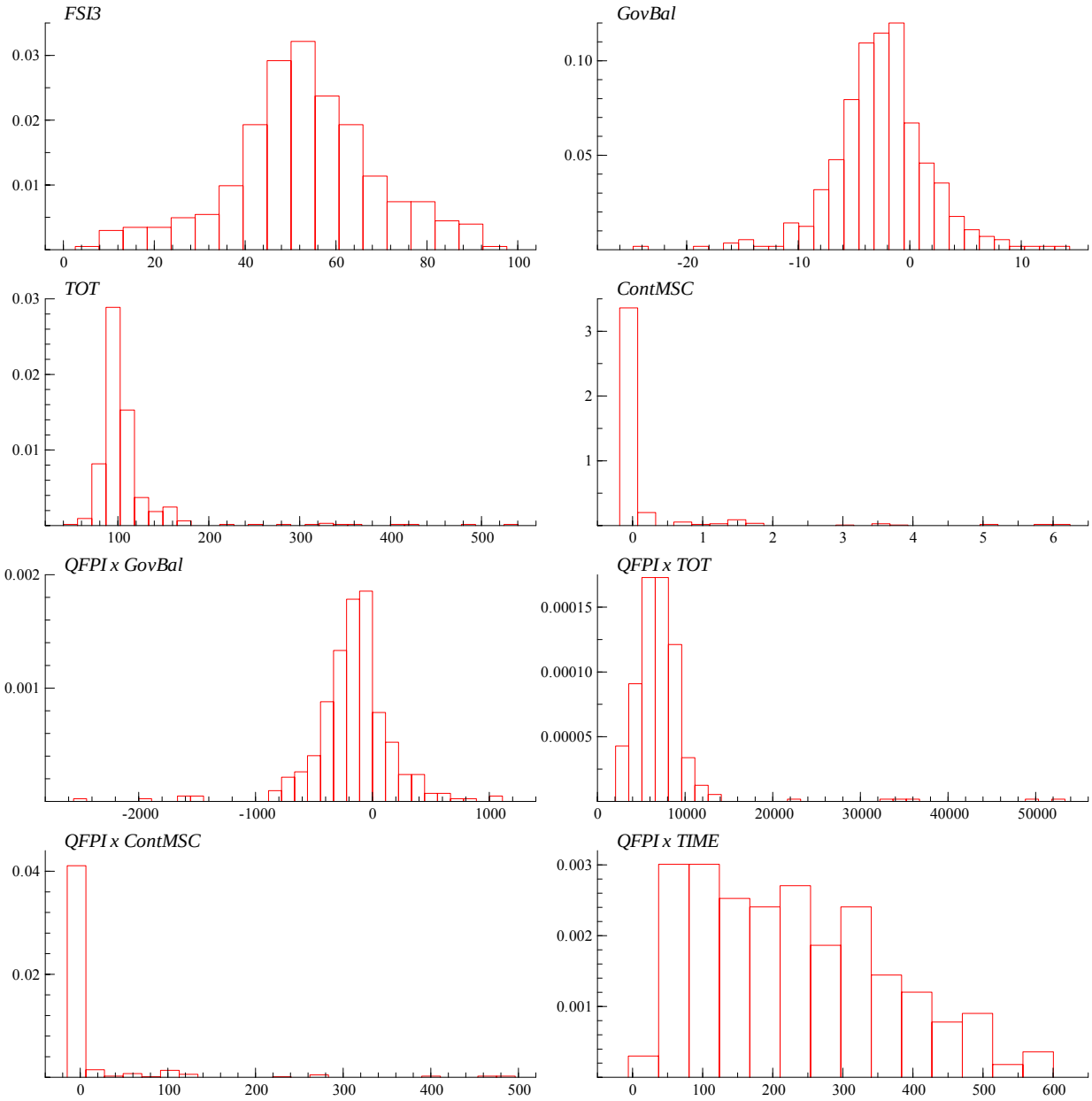
Source: Table 1, Table 3, and authors' estimates.

Table 3. Descriptive Statistics of Variables in Regression Model of Financial System Stress

Variable	Valid Observations	Mean	Standard Deviation	Minimum	Maximum
FSI3 (basis points)	271	52.12	16.99	5.73	92.65
GovBal (%)	271	-2.30	4.51	-24.61	13.73
TOT (basis points)	271	112.43	58.01	53.11	532.73
ContMSC (basis points)	271	0.26	0.91	0	6.14
TIME	271	4.01	1.42	2	6
QFPI (basis points)	271	67.66	18.44	24.73	100
QFPI x *GovBal*	271	-154.25	358.48	-2460.56	1107.54
QFPI x *TOT*	271	7618.83	5253.51	2080.99	53272.53
QFPI x *ContMSC*	271	19.58	70.06	0	477.63
QFPI x *TIME*	271	271.04	123.64	49.46	600

Source: Authors' estimates.

