Journal of Banking and Financial Economics

No 1(11)2019

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Aims and Scope

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Financial Deepening in Mexico

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ABSTRACT

International comparisons reveal that – even controlling for a host of explanatory factors – credit depth is exceptionally low in Mexico. Using panel data methods linking credit growth and fundamentals, this paper estimates a long-term gap between actual and expected credit of about 40 percent of GDP. Possible explanations include the history of banking crises, the large informal sector and an inefficient legal system. Using a disequilibrium regression approach, this paper also finds that supply factors are particularly important as determinants of credit in Mexico. Recent financial reforms address many of the supply constraints, but their success will depend on implementation. The main challenge going forward will be to support financial deepening, while limiting risks to financial stability.

JEL Classification: G18; G21; O16.

Keywords: Mexico; credit gap; credit growth; financial development.

1. INTRODUCTION

The Mexican economy has been marked by low growth by emerging market standards over the last decades. Following the improvements in macroeconomic frameworks and the recent structural reforms, it is important to ensure that there are no other factors holding back the expected improvement in growth rates. One of the potentially important conditions for economic growth is the availability of financial intermediation, as recent studies (e.g., Sahay and others (2015) and papers quoted therein) have shown a positive growth impact from financial development. The economic benefits of deepening financial integration need to be weighed against the risks to financial stability. Excessive credit growth can lead to financial risks and has been shown to be one of the most robust predictors of banking and currency crises (the other predictor being real appreciation, see Gourinchas and Obstfeld (2012)). This is particularly important in an environment of rising interest rates. This would immediately affect the affordability of variable interest rate loans, but ultimately also the cost of rolling over fixed-term debt, and it could entail

risks for financial institutions with maturity mismatches. The question of whether credit and its growth are too low or too high is therefore of great policy relevance.

This paper aims to analyze the depth of financial intermediation in Mexico. The starting hypothesis is that credit depth is exceptionally low. This hypothesis is tested both descriptively, by comparing to other countries, and more formally, in regressions that control potential explanatory factors. In assessing such credit gap, the main interest is in the structural long-term gap, but empirically it can be difficult to disentangle this from the cyclical credit gap, which we also briefly look into. Having confirmed the presence of a structural credit gap, the paper then uses empirical methods to ascertain whether credit growth is mostly demand or supply driven in Mexico. On this we have an open mind, as one could think of both demand and supply factors that hold down credit growth in Mexico, notably the history of financial crises is likely have affected both borrowers and lenders. The contribution of this paper is to show that credit depth in Mexico is indeed very low, even controlling for typical explanatory factors. We show that this is mostly supply driven, and discuss the expected impact of recent financial reforms.

The paper is structured as follows: Section 2 provides a descriptive analysis of credit in Mexico, both in terms of its components and its recipients, documenting the low level of credit depth by international comparison, and the role of the private sector. Section 3 assesses more formally the size of the credit gap in Mexico, using both a short-term approach, looking at deviations from trend credit growth, and a long-term approach, comparing credit depth in Mexico and other economies, controlling for macroeconomic and structural fundamentals between 1990 and 2014. Section 4 discusses possible reasons for the low level of financial intermediation, including through a disequilibrium regression analysis, exploiting higher frequency data between January 2007 and February 2015 to see whether credit growth is supply or demand driven. Section 5 discusses recent policy developments and the likely time frame of and obstacles to financial deepening. Section 6 concludes.

2. DESCRIPTIVE ANALYSIS OF CREDIT IN MEXICO

Credit depth is very low in Mexico, not only in comparison to advanced economies, but also emerging markets. Bank credit is about a quarter of the level observed in other emerging markets, including Brazil, and it is just 1/6th of advanced economy average (Figure 1). While this paper focuses on bank credit, even total credit is comparatively low, so including other sources of credit should not change this broad finding. One caveat is that informal credit may play an important role, given the large size of Mexico's informal sector.
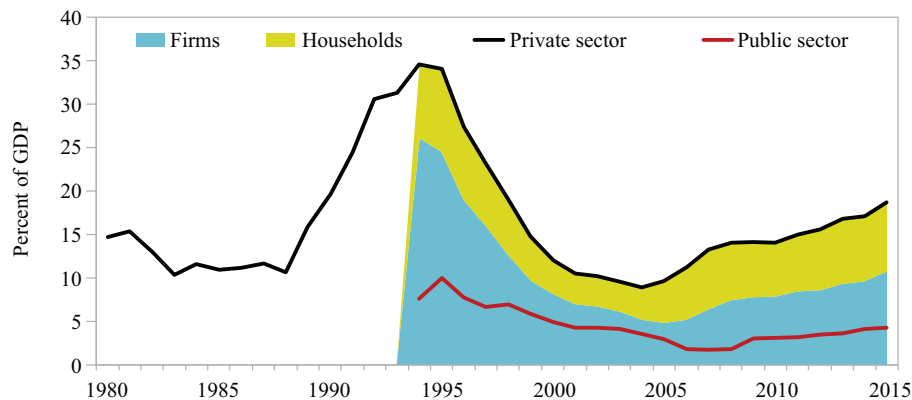
Figure 1.
Credit to the Nonfinancial Private Sector, 2015
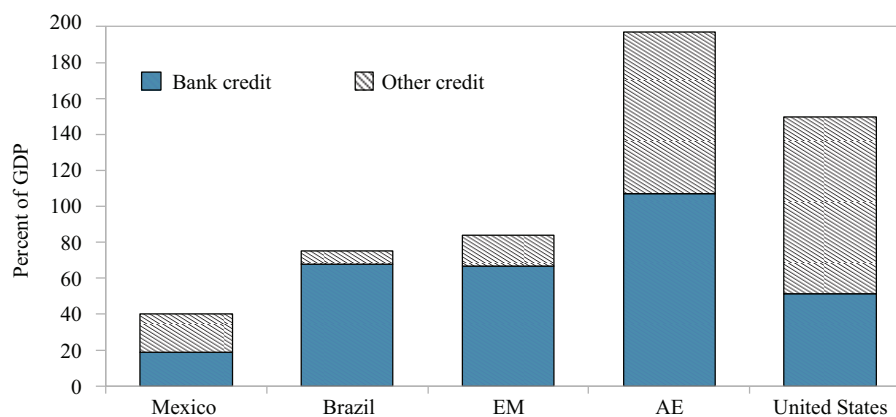
Sources: BIS and Banxico.

The low degree of financial intermediation has been a feature of the Mexican economy for the last two decades and – apart from a short-lived boom in the early nineties – many years before. In particular, credit to firms has been low, which is worrying, as empirically this part of credit is particularly important for growth (Angeles, 2015). Given prudent macroeconomic policies, this is not caused by financial repression. Indeed, bank credit to the public sector is also quite low and while there may be some crowding out of other lending, it is unlikely to be a sufficient explanation (Figure 2).

Figure 2.
Recipients of Banking System Credit

Sources: BIS and Banxico.

Summary measures of overall financial sector development are negatively affected by the low level of credit depth (Figure 3). Mexico has fallen behind the LA5 (the other financially integrated economies in Latin America: Brazil, Chile, Colombia, Peru, and Uruguay), although still remains above the overall LAC (Latin America and Caribbean) average. An analysis of the components of the financial development index[2] reveals that Mexico's market development is quite strong, but the institutions lag behind the LA5. Among the institutional components, access and depth are weak, with the low value for depth driven by the low credit figures, and also low deposits and a small stock of insurance and mutual fund assets. The low value for access is the result of a comparatively small network of branches, and to a lesser extent a comparative scarcity of ATMs.

Figure 3.
Financial Development in Mexico and Latin America
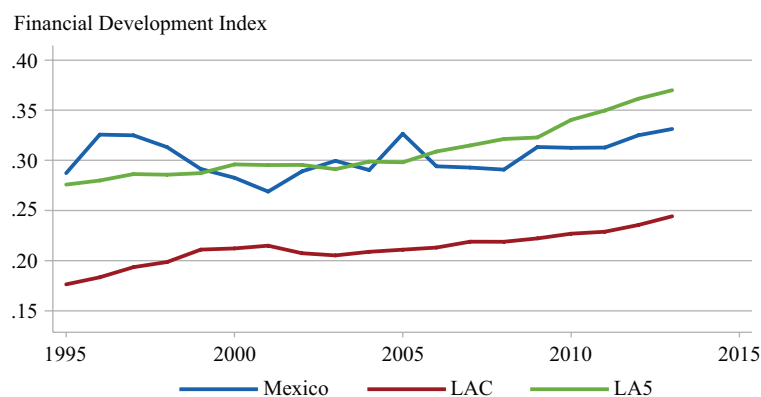
Note: LAC = Average of Latin American and Caribbean economies other than Mexico; LA5 = Brazil, Chile, Colombia, Peru, and Uruguay.

Sources: Heng and others (2015) and authors' calculations.

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[2]   The financial development index was developed in Sahay and others (2015). It covers markets and institutions, and looks in each of them for variables that proxy for access, depth, and efficiency. The data used here are from the October 2015 Western Hemisphere REO (Heng and others, 2015) which calculates this index for Latin American economies.

Financial deepening does not necessarily imply financial inclusion, and access to credit remains indeed difficult for some individuals and businesses. According to the World Bank Financial Inclusion Database, 51 percent of adults borrowed some money in 2014, but only 10 percent (up from 8 percent in 2011) used a formal financial institution. According to the 2010 World Bank enterprise survey, access to credit by small and medium-sized firms is low by international standards: only 27 percent of small firms had access to credit, compared to 38 percent on average in Latin America and 29 percent worldwide. Among medium-sized firms, 27 percent had access, compared to 56 percent on average in Latin America, and 43 percent worldwide. CNBV data show that the amount of credit has been growing for most categories. However, the number of businesses obtaining loans has stagnated in the case of medium-sized firms and recently even fallen in the case of microenterprises (Figure 4). According to the World Bank's Doing Business Indicators, however, Mexico fares relatively well in terms of ease of getting credit, with a rank of 12, and a distance to frontier of 20 percentage points (down from 25 percentage points in 2014) in 2015. The subcomponent of the strength of legal rights was however a weak point (at 8 out of 12 points).

Figure 4.
Mexico: Bank Loans to Enterprises
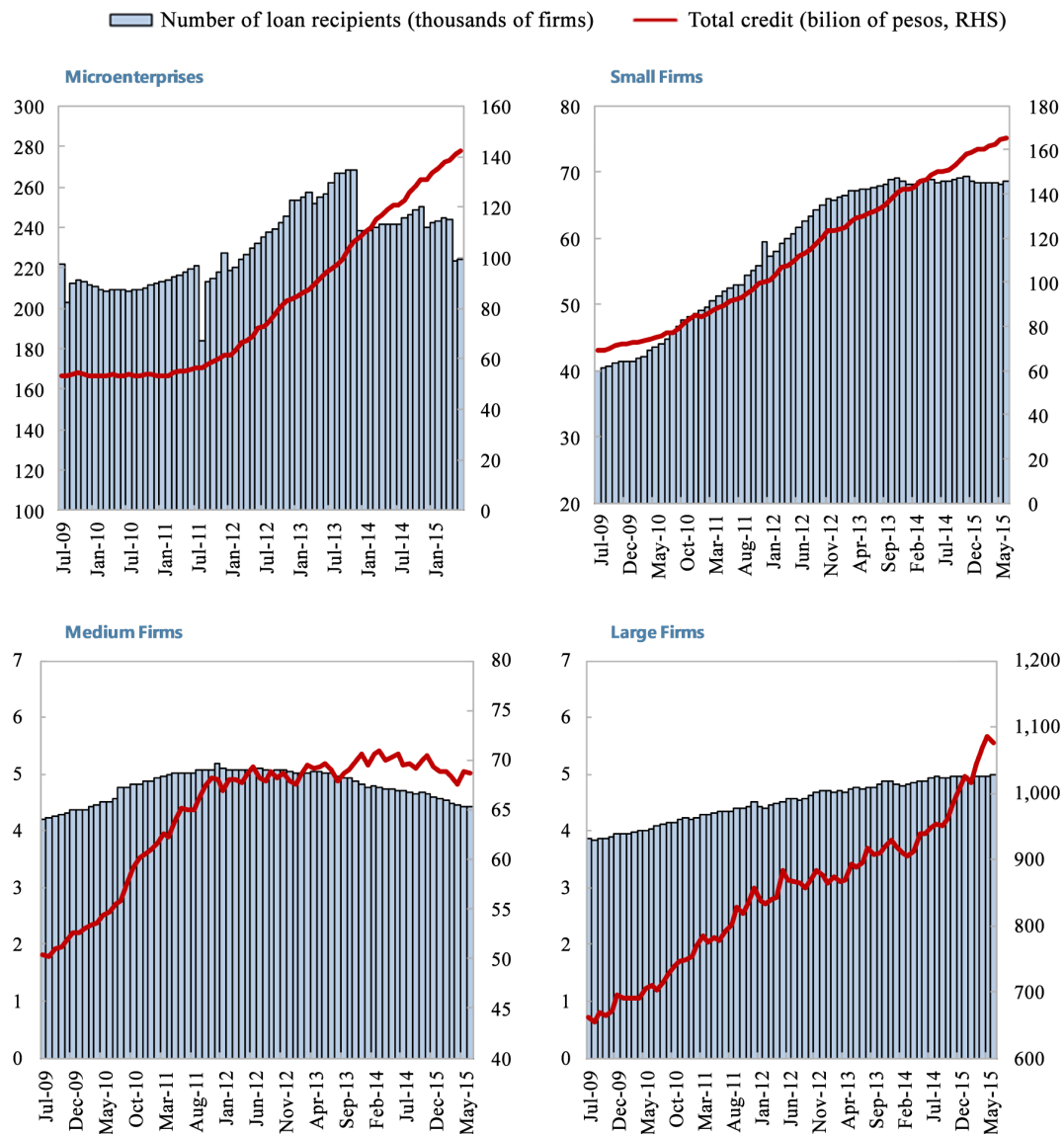
Source: CNBV.

3. CREDIT DEPTH IN MEXICO

3.1. Credit cycles

Before tackling the estimation of long-term credit gaps, we briefly review estimates of the cyclical credit gap, which is small in Mexico (Figure 5). This means that credit is currently growing close to its trend rate. However, if there is a structural change in trend credit growth, then estimates based on an HP-filter are hard to interpret. Credit cycles also appear to lag output cycles, a finding which has also been confirmed in a dedicated empirical study (Banco de Mexico (2010), Box 3).

Figure 5.
Credit and Output Gaps
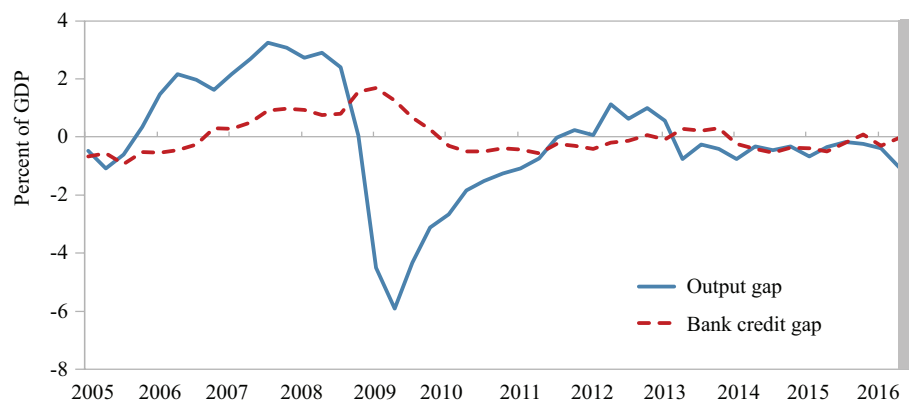
Sources: National authorities; and authors' calculations.

Empirical evidence suggests that credit and real cycles are synchronized, but not very strongly. Indeed, credit cycles have been shorter and more volatile on average[3] between 1980 and 2014 (Table 1).

Table 1.
Mexico: Synchronization of Credit and Real Cycles

	Number of cycles (1980–2014)	Average cycle duration (in years)	Amplitude	Synchronization Ratio with GDP
GDP	8	4.4	0.3	1.00
Total credit	12	2.9	0.8	0.54
Commercial bank credit	10	3.5	1.0	0.56
Other credit	13	2.7	0.9	0.49

Note: Amplitude is defined as the standard deviation divided by the mean of a series. Synchronization ratio is the ratio of number of observations where GDP and credit are in the same phase divided by total observations.

Source: Authors' calculations.