Figure 2. Histograms of Variables in Regression Model of Financial System Stress



Source: Authors' estimates.

V. CONCLUSION

In this paper, we construct multi-country indices of financial system stress and quality of financial policies. The overall index of financial stress, used in the regression analysis of its determinants, encompasses the banking sector, and the foreign exchange and equity markets. It is created by combining sector-wise indices of financial stress, based on variables that measure the first and, whenever possible, the second moments of price data from the respective sectors/markets. The index of quality of financial policies is based on information

on countries' practices relating to financial policies relating to banking supervision and securities markets.

Regression analysis of determinants of financial system stress suggests that it is a function of the interplay between macroeconomic fundamentals and cross-border contagion, and the quality of institutions. The level of financial system stress is positively related to government budget deficits and the terms-of-trade index, with the strength of the association determined by the quality of countries' financial policies (the higher the quality, the smaller the impact on financial system stress). We do not find evidence of the presence of portfolio rebalancing contagion channel among emerging market countries. On the contrary, the direct effect of a higher realization of financial stress in the stock market of a country that is a member of the MSCI Emerging Markets Index is to decrease financial system stress in the other member countries of the index. The overall negative effect of contagion-driven influx of foreign funds on financial system stress in emerging stock markets is more pronounced for low values of the index of quality of financial policies.

Over time, wider availability of data should allow further examination of the issues analyzed in this paper. The attention paid to financial sector health and related policies has increased in recent years and this is likely to gradually improve the availability of data about segments of the financial sector and the characteristics of the financial polices in place. Additional data should allow, for instance, construction of stress indices incorporating other segments of the financial sector or increased robustness of regression analysis by using repeated measurements of the quality of financial policies.

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SECTOR-WISE INDICES OF FINANCIAL STRESS

We carry out the analysis at quarterly frequency (raw daily data and estimates based on it are averaged by quarter) over an eleven year period 1993–2003. We choose a relatively long time span for our sample for several reasons. On the one hand, one of the weighting schemes described in the following section relies on the assumption of normality of the distributions of individual variables within a country. Having 44 quarterly observations (minus any missing values) per country for all variables goes a long way in meeting this requirement. On the other hand, a frequent criticism of using quantitative indicators to identify incidences of financial crises or to measure the severity of financial stress is that this method is guaranteed to signal occurrences of crises/high level of stress, even in relatively tranquil periods. Pushing back the start date of our sample to include all major financial crises in the 1990s, addresses this valid point. We carry out the analysis at quarterly frequency to mitigate the effect of seasonality of constituent variables on the values of the final indices, and because we believe that reported quarterly data on the consumer price index and some of the other variables used in the construction of financial stress indices is less prone to sizable revisions relative to monthly data and is generally more reliable.

The construction of indices requires judgment on the part of the researcher on: (1) the set of variables included in the index; (2) the necessary transformations of the values of each variable; and (3) the choice of a weighting scheme.

Transformations

An increase in the values of each component of the index must signal an increase in the level of financial stress. Therefore, variables, which in their original specification signal higher financial stress when they assume low values (e.g., real asset prices, level of international reserves, etc.) are multiplied by -1 before added to the index.

Treatment of missing values. Some of the variables, used in the construction of sector-wise indices of financial stress, have a number of missing values for some countries. When the missing values are in the beginning, at the end, or permeate the whole country series, we do not attempt to extrapolate them. In all other cases, we extrapolate missing values as follows: (1) Series that do not exhibit time trends: missing values are replaced by the arithmetic average of the realizations of the variable before and after the period with missing observations; and (2) Trending series: Missing values are extrapolated under the assumption that in each quarter with missing observation, the variable grew at a constant rate equal to the geometric mean of its quarterly growth implied by the realizations of the variable before and after the period with missing observations.

Variables

Banking sector

- **Real Overnight Interbank Rate** $\left(\frac{1+R_t}{1+\pi_t}\right)$ (quarterly frequency):

- R_t – *nominal money market rate* (quarterly frequency). Source: IMF's *International Financial Statistics*; CEIC Data Company Limited; Bloomberg; country websites.
- π_t – *inflation* (quarterly frequency). Annualized growth rate of quarterly CPI: $Infl_t = 4 \cdot \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$, where *CPI* is the Consumer Price Index (base equal to 100 in 2000). Source: IMF's *International Financial Statistics*.

- **Central bank credit to deposit money banks (DMB) as ratio of DMB's total assets** (quarterly frequency):

  - *Central bank credit to deposit money banks* (quarterly frequency). Source: IMF's International *Financial Statistic*s; unpublished country data.
  - *DMB's total assets* (extrapolated quarterly data[27])—Sum of all asset types in DMBs' aggregate balance sheet. If the sum of assets exceeds the sum of liabilities by more than one percent, value set to not available.[28] Source: IMF's *International Financial Statistics*.