Cyclical analysis cannot reveal structural credit gaps. While there does not appear to be a short-term credit gap in Mexico, international comparative data are needed to assess the structural level of financial intermediation. Moreover, if Mexico is in a process of increasing credit depth, then estimated trend growth may be affected by a structural increase lasting many years.

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[3] The findings on the length of financial cycle are broadly comparable to results from other countries, see Claessens (2011).

3.2. Credit depth in international comparison

Regressions linking credit growth and fundamentals using international panel data allow the estimation of expected credit levels in Mexico. Specifically, we estimate a random-effects regression linking credit depth to fundamentals using annual data from advanced and emerging markets between 1990 and 2014. The specification follows closely Cottarelli and others (2005):

$$\frac{\text{BCPS}}{\text{GDP}} = X\beta + u_i + \varepsilon_{it} \tag{1}$$

where BCPS stands for bank credit to the private sector, u_i is a random effect and ε_{it} an error term. X contains explanatory variables, which are: public debt as a share of GDP, logged per capita GDP, inflation,[4] capital account openness (Chinn and Ito (2006), updated data through 2014), bank regulation indicators,[5] a dummy for German legal origin (as proxy for greater creditor protection), and a time trend.

This regression is estimated both on a panel of advanced and emerging markets and a panel of only emerging markets, in both cases excluding Mexico.[6] The regression results are broadly in line with expectations (Table 2). Regressions (1) and (2) show the basic results for the full and emerging market samples. In both samples, an increase in public debt is associated with less credit to the private sector, suggesting some crowding out. Rising incomes are associated with greater credit depth, although the effect is only statistically significant in emerging market sample. Inflation is mostly insignificant. Great capital account openness is associated with deeper credit. Structural variables on banking regulation and the legal background turn out insignificant. In the full sample, there is also a positive time trend, revealing the worldwide increase of credit over the last decades. Given Mexico's low levels of credit depth relative to other economies, we expect the model to suggest a higher level of bank credit to GDP in Mexico than actually observed.

Having estimated the coefficients, they are then used to predict the expected level of credit depth in Mexico, given its fundamentals. Based on estimates from the full sample, including advanced economies, credit would be expected to reach almost 100 percent of GDP given Mexican fundamentals (Figure 6). Based on estimates from the sample of emerging markets only, bank credit would be expected to reach 60 percent of GDP. This implies a structural long-term bank credit gap between 40 and 80 percent of GDP, given the current credit levels of around 20 percent of GDP.

To allow for the impact of bank crises, a variable containing the number of years the banking system was in crisis (using data from Laeven and Valencia (2012)) in each country is added (Regression (3) in Table 2). With this approach, Mexican credit depth appears to be in line with expectations during the crisis years. After the year 2000, however, when macroeconomic policy stabilized, credit would have been expected to be much higher. In recent years, the resulting gap is the virtually the same as in the specification without a crisis variable. As these are estimates of the long-term gap, it does not mean that following the crisis credit would be expected to jump up, but rather that the expected level that should be reached over the medium term is much higher in the absence of a crisis.

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[4]   Just like Cottarelli and others (2005), we follow Kahn and others (2001) and model inflation using a non-linear threshold specification, by adding an inflation variable that is defined as (1/inflation – 1/threshold), which is then interacted with the threshold of 4 percent.

[5]   The two variables used are an index of entry into banking requirements from and the quality of bank accounting, both at the level of 1999. As the indexes do not change much over time adding value for later surveys (available for 2003, 2007, and 2011) did not affect results. Data are from the World Bank: Bank Regulation and Supervision, updated 2012.

[6]   The emerging market sample includes, apart from Mexico: Brazil, China, Hungary, India, Indonesia, Malaysia, Poland, Russia, Saudi Arabia, South Africa, Thailand, and Turkey. The full sample, additionally includes: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Netherlands, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

Table 2.
Regressions of Bank Credit on Fundamentals

	(1)	(2)	(3)
	Full sample	EM sample	
Public debt/GDP	-0.15*	-0.14**	-0.55**
	(0.08)	(0.06)	(0.27)
ln(GDP/population)	-0.20	20.11***	8.32
	(7.27)	(7.34)	(12.05)
Inflation variable, inflation <=4 percent	0.11***	0.64	5.69
	(0.02)	(0.78)	(4.95)
Inflation variable, inflation >4 percent	-48.09	5.64	428.42***
	(37.75)	(33.37)	(104.84)
Capital account openness	5.67**	3.70**	-4.22
	(2.61)	(1.82)	(3.22)
Entry into banking requirements	0.96	-28.58	-0.10
	(3.39)	(26.78)	(19.23)
Bank accounting quality	11.95	8.88	5.43
	(9.62)	(27.35)	(13.90)
German legal origin dummy	12.68	-15.92	-9.70
	(15.03)	(27.29)	(21.21)
Bank crisis dummy			-2.75
			(3.65)
Trend	1.71***	0.10	-1.86*
	(0.41)	(0.51)	(0.96)
Constant	8.64	54.91	47.71
	(56.68)	(135.75)	(123.32)
Observations	784	268	193
Number of countries	34	12	10
R-squared, overall	15.7	0.8	53.0

Random effect estimation on all countries other than Mexico. Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' calculations.

Figure 6.
Bank Credit to the Private Sector
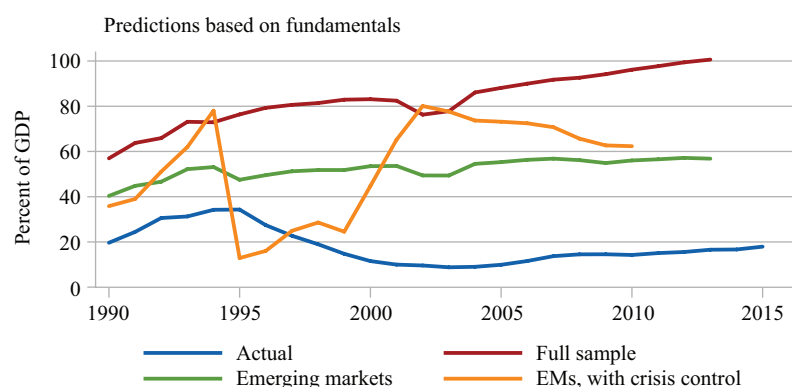
Source: Authors' calculations.

4. REASONS FOR THE LOW LEVEL OF FINANCIAL INTERMEDIATION

4.1. History of banking crises

The Mexican banking sector has had a tumultuous history, with two major banking crises since 1980. During the debt crisis of 1982, Mexican banks were nationalized and reduced in numbers through mergers. They faced tight regulations, such as interest rate caps and credit allocation regulations, which limited possibilities for credit growth. In the early 1990s the sector was liberalized, banks were privatized again, and new banks also entered the market. Credit supply boomed, but lending standards were low, possibly because of lack of experience after the years of state-owned banking. There were also weaknesses in financial supervision, for example banks circumvented the not open foreign currency exposure limit of 15 percent of capital by using derivatives. The currency crisis of 1994 then had a greater than expected impact on banks, both through international funding difficulties, and because of rising NPLs, resulting from the economic crisis, and specifically from the widespread use of variable rate mortgages, which were affected by the interest rate rises. A major rescue program, partly financed by the IMF and the U.S., was put in place addressing (i) the short-term funding needs of banks that lost access to international markets and (ii) recapitalization needs, both through capital injections via convertible debt and the purchase of NPLs above market value. For some banks these programs were insufficient and the government needed to intervene and take them over. Additionally, various programs were set up to support debtors, especially for mortgages.[7] Overall, estimates of the cost of financial sector support are about 15 percent of GDP (see, for example, McQuerry (1999)).

The history of banking crisis is likely to have had lasting effects. Trust in financial institutions was eroded, both for savers who lost deposits in the crisis of the 1980s and for borrowers, who faced difficulties due to rising interest rates in the 1990s. Moreover, banking know-how was lost, because following the nationalization of banks, a tightly regulated system required very different skills from commercial banking and offered lower rewards. While these effects are likely to have largely faded, the legacy of a years of slow credit and deposit growth still affects today's stocks, even though growth is now at a healthy pace.

4.2. Structure of the banking sector

Lack of competition in the banking sector may play a role, but does not seem to be a major impediment. Claessens and Laeven (2004) show that already between 1994 and 2001, banking competition as measured by the H-statistic[8] was relatively high in Mexico compared to other economies. We also estimate an updated H-statistic, which shows a slow, improvement in competition over time (Figure 7). The Herfindahl concentration index[9] stands at 0.13, indicating that the commercial banking sector is moderately concentrated. Recent developments in lending and deposit rates also suggest that competition may be intensifying as spreads are coming down, particularly for micro enterprises (Figure 8).

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[7]   This paragraph draws heavily on Graf (1999), which contains further details on the post 1994 banking crisis.

[8]   The H-statistic is a measure of industry competitiveness, where one equals perfect competition, and is calculated by estimating the change in a bank's marginal costs given its equilibrium total revenues.

[9]   This is defined as $\Sigma_{i=1}^{n}a_i^2$, where a_i corresponds to a bank's market shares based on total gross credit provision.

Figure 7.
Competition in the Banking Sector
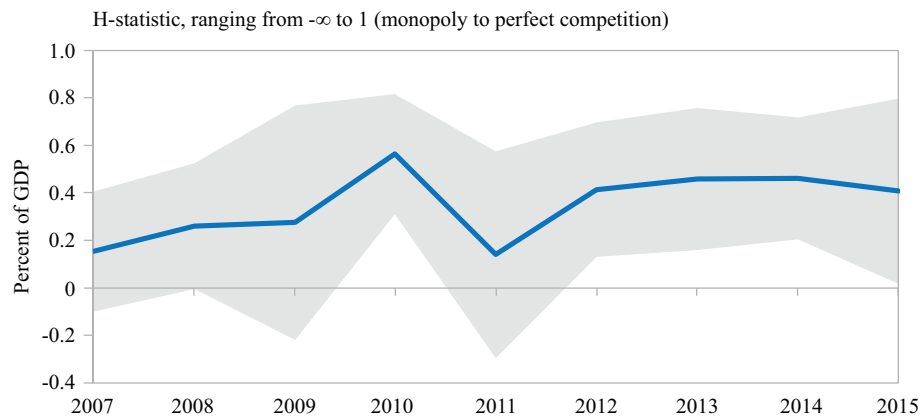
Source: Authors' calculations.

Figure 8.
Marginal lending rates to enterprises
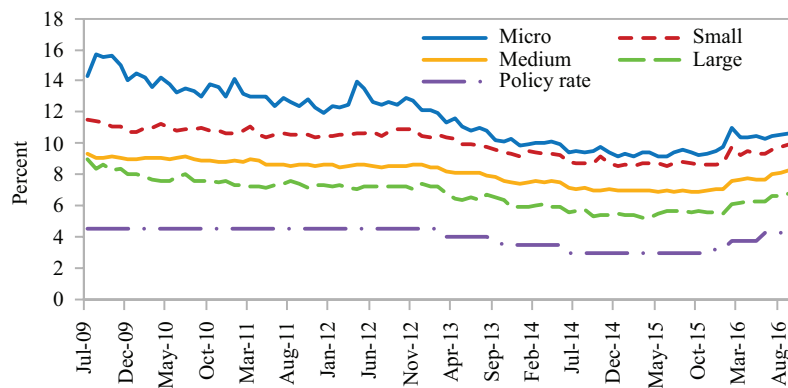
Source: CNBV and Bank of Mexico.

Regressions using a disequilibrium approach allow for distinguishing between supply and demand factors in determining credit growth. Following Everaert and others (2015)[10] we use a disequilibrium approach to estimate credit demand and supply separately, using monthly data between January 2007 and February 2015. Thus, actual credit is estimated to be the minimum of both:

$$C^D = \beta_1'X_1 + \varepsilon^D \qquad (2)$$

$$C^S = \beta_2'X2 + \varepsilon^S \qquad (3)$$

$$C = min(C^D, C^S) \qquad (4)$$

where C is new credit to firms measured in real monthly terms, superscripts S and D indicate supply and demand, and X_1 and X_2 are two sets of explanatory variables. Both include the real lending rate as the price of credit. Moreover, demand equation contains the NPL ratio as a measure of debt overhang, consumer confidence as a measure of economic conditions, and the growth of the stock market as a measure of alternative funding sources. The supply equation includes also

[10]   Based on a methodology originally proposed by Laffont and Garcia (1977).

the NPL ratio as measure of debt overhang, the deposit rate as a measure of funding costs, and banking system capital as a share of the minimum capital requirement as a measure of capacity to lend. This set of related equations is estimated using a maximum likelihood method developed by Maddala and Nelson (1974). Here, we take an agnostic approach in hypothesizing whether credit was supply or demand driven; since a number of factors may drive both demand and supply, as laid out in Everaert and others (2015), presupposing the role of demand and supply is difficult.

An analysis of supply and demand for credit suggests that in recent years, credit was mostly supply driven (Figure 9). Since 2008, credit supply has been insufficient to meet de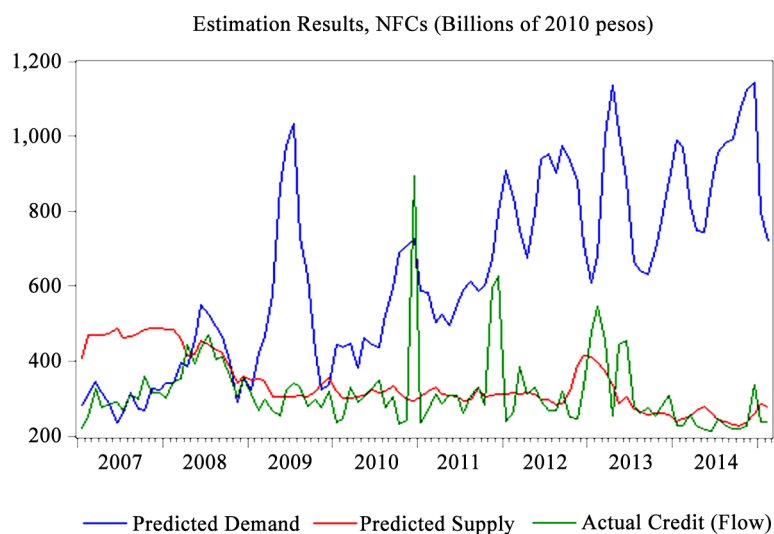mand by about MXN (of 2010) 300 billion in recent months. While the estimated figures for the gap between demand and supply are quite sensitive to the explanatory variables used, the general finding of supply-driven credit flows remains robust over many possible choices.

Figure 9.
Predicted Credit Demand and Supply

Estimation Results, NFCs (Billions of 2010 pesos)

Source: Authors' estimates.

To approach the behavior of banks from yet another angle, we also run regressions relating bank credit to deposits reveal the long-run relationship between both. Similar to Hansen and Sulla (2013), the long-run relationship between bank credit and deposits is estimated using a pooled mean regression:

$$\frac{\text{BCPS}}{\text{GDP}} = \alpha + \beta\frac{\text{Deposits}}{\text{GDP}} + u_i + \varepsilon_{it} \tag{5}$$

As in equation (1), the coefficient was estimated using international panel data on countries other than Mexico.[11] Then, predicted bank credit ratios are estimated using Mexico's deposit ratio. Credit and deposits are both low, but the long-run relationship between them is in line with other emerging markets. Given the level of deposits, credit provision is close to what would be expected based on coefficients from other emerging markets (Figure 10). With coefficients estimated on the full sample, however, credit is below expectations, although to a much smaller extent than in the regressions based on fundamentals. These results suggest that the issue is not one of an inability of turning deposits into loans, but rather an overall lack of financial depth, both in terms of loans and deposits.

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[11]   The estimated regression coefficients were: $\hat{\alpha} = 12.1$ (14.4), $\hat{\beta} = 1.1$ (0.2) for the full sample and $\hat{\alpha} = -19.3$ (20.3), $\hat{\beta} = 1.5$ (0.5) for the emerging market sample.

Figure 10.
Bank Credit to the Private Sector, pooled mean regression

Predictions based on deposits
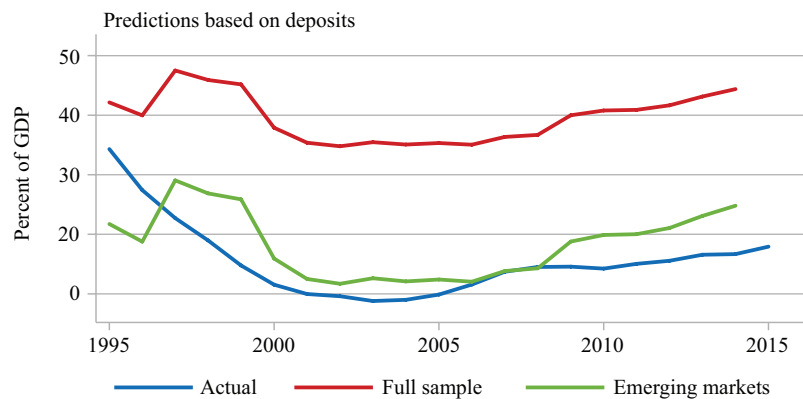
Source: Authors' calculations.