Foreign exchange market

- **International reserves net of gold in U.S. dollars as ratio of imports in U.S. dollars multiplied by -1** (quarterly frequency). We use this indicator for all countries in our sample, even though a number of them maintain floating exchange rate regimes, because as pointed out by Fischer (2001, p. 13): "Many countries that claim to have floating exchange rates do not allow the exchange rate to float freely, but rather deploy interest rates and intervention policy to affect its behavior." Source: IMF's *International Financial Statistics*.

- **Real effective exchange rate (REER—nominal exchange rate, measured in foreign currency units per unit of domestic currency, expressed in real terms)[29] multiplied by -1** (quarterly frequency). Source: IMF's International Financial Statistics and unpublished data.

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[27] Quarterly data extrapolated from annual data under the assumption that, in each quarter, the variable grew at a constant rate equal to the geometric mean of its quarterly growth implied by the end-of-year realizations of the variable.

[28] In the case of member states of the euro area, special rules apply for the post-1998 data: (1) the sum of assets excludes the following items: "CLAIMS ON GEN. GOVT. IN CTY;" "CL. ON OTH. RES. SECT. IN CTY;" (2) the sum of liabilities excludes the following items: "D. DEP. OF OTH. RES. SECT. IN CTY;" "O. DEP. OF OTH. RES. SECT. IN CTY;" "CENT. GOVT. DEP. IN CTY;" "MMFS HELD BY RESID. OF CTY;" "BONDS & MMI HELD BY RESID. OF CTY."

[29] An increase in REER indicates appreciation, in real terms, of the domestic currency.

- **Quarterly averages of the conditional variance (h_t) of the one-day nominal returns (in percentage terms) on the foreign exchange market** (domestic currency units per US$1), modeled as GARCH(1,1) process for all countries with exchange rate regimes other than fixed:[30]

$$r_t = \zeta_0 + u_t,$$
$$u_t = \varepsilon_t h_t^{1/2}, \ \varepsilon_t | F_{t-1} \sim N[0,1],$$
$$h_t = \alpha_0 + \alpha_1 u^2_{t-1} + \beta_1 h_{t-1}, \ t = 2, \ldots, T,$$
$$\alpha_0 \geq 0, \ \alpha_1 + \beta_1 \geq 0, \text{ and } \alpha_1 + \beta_1 < 1$$

$r_t = 100.\ln(E_t - E_{t-1})$;
E_t – nominal exchange rate (domestic currency units per US$1) (daily frequency). Source: Bloomberg and Datastream.

For countries with fixed exchange rates, for which the distributions of one-day nominal foreign exchange returns does not exhibit the leptokurtosis and volatility clustering characteristic of ARCH processes, we use an alternative measure of uncertainty (Bollerslev, Chou, and Kroner, 1992)—quarterly averages of the realized squared one-day nominal foreign exchange returns. The data on countries' exchange rate regimes comes from IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*. Countries with the following exchange rate arrangements—exchange arrangements with no separate legal tender, currency board arrangements, and conventional pegs—were classified as having fixed exchange rate regimes.

Stock market

- **Real stock market index** $\left(\frac{100 \cdot SMI_t}{CPI_t}\right)$, scaled by the average of its quarterly values in 2002 (average 2002=100), and multiplied by -1 (quarterly frequency):

  - SMI_t—average quarterly values of the nominal stock market index derived from daily data. Source: Bloomberg, Datastream, CEIC Data Company Limited, websites of country exchanges.
  - CPI_t—Consumer Price Index (base equal to 100 in 2000). Source: IMF's *International Financial Statistics*.

- **Quarterly averages of the conditional variance (h_t) of the one-day nominal stock market returns (in percentage terms)**, modeled as GARCH(1,1) process for all countries:

$$r_t = \zeta_0 + u_t,$$

[30] As pointed out by Bollerslev, Chou, and Kroner (1992), in most empirical studies the GARCH(1,1) model suffices to remove the autocorrelation in the squared residuals from the conditional mean regressions of nominal returns.

$u_t = \varepsilon_t h_t^{1/2}$, $\varepsilon_t | F_{t-1} \sim N[0,1]$,
$h_t = \alpha_0 + \alpha_1 u^2_{t-1} + \beta_1 h_{t-1}$, $t = 2, \ldots, T$,
$\alpha_0 \geq 0$, $\alpha_1 + \beta_1 \geq 0$, and $\alpha_1 + \beta_1 < 1$
$r_t = 100.\ln(SMI_t - SMI_{t-1})$;
SMI_t – nominal stock market index (daily frequency). Source: Bloomberg, Datastream, CEIC Data Company Limited, websites of country exchanges.