4.3. Issues beyond the banking sector

Financial education may still be lacking in some sectors of the economy and some regions of the country. More generally, Campero and Kaiser (2013) have shown that households with greater levels of schooling are more likely to be aware of credit sources (formal and informal) and that regions with greater average schooling levels are marked by greater use of formal credit.

The large informal sector may impede access to financial services. Participants in the informal sector find it harder to document their financial situation, given the absence of tax returns. They may also prefer to deal in cash to avoid leaving traces in the financial system.[12] Campero and Kaiser (2013) show empirically for Mexico that households employed in the formal sector are 5.7 times more likely to use bank credit than those in the informal sector.

The application of the rule of law remains subject to difficulties. Repossession of collateral, in particular, is difficult and costly to enforce.

5. CURRENT TRENDS AND POLICIES

Measures taken in response to the 1994 foreign currency crisis, as well as more recent reforms can be expected to increase trust in the banking system. The Bank of Mexico tightened the regulation on net open foreign currency positions following the 1994 crisis to close the loophole that allowed banks circumventing it by using derivatives or off-balance sheet positions. Financial regulation has been strengthened over the years, and Mexico has been fast in adopting Basel III accord standards, with both the risk-based capital and the liquidity rules assessed as compliant (Basel Committee on Banking Supervision, 2015). The Liquidity Coverage Ratio applies from 2015 and is phased in according to the Basel implementation schedule reaching the final value of 100 percent in 2019. A new deposit insurance institution (IPAB) was set up in 1999. This now insures deposits of up to MXN 2.1 million,[13] which is clearer and more credible than the previous system, which did not have an explicit limit.

Difficulties in monitoring credit quality and obtaining access to collateral are being addressed. The 2014 financial reform created a new legal instrument to allow for quicker execution of client collateral in case of default. As a result of this and other changes, in the World Bank's (2014) Doing Business data, Mexico's distance to frontier indicator for resolving bankruptcy improved by 6.5 percentage points. More mercantile matters, such as loans involving physical collateral,

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[12]   Nevertheless, indicators of informality are insignificant in the regressions estimating expected credit depth.

[13]   Legally it is fixed in the inflation-adjusted unit of account (Unidad de Inversion, UDI) at a level of 400,000 UDIs.

will be shifted to federal courts, but this is not implemented yet. Information sharing between the private credit bureaus is improved and will contain information from the public mortgage lenders (Infonavit and FOVISSSTE) in addition to information from private banks.

Financial education is being strengthened. CONDUSEF, the financial consumer protection agency provides various online tools. A new Financial Entities Bureau will facilitate product comparisons across financial entities. It already allows a broad comparison of banks and lists abusive clauses and bad practices. The move toward cashless salaries and benefits[14] familiarizes recipients with financial services. A more general education reform aims at improving the quality of education.

Competition in the banking sector is supported by various measures of the 2014 financial reform. These include new provisions that facilitate the portability of bank accounts and mortgages between banks. Moreover, transparency has been improved by obliging banks to publish comparable interest rates.

The Secretary of Finance has been given the mandate to assess compliance of banks with their objective to support and promote productive sectors and domestic economic growth in accordance to best practices and banking guidelines. The first report was prepared during 2016 and contains recommendations. Banks which are assessed as providing insufficient credit will have to prepare action plans to address this.

At current credit growth rates, credit depth is increasing gradually. The current growth rate of around 15 percent exceeds the rate of nominal GDP growth. While rising credit to GDP shares are sometimes considered a warning sign, in the case of Mexico this is welcome after years of weak credit. According to estimates by Arcand and others (2015), increasing the share of bank credit by 1 percentage point of GDP to 19 percent of GDP (as forecast for 2016), would boost growth by 0.03 percentage points. Increasing the ratio of bank credit to GDP to 60 percent, would boost growth rates by 0.8 percentage points. At a credit growth rate of around 15 percent, and assuming nominal growth of 6 percent over the medium term (potential growth of 3 percent and 3 percent inflation), the predicted bank credit ratio of 60 percent of GDP would be reached in about 13 years. If credit growth were to fall, to a still high level of 10 percent, it would take 30 years. Boosting credit growth even further beyond the current rate, however, would also be risky. Sahay and others (2015) shows that financial deepening at a fast pace leads to increased growth volatility and financial instability. Moreover, the amount of feasible credit growth will also depend on the level of bank capital adequacy and other factors, including nonperforming loans, provisioning, the economic cycle, and sentiment.

Despite the overall low level of credit depth, some sectors have seen excessive growth and subsequent problems. Consumer credit – especially credit cards – has seen large growth rates between 2004 and 2007, but standards were low and the quality of credit fell. A rise in nonperforming loans put a stop to the expansion in 2008. In annual terms, credit contracted every month from September 2009 through March 2011. Nonperforming credit card loans rose from 3.1 percent of credit in January 2004 to a peak of 12.6 percent in May 2009.

6. CONCLUSIONS

Credit depth has been exceptionally low in Mexico for decades, but credit growth is recovering. The key challenge going forward will be to encourage further credit expansion without jeopardizing financial stability. This will require a continuation of tight regulation, maintaining high credit standards, and avoiding excessively rapid credit growth.

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[14]   See Babatz (2013) for details on this shift.

Given the history of bank crises, it is paramount to build up a resilient financial sector in which lenders and borrowers have full trust. The strong financial regulation should therefore be maintained and must not be sacrificed in an attempt to boost credit.

Empirical evidence supports our hypothesis that credit depth in Mexico is lower than what fundamentals would suggest, implying a structural long-term bank credit gap, as well as the idea that structural aspects of the banking sector are behind the low degree of financial intermediation. This latter point is suggested both by results showing that credit growth has been supply-driven in recent years, and by the apparent lagging of credit cycles with respect to business cycles.

The financial reforms over the last few years address the weaknesses but must be strongly implemented and further evolutionary changes will be needed. The shifting of more mercantile matters to federal courts, which is essential for improving bankruptcy procedures and collateral recovery, has been delayed and should be urgently implemented. The IPAB needs to be put on a stronger financial footing to strengthen its credibility, as the fund now contains just a very small percentage of the insured deposits. The new mandate that allows the Finance Secretary to scrutinize banks' compliance with their mandates could be risky depending on its implementation. The perception of putting pressure on banks to increase lending could have negative financial stability consequences, although the strong regulatory standards provide protection. The international financial system is undergoing continuous reform, with Basel III still not completely agreed among the Basel Committee members. Mexico will have to follow these developments and ensure that Mexican law evolves in line.

Acknowledgements

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Frontier and Emerging Markets:
A Perspective from Portfolio Flows and Financial Integration

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ABSTRACT

This paper investigates to what extent low-income developing countries (LIDCs) characterized as frontier markets (FMs) have begun to be subject to capital flows dynamics typically associated with emerging markets (EMs). Using a sample of developing countries covering the period 2000–14, we show that: (i) average annual portfolio flows to FMs as a share of gross domestic product (GDP) outstripped those to EMs by about 0.6 percentage points of GDP; (ii) during years of heightened stress in global financial markets, portfolio flows to FMs dried up like those to EMs; and that (iii) FMs have become more integrated into international financial markets. Our findings confirm that, in terms of portfolio flows, FMs have become more similar to EMs than to the rest of LIDCs and are therefore more vulnerable to swings in global financial markets conditions. Accordingly, it is important to have in place frameworks to strengthen FMs' resilience to adverse capital flows shocks.

1. INTRODUCTION

A key lesson from the emerging markets (EMs) crises of the 1990s and early 2000s is that sharp swings in capital flows can have dire macroeconomic consequences. In emerging markets and developing countries (EMDCs), capital inflows can supplement domestic savings and help boost both physical investment and economic growth. However, reaping the benefits of financial openness and large capital flows without incurring considerable risks is a challenge for policymakers in many countries. In EMs, surges in inflows are often associated with procyclical macroeconomic policies and precede financial crises (Kaminsky et al., 2004). In economies with

intermediate levels of financial development, financial openness may, as Aghion et al. (2004) note, induce chronic phases of strong economic growth with capital inflows followed by collapses with capital flow reversals. The likelihood of reversals and the severity of the ensuing economic downturn depends in part on the composition of capital flows. Foreign direct investment (FDI) is found to be more stable and less prone to reversals than private loans and portfolio flows (Sula and Willett, 2009; Chuhan et al., 1998).

Against this backdrop, the surge of portfolio flows to some frontier markets among low-income developing countries (LIDCs) since the mid-2000s has fueled debates about those countries' growing vulnerability to similar adverse capital account shocks.[1] Traditionally, LIDCs had to rely on official resources to cover their balance of payments (BoP) needs (IMF, 2014a), and most of them continue to do so. However, since the mid-2000s and especially in the aftermath of the 2008 global financial crisis (GFC), relatively strong macroeconomic performance in a subset of frontier markets (FMs), together with low interest rates in advanced economies (AEs), heightened foreign investors' interest in portfolio assets from those markets. Based on the experience of EMs' crises, larger inflows into FMs have raised several questions from researchers and policymakers regarding not only short-term but also medium-term macroeconomic management challenges and external vulnerability.[2]

In this paper, we investigate whether, in light of low-income FMs' experience with capital flows in recent years, they actually resemble EMs and are thereby vulnerable to capital flow reversals or they remain as the rest of LIDCs. Our analysis focuses on similarities in portfolio flow dynamics facing FMs, the rest of the LIDCs, and EMs. Insights from a number of recent studies offer a storyline that buttresses the motivation of this paper. By 2015, surges in gross non-FDI private flows (as percent of GDP) to LIDCs were comparable to those of EMs (Araujo et al., 2015). Most of these flows have gone to FMs. This is in line with the fact that investing in FMs, more broadly defined, has been considered as a good diversification strategy because returns on FMs' assets have generally been less correlated with global market returns owing to their limited integration with global economic and financial markets (Berger et al., 2011; Oey, 2014). While the limited integration of low-income FMs in global financial markets explains their resilience to the GFC, large cross-border portfolio flows to FMs in the aftermath of the crisis are seen as exposing FMs more than in the past to global markets volatility. However, this important issue has not been empirically tested much using econometric methods.

Our empirical investigation of whether FMs resemble EMs in terms of their exposure to private capital flows and their volatility relies on a two-pronged econometric analysis and makes important contributions to the literature. First, using a difference-in-differences (DiD) estimation on annual data covering a panel of 76 countries during 2000–14, the paper assesses the order of magnitude of net portfolio investment to FMs relative to other developing countries subgroups – EMs and the rest of LIDCs, referred to as the non-FM LIDCs – controlling for standard determinants of capital flows. The use of a DiD estimation is, to the best of our knowledge, a novelty to the capital flows literature. Second, using an international capital asset pricing model (ICAPM) model including monthly sovereign bond returns for FMs over 2000–14, the paper investigates whether there have been significant changes in the linkage between FMs and international capital markets since the GFC and discusses what the changes, if any, entail for risks facing FMs relative to EMs.

Three main results emerge from our analysis and support the view that FMs resemble EMs in terms of vulnerability to capital flow reversals. First, based on the DiD approach, we find that, after the GFC, average annual net portfolio investment to FMs outstripped those to

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[1]   There is not a single definition of FMs. For the purpose of our analysis, we rely on the taxonomy of LIDCs the IMF proposes in a 2014 policy paper in which FMs are LIDCs that meet well-defined criteria related mainly to the depth and openness of their financial markets and access to international sovereign bond markets. From the perspective of investment banks and rating agencies, FMs represent a relatively diverse group of countries, including also medium and high-income countries that fall outside the markets generally included in global equity or bond indices and are characterized by their less-developed capital markets, structural weaknesses, and their tendency to have higher idiosyncratic risks.

[2]   Berger et al. (2011); Chan-Lau J., 2014; Marshall et al. (2015), IMF, 2014.

EMs by about 0.6 percentage point of GDP while, unsurprisingly, portfolio flows to non-FMs LIDCs (NFM-LIDCs, henceforth) did not exhibit substantial changes. This suggests that, although portfolio flows to FMs remain small in dollar terms compared with those of EMs, their importance relative to the size of recipient countries' economies has increased drastically in the post-GFC period. Second, while having increased in the post-GFC period as a whole, net portfolio flows to FMs dried out in years of heightened global risk aversion, notably during 2008–09 and in 2013, the year of the taper tantrum. Third, from the asset pricing analysis, we find that there has been a noteworthy change in FMs' market betas with respect to global market returns, indicating an increase in financial integration and comovement of returns after 2008. These findings confirm that FMs have become more similar to EMs than the rest of the LIDCs and are therefore more likely to be subject in similar ways to the effects of adverse changes in global financial markets conditions. Our findings withstand various robustness checks.

The paper complements three strands of the empirical literature on the drivers of capital flows and the vulnerability of recipient countries' economies to flow reversals. First, the paper belongs to the literature on the determinants of capital flows to developing countries, the so-called pull and push factors, which also encompasses the literature on the spillovers of monetary easing in the United States (US) and other AEs (Byrne and Fiess, 2011; Blanchard et al., 2011; Ghosh et al., 2014; Joyce et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011; Fratzscher et al., 2013); Forbes and Warnock, 2012; Suchanek and Rai, 2014; and Claeys and Darvas, 2015). Second, it contributes to the growing literature on capital flows to FMs. Third, it contributes to the literature on the integration of developing countries into international financial markets and their vulnerability to changes in global financing conditions, with a particular focus on FMs (Cheng et al. (2010), Berger et al. (2011), Chan-Lau (2014), Marshall et al. (2015)).

The remainder of the paper is organized as follows. Section 2 presents a review of the literature. Section 3 discusses the data and empirical methodology. Section 4 presents the results. Section 5 concludes.

2. LITERATURE REVIEW

The literature on capital flows dynamics has a long tradition of distinguishing the role of external or global factors from that of country-specific ones. External or global factors reflect a push on investment funds generally toward developing countries. Country-specific or pull factors are those reflecting domestic investment opportunities and associated risks. They include indicators of domestic economic performance, asset returns, and country risk. Push factors are meant to capture the returns on alternative investment opportunities in mature economies, as well as global risk aversion. From a theoretical viewpoint, capital flows must reflect the confluence of both push and pull factors.

The push and pull factors fit into two key broad theories of the economics and finance literature that have relevance for our analysis. The first is the neoclassical economic theory, which posits that capital flows are driven by returns differentials. According to this theory, in the absence of capital account restrictions, capital would flow from capital-abundant economies to capital-scarce economies where returns higher. Against this background, it is expected that capital moves from advanced economies to developing ones. The second key theory is the Capital Asset Pricing Model (CAPM) from the finance literature. The CAPM introduces the notion of risk as an element that, beside returns, should influence investors' allocation of capital among alternative assets in their portfolios. The CAPM builds on the model of portfolio choice developed by Harry Markowitz (1959), which assumes perfect capital markets. It also assumes that, in making their portfolio choices, risk averse investors care only about the mean and variance of their investments' returns. This model was augmented later with the introduction by William Sharpe and John Lintner of the

assumption that investors can borrow and lend at the risk-free rate, resulting in the Sharpe-Lintner CAPM model. This model suggests that the expected value of an asset's return is equal to the risk-free rate plus the asset's expected risk premium, which is the asset's beta times the expected market return in excess of the risk-free rate.[3] The extension of the CAPM to portfolio choices in an international setting results in the international CAPM (ICAPM).

In empirical studies, the predictions of the two main theories underpinning capital flow dynamics have, at best, been mixed. On the one hand, several studies confirm the role of returns differentials between advanced and developing countries as drivers of capital flows to developing countries. Such studies include also those that examine the spillovers of monetary easing in the United States and other AEs (Byrne and Fiess, 2011; Blanchard et al., 2011, Ghosh et al., 2014; Joyce et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011; Fratzscher et al. 2013; Forbes and Warnock, 2012; Suchanek and Rai, 2014, Claeys and Darvas, 2015). Likewise, some studies find evidence supporting the predictions of the ICAPM. On the other hand, several empirical studies highlight puzzles that do not conform to the predictions of the above-mentioned two theories. For instance, some studies find that capital does not flow from rich to poor countries, the so-called Lucas paradox (Lucas, 1990; Alfaro, 2008). Others find that portfolios are not diversified enough to take advantage of higher returns/yields on foreign assets, the so-called home bias (Levy and Levy, 2004; Mishra, 2015).