External government debt market

- *For emerging markets*: **Quarterly averages of stripped spreads between the return on countries' U.S. dollar-denominated foreign debt and that of U.S. government securities with comparable maturity** (daily frequency). Source: J.P. Morgan Emerging Markets Bond Index.[31]

- *For developed countries*: **Quarterly averages of the spread between the 12-month hedged return in U.S. dollars of benchmark government bond index and the 12-month return of the U.S. benchmark government bond index** (daily frequency). Source: J.P. Morgan Government Bond Index.[32]

Domestic government debt market

- **Real 3-Month Treasury Bill rate** $\left(\frac{1+R_t}{1+\pi_t}\right)$ (quarterly frequency):

  - R_t—*nominal 3-Month Treasury Bill rate* (quarterly frequency). Source: IMF's *International Financial Statistics*.
  - π_t—*inflation* (quarterly frequency). Annualized growth rate of quarterly CPI: $Infl_t = 4 \cdot \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$, where *CPI* is the Consumer Price Index (base equal to 100 in 2000). Source: IMF's *International Financial Statistics*.

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[31] "Included in the EMBI Global are U.S.-dollar-denominated Brady bonds, Eurobonds, traded loans, and local market debt instruments issued by sovereign and quasi-sovereign entities. (Effective May 31, 2002, local law instruments are no longer eligible for the index; inclusion will be limited to issues with legal jurisdiction that is domestic to a G7 country.)" (J.P. Morgan, www.utdt.edu/~ely/intro_embig.pdf).

[32] "The J.P. Morgan Government Bond Index is the most widely-used benchmark for measuring performance and quantifying risk across international fixed income bond markets. The indices measure the total, principal, and interest returns in each market and can be reported in 19 different currencies. By including only traded issues available to international investors, the Index provides a realistic measure of market performance." (J.P. Morgan, www2.jpmorgan.com/MarketDataInd/GovernBondIndex/Introduction/Introduction.html).

Weighting scheme

We experiment with two different weighting schemes for constructing sector-wise indices of financial stress. The first one is a variant of the standard "variance-equal weights" method. The second one uses the sample cumulative distribution function of each variable across all countries and quarters to transform its values in percentiles. According to Illing and Liu (2003, p. 6), this is the weighting scheme used in the construction of the JP Morgan Liquidity, Credit and Volatility Index (LCVI).

After comparing country scores on the financial stress indices based on each of the two techniques described above, we choose in favor of the percentile transformation. On the one hand, the variance-equal weights method is particularly ill-suited for constructing indices that measure the severity of financial stress in a heterogeneous set of countries. Because by construction the weights do not sum up to one, countries with low variances of individual components of the financial stress index (developed countries that have not suffered from actual financial crises) could potentially be assigned higher scores on this index than countries, in which these variables exhibit greater variability (crises-prone emerging markets). Secondly, using this technique allows us to assign scores on the financial stress indices to more countries in our sample, because it accepts a more liberal treatment of missing values of constituent variables.[33] Finally, in our judgment, the percentiles transformation method is more transparent and the resultant country scores have more intuitive interpretation.

"Variance-equal weights" method

In the empirical financial crises literature, the most commonly used procedure for combining several variables in an overall sector-wise crisis index is the "variance-equal weights" method, which weights each variable by the inverse of its sample standard deviation (Illing and Liu, 2003, p. 20). Under the assumption of normality of the distributions of individual variables within a country, the weighted variables have equal variances, which prevent one of them from dominating the others in the created index. Existing studies that use the "variance-equal weights" method (e.g., Eichengreen, Rose, and Wyplosz, 1996, p. 31; Kaminsky and Reinhart, 1999, p. 498; etc.) do not discuss in detail its properties and suitability for different types of analyses.

Our own analysis shows that the use of the "variance-equal weights" method is only justified in the rather special cases, for which (by luck or authors' good judgment) it has been used thus far—namely, for constructing intermediate indices, the extreme realizations of which are then used to define binary variables that capture the incidence of crises for a homogenous set

[33] Because the percentiles transformation method assigns equal weights to each variable that depend only on the number of variables that enter the index, it is both possible and logical to redefine the weights, in the presence of missing values, as the reciprocal of the number of variables with valid observations in a given quarter. This is the approach that we use in this paper.

of countries (i.e., emerging markets with fixed exchange rate regimes (Breuer, 2004, p. 295; Illing and Liu, 2003, p. 23)). The severe limitations of the "variance-equal weights" method stem from its very nature. By equating the variances of different variables, it effectively penalizes variables with higher within-country variance, under the assumption that more volatile series are noisier (Sachs, Tornell, Velasco, 1995, p. 159). However, volatility and crises are intimately intertwined (Aizenman and Pinto, 2004). The time-varying nature of financial prices' volatilities (Bollerslev, Chou, and Kroner, 1992; Bera and Higgins, 1993) and their tendency to increase dramatically in the distress and crash phases of crises (Forbes and Rigobon, 2002, p. 2234) mean that the better an indicator is in capturing the incidence and magnitude of different symptoms of financial system disruption, the higher its variance will be. The "variance-equal weights" method, therefore, assigns small weights to variables that best measure financial stress and gives high weights to less-precise indicators. While undesirable on theoretical grounds, this will not compromise the analysis, if all variables are relatively good indicators of financial stress for all analyzed countries (e.g., nominal exchange rate devaluation and loss of foreign exchange reserves in countries with fixed exchange rates), and if the constructed index is used as an intermediate step in defining country-specific dummy variables for the incidence of crises.