The puzzles or paradoxes are attributed to realities that depart from the two models' simplifying assumptions, fueling related research built on alternative theories or assumptions. For instance, the assumption of perfect or complete integration of international financial markets, which is central to the predicted efficient portfolio outcome in the ICAPM turns out not to be plausible. Based on this assumption, by analogy to what the CAPM posits for a single domestic market, in the global market, investors are exposed to global market risk and diversifiable country-specific risks, resulting in expected returns that solely depend on global risks factors in an asset pricing relationship common to all countries. In reality, there are frictions and informational asymmetries that make integration imperfect and time-varying, thereby helping explain investors' overreaction to changes in global factors, which lead to observed phenomena such as, shifting risk appetite, herding, contagion, as well as surges and reversals that characterize capital flows to EMs. Against this backdrop, the empirical literature on capital flows that brings to light these realities that depart from highly stylized models' assumptions is particularly relevant for our study. We next review selected relevant papers.

In the empirical literature on the push and pull factors of capital flows, we focus on the strand investigating the dynamics of capital flows to EMs, as well as the strand on capital flows to FMs. There are numerous studies that try to identify push and pull factors explaining the size and volatility of capital flows (Calvo, Leiderman and Reinhart, 1993; Chuhan, Claessens, and Mamingi, 1993; Fernandez-Arias, 1996; Taylor and Sarno, 1997; Fratzscher, 2011; Ghosh, Ostry and Qureshi, 2018). Of particular interest are studies highlighting the reaction of capital flows to changes in global factors around times of crises or heightened global risk aversion. We briefly review three studies: Fratzscher (2012), Byrne and Fiess (2016), and Avdjievet al. (2016). Fratzscher (2012) employs a factor model to investigate the main drivers of portfolio flows for a sample of 50 AEs and EMs during 2005–2010. He finds that push factors in the form of shocks to global liquidity and risk have exerted large, heterogeneous, and time-varying effects on capital flows. In particular, consistent with the flight-to-quality hypothesis, a rise in risk during the crisis triggered a reallocation of capital from many EMs to some AEs, while it had the opposite effect prior to the crisis and during the recovery. Heterogeneity of the impacts across countries arises from differences in the strength of domestic institutions and macroeconomic fundamentals.

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[3] The market beta of a given asset is the covariance of the asset's return with the market return divided by the variance of the market return. For a comprehensive review of CAPM literature, see: Fama and French, 2004; Perold, 2004.

There is broad support for the findings of Fratzscher (2012) in Byrne and Fiess (2016) as well as Avdjievet al. (2016). Using a sample of nearly 65 EMs during 1993–2009, Byrne and Fiess (2016) investigate the determinants of capital inflows and the importance of common factors in driving the global supply of capital using fixed effects and principal components estimation, respectively. They find evidence of a negative correlation between aggregate flows to EMs and real long-run interest rates in the US. They also find that an increase in global risk aversion reduces flows to EMs. Avdjievet al. (2016) use fixed-effects estimation to examine the importance of global factors for cross-border loans and international debt securities flows using panel of 64 AEs and EMs covering the period 2000–2013. They find a negative relationship between these flows and both US monetary policy rate and global risk aversion. They also find that the sensitivity of both types of capital flows to global factors changed considerably in the aftermath of the GFC, with some heterogeneity. In particular, the impact of US monetary policy on both flows increased while that of global risk aversion decreased for bank flows and increased for bond flows, with the latter driven by bond flows to EMs.

In the second strand on capital flows to FMs, studies focused on the increased flows and associated vulnerabilities are particularly of interest. Guscina et al. (2014) documents how the search for yield in the context of low interest rates made international bonds an attractive financing alternative for many developing countries, including some first-time issuers, resulting in a sharp increase in portfolio inflows to these countries. To highlight the vulnerabilities associated with the increased portfolio flows for FMs, they focus on the pricing of bonds in secondary markets and estimate the determinants of bond spreads on a panel of 44 EMs and FMs during 2000–2013. They find that, controlling for institutions and macroeconomic fundamentals, FMs' bonds trade at a premium relative to EMs' bonds. Moreover, they find evidence that spreads increase in times of heightened global risk aversion reflected in an increase of the VIX or drop in global liquidity, captured by a higher Federal funds rate. These findings are in line with those of other studies suggesting that FMs tend to face wider bond spreads when global financial conditions tighten (IMF, 2014b; IMF, 2016).

The third strand of the empirical literature related to ours is that assessing the level of financial markets integration. In this literature, there are variations in how integration is measured. Integration is measured by looking at returns on a country or group of countries' assets relative to regional or global asset returns. A widely used measure of integration is the correlation of financial assets' returns. Critics suggest that correlations do not properly reflect integration when there are several sources of volatility affecting global market indices to which country-specific indices respond differently (Pukthuanthong and Roll (2009), Bekaert and Harvey (1995), Bekaert et Mehl (2014)).

We discuss two alternative measures of financial integration proposed in the literature. Market integration is measured by the proportion of a country's returns that can be explained by global factors (Pukthuanthong and Roll (2009)). Following Forbes and Rigobon (2002), critics of this measure of integration argue that it is flawed because, in times of higher volatility of global relative to country-specific volatility, it will unduly indicate a greater degree of integration. Bekaert and Harvey (1995) propose a methodology that allows for the degree of market integration to change through time. Bekaert and Harvey (1995) propose a measure of integration that allows for differing prices of variance risk across countries which depending on country-specific information and a world price of covariance risk which depends on global information. Related to Bekaert and Harvey (1995), Bekaert et Mehl (2014) proposes a measure of integration that employs conditional betas of a country's stock return with respect to global and regional equity market returns. We adopt the beta-related measure of integration according to which the higher the beta, the greater the integration.

Our review of studies investigating market integration covers selected papers using variants of the ICAPM. Pukthuanthong and Roll (2009) investigate trends in global integration based

on a sample of 34 countries during 1973–2006. They find that for most countries, integration increased over the three-decade period while for some, including certain FMs, it is the opposite. Bekaert et Mehl (2014) investigate stock markets integration based on stock indices of 15 countries and global as well as regional indices covering the period 1885 to 2014. They find that global financial market integration was high in the period before 1913, still higher post-1990, and low in the interwar period. Berger, Pukthuanthong, and Yang (2010) employ principal components to examine the extent to which FMs are integrated within international financial markets using returns on global and Emerging Markets indices and returns on country-specific indices for 25 FMs during 1989–2009. They find that not only do FMs exhibit low levels of integration with world markets, but also these levels of integration do not appear to increase through time. There are two takeaways on financial markets integration from the papers reviewed. First, conclusions about the degree of integration depend on the definition used. Second, integration is time-varying, suggesting that the process of international financial integration is not a gentle climb towards ever higher peaks (Bekaert and Mehl, 2014).

Our paper brings together the literature on the determinants of capital flows to developing countries and that of their integration into the global financial market with a focus on FMs. On the capital flows front, we contribute to the literature by looking at flows dynamics before and after an exogenous shock, using a methodology new to this literature, the difference-in-difference (DiD) estimation. This methodology has been used in several areas of the economics and finance literature. For instance, Acemoglu et al. (2004) use DiD to investigate the effects of female labor force participation before and after World War II on earnings by level of education. Ouyang and Peng (2015) uses DiD to study the macroeconomic effect of the 2008 Chinese Economic Stimulus Program. To the best of our knowledge, DiD has not been used to analyze differences in capital flows dynamics between groups. To gauge FMs' integration in global markets, we rely on the ICAPM.

We build on the insights from the literature to formulate three hypotheses that are subsequently tested in econometric analyses. The first hypothesis (H1) is the basis of our tests for the shift in the size of capital flows. Conditional upon H1 being true, the second hypothesis (H2) allows us to test the sensitivity of capital flows to changes in global risk aversion, thereby helping to assess differences in volatility of capital flows between FMs and the control group. The third hypothesis (H3) aims to test for changes in FMs' financial integration with the global markets, i.e., financial spillover risk. H3 is conditional upon H1 being true. Each hypothesis is explained below.

Hypothesis 1 (H1): Catching-up on capital flows

$$\{low\ \boldsymbol{r}\ environment\} + \{\sigma_{LQ-EM} \approx \sigma_{FM}\} + \{E[R_{FM}] \geq E[R_{LQ-EM}]\} \rightarrow$$

$$\rightarrow \{\text{"Serch for Yield"}\} \rightarrow \Delta\left[\frac{CF}{Y}\right]_{FM} \geq \Delta\left[\frac{CF}{Y}\right]_{LQ-EM}$$

where *r* is the world interest rate, σ stands for the country risk profile, *E*[.] denotes mathematical expectation, *R* represents the rate of return on private investment, *Y* is the output and *CF* stands for capital flows.

Hypothesis 1 suggests that in a low interest rate environment, where the underlying macroeconomic risks in EMs and FMs are broadly similar and where the expected rate of return on FM assets is equal to or higher than that on EMs' assets (as in Figure 4), increases in private capital flows to FMs will be comparable to those to EMs reflecting the investors' search for higher yields. In our analysis, we take the 2008 monetary easing in AEs as an exogenous shock that

results in ample liquidity, search for yield, reduction in investors' risk aversion, and increased capital flows to EMDCs. Drawing on the stylized facts, we consider that these increases, measured in percent of recipient countries' GDP, differ across the following three subgroups of EMDCs: (i) NFM-LIDCs with low integration and financial development; (ii) FMs with stronger macroeconomic fundamentals; (iii) EMs with the strongest fundamentals. We expect FMs to attract more or at least equal amount of capital flows compared to EMs unlike NFM-LIDCs.

Hypothesis 2 (H2): Increased sensitivity of FMs to global economic and financial developments

If Hypothesis 1 is true, i.e., if we find evidence of a significant increase in private portfolio flows to FMs that make them resemble more those to EMs, we expect FMs to become more exposed to external financial shocks and changes in investor sentiment. Therefore, in turmoil times the flows would significantly decrease. This is also a reflection of greater integration into global financial markets. Hence, our third hypothesis.

Hypothesis 3 (H3): Greater integration of FMs into global financial markets

If H1 is verified, it means that FMs increasingly resemble EMs and their financial integration increases. Therefore, we expect increased comovement between FMs' bond returns and global bond returns. In particular, we expect, in an ICAPM regression, FMs' market beta to increase and become significant after 2008.

3. DATA AND METHODOLOGY

3.1. Data

To investigate our questions of interest, we first define country groups and then collect two types of data: variables on non-official capital flows and determinants, and financial market variables. First, to construct the country groups, we use the IMF's World Economic Outlook (WEO) country classification, consisting of advanced economies (AEs) and emerging markets and developing countries (EMDCs). The EMDCs group is very heterogeneous. Within the EMDCs, the subgroup of countries whose gross national income (GNI) fall below the World Bank's upper middle-income countries' (UMIC) threshold is relevant for our study as it includes lower quartile emerging markets (LQ-EMs) and low income developing countries (LIDCs). The subgroup of LQ-EMs is made up of 16 countries (listed in Appendix Table II, Panel A) with per capita GNI higher than the IDA cutoff.[4] The remaining countries comprise the LIDCs group, and consist of 60 countries listed in Appendix Table I.[5] In 2014, the IMF classified 14 LIDCs as FMs based on a number of criteria.[6] The list of FMs with the year in which they first met the FMs' qualification criteria is in the left column of Panel A, Appendix Table II. Countries in the LQ-EMs subgroup are closest to FMs in terms of depth and openness of financial markets and

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[4]   These correspond to the World Bank's cut-off points for lower middle-income (LMIC) and upper middle-income (UMIC) countries for FY2013, respectively.

[5]   These countries have economic features that differ markedly from those of higher income countries and are eligible for concessional financing from both the IMF and the World Bank based on relative poverty assessed through income thresholds set by the International Development Association (IDA). The IDA income threshold that guide the determination of eligibility for IMF's concessional lending under the Poverty Reduction and Growth Trust (PRGT) facilities is updated annually. As of end-2014, LIDCs had the following characteristics: (i) PRGT-eligible as per the 2013 PRGT Eligibility Report; (ii) Gross National Income (GNI) per capita less than the ad-hoc PRGT income graduation level for non-small states (twice the IDA cut-off point or US$2,390 for FY2013).

[6]   The selection criteria focus on the depth and openness of the financial system and the issuance of sovereign bonds. Each LIDC is benchmarked against EMs as follows: (i) LIDCs that are within one standard deviation below the EM average for the following variables: M2 to GDP; cross border loans/deposits, stock market capitalization, and portfolio inflows; and (ii) LIDCs that have accessed (or have the potential to access: proxied by sovereign ratings similar to those that have issued sovereign bonds) sovereign bond markets, putting them on the radar screen of international fund managers. Details are in Appendix II of IMF, 2014b.

access to international sovereign bond markets and also in terms of economic and development indicators such as poverty rates, life expectancy at birth, the share of agricultural employment in total employment, and domestic credit to the private sector relative to GDP. Moreover, the quality of their institutions as rated by the World Bank's Country Policy and Institutional Assessment (CPIA) and their risk of debt distress ratings ("Short-term Vulnerabilities") are similar to the LIDCs' average.[7] Therefore, countries in the LQ-EM subgroup are used as a control group.

Secondly, to analyze the private capital flows to LIDCs and FMs, we collect data for two sets of variables. The first set comprises net portfolio inflows and pull factors. Portfolio flows and pull factor series related to countries' macroeconomic performance are obtained from WEO. Data for an additional pull factor we use as a proxy for governance in some robustness check regressions, country-specific financial risk rating, is obtained from the International Country Risk Guide (ICRG). We construct a panel of 76 countries with annual data covering the period 2000–14. The sample includes all LIDCs and countries in the LQ-EMs.[8] The net portfolio investment variable is scaled by GDP. The issue of using net flows versus gross flows has been frequently debated in the literature. Given the questions we are interested in, we report results on net flows, following Ahmed and Zlate (2014). The second set of variables includes global push factors such as the U.S. 10-Year Treasury Bond Yield and VIX index, obtained from FRED (Federal Reserve Economic Data) and Bloomberg. This variable is available for only half of the countries in our sample.

Thirdly, to test for changes in FMs' financial integration with the global markets, we use bond-index data. These include individual FM country indices and a global bond index. To construct bond returns in FMs in our sample, we use JP Morgan's NEXGEM index. NEXGEM index is a fixed-income benchmark that provides exposure to non-investment grade rated, smaller, less liquid population of EMs economies or FMs. It includes 18 countries representing Sub-Saharan Africa, Central American, the Caribbean, Middle East, Europe, and Asia. We use the bond index for each country to construct bond returns and apply our financial integration methodology. In total, we have 12 FMs and 10 EMs with data available (Appendix II Panel B). To capture the global bond returns, we use JP Morgan Global Aggregate Bond Index (GABI), which consists of the JPM GABI US, a U.S. dollar denominated, investment-grade index spanning asset classes from developed to emerging markets, and the JPM GABI extends the U.S. index to also include multi-currency, investment-grade instruments.

3.2. Stylized Facts

Summary statistics in Table 1 provide insights on the volume and volatility of portfolio flows to developing countries across subgroups and time periods. We report statistics on the evolution of net portfolio flows to the two LIDCs' subgroups and the EM control group before and after 2008. The figures suggest that, on average, net portfolio flows to all groups increased after 2008. The means suggest also that net portfolio to FMs outstripped those to the EM control group. Standard deviations suggest that after 2008, the volatility of net portfolio flows to all but the NFM-LIDC group increased and that the increase was more pronounced for FMs.

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[7]　The World Bank maintains and updates the CPIA to assess the quality of a country's policies and institutional arrangements along 16 criteria grouped into four equally-weighted clusters: economic management, structural policies, policies for social inclusion and equity, and public sector management and institutions. Countries are rated on a scale of 1 (low) to 6 (high) for all of the sixteen criteria and are assigned an overall score.

[8]　The sample size for regressions including the financial risk rating variable is reduced as this variable is available for only half of the countries in our sample.

Table 1.
Summary Statistics

	Net Portfolio Investment (% GDP)			
	Mean	Std.Dev	Min.	Max.
LIDCs				
2000–08	0.693	1.129	0.124	0.329
2008–14	0.354	0.207	0.105	0.670
FMs				
2000–08	0.135	0.446	-0.444	1.277
2008–14	1.007	0.807	-0.108	2.397
NFM-LIDCs				
2000–08	0.046	0.719	-0.054	0.218
2008–14	0.130	0.124	-0.063	0.335
EMs (Control group)				
2000–08	0.077	0.331	-0.507	0.686
2008–14	0.386	0.317	0.005	0.843

The correlation matrix in Table 2 provides preliminary insights into the bivariate relationships between the variables we use in our empirical estimation of net portfolio flows. In particular, there is a negative relationship between portfolio inflows EMDCs receive and the VIX as well as interest rates in major AEs, proxied by the 10-year US Treasury bond yield. Also, the correlations among the variables we use are all very low, suggesting that there should be no concerns about multicollinearity among regressors.

Table 2.
Explanatory Variables-Correlation Matrix

	Portfolio Investment/ GDP	VIX	U.S 10-Y Treasury Bond Yield	Growth	Debt/ GDP	Fiscal Balance/ GDP	Current-Account/ GDP	Exports/ GDP
Portfolio Investment/GDP	1							
VIX	-0.0672* (*0.0302*)	1						
U.S 10-Y Treasury Bond Yield	-0.1303* (*0.0000*)	0.1124* (*0.0002*)	1					
Growth	0.0429 (*0.1674*)	-0.1084* (*0.0004*)	-0.008 (*0.7760*)	1				
Debt/GDP	-0.0562 (*0.0784*)	0.0261 (*0.4083*)	0.267* (*0.0000*)	0.1061* (*0.0008*)	1			
Fiscal Balance/GDP	-0.0392 (*0.2102*)	-0.0875* (*0.0047*)	0.089* (*0.0030*)	-0.0897 (*0.0013*)	-0.102* (*0.0010*)	1		
Current-Account/GDP	-0.1189* (*0.0001*)	-0.0324 (*0.2919*)	0.189* (*0.0000*)	0.0257 (*0.4032*)	-0.086* (*0.0050*)	0.112* (*0.0030*)	1	
Exports/GDP	0.0463 (*0.1357*)	-0.0406 (*0.1857*)	0.0305 (*0.3200*)	0.1114* (*0.0003*)	-0.066* (*0.0350*)	0.1053* (*0.0006*)	0.1668* (*0.0000*)	1

p-values are reported in parantheses and * denotes significance.

3.3. EMPIRICAL METHODOLOGY

In this paper, we use a two-pronged empirical strategy based on: (i) Difference-in-differences (DiD); (ii) International Capital Asset Pricing Model (ICAPM). DiD helps analyze the changes in net portfolio flows to FMs. ICAPM enables us to test and document impact of these changes on the financial integration of FMs.

In the first part of our empirical analyses, we use the ***difference-in-differences (DiD)*** approach to identify, the average effect of being perceived as a frontier market (FM) on net portfolio flows. Borrowing from Rubin's (1974) description of causal effects in non-randomized experiments, we are interested in estimating, from a population of developing countries, the typical causal effect of a country being treated as FM versus non-FM on net portfolio flows to the country (i.e., the average impact of treatment on the treated). The GFC and the ensuing search for yields associated with low interest rates offer a useful window for assessing variations in portfolio flows within and across developing countries subgroups. We exploit the pre- and post-crisis pattern of capital flows to compare portfolio flows to countries when they are perceived as FMs to portfolio flows to a control group (LQ-EMs), an estimate of the counterfactual.

In DiD estimation in general, outcomes are observed for two groups during two time-periods and the estimation is used to assess the impact of a particular treatment on the outcome of the treated group. One of the groups is exposed to a treatment in the second period but not in the first period. In panel data, with the same units within a group being observed in each period, the average gain in the non-treated group (the control group) is subtracted from the average gain in the treatment group to get an estimate of the effect of the treatment. Assuming that Y_1 and Y_0 are outcomes (net portfolio flows) after and before the crisis, the DiD logic can be better illustrated in a box using, in line with our analysis, FMs and LQ-EMs as treatment group and control group, respectively, to derive the effect of the treatment after the crisis.

Table 3.
Illustration of DiD estimation

	FMs (treatment group), $FM = 1$	LQ-EMs (control group), $FM = 0$
After the crisis, $t = 1$	$Y_1 / FM = 1$	$Y_1 / FM = 0$
Before the crisis, $t = 0$	$Y_0 / FM = 1$	$Y_0 / FM = 0$
In-group difference between post and pre-crisis outcomes	$(\overline{Y}_1 / FM = 1) - (\overline{Y}_0 / FM = 1)$	$(\overline{Y}_1 / FM = 0) - (\overline{Y}_0 / FM = 0)$
$DiD = [(\overline{Y}_1 / FM = 1) - (\overline{Y}_0 / FM = 1)] - [(\overline{Y}_1 / FM = 0) - (\overline{Y}_0 / FM = 0)]$		

An important methodological concern of the DiD estimation that is addressed in our analysis is that the estimate of the difference in outcomes between the treated group and the control group could be affected by other shocks taking place at the same time or by time-invariant country characteristics that have a bearing on portfolio flows, thereby precluding a meaningful causal inference between the treatment and the outcome. This concern is addressed in two ways. First, as indicated earlier, the control group is made of countries that are broadly similar to FMs in terms of developmental characteristics and are exposed to similar shocks. Second, using panel data and fixed-effects (FEs), we control for observed and unobserved time-invariant country-specific characteristics that might be correlated with both a country's characterization as FM, as well as the volume of portfolio flows it attracts.

The use of DiD approach is a novelty of this paper and an important contribution to the literature on capital flows in terms of assessing shifts in capital flows dynamics. To the best of our knowledge, this is the first paper that uses this type of empirical approach in a macroeconomic

setting to understand the differences in capital flows dynamics between country groups. The DiD approach makes it possible to compare the convergence in portfolio flows both cross-sectionally and across time. The cross-sectional comparison avoids the problem of omitted trends by comparing two groups over the same period. The time series comparison avoids the problem of unobserved differences between two different country groups by looking at the same group of countries before and after the change (Roberts and Whited, 2013).

We model net portfolio inflows to FMs, NFM-LIDCs, and LQ-EMs (control group) using annual panel data from about 76 countries during 2000–14 and compare changes in portfolio flows taking into account country and time fixed effects. The country fixed effects control for unobserved, time invariant heterogeneity in countries' risks. The year fixed effects control for shocks common to all countries. The start date 2000 allows us to compare the period prior to the GFC (2000–08) when flows to LIDCs were lower, to the post-2008 period with notable increase in inflows following the monetary easing (shock). Our baseline regression is:[9]

$$\frac{NPI_{i,t}}{Y_{i,t}} = \beta_0 LIDC_{i,t} + \beta_1 Crisis_t + \beta_2 FM_{i,t} + \beta_3 FM_{i,t} Crisis_t +$$

$$+ \beta_4 NFM_{i,t} Crisis_t + \gamma * X_{i,t} + \upsilon_i + \xi_t + u_{i,t}$$

(1)

where:
$NPI_{i,t}$ – Net Portfolio investment in US\$
$Y_{i,t}$ – GDP in US\$
$LIDC_{i,t}$ – 1 if country i is LIDC, 0 otherwise
$Crisis_t$ – 1 if the observation is after 2008, 0 otherwise
$FM_{i,t}$ – 1 if country i is FM, 0 otherwise
$NFM_{i,t}$ – 1 if country i is NFM-LIDC, 0 otherwise
$X_{i,t}$ – control factors
υ_i – country fixed effects
ξ_t – year fixed effects

Key variables of interest are: the interaction term between $FM_{i,t}$ and the crisis dummy (β_3) and the interaction term between $NFM_{i,t}$ and the crisis dummy(β_4) in Equation 1. If FMs and NFM-LIDCs are differently affected after 2008, we expect β_3 and β_4 to be statistically significant. If only FMs are affected, we expect β_3 to be positive and statistically significant.

A common approach in this type of regressions is to control for country-level characteristics as well as global determinants.[10] Therefore, we include several control variables, i.e., push and pull factors which the existing literature have found to explain changes in capital flows across time and countries. This allows us to get a "clean" measure of difference between portfolio flows to FMs and the EMs' control group (LQ-EMs) that can be attributed primarily to the monetary easing after the shock represented by the 2008 GFC.

As a second step, we use DiD to test for the increasing sensitivity of FMs to global risk aversion with two additional specifications (Eq. 2). With these, we examine whether, taking into account the level of global risk aversion, FMs are treated the same as EMs. In the first specification, we introduce a triple interaction term comprising FM, crisis, and VIX. If, after the crisis, FMs are treated as EMs, this interaction term should not be statistically significant.

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[9]   Details on the DiD empirical strategy can be found in the technical appendix.

[10]   The approach can be found in several studies on the determinants of capital flows, e.g. Byrne and Fies, 2016; IMF, 2011; Ghosh et al., 2014; Fratzscher et al., 2013; Forbes and Warnock, 2012; Shaghil and Andrei, 2014; IMF, 2014.

In the second step, considering that EMs experience a reduction of capital flows in periods of heightened stress in global financial markets, we run regressions to ascertain, from the yearly pattern of net portfolio flows, whether the experience of FMs is the same as that of EMs. Accordingly, in lieu of including one interaction term of the FM and crisis dummies, the regression includes several interactions terms of the dummy FM with a dummy for each of the years the sample covers. Focusing particularly on the post-crisis period, during which FMs are found to have experienced an increase in portfolio flows exceeding that of EMs, we expect the interaction terms of the FM dummy and year dummies to be positive and significant, except in years of heightened stress in global financial markets. We estimate the following regression model:

$$\frac{NPI_{i,t}}{Y_{i,t}} = \beta_0 LIDC_{i,t} + \sum_{t=2001}^{2014} \beta_t * D_t + \beta_2 FM_{i,t} + \sum_{t=2001}^{2014} \alpha_t * D_t * FM_{i,t} +$$

$$+ \sum_{t=2001}^{2014} \gamma_t * D_t * NFM_{i,t} + \upsilon_i + \xi_t + \epsilon_{i,t}$$

$$(2)$$

where *LIDC*, *FM*, and *NFM* are defined as in equation (1); D_t is a dummy variable set equal to 1 if the observation falls during year *t*.

Our second empirical methodology, ***International CAPM (ICAPM)***, serves to test for changes in the financial integration of FMs with global financial markets. We argue that as a result of FMs' larger capital flows after 2008, their financial integration with the global markets also increased. In other words, in a fully integrated world, local assets in an FM country are affected by the same type of world shocks that advanced markets experience. By contrast, when markets are segmented, a local economy may be largely shielded from such external shocks. However, as both the economic and financial integration increase, local assets would be affected more by shocks in advanced markets. As a result, correlations would increase (Bekaert and Harvey, 2000).

We calculate global market betas to test for the changes in FMs' integration with the global markets. To test for these, we use an ICAPM model. CAPM beta has been widely used for gauging the level of market integration. Some studies that have used it besides the selected discussed in the literature review are Bodnar et al. (2003) and Bruner et al. (2008). We also compare FMs' market beta with that of EMs'. The crisis year 2008, which corresponds to US monetary easing, is used as a break point in the sample period 2000–14. The sample covers 12 FMs and 10 EMs, and all the data is at monthly frequency. Our empirical model provides estimates of FMs' sensitivities to and comovement with global financial markets:

$$R_{i,t} - R_t^f = \alpha + \beta * \left(R_t^{Mkt} - R_t^f \right) + \gamma_i + \varepsilon_{i,t}$$

$$(3)$$

where $R_{i,t}$ represents the bond index return of country *i* at month *t*, R^{Mkt} is the market return on Barclays Global Bond Index, R_f is the risk-free rate proxied by 3-month US T-bill rate, γ_i stands for country fixed effects, and is the unexplained portion of the variance in the return for country *i* during month *t*. All returns are calculated using US$ prices.

Initially, we run single-factor CAPM tests with the global market index as specified above. Through these regressions, we aim to see if and how the global market beta changed after the monetary easing, which would indicate increase in financial integration if true. Then, we also run a two-factor CAPM, with both local and global indices (Equation 4 below). These reflect local

and global factors, respectively. This results in a partial-integration model, where we assume that investors price both the global and local risk factors, but separately. In the literature, the notion of 'partial market integration' has been widely used for asset pricing in emerging markets. In our case, it is appropriate given the similarities between the current FMs' and the earlier EMs' experiences.

$$R_{i,t} - R_t^f = \alpha + \beta_1 * \left(R_t^{Mkt} - R_t^f \right) + \beta_2 * \left(R_t^{local} - R_t^f \right) + \gamma_i + \varepsilon_{i,t} \qquad (4)$$

where the only difference from Equation 3 is the term $\beta_2 * \left(R_t^{local} - R_t^f \right)$. R_t^{local} stands for the return on a narrow or immediate benchmark index that includes FM or EM bonds. For FMs and EMs, "local" indices are proxied by JP NEXGEM index and EMBI, respectively.

If FMs are not integrated with the global market, the market beta should be insignificant, i.e., an asset's risk is not measured by its covariance with world returns as it would be in the case of full integration. Instead it would be measured by its own variance, as captured by local market returns. If FMs are integrated, then the market beta should be significant. In this case, if our second hypothesis is true, we should expect to find a significant global market β for FMs after 2008.

4. RESULTS

Our DiD analysis provide evidence on changes in portfolio flows to LQ-EMs, FMs and the rest of the LIDCs (NFM-LIDCs). The results from the first step of our DiD analysis (Eq. 1) are shown in Table 4. These illustrate that during 2000–14 portfolio flows to FMs exceeded those to LQ-EMs by 1.4 percentage points of GDP, while portfolio flows to other LIDCs in comparison to EMs have not changed significantly. Here, we are able to demonstrate that (i) the upward trend was similar for both groups; and (ii) the increase has been higher for FMs as a percentage of GDP.

Overall, the results provide answers to the following question: comparing net portfolio flows to two countries after controlling for standard determinants of capital flows, does the country that happens to be an FM (or NFM-LIDCs) observe a significant increase in portfolio flows after 2008 compared to LQ-EMs? The coefficients on our variables of interest are highly significant and robust (Table 4). This result suggests that while FMs are becoming more similar to LQ-EMs in terms of portfolio flows, there is no evidence of a similar trend for the rest of the LIDC group. Including only the push factors (VIX and US bond yield) does not change the results. When controlling for pull factors, we find that FMs' portfolio flows exceed EMs' by 0.62 percent of GDP, less than our initial finding of 1.4 percent.

Table 4.
Comparison of Portfolio Flows to FMs with EMs

	NPI/GDP							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crisis$_t$*Frontier$_i$	1.417**	1.417**	0.623**	0.623**	0.623**	0.876***	0.845***	0.844***
	(0.6820)	(0.6820)	(0.2690)	(0.2560)	(0.2560)	(0.2160)	(0.2230)	(0.2360)
Crisis$_t$*NFM$_i$	0.611	0.611	-0.12	-0.0775	-0.137	-0.129	-0.0902	-0.146
	(0.6140)	(0.6140)	(0.2040)	(0.1940)	(0.1870)	(0.2010)	(0.1910)	(0.1840)
VIX$_t$		-0.0363	-0.0219***	-0.0231***	-0.0223***	-0.0210***	-0.0220***	-0.0213***
		(0.0244)	(0.0067)	(0.0068)	(0.0068)	(0.0068)	(0.0070)	(0.0069)
U.S 10-Y TB yield$_t$		0.108	-0.0253	0.00238	-0.0303	-0.0265	-0.000221	-0.0312
		(0.2190)	(0.0723)	(0.0730)	(0.0698)	(0.0727)	(0.0732)	(0.0704)
Growth$_t$			0.00325	0.0027	0.00367	0.00382	0.00326	0.00417
			(0.0051)	(0.0051)	(0.0049)	(0.0051)	(0.0051)	(0.0049)
Debt-to-GDP$_{t-1}$			-3.84E-08	-4.06E-08	-1.75E-08	-3.77E-08	-3.98E-08	-1.84E-08
			(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Fiscal-Balance/GDP$_{t-1}$			9.91E-08	1.17E-08	7.70E-08	8.25E-08	-1.30E-09	6.13E-08
			(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Current-Account/GDP$_t$				-0.0151**			-0.0144**	
				(0.0068)			(0.0068)	
Export-to-GDP$_t$					-0.0139			-0.0139
					(0.0169)			(0.0170)
Observations	1,220	1,220	896	896	896	896	896	896
Country FEs	YES	YES	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.557	0.557	0.321	0.326	0.324	0.322	0.327	0.325

Notes: The dependent variable is the ratio of (net) portfolio investment liabilities to GDP. The main regressors are: (i) interaction term of a frontier market (= 1 if country i is *FM*) and a time dummy variable that indicates the start of the crisis (= 1 after 2008). All columns include country and year fixed effects. Country observable characteristics push factors and pull factors are added as control variables. Columns (1)–(5) present the baseline specification where FMs are time-invariant. Columns (6)–(8) present the baseline specification where the composition of the FM group is time varying based on countries' qualification dates shown in the first column of Panel A Appendix Table II. All standard errors are clustered at the country-level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Observations are between 2000 and 2014.