Percentiles transformation method

The second weighting scheme for constructing sector-wise indices of financial stress uses the sample cumulative distribution function of each variable across all countries and quarters to transform its values in percentiles. "For a set of measurements arranged in order of magnitude, the p-th percentile is the value that has p percent of the measurements below it and (100-p) percent above it" (SAS Procedures Guide, http://v8doc.sas.com/sashtml/proc/ztatback.htm). The minimum value of variables transformed in percentiles is 0 and the maximum is 99. This technique does not rely on the assumption of normality of the distributions of individual variables. The final sector-wise index of financial stress is obtained by averaging the values of the transformed series for each country in each quarter.

Table 1. Coverage of Financial Stress Indices

	Sector-wise financial stress indices					Overall financial stress indices	
	Banking sector	Stock market	Foreign exchange market	External government debt market	Domestic government debt market	Based on all five sectors/markets	Based on the banking sector, and stock and foreign exchange markets
Algeria	X		X	X	X	X	X
Armenia	X		X		X		X
Bangladesh	X	X	X				X
Barbados	X		X		X		
Brazil	X	X	X	X	X	X	X
Bulgaria	X	X	X	X	X	X	X
Cameroon	X		X				X
Canada	X	X	X	X	X	X	X
Colombia	X	X	X	X			X
Costa Rica	X	X	X				X
Croatia	X	X	X	X			X
Czech Rep.	X	X	X	X	X	X	X
Dominican Rep.	X		X	X			X
Egypt	X	X	X	X	X		X
El Salvador	X		X	X			X
Estonia	X	X	X				X
Finland	X	X	X		X		X
Gabon	X		X				X
Georgia	X		X				
Germany	X	X	X	X	X	X	X
Ghana			X		X		
Guatemala	X		X				X
Honduras	X		X				X
Hong Kong SAR	X	X	X	X	X	X	X
Hungary	X	X	X	X	X	X	X
Iceland	X	X	X		X		X
India	X	X	X				X
Iran, I.R. of	X		X				X
Ireland	X	X	X	X			X
Israel	X	X	X		X		X
Japan	X	X	X	X	X	X	X
Jordan	X	X	X				X
Kazakhstan	X		X		X		
Korea, Rep. of	X	X	X	X			X
Kyrgyz Rep.	X		X		X		X
Latvia	X	X	X		X		X
Lebanon	X	X	X	X			X
Lithuania	X	X	X		X		X
Luxembourg	X	X	X				X
Macedonia, FYR	X	X	X				X
Malta		X	X		X		
Mauritius	X	X	X				X
Mexico	X	X	X	X	X	X	X
Morocco	X	X	X	X			X
Mozambique	X		X				X
New Zealand	X	X	X	X	X	X	X
Nigeria	X	X	X	X	X	X	X

	Sector-wise financial stress indices					Overall financial stress indices	
	Banking sector	Stock market	Foreign exchange market	External government debt market	Domestic government debt market	Based on all five sectors/markets	Based on the banking sector, and stock and foreign exchange markets
Peru	X	X	X	X			X
Philippines	X	X	X	X	X	X	X
Poland	X	X	X	X	X	X	X
Romania	X	X	X		X		X
Russian Federation	X	X	X	X	X	X	X
Senegal	X		X				X
Singapore	X	X	X	X	X	X	X
Slovak Rep.	X	X	X				X
Slovenia	X	X	X		X		X
South Africa	X	X	X	X	X	X	X
Sri Lanka	X	X	X		X		X
Sweden	X	X	X	X	X	X	X
Switzerland	X	X	X		X		X
Tanzania	X		X		X		X
Tunisia	X	X	X	X			X
Uganda	X		X		X		X
Ukraine	X	X	X	X			X
United Arab Emirates	X	X	X				X
United Kingdom	X	X	X	X	X	X	X
Yemen, Rep. of							
Zambia	X	X	X		X		X
Memorandum items							
United States	X	X	X		X	X	X
France	X	X	X	X	X	X	X
Italy	X	X	X	X	X	X	X
Column counts:	68	52	70	33	41	22	65

Notes:
1. "X" indicates the existence of valid observations on the particular index of financial stress for a given country or economy.
2. An empty cell indicates that a particular index could not be estimated due to lack of data.
3. The overall indices of financial stress could have valid observations for a given country or economy, even when some of the indices used in their construction do not, if the weights assigned to these indices are zero.