The second step of our DiD analysis enables us to document similarities in capital flows to EMs and FMs taking into account the level of global risk aversion. After showing that portfolio flows to FMs have significantly increased, comparable to EMs, we conclude, from the nonsignificant coefficient of the triple interaction term, that after the crisis, FMs' exposure to changes in investor sentiment has become comparable to that of our EM control group (LQ-EMs). The coefficient of the triple interaction term reflects the comparison of portfolio flows to FMs relative to EMs after the crisis both in times of lower or heightened stress in global financial markets (Table 5). Secondly, in the regression including interactions of the FM dummy with each of the years, unsurprisingly the interaction terms involving the pre-crisis years are generally not significant, except for 2007, while for the post-crisis years there are differences (Appendix Table IV). In particular, interactions involving years of heightened stress in global financial markets – 2008, 2009, and 2013, the year of the taper tantrum – are not significant. While there is no evidence of a flow reversal, the finding that portfolio flows appear to have dried out in

times of financial market stress makes FMs somewhat resemble EMs. These findings provide statistical evidence for increased sensitivity of capital flows into FMs to developments in the global economy, lending support to findings in the earlier literature such as Fratzscher (2012) and Byrne and Fiess (2016).

Table 5.
FM Portfolio Flows' Sensitivity to Global Risk Aversion

	NPI/Y			
	(1)	(2)	(3)	(4)
$Crisis_t{}^*FM_t{}^*VIX_t$	-0.0425	-0.0425	-0.0462	-0.0490
	(0.0336)	(0.0336)	(0.0344)	(0.0342)
$Crisis_t{}^*FM_t$	1.506*	1.506*	1.630*	1.861**
	(0.825)	(0.825)	(0.858)	(0.860)
VIX_t		-0.00106	-0.00129	-0.00887
		(0.0344)	(0.0355)	(0.0355)
U.S 10-Y TB yield$_t$		-0.0834	-0.0987	-0.0609
		(0.147)	(0.157)	(0.0158)
Growth$_t$			-0.00283	-0.00638
			(0.0289)	(0.0288)
Fiscal Balance/GDP$_{t-1}$			0.0348	0.0399
			(0.0323)	(0.0322)
Export/GDP$_t$				-0.0303**
				(0.0138)
Observations	440	440	428	428
Country FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
R-squared	0.239	0.239	0.232	0.241

Notes: This table implements a triple interaction DiD estimation using the interaction of risk aversion (proxied by the VIX index), a crisis dummy (= 1 in 2008 and after) and a frontier market dummy. All standard errors are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Observations are between 2000 and 2014.

Our ICAPM results indicate enhanced market integration for FMs in the post-2008 period, which also implies more pronounced financial vulnerabilities. To document this, we compare FMs' market betas before and after 2008 as well as comparing with those of EMs. First, we find that before 2008 the correlation between FM bond index returns and global bond market returns is insignificant. After 2008 we find a significant and positive relationship between these returns, and FMs' market beta becomes comparable to that of EMs at around 1.7. The econometric results are illustrated inh Table 6; FMs in Panel A and LQ-EMs in Panel B. The results for the periods 2000–08 and 2008–14 are reported separately; labelled as "before" and "after" respectively. Columns 1–4 are populated by the results from single-factor ICAPM regressions; without and with fixed effects. Columns 5 and 6 show the results from two-factor ICAPM regressions. Overall, the findings show that, as portfolio flows to FMs started to become similar to those to EMs after 2008, the comovement between FMs' and global markets' returns has also increased, implying enhanced financial integration and vulnerabilities.

Table 6.
Changes in Financial Integration for FMs and EMs

	Panel A: ICAPM Frontier Markets					
Variables	(1) BEFORE	(2) AFTER	(3) BEFORE	(4) AFTER	(5) BEFORE	(6) AFTER
$R_t^{mkt} - R_t^f$	0.454 (0.312)	1.716*** (0.391)	0.499 (0.322)	1.716*** (0.402)	0.179 (0.282)	1.121*** (0.323)
$R_t^{nexgem} - R_t^f$	–	–	–	–	0.339** (0.159)	0.473*** (0.127)
Constant	-0.236 (0.267)	-0.079 (0.291)	-1.035 (0.648)	-0.470 (0.425)	-0.944** (0.426)	-0.178 (0.284)
Country FE	–	–	YES	YES	YES	YES
Observations	824	839	824	839	824	839
R-squared	0.008	0.081	0.020	0.088	0.140	0.315
	Panel B: ICAPM Emerging Markets					
Variables	(1) BEFORE	(2) AFTER	(3) BEFORE	(4) AFTER	(5) BEFORE	(6) AFTER
$R_t^{mkt} - R_t^f$	1.373*** (0.332)	1.669*** (0.439)	1.312*** (0.331)	1.656*** (0.450)	0.541** (0.219)	0.713** (0.327)
$R_t^{em\ bi} - R_t^f$	–	–	–	–	0.681*** (0.0413)	0.744*** (0.0509)
Constant	-0.246 (0.288)	-0.317 (0.359)	-6.115*** (1.763)	-1.11 (1.799)	-1.117 (1.178)	-0.962 (1.282)
Country FE	–	–	YES	YES	YES	YES
Observations	702	730	702	730	702	730
R-squared	0.079	0.059	0.135	0.072	0.641	0.531

Notes: The dependent variable is $R_{i,t} - R_t^f$, where i and t stands for country and time, respectively. The estimation uses robust standard errors to allow for correlation across error terms. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Monthly observations are between 2001 and 2014.

Initially, we test for changes in financial integration by using a single-factor CAPM model. For FMs, we find that there is a noteworthy difference in the global market beta before and after 2008. The beta becomes positive and significant in the latter, implying that FMs have become more financially integrated after 2008, while they were segmented from the global markets before. On the other hand, for EMs, the global market beta is positive and significant for both periods, with a slight increase after 2008. Another interesting result we obtain is that the post-2008 market betas for FMs and EMs are of comparable size at approximately 1.7, supporting our view on FMs becoming like EMs in terms of market integration. The magnitude of the coefficient (market beta) is also economically important, implying that a change in international bond returns of 1 percent translates into a 1.7 percent change in FM bond returns after 2008. In this case, assuming a negative shock in global markets that leads to a 1 percent increase in returns, FM bonds will experience an increase of 1.7 percent in returns. Given the nature of bonds, asset prices will move in the opposite direction, i.e., FM bond prices will decrease. As a result, FMs will experience this global shock more severely than advanced markets. As a result, we interpret

our findings as robust evidence in favor of integration of LQ-EMs (over 2000–14) and post-2008 integration of FMs with the global markets.

The results from two-factor ICAPM regressions support the partial-integration argument, where sub-group bond indices are assumed to proxy for local risk factors and the global index is a proxy for global risk factors. For both FMs and EMs, R^2 values are notably higher than those of single-factor regressions, demonstrating that both local and global factors are priced, but separately. In the FM case, while before 2008 only local factors are priced, after 2008 this is true for both local and global factors. R^2 increases from 8.8 percent to 31.5 percent, and large unexplained variance indicate significant other (omitted) risk factors and idiosyncratic risks. For EMs, local and global factors are significant both before and after 2008, indicating their already partially-integrated nature in the 2000s.[11]

All in all, our findings support enhanced financial integration of FMs. Following the monetary easing and increase in capital flows, we find that FMs moved from full-segmentation to greater integration with the global markets. This finding contrasts with Pukthuanthong and Roll (2009) who find little evidence of FMs' integration in world's financial markets and no evidence that integration has been increasing. This also shows that they resemble EMs in terms of their vulnerability to global shocks and to external risks. This comes as no surprise given that financial integration is often accompanied or preceded by economic integration.

Robustness Tests

We run a number of robustness tests. First, we use an alternative specification that includes a proxy for governance (World Bank's International Country Risk Guide Indicators) to see if changes in governance could be driving the main results, i.e. countries with better governance attract more portfolio flows. These governance indicators are not available for all countries, decreasing the sample size by 50 percent. The regressions follow our baseline setup, including a full set of country and year fixed effects. We find an increase in portfolio flows to FMs of about 0.6 percent of GDP relative to LQ-EMs (Appendix Table V). Our reading of the evidence is that although some results lose significance in some specifications, overall our results are highly robust across different specifications.

We also run regressions in which we compare all LIDCs (FMs and NFM-LIDCs) as a group to LQ-EMs using a DiD test. The results are presented in (Appendix Table VI). These tests illustrate that the coefficients of interest are not statistically significant, i.e., when LQ-EMs are compared with the whole LIDC universe, there is no evidence of increased portfolio flows to LIDCs that would suggest convergence towards, or greater similarity with, EMs in terms of these flows. Our initial findings indicating a similar trajectory between FMs and EMs are specific to FMs. After 2008, private capital flows to FMs have been on a different trajectory from those to the rest of the LIDC group.

Additionally, we test for the suitability of our FM classification, as this might distort our findings. The IMF taxonomy used to identify FMs differs from the developing countries' classification by rating agencies and market analysts in some respects but is robust. As noted above, in the IMF's classification, FMs are first and foremost LIDCs, whereas for market analysts FMs are primarily a subset of EMs though they also include some AEs.[12] A common feature of market analysts' classifications is that they are designed for financial professionals and tend to put more weight on financial accessibility[13] and investment returns while considering other macroeconomic fundamentals that have a bearing on investment returns. By contrast, in the IMF's classification, macroeconomic fundamentals and indicators of financial depth and openness

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[11]   The literature documents that EMs moved from full-segmentation to partial-integration in the 1990s (Henry, 2000).

[12]   Including rating agencies' bond indices—Next Eleven, FTSE, MSCI, Russell, NEXGEM, and EMBI.

[13]   Referring to multiple indicators including market depth, liquidity, and openness to foreign investors.

have a more prominent role as the FMs' selection or qualification criteria. After an exercise aimed at constructing an FMs' group that takes into account both the IMF's taxonomy and the classification by market analysts, we end up with an FMs' group that confirms the robustness of the IMF's classification (Appendix Table III provides details on the exercise).

5. CONCLUSION

Over the past decade, capital flows to FMs increased significantly, reflecting FMs' improved macroeconomic performance and investors' greater interest in these economies. Data shows that this trend was particularly strong after the GFC in 2008, a period of loose monetary policy in major AEs and ample global liquidity. In this paper, based on panel data on EMDCs covering the period 2000–14, we focus on investigating whether FMs resemble EMs in terms of both the trends and patterns portfolio flows, as well as the level of FMs' integration with global financial markets. We use two empirical frameworks for our analysis. First, we use the DiD framework to test for the changing trends in portfolio flows and the patterns of such flows for different EMDCs subgroups. Second, to test for the change in FMs' integration with global markets, we rely on an ICAPM model.

The evidence from our DiD results suggests that, in terms of capital flows, since the 2008 crisis, FMs resemble EMs and that they differ from the rest of LIDCs. FMs' resemblance to EMs after the crisis stems from two findings. First, in terms of the volume of capital flows, portfolio flows to FMs have exceeded those to EMs by about 0.6 percentage points of GDP a year, meaning that FMs have been catching up with EMs. Second, when the level of risk aversion is taken into account, portfolio flows to FMs are not statistically different from those to EMs. The finding suggests that in times of heightened stress in global financial markets FMs are just as vulnerable as EMs to portfolio flows drying up or being reversed. This was observed in 2008, 2009, and in 2013, the year of the taper tantrum.

Our findings from the ICAPM analysis complements the results from the DiD in two respects. First, they suggest that FMs were not integrated with global financial markets by the time of the 2008 GFC, confirming why FMs largely escaped the turmoil in global markets and lending support to the finding of a significantly higher increase in portfolio flows relative to those to EMs only after the crisis. Second, there has been a shift in FMs' integration with global financial markets after the crisis, reflected by their market beta becoming positive and significant. This sign of greater comovement between FMs' and global markets' returns points to a new risk of increased vulnerability to changes in global market conditions and capital reversals that these economies face.

The results suggest that there has been a change in the landscape of capital flows to developing countries that may have policy implications. The finding of FMs' greater vulnerability to adverse developments in global financial markets points to the importance having in place frameworks for FMs to manage vulnerabilities to capital flow reversals and cope with such reversals that could jeopardize macroeconomic performance.

There are a number of caveats in our paper. First, the study's conclusions are based on changes that have occurred during a relatively short period of unusually lax monetary conditions in major AEs. As such, they may not reflect a permanent shift in the way FMs compare to EMs. Also, identifying FMs in our sample, might entail a certain level of sample bias to the extent that the selection of FMs is not random. However, controlling for other determinants of portfolio flows, as done in our regressions, mitigates this bias. Moreover, the selection does not drive our findings, which are interesting and quite intuitive. Additionally, in our tests of financial market integration, we are not able to include all FMs in our regressions, as the bond return data is not available. A larger sample size would have improved the robustness of our findings. As we do not provide

any indication of what the shifts imply for either FMs' financing needs or the framework for strengthening resilience to adverse external financial shocks, there is room for further research on the policy implications of our findings.

Acknowledgement

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APPENDIX

Technical Appendix. Econometric Framework and Identification Strategy

This section will provide an overview of the underlying assumptions for our empirical strategy. Let us first rewrite a simplified version Equation 1:

$$\frac{NPI_{i,t}}{Y_{i,t}} = \beta_0 LIDC_{i,t} + \beta_1 Crisis_t + \beta_2 FM_{i,t} + \beta_3 FM_{i,t} * Crisis_t +$$

$$+ \beta_4 NFM_{i,t} * Crisis_t + \gamma X_{i,t} + u_{i,t} \tag{E1}$$

We define the LIDCs eligibility assignment set $\varepsilon_t \equiv \{i \in \mathcal{I} : LIDC_{i,t} = 1\}$. The complement of ε_t, ε_t^C is the control assignment set. Let F_t^- be the frontier of some set F_t. Then,

$$B_t \equiv \bar{\varepsilon}_t \cap \varepsilon_t^C \tag{E2}$$

we define the lower bound of EMs B_t as:

We define three groups by their distance to ad-hoc cutoffs.

Let $B_{h^+,t} \equiv B_{h,t} \cap \varepsilon_t, B_{h^-,t} \equiv B_{h,t} \cap \varepsilon_t^C, B_{h^{--},t} \equiv \varepsilon_t \cap B_{h^-,t}$ be the lower bound of the EMs and the FMs and the LIDC non-FMs countries, respectively.

The idea of the methodology used in this paper is to compare the outcome (i.e., portfolio investments) while controlling for the cross-sectional variation between countries and the time series variation. Using the diff-in-diff, our estimators take into account any permanent, i.e., time-invariant, difference between the treatment groups (FMs and NFM-LIDCs) and the control group (lower bound of EMs) by the inclusion the $FM_{i,t}$, $LIDC_{i,t}$ and $NFM_{i,t}$. Further, any common trend affecting both groups is also differentiated away by the inclusion of $Crisis_t$. In sum, treat for endogeneity issues cannot come from either permanent differences between the control and the treatment groups, or shared trends.

Consider each group of countries and denote τ the conditional expectation of equation E1. We have:

- EMs, $\beta_{h^+,t}$: $LIDC_{i,t} = 0$, $Frontier_{i,t} = 0$, $NFM_{i,t} = 0$

$$\tau^{Before} = E\left(Y_{i,t} \mid Crisis_t = 0, X_{i,t}\right) = \gamma X_{i,t} \tag{E3}$$

$$\tau^{After} = E\left(Y_{i,t} \mid Crisis_t = 1, X_{i,t}\right) = \beta_1 + \gamma X_{i,t} \tag{E4}$$

(E4) – (E3) is the effect of the crisis on the EMs control group = β_1. Adding $X_{i,t}$ allows us to diminish the endogeneity concern that these countries' capital flows would have changed over the period of observation even if the financial crisis had not been here.

- FMs, $\beta_{h^-,t}$: $LIDC_{i,t} = 1$, $Frontier_{i,t} = 1$, $NFM_{i,t} = 0$

$$\tau^{Before} = E\left(Y_{i,t} \mid Crisis_t = 0, X_{i,t}\right) = \beta_0 + \beta_2 + \gamma X_{i,t} \tag{E5}$$

$$\tau^{After} = E\left(Y_{i,t} \mid Crisis_t = 1, X_{i,t}\right) = \beta_0 + \beta_1 + \beta_2 + \beta_3 + \gamma X_{i,t} \tag{E6}$$

(E6) – (E5) is the effect of the crisis on the FMs = $\beta_1 + \beta_3$. Adding $X_{i,t}$ allows us to diminish the endogeneity concern that these countries' capital flows would have changed over the period of observation even if the financial crisis had not been here.

- LIDCs Non-FMs: $LIDC_{i,t} = 1$, $Frontier_{i,t} = 0$, $NFM_{i,t} = 1$

$$\tau^{Before} = E\left(Y_{i,t} \mid Crisis_t = 0, X_{i,t}\right) = \beta_0 + \gamma X_{i,t} \tag{E7}$$

$$\tau^{After} = E\left(Y_{i,t} \mid Crisis_t = 1, X_{i,t}\right) = \beta_0 + \beta_1 + \beta_4 + \gamma X_{i,t} \tag{E8}$$

(E8) – (E7) is the effect of the crisis on the NFM-LIDCs = $\beta_1 + \beta_4$. Adding $X_{i,t}$ allow us to diminish the endogeneity concern that these countries' capital flows would have changed over the period of observation even if the financial crisis had not been here. Further, the vector $X_{i,t}$ improves the efficiency of our estimators (Roberts and Whited, 2012).

Our strategy addresses the secular trends by examining the outcomes (i.e., Portfolio Investments) for similar groups of countries that are less likely to receive the "treatment" but share broadly similar influence to the trending variables. Compared to our control group for EMs, one would expect to see a sharp change in capital flows for the FMs following 2008, this approach is called the difference-in differences (DiD). In our context, the DiD estimator for FMs countries is obtained by differentiating (E6 – E5) and (E4 – E3) which yields β_3.

Table I.
List of Low Income Developing Countries (LIDCs)

This table illustrates all countries classified as low-income and developing (LIDCs) by the IMF (as of 2014). LIDCS are defined as countries that can benefit from IMF's Poverty Reduction and Growth Trust as of 2013 and have a per capita Gross National Income (GNI) less than twice the IDA cut-off point or US$2,390 for 2013).

Afghanistan	Guinea	Niger
Bangladesh	Guinea-Bissau	Nigeria
Benin	Haiti	Papua New Guinea
Bhutan	Honduras	Rwanda Senegal
Bolivia	Kenya	Sierra Leone
Burkina Faso	Kiribati	Solomon Islands
Burundi	Kyrgyz Republic	Somalia
Cambodia	Lao P.D.R.	South Sudan
Cameroon	Lesotho	Sudan
Central African Republic	Liberia	Sao Tome and Príncipe
Chad	Madagascar	Tajikistan
Comoros	Malawi	Tanzania
Congo, Democratic Republic of the	Mali	Togo
Congo, Republic of	Mauritania	Uganda
Côte d'Ivoire	Moldova	Uzbekistan
Djibouti	Mongolia	Vietnam
Eritrea	Mozambique	Yemen
Ethiopia	Myanmar	Zambia
Gambia, The	Nepal	Zimbabwe
Ghana	Nicaragua	

Table II.

Countries' Sub-Groups

This table illustrate developing countries' sub-groups used in this paper for analytical purposes. In Panel A, the first column shows the list of FMs and, besides each country, the year in which it met the FMs classification criteria. The second column shows the EMs in our control group. Panel B presents the subgroups used in our financial integration (ICAPM) analysis.

Panel A		Panel B	
FMs	EMs (Control Group)	FMs	EMs
Bangladesh (2010)	Angola	Bolivia	Angola
Bolivia (1997)	Armenia	Ghana	Egypt
Côte d'Ivoire (2010)	Egypt	Côte d'Ivoire	El Salvador
Ghana (1997)	El Salvador	Senegal	Georgia
Kenya (1996)	Fiji	Tanzania	Indonesia
Mongolia (2008)	Georgia	Vietnam	Morocco
Mozambique (1999)	Guatemala	Zambia	Paraguay
Nigeria (1998)	Indonesia	Nigeria	Sri Lanka
Papua New Guinea (2003)	Kosovo	Kenya	Tunisia
Senegal (2009)	Morocco	Mongolia	Guatemala
Tanzania (2010)	Paraguay	Honduras	Ukraine
Uganda (2010)	Sri Lanka	Mozambique	
Vietnam (2008)	Swaziland		
Zambia (1998)	Syria		
(Honduras)	Tunisia		
	Ukraine		

Table III.
Deriving a Frontier Market Group Combining IMF and Market Analysts' Classifications

This table illustrates the results from robustness checks conducted for FM country classification. To construct an FM group that takes into account IMF's and market analysts' classification, for each country that does not exceed the income threshold separating LMIC from UMIC, the classification by each of the market analysts or the IMF takes discrete values of -1, 1, and 0, when the country is classified as an EM, an FM, or neither, respectively. As we are more interested in macroeconomic fundamentals, the IMF's classification is assigned the same weight as all the market analysts together while individually, market analysts are assigned equal weights. For a country, if the overall weighted average rating is at least 0.5, it means that either the IMF's characterization of the country as FM is confirmed or that market analysts overwhelmingly classifies the country as an FM even when the IMF considers it to be a NFM-LIDC. Yellow highlights indicate country is not FM while green highlights indicate country is FM after taking into account IMF and market analysts' classifications.

Country	IMF	Next Eleven	FTSE	MSCI	Russell	NEXGEM	EMBI	Weighted average rating (WaR)	Classification, FM = 1 if WaR ≥ 0.5
Indonesia	-1	-1	-1	-1	-1		-1	-0.917	0
Egypt	-1	-1	-1	-1	1	1	-1	-0.667	0
Angola	-1	0	0	0	0	1	-1	-0.500	0
El Salvador	-1	0	0	0	0	1	-1	-0.500	0
Fiji	-1	0	0	0	0	0	0	-0.500	0
Guatemala	-1	0	0	0	0	1	-1	-0.500	0
Kosovo	-1	0	0	0	0	0	0	-0.500	0
Paraguay	-1	0	0	0	0	1	-1	-0.500	0
Swaziland	-1	0	0	0	0	0	0	-0.500	0
Syria	-1	0	0	0	0	0	0	-0.500	0
Armenia	-1	0	0	0	0	1	0	-0.417	0
Georgia	-1	0	0	0	0	1	0	-0.417	0
Ukraine	-1	0	0	1	1	0	-1	-0.417	0
Morocco	-1	0	1	1	1	0	-1	-0.333	0
Tunisia	-1	0	1	1	1	0	-1	-0.333	0
Sri Lanka	-1	0	1	1	1	1	-1	-0.250	0
Bolivia	1	0	0	0	0	1	-1	0.500	1
Mongolia	1	0	0	0	0	1	-1	0.500	1
Papua New Guinea	1	0	0	0	0	0	0	0.500	1
Tanzania	1	0	0	0	0	1	-1	0.500	1
Uganda	1	0	0	0	0	0	0	0.500	1
Mozambique	1	0	0	0	0	1	0	0.583	1
Senegal	1	0	0	0	1	1	-1	0.583	1
Zambia	1	0	0	0	1	1	-1	0.583	1
Honduras	0	0	0	0	0	1	0	0.083	0
Bangladesh	1	-1	1	1	1	0	0	0.667	1
Côte d'Ivoire	1	0	1	0	1	1	-1	0.667	1
Nigeria	1	-1	1	1	1	1	-1	0.667	1
Vietnam	1	-1	1	1	1	1	-1	0.667	1
Ghana	1	0	1	1	1	1	-1	0.750	1
Kenya	1	0	1	1	1	1	0	0.833	1

Table IV.

Robustness Checks: Investigating Treatment Effects per year

The regressions in this table replicate the specifications of the main results, with the exception that FM or NFM-LIDC are interacted with time dummies for each year. All columns include country and year fixed effects. The table shows only the interactions of FM with year dummies. All standard errors are clustered at the country level, allowing for autocorrelation across time and within the country. Observations are between 2000 and 2014. [***] $p < 0.01$, [**] $p < 0.05$, [*] $p < 0.1$.

	NPI/Y			
	(1)	(2)	(3)	(4)
(year==2001)[*]FM$_{i,t}$	0.304	0.304	0.304	0.263
	(0.532)	(0.532)	(0.571)	(0.567)
(year==2002)[*]FM$_{i,t}$	0.167	0.167	0.230	0.203
	(0.530)	(0.530)	(0.568)	(0.564)
(year==2003)[*]FM$_{i,t}$	0.188	0.188	0.273	0.235
	(0.530)	(0.530)	(0.567)	(0.563)
(year==2004)[*]FM$_{i,t}$	-0.430	-0.430	-0.357	-0.399
	(0.530)	(0.530)	(0.566)	(0.562)
(year==2005)[*]FM$_{i,t}$	0.101	0.101	0.211	0.198
	(0.530)	(0.530)	(0.565)	(0.561)
(year==2006)[*]FM$_{i,t}$	0.101	0.101	0.217	0.196
	(0.530)	(0.530)	(0.564)	(0.560)
(year==2007)[*]FM$_{i,t}$	1.243[**]	1.243[**]	1.357[**]	1.276[**]
	(0.530)	(0.530)	(0.565)	(0.560)
(year==2008)[*]FM$_{i,t}$	0.0197	0.0197	0.128	0.122
	(0.530)	(0.530)	(0.565)	(0.560)
(year==2009)[*]FM$_{i,t}$	0.0151	0.0151	0.128	0.121
	(0.530)	(0.530)	(0.564)	(0.560)
(year==2010)[*]FM$_{i,t}$	1.169[**]	1.169[**]	1.286[**]	1.237[**]
	(0.530)	(0.530)	(0.565)	(0.560)
(year==2011)[*]FM$_{i,t}$	1.115[**]	1.115[**]	1.232[**]	1.166[**]
	(0.531)	(0.531)	(0.565)	(0.561)
(year==2012)[*]FM$_{i,t}$	2.045[***]	2.045[***]	2.150[***]	1.981[***]
	(0.531)	(0.531)	(0.565)	(0.561)
(year==2013)[*]FM$_{i,t}$	0.303	0.303	0.380	0.270
	(0.531)	(0.531)	(0.565)	(0.561)
(year==2014)[*]FM$_{i,t}$	1.254[**]	1.254[**]	1.358[**]	1.302[**]
	(0.531)	(0.531)	(0.566)	(0.561)
Observations	1,040	1,040	1,002	1,002
R-Squared	0.233	0.233	0.232	0.242
F tests on equality of coefficients				
F-stat 2008=2011	2.91	2.91	3.06	2.78
p-val 2011	0.0549	0.0549	0.0474	0.0628
F-stat 2008=2012	9.88	9.88	9.77	8.34
p-val 2012	0.0001	0.0001	0.0001	0.0003
F-stat 2008=2013	0.21	0.21	0.24	0.12
p-val 2013	0.8137	0.8137	0.7861	0.8889

Table V.
Robustness Check: Controlling for Governance

The regressions in this table serve as a robustness check of the main results presented in Table 2. The specifications are somewhat modified and one regression specifically includes the quality of governance among the regressors. All columns include country and year fixed effects. All standard errors are clustered at the country level, allowing for autocorrelation across time and within the country. Observations are between 2000 and 2014. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

VARIABLES	NPI/Y			NPI/Y		
	(1)	(2)	(3)	(4)	(5)	(6)
$Crisis_t{}^*Frontier_t$	0.674*	0.649*	0.632**	0.630**	0.647**	0.638**
	(0.374)	(0.374)	(0.279)	(0.281)	(0.273)	(0.276)
$Crisis_t{}^*NFM_t$	-0.284	-0.235	-0.316	-0.318	-0.322	-0.315
	(0.287)	(0.287)	(0.273)	(0.275)	(0.281)	(0.277)
VIX_t		-0.00936	-0.0126	-0.0299***	-0.0131	-0.0301***
		(0.00837)	(0.00974)	(0.00811)	(0.00987)	(0.00837)
U.S 10-Y TB yield$_t$		-0.379**	-0.279***	-0.155*	-0.262**	-0.143*
		(0.147)	(0.101)	(0.0794)	(0.104)	(0.0798)
Growth$_t$		0.892	1.122*	1.270**	1.071*	1.259**
		(0.696)	(0.597)	(0.571)	(0.604)	(0.592)
Debt/GDP$_{t-1}$			-1.57e-06***	-1.59e-06***	-1.60e-06***	-1.63e-06***
			(5.16e-07)	(4.78e-07)	(5.57e-07)	(5.08e-07)
Fiscal-Balance/GDP$_{t-1}$			-5.87e-06	-4.62e-06	-6.82e-06	-5.44e-06
			(5.02e-06)	(5.12e-06)	(7.81e-06)	(7.70e-06)
Governance$t$					0.00774	0.00146
					(0.0158)	(0.0164)
Country Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	731	682	580	580	571	571
R-squared	0.164	0.199	0.188	0.221	0.188	0.222

Table VI.

Robustness Check: Investigating the Difference of all LIDCs with EMs

The regressions in this table serve to investigate whether, compared to the LQ-EMs, all LIDCs are affected differently in term portfolio investments. The dependent variable is the ratio of (net) portfolio investment liabilities to GDP. The main regressors are: (i) interaction term of the dummy variable *LIDC* (= 1 if country i is part of the LIDC group) and a time dummy variable that indicates the start of the crisis (= 1 after 2008). All columns include country and year fixed effects. Country observable characteristics, push and pull factors are added to control for capital flow determinants. All standard errors are one-way clustered at the country level. Observations are between 2000 and 2014. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

	NPI/Y			NPI/Y	
	(1)	(2)	(3)	(4)	(5)
$Crisis_t {}^* LIDC_t$	1.569	1.569	0.0118	-0.00923	0.0544
	(1.380)	(1.380)	(0.236)	(0.234)	(0.226)
VIX_t		-0.0549	-0.0196**	-0.203***	-0.0208***
		(0.0404)	(0.00756)	(0.00766)	(0.00769)
$U.S\ 10\text{-}Y\ TB\ yield_t$		0.331	-0.0515	-0.0289	-0.0470
		(0.438)	(0.0939)	(0.0935)	(0.0954)
$Growth_t$			0.00313	0.0259	0.00350
			(0.00533)	(0.00529)	(0.00509)
$Debt/GDP_{t-1}$			2.05e-08	1.05e-08	4.61e-08
			(5.62e-08)	(5.27e-08)	(5.02e-08)
$Fiscal\ Balance/GDP_{t-1}$			9.12e-08	5.44e-09	6.74e-08
			(1.16e-07)	(1.21e-07)	(1.15e-07)
$Current\ Account/GDP_t$				-0.0155**	
				(0.00695)	
$Export/GDP_t$					-0.0140
					(0.0167)
Observations	1,220	1,220	896	896	896
Country FEs	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES
R-squared	0.561	0.561	0.313	0.318	0.316

Financial Stability Reports in Latin America and the Caribbean

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ABSTRACT

Many countries in Latin America and the Caribbean now publish financial stability reports. They use FSRs as a tool for financial surveillance and communication. This study reviews their latest issues to assess their content, quality, and transparency, and the extent to which the country's macrofinancial and institutional context affect the quality of the publications. While some reports provide a strong analysis of risks and vulnerabilities, there are significant cross-country differences, and many reports could be improved by adopting a more comprehensive, forward-looking, and thematic assessment of financial stability. A well thought out communication strategy, including a regular and predictable publication schedule and an easily accessible website, is also important to enhance the impact of the reports. Data gaps, particularly at the disaggregated level, are material and need to be urgently addressed.

JEL classification: G01; G18; G28.

Key words: Financial Stability Report; Financial Supervision.

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1. INTRODUCTION

Ensuring safe and healthy financial systems has become an important policy objective for policymakers around the world. While the real economy is dependent on credit intermediated by the financial sector to grow and innovate, the scale and speed of financial flows can overwhelm the real economy, especially in times of stress. From 1980 through 2007, the world's financial assets – including equities, private and public debt, and bank deposits – nearly quadrupled in size relative to world gross product.[2] A disruption to financial services could generate market volatility and, in a worst case, trigger a full-blown crisis that brings significant social and economic hardship to the population. The Great Recession that followed the 2008 upheaval in global financial markets, when the total value of the world's financial assets fell by a record $16 trillion,[3] is an important case in point.