SECTOR-WISE INDICES OF QUALITY OF FINANCIAL POLICIES

The primary data available from the principle-by-principle BCP and OPSR assessments is a set of categorical variables that show the assessment grade assigned to countries' observance of each of the constituent principles. Extensive analysis of the assessments of the main regulatory standards[34] (IMF, 2001c, 2002a, 2002b) has led to a mapping of their constituent principles in four broad areas of financial policies that are of particular relevance from financial stability viewpoint (the mapping is broadly based on the framework developed by the Joint Forum, 2001; for details see IMF (2004):

- **Regulatory governance,** which refers to the capacity of supervisory agencies to manage resources efficiently and to formulate, implement, and enforce sound regulatory policies and practices. Principles that fall in this grouping address the objectives of regulation; the independence and adequate resources of supervisory agencies; their enforcement powers and capabilities; the clarity and transparency of regulatory process; and external participation.

- **Regulatory practices** refer to the practical application of laws, rules, and procedures by supervisory agencies. Principles that fall in this grouping address issues of group-wide supervision; monitoring and on-site inspection; reporting to supervisors; enforcement, cooperation and information sharing; confidentiality; licensing, ownership transfer, and corporate control; and qualifications.

- **Prudential framework** comprises the rules, directives, and regulatory requirements that lay down the structure to guide financial firms to exercise judgment and caution in their operations. Principles that fall in this grouping deal with risk management; risk concentration; capital requirements; corporate governance; and internal controls.

- **Financial integrity and safety net arrangements** refer to the regulatory policies and instruments designed to promote fairness and integrity in the operations of financial institutions and markets, and the provision of safeguards for depositors, investors and policyholders.

In the construction of indices of quality of financial policies in the banking sector and securities market, we assign equal weights to countries' performance in the four areas of financial policies that are of particular relevance for financial stability.[35] The constituent principles of the two regulatory standards are first grouped under the above four headings (Appendix Table 3). For each regulatory standard, we next calculate the proportion of principles, under each of the four groupings that have been assigned a particular assessment

[34] The Basel Core Principles for Effective Banking Supervision; the IOSCO Objectives and Principles of Securities Regulation; and the IAIS Insurance Core Principles.

[35] We do not create an index of quality of financial policies in the insurance sector, because for this sector we were not able to collect enough information to construct an index of financial stress.

grade, out of the total principles in that grouping that have been found to be applicable and have been assessed. For each IFS regulatory standard and area of financial policies, we then multiply the respective proportions with the following weights: Compliant/Implemented—100; largely compliant/Broadly implemented—66.67; materially noncompliant/Partially implemented—33.33; Noncompliant/Nonimplemented—0, and sum up the resulting terms. Countries' final scores on the sector-wise indices of quality of financial policies are then obtained by taking simple averages of the respective four scores obtained in the preceding step.

Table 2. Coverage of BCP and IOSCO Standards in Economies with Completed FSAPs (as of end of June 2004)

	Basel core principles for effective banking supervision [1/]	IOSCO objectives and principles of securities regulation
Algeria	X	
Armenia	X	X
Bangladesh	X	X
Barbados	X	X
Brazil	X	X
Bulgaria	X	X
Cameroon	X	
Canada		
Colombia	X	
Costa Rica	X	
Croatia	X	X
Czech Rep.	X	X
Dominican Rep.	X	
Egypt	X	X
El Salvador	X	
Estonia	X	X
Finland	X	X
Gabon	X	
Georgia	X	X
Germany	X	X
Ghana	X	X
Guatemala	X	
Honduras	X	
Hong Kong SAR	X	X
Hungary	X	X
Iceland	X	X
India	X	X
Iran, I.R. of	X	
Ireland	X	X
Israel	X	X
Japan	X	X
Jordan	X	X
Kazakhstan	X	X
Korea, Rep. of	X	X
Kyrgyz Rep.	X	
Latvia	X	X

	Basel core principles for effective banking supervision [1/]	IOSCO objectives and principles of securities regulation
Lebanon	X	
Lithuania	X	X
Luxembourg	X	X
Macedonia, FYR	X	
Malta	X	X
Mauritius	X	
Mexico	X	X
Morocco	X	X
Mozambique	X	
New Zealand	X	X
Nigeria	X	X
Peru	X	
Philippines	X	X
Poland	X	X
Romania	X	X
Russia	X	X
Senegal		X
Singapore	X	X
Slovak Rep.	X	X
Slovenia	X	X
South Africa	X	X
Sri Lanka	X	X
Sweden	X	X
Switzerland	X	X
Tanzania	X	
Tunisia	X	X
Uganda	X	
Ukraine	X	X
United Arab Emirates	X	
United Kingdom	X	X
Yemen, Rep. of	X	
Zambia	X	
Memorandum item		
Column counts:		
68	66	46

Source: IMF internal databases.

[1/] Excluding assessments conducted prior to the development of the assessment methodology by the Basel Committee on Banking Supervision.

[2/] Excluding qualitative assessments that do not assign assessment grades to individual principles.

Table 3. Groupings of Principles of Main Regulatory IFS Standards by Areas of Financial Policies of Particular Relevance for Financial Stability

Areas of financial policies / financial system's sectors	Banking sector	Securities markets
I. Regulatory governance	BCP Principle 1(1)	OPSR Principle 1
	BCP Principle 1(2)	OPSR Principle 2
	BCP Principle 1(3)	OPSR Principle 3
	BCP Principle 1(4)	OPSR Principle 4
	BCP Principle 1(5)	OPSR Principle 5
	BCP Principle 1(6)	OPSR Principle 6
	BCP Principle 19	OPSR Principle 7
II. Prudential framework	BCP Principle 2	OPSR Principle 8
	BCP Principle 3	OPSR Principle 9
	BCP Principle 4	OPSR Principle 10
	BCP Principle 6	OPSR Principle 11
	BCP Principle 16	OPSR Principle 12
	BCP Principle 17	OPSR Principle 13
	BCP Principle 18	OPSR Principle 29
	BCP Principle 20	
	BCP Principle 22	
	BCP Principle 23	
	BCP Principle 24	
	BCP Principle 25	
III. Regulatory practices	BCP Principle 5	OPSR Principle 17
	BCP Principle 6	OPSR Principle 18
	BCP Principle 7	OPSR Principle 20
	BCP Principle 8	OPSR Principle 21
	BCP Principle 9	OPSR Principle 22
	BCP Principle 10	OPSR Principle 23
	BCP Principle 11	OPSR Principle 25
	BCP Principle 12	OPSR Principle 27
	BCP Principle 13	
	BCP Principle 14	
IV. Financial integrity and safety nets	BCP Principle 15	OPSR Principle 14
	BCP Principle 21	OPSR Principle 15
		OPSR Principle 16
		OPSR Principle 19
		OPSR Principle 24
		OPSR Principle 26
		OPSR Principle 28
		OPSR Principle 30

Source: IMF.

BCP—Basel Core Principles for Effective Banking Supervision;
OPSR—IOSCO Objectives and Principles of Securities Regulation.

MEASURES OF CONTAGION

All contagion measures are constructed in the spirit of the Eichengreen, Rose, and Wyplosz (1996) analysis of contagious currency crises. The value of each contagion measure for a country (X) in a given year is calculated as the product of the appropriate sector-wise index of financial stress in another country (Y, chosen on the basis of some criteria) multiplied by the importance for country X of the trade or financial links with country Y. Because, typically the initial spill-over of financial stress occurs between segments of the foreign and domestic financial systems of the same type (e.g., equity markets, etc.), we weight each contagion measure by the relative importance of the financial system segment, through which stress spills over, in the financial systems of our sample countries.

Foreign exchange market

Contagion via the trade channel affects primarily the foreign exchange market. To construct measures for the two types of contagion via trade, we first identify the top three trading partners of each country in our sample, using the country weights, applied by the IMF, in the estimation of real multilateral effective exchange rates.[36] We next establish that Germany is the country that is one of the top three trading partners for the largest number of countries (54) in our sample. The two measures of contagion via trade are then constructed as follows:

- The maximum quarterly realization of the index of financial stress in the foreign exchange market in the top trading partner of each country in our sample, multiplied by the trading partner's weight in the total external trade of the sample country. The result is multiplied by the relative share of the foreign exchange market in the financial systems of our sample countries.

- *For all sample countries that have Germany as one of their three top trading partners*: The maximum quarterly realization of the index of financial stress in the foreign exchange markets of all countries that have Germany as one of their three top trading partners, multiplied by the weight of Germany in the total external trade of each of these countries (the value of the contagion measure is set to "0" in the country, where the maximum realization of stress occurred). The result is multiplied by the relative share of the foreign exchange market in the financial systems of our sample countries. *For all other countries in the sample*: the value of the contagion measure is set to "0."

[36] The IMF's methodology derives the weight for "j" in country "i's" effective exchange rate as a convex combination of bilateral import weights and double export weights, using trade in manufacturing…. The weights are time-invariant." (Eichengreen, Rose, and Wyplosz (1996, p. 30).

Banking sector

To construct the measures of contagion via international bank lending, we first identify the number one international lender of bank funds of each country in our sample. We use BIS (2004) data to calculate the average shares over 1993–2003 of each of the 24 BIS reporting countries in the consolidated international claims on each country in our sample, and determine the three BIS reporting countries with the highest shares. We next establish that France is the country that is one of the top three international bank lenders for the largest number of countries (40) in our sample. The two measures of contagion via international bank lending are then constructed as follows:

- The maximum quarterly realization of the index of financial stress in the banking sector in the top international bank lender of each country in our sample, multiplied by the international bank lender's weight in the consolidated international claims on each country in our sample. The result is multiplied by the relative share of the banking sector in the financial systems of our sample countries.

- *For all sample countries that have France as one of their three top international bank lenders*: The maximum quarterly realization of the index of financial stress in the banking sectors of all countries that have France as one of their three top international bank lenders, multiplied by the weight of France in the consolidated international claims on each of these countries (the value of the contagion measure is set to "0" in the country, where the maximum realization of stress occurred). *For all other countries in the sample*: the value of the contagion measure is set to "0." The result is multiplied by the relative share of the banking sector in the financial systems of our sample countries.

Stock market

In the case of the stock market, we focus on sample countries' inclusion in the MSCI Emerging Markets Index:[37]

- *For all sample countries members of the MSCI Emerging Markets Index*: The maximum quarterly realization of the index of financial stress in the stock markets of all countries members of the MSCI Emerging Markets Index, multiplied by the weight of each sample country in that index (the value of the contagion measure is set to "0" in the country, where the maximum realization of stress occurred). *For all other countries in the sample*: the value of the contagion measure is set to "0." The

[37] The following countries in our sample are constituents of the MSCI Emerging Markets Index (www.msci.com/licensing/em_factsheet.pdf): Brazil, Colombia, Czech Republic, Egypt, Hungary, India, Israel, Jordan, Korea, Mexico, Morocco, Peru, Philippines, Poland, Russian Federation, and South Africa.

result is multiplied by the relative share of the equity market in the financial systems of our sample countries.

External government debt market

In the case of the external government debt market, we focus on sample countries' inclusion in the J.P. Morgan Emerging Markets Bond Index:[38]

- *For all sample countries members of the J.P. Morgan Emerging Markets Bond Index*: The maximum quarterly realization of the index of financial stress in the external government debt markets of all countries members of the J.P. Morgan Emerging Markets Bond Index, multiplied by the weight of each sample country in that index (the value of the contagion measure is set to "0" in the country, where the maximum realization of stress occurred). The result is multiplied by the relative share of the foreign exchange market in the financial systems of our sample countries. The weight is not the relative share of the external government debt market, because our index of financial stress does not cover this segment of the financial system. On the other hand, stress in the external government debt market, more often than not, results in heightened stress in the foreign currency market. *For all other countries in the sample*: the value of the contagion measure is set to "0."

[38] The following countries in our sample are constituents of the J.P. Morgan Emerging Markets Bond Index: Algeria, Brazil, Bulgaria, Colombia, Croatia, Dominican Republic, Egypt, El Salvador, Hungary, Korea, Lebanon, Mexico, Morocco, Nigeria, Peru, Philippines, Poland, Russian Federation, South Africa, Tunisia, and Ukraine.

MACROECONOMIC FUNDAMENTALS

The definition and selection of macroeconomic fundamentals follow the consensus in the empirical literature on financial crises (Kaminsky and Reinhart, 1999; Eichengreen and Arteta, 2000):

- Log of real PPP GDP per capita, measured in constant 1995 international U.S. dollars (annual frequency). Source: World Bank's World Development Indicators.

- Average value of inflation, measured at quarterly frequency in percent. Inflation at quarterly frequency estimated as the annualized growth rate of quarterly CPI in percent. Source: IMF's *International Financial Statistics*.

- Index of terms of trade in goods and services (1995=100, annual frequency). Unit value of exports as a ratio of the unit value of imports. Source: Unpublished IMF data, derived from IMF's *International Financial Statistics*.

- General government balance as percent of GDP (annual frequency). Source: Unpublished IMF data, derived from IMF's *International Financial Statistics*.

- Gross fixed capital formation as percent of GDP (annual frequency). Source: Unpublished IMF data, derived from IMF's *International Financial Statistics*.

- Ratio of broad money (converted in U.S. dollars) to international reserves net of gold in USD (annual averages of quarterly data). Source: IMF's I*nternational Financial Statistics*.

- Imports of goods and services plus exports of goods and services as percent of GDP (annual frequency). Source: Unpublished IMF data, derived from IMF's *International Financial Statistics*.

- Number of capital account restrictions in place as percent of the total number of capital account restrictions[39] judged to be applicable for a given country (annual frequency). Source: IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*.

- Dummy variables for countries' exchange rate regimes (annual frequency). Source: IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*:

[39] Capital account restrictions on: (1) restrictions on transactions with capital market securities; (2) restrictions on transactions with money market instruments; (3) restrictions on transactions with collective investment securities; (4) controls on derivatives and other instruments; (5) restrictions on commercial credits; (6) restrictions on financial credits; (7) restrictions on guarantees, sureties, and financial backup facilities; (8) controls on direct investment; (9) controls on liquidation of direct investment; (10) controls on real estate transactions; and (11) controls on personal capital transactions.

  - Fixed exchange rate regime—countries with the following exchange rate arrangements—exchange arrangements with no separate legal tender; currency board arrangements; and conventional pegs.

  - Crawling peg exchange rate regime—countries with the following exchange rate arrangements—pegs within horizontal bands; crawling pegs; crawling bands.

  - Floating exchange rate regime—countries with the following exchange rate arrangements—managed floating and independently floating.

- Dummy for explicit deposit insurance scheme in 1999. Source: Demirguc-Kunt and Sobaci, 2000.