An effective tool for communicating the health of the financial system and for presenting the policy toolkit available to address emerging risks is the publication of financial stability reports (FSRs). Publishing the assessment of financial stability on a regular basis alerts the general public (investors, savers, market analysts, and other observers) about potential and emerging risks and hold central banks and financial supervisors accountable for designing effective policy responses. By anticipating systemic risk and promoting a public debate about policies, FSRs would encourage more prudent behaviors and prompt the authorities to take actions that enhance financial system stability. Among the first countries to publish FSRs were the Bank of England and the Nordic central banks, whose countries had suffered a series of banking failures in the early 1990s. More recently, macroprudential authorities, including the U.K. Financial Policy Committee and the U.S. Financial Stability Oversight Council (FSOC)[4] have assumed the responsibility for publishing FSRs in accordance to their new mandate to oversee systemic risk in the financial system.[5]

The purpose of this paper is to assess the extent which publication of FSRs have taken root in Latin America and the Caribbean (LAC) as a tool for financial surveillance and communication. The paper asks four questions: (i) who produces FSRs – the central bank or the macroprudential authorities, or a combination of both? (ii) how good is the content and quality of FSRs? This will be assessed against a defined set of benchmarks that covers the purpose and scope of the FSR, the data and analytical depth, and the communication strategy; and (iii) does the quality of an FSR depend on who issues it? and (iv) what are the FSRs' key strengths and areas for improvements? The paper will provide specific recommendations to improve the effectiveness and impact of FSRs.

Building on existing work, this study will review the content and quality of FSRs issued in Latin America and the Caribbean (LAC). There are two reasons why this is a timely exercise. First, the LAC region is undergoing significant financial deepening and development, and banks are becoming increasingly integrated across borders through financial conglomerate structures. With the region coping with slower growth and volatile capital flows as advanced economies continue to normalize monetary policy, it is important for central banks and regulatory authorities to closely monitor financial trends and emerging risks, and to develop a better understanding of the underlying structure of domestic and global financial markets. Second, the number of countries in the region issuing FSRs has now become sufficiently large to allow a comparative study of their quality and impact**.** Since 2002, when Brazil first published its FSR, the number

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[2]   McKinsey & Company, "Global capital markets: Entering a new era", McKinsey Global Institute report, September 2009.

[3]   McKinsey & Co. (2009).

[4]   The FSOC was established as part of the wholesale regulatory changes mandated by the Dodd-Frank Act. FSOC Annual Reports can be found on the FSOC website at https://www.treasury.gov/initiatives/fsoc/.

[5]   See "Country Reports", Center for Financial Stability.

has grown to 19 (Table 1).[6] Given that the exercise is based on a subjective assessment relative to the established criteria, it will invariably involve an element of judgment.

The paper is organized as follows. Section 2 provides a brief literature review and the methodology that will be used in the assessment. Section 3 provides a brief description of the country sample, Section 4 reviews the types of institutions issuing the reposts, and Section 5 reports the results of the analysis, and discusses the correlation between the quality of FSRs with key macroeconomic and financial indicators. Section 6 concludes with specific recommendations to improve the quality and traction of FSRs.

2. LITERATURE AND METHODOLOGY

Studies that have attempted to assess the link between FSR publication and financial stability have indicated a positive relationship although the results are tentative at best. The first studies to make this attempt (Cihak (2006), Osterloo et al. (2007), and Cihak et al. (2012)) do not find a direct link between FSR publication and financial stability, although Cihak et al. (2012) conclude that "higher-quality reports tend to be associated with more stable financial environments."[7] In another review, Wilkinson et al. (2010) find the FSRs of four advanced countries that have had considerable experience in preparing these reports (United Kingdom, Sweden, the Netherlands, and Spain) correctly identified the risks that contributed to the 2008 financial crisis in the period leading up to the crisis, but significantly underestimated their effects. The authors argue that had the FSRs fully anticipated the magnitudes of the potential problems, regulatory authorities and financial institutions might have taken more aggressive steps to mitigate the identified risk exposures. In their view, the challenge for policymakers going forward is to strengthen the surveillance role of FSRs with more rigorous and objective analysis. Born et al. (2014) analyze the impact of FSRs and other central bank communication on financial sector stock prices. They find that FSRs, especially when containing optimistic assessments, have a significantly positive impact on stock prices, highlighting the importance of FSRs as communication tools. Correa et al. (2017) construct a financial stability index based on positive and negative connotations of wording used in FSRs. They find that the sentiment captured in this index deteriorates just before the beginning of banking crises.

We apply the method developed by Cihak (2006) and illustrated in detail in Cihak et al. (2012). Under this approach, the quality of the reports is evaluated on the basis of 26 criteria covering five broad elements: clarity of aims (A), overall assessment (B), coverage of issues (C), data, assumptions, and tools (D), and structure and other features (E). For operational reasons, we have fleshed out the criteria in more detail than in the two Cihak studies but, to enhance the comparability with previous results, we have kept the same weighting and rating scale. While the details of the criteria are spelled out in the Appendix (Appendix Tables 1-2), the following gives an overview of the underlying principles.

A: Aims, Objectives, and Reasons
- **FSRs should explicitly state their aims.** The reports should aim to inform the public and encourage a constructive debate about financial sector developments and policies, holding public authorities accountable for their surveillance of the financial system. The information provided should facilitate a proper assessment of risks by investors active in the market.

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[6] In addition, the Caribbean Centre for Money and Finance (2016) at the University of the West Indies, in collaboration with the CARICOM central bank and banking supervisors, has recently published a Caribbean Regional Financial Stability Report. The report "complements the national financial stability reports and its purpose is to sensitize the main regional financial stability stakeholders, including the regional public, of issues relevant to the stability of the financial system in the region." This report is not assessed in this study.

[7] The authors assessed the impact of FSRs on various indicators of financial stability (such as the occurrence of systemic banking crisis or indices of financial vulnerabilities) for 44 countries.

- **FSRs should be clear about what is meant by financial stability.** The definition should include a dynamic perspective: a financial system is stable not only when it is carrying out its essential functions and services (such as providing payments and ensuring an efficient reallocation of funds from savers to investors), but when it is also capable of withstanding the shocks and strains that can be reasonably expected to affect it in the short and medium term. Since countries are exposed to different types of shocks, the definition can vary, to some extent, from country to country; it is however important that the report should clarify the operational benchmarks used to assess whether or not the system is stable, explaining what data, indicators, and type of information would be monitored for this purpose.

B: Overall Assessment
- **The executive summary should be succinct and easy to read.** The lack of a well-articulated executive summary is a missed opportunity to inform and guide public opinion. A reader should not have to sift through the entire report to distill the main conclusions of the analysis and should be able to understand the key messages of the report even if the reader is not financially sophisticated. More advanced and technical material should be covered in the analytical chapters, preferably in boxes or annexes. The function of the executive summary is to bring together the various strands of analysis developed in the rest of the report, presenting a panoramic and candid view of risks and vulnerabilities, including politically sensitive risks. The executive summary should also discuss how these risks have evolved since the previous issue of the report and provide a summary of the key recommendations.
- **FSRs should integrate macroeconomic and financial analysis.** This analysis should flow in both directions, assessing the key macroeconomic trends that can have an impact on the stability of the financial sector as well as the key financial sector developments that can, in turn, have an impact on the real economy. The report should identify the main transmission channels that link the financial and real economy and assess in quantitative terms how shocks in one area could reverberate in the other areas.

C: Coverage of Issues
- **FSRs should be forward looking, frank, and consistent over time.** This is the most important criterion and is often found lacking. The reports should not only describe past and current developments but look ahead to identify future trends that could bring both opportunities and risks to the financial sector. FSRs should not refrain from highlighting potential weaknesses or vulnerabilities, nor from addressing sensitive issues, while paying due regard to protecting confidentiality and avoiding unwarranted destabilizing comments. To facilitate clarity and comparisons, reports should also maintain a consistent approach over time, following up on topics raised in previous issues while they remain relevant; changes can be introduced occasionally, but they should be well motivated and clearly explained to the readers.
- **FSRs should cover all relevant areas of the financial sector.** While banks typically account for the largest share of the financial sector (e.g., in terms of assets or value-added), the reports should not limit the discussion to banks, especially if the nonbank financial sector and capital markets are significant by size or pose their own challenges. All these areas are potential sources of risk and vulnerabilities that could spread to other areas of the financial sector and also affect the real economy.

D: Data, Assumptions, and Tools
- **FSRs should not only explain, but also properly justify the assumptions used.** This is especially relevant in the case of stress tests, whose meaning and interpretation depends critically on the assumptions made regarding the severity of the shocks, the speed and scale

of the impact of shocks on default probabilities, the hurdle rates on capital and liquidity, dividend distribution, and other parameters of the test. Ideally, stress tests should be computed within a general equilibrium framework with the support of satellite econometric models that link macroeconomic and financial conditions. Simpler, partial-equilibrium, or even ad hoc tests can also be appropriate, and could be the inevitable consequence of capacity or data constraints, but any limitations of this choice should be described and explained.

- **FSRs should indicate the data and methodology used and make them easily available.** As most reports already do, the sources and cut-off date of the data should be indicated clearly and in an easily identifiable place (in the introduction or preface of the report). The data used should also be made available to the public on the internet, in the same website where the reports are published. The methodology used for projections, sensitivity analyses, and stress tests should be explained in clear and simple terms in the text, with more technical details provided in special boxes or annexes. In analyzing the data, the report should consider not only aggregate and average measures but also distributional indicators and, where appropriate, extreme or individual values (with proper safeguards to preserve confidentiality), highlighting, for instance, the position of the weakest or most vulnerable institutions or asset classes.

E: Structure and other features

- **The reports should follow a logical and integrated structure with unifying themes centered on the key risks.** The structure should enable the reader to identify which parts of the report contain specific information about different topics, while also facilitating the discussion of cross-cutting topics. The structure should be consistent over time to allow the reader to compare the assessments and should contain boxes or appendices dedicated to issues that either evolve slowly over time (such as financial inclusion) or reflect passing concerns (such as "taper tantrum" capital flows). The reports should have an executive summary, several chapters devoted to external and domestic developments that affect the financial sector and changes in the financial infrastructure, including on the regulatory and supervisory framework, and should preferably include a table of acronyms, a glossary of technical terms, a methodological annex, and a statistical appendix.

- **The publication of the reports should be supported by a well-designed communication strategy.** The current and past issues of the reports should be made available on the internet in a dedicated webpage that is easy to navigate and easy to find on the home page of the publishing authority; this page should also contain a database containing the data used as well as links to other relevant publications and to other agencies and sources of information. The launch of the report should be supported by an outreach campaign aimed at disseminating the main messages and recommendations through audio-visual broadcasts, press releases, public presentations, and press conferences. The format and medium of the communication should be adapted depending on the intended audience.

- **The publication of the report should follow a timely, regular and predictable schedule.** As financial sector conditions can change very rapidly, reports should be published within three months of the cutoff date for the data, preferably at least two times a year. The publication date should be announced in advance, so that the readers know when to expect the next issue; and should change only infrequently. The past publication dates should also be clearly indicated on the website, to enable the readers to know what information was available to the public at different times.

To illustrate how this method is used to assess the quality of an FSR, we apply it to the July 2016 issue of the Bank of England's FSR as a demonstration of a report that meets these criteria effectively (Box 1). Nevertheless, this example should be put in context given that the United Kingdom has a much deeper financial system and the Bank of England has access to extensive

technical and professional resources, the institutional mandate, and historical experience, that are not available to all the authorities that issue FSRs in the LAC region.

Each report is given a score between 1 and 4 (higher values representing better quality) on each of the 26 criteria.[8] An overall composite score is computed as the weighted average of the ratings for all criteria, using the weights suggested in Cihak (2006) to maintain comparability.[9] While the criteria and weights are the same for all countries, allowing a comparable assessment, this does not mean that a one-size fits all approach is taken. While some criteria clearly apply equally to all countries (e.g., the statement of aims), others are interpreted based on country-specific factors. For example, when assessing whether all relevant risks are covered, comparisons were made with respect to country-specific risks and not a common set of global risk factors.

Box 1. The Financial Stability Report of the Bank of England

The Bank of England (BoE) has been one of the first central banks to publish FSRs, with the first report issued as early as 1996.[1] Given its long history, the BoE has over the years honed the report to what is today considered an industry best practice. The key features of the July 2016 report include:

- **A clear statement of aims and objectives**. The FSR sets out the Financial Policy Committee's views of the outlook for financial stability, including its assessment of the resilience of the U.K. financial system and the current main risks to financial stability, and the action the Committee is taking to remove or reduce these risks. It also reports on the activities of the Committee over the reporting period and on the extent to which the previous policy actions have succeeded in meeting the Committee's objectives.
- **A succinct executive summary**. The Executive Summary pulls together the assessment under a single theme (in this issue, risks around the Brexit referendum) as the most significant near-term domestic risks to financial stability.
- **A candid assessment**. The report clearly flags the challenging outlook for U.K. financial stability, noting the United Kingdom's large current account deficit, the over-stretched commercial real estate market, the high level of household indebtedness, subdued growth in the global economy, and fragilities in financial market functioning, are channels through which the referendum could increase risks to financial stability. The report identifies the policy actions that have been taken so far and makes clear that as the outlook evolves, the Financial Policy Committee stands ready to take any further actions deemed appropriate to support financial stability.
- **An easy-to-follow structure that facilitates comparison over time.** The report is divided into two parts (risks and resilience), with annexes that highlight previous macroprudential policy decisions and core indicators underpinning the countercyclical capital buffer and sectoral capital requirements.
- **A full-fledged communication strategy**. The BoE maintains a dedicated webpage on financial stability that is easily accessible from its home page and contains the latest and past issues of the FSR (since 1996), links to data and relevant studies, and an e-mail address for providing questions and feedback. The report is launched by the Governor with a press conference whose video recording and transcript are also available on the web page. The publication schedule is fairly regular, with past and next-issue publication dates clearly indicated on the webpage.
- **Well documented data sources.** While the report uses mainly aggregate data, it provides distributional analysis of key variables (such as capital) among banks. The cutoff date for the data is clearly indicated (July 1, 2016) and data corrections are also posted subsequently. Data for charts and tables used in the report are made available online, and a detailed description of the data used are provided in a series of footnotes.

[1] Prior to 2006, the reports were known as "Financial Stability Review."

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[8] Each FSR undergoes several rounds of reviews. The final scores are determined after multiple iterations to ensure consistent application of the criteria.

[9] We have also tested the robustness of the results to different weights by applying equal weights to all elements. These changes do not alter the substance of the results.

3. DATA AND SAMPLE

The sample consists of the 20 latest FSRs issued by 19 countries in the region as of July 2016 (Appendix Table 3). In addition to the main sample of reports, we have also examined preceding reports, notably to asses those criteria that are about consistency (A3, A4, B3, C2, E3). These reports are available online.[10] Among the Caribbean economies, four produce FSRs, a remarkable number considering the small size of these economies. However, three countries appear to have either delayed or discontinued their publication in the last few years (Ecuador, Guatemala, and Nicaragua).[11]

The 19 countries in the sample form a heterogeneous group, with per-capita GDP ranging from less than US$2,000 (Nicaragua) to more than US$20,000 (The Bahamas), population ranging from less than 300,000 (Barbados) to more than 200 million (Brazil), and GDP ranging from US$4.4 billion dollars (Barbados) to more than US$1 trillion (Brazil and Mexico) (Table 1). The three largest countries in the group (Brazil, Mexico, and Argentina) account for two-thirds of its population and GDP.

Table 1
Economic and Social Indicators of Sample Countries (as of end-2015)

| Country	GDP(US$ billion)	Population (million)	GDP per capita (US$)
Argentina	585.6	43.1	13,589
Barbados	4.4	0.3	15,774
Bolivia	33.2	11.5	2,886
Brazil	1,772.6	204.5	8,670
Chile	240.2	18.0	13,341
Colombia	293.2	48.2	6,084
Ecuador	98.8	16.3	6,071
El Salvador	25.8	6.4	4,040
Guatemala	63.9	16.3	3,929
Honduras	20.3	8.4	2,407
Jamaica	13.9	2.8	4,948
Mexico	1,144.3	127.0	9,009
Nicaragua	12.2	6.3	1,949
Panama	52.1	4.0	13,013
Paraguay	28.1	7.0	4,010
Peru	192.1	31.9	6,021
The Bahamas	8.7	0.4	23,903
Trinidad and Tobago	24.6	1.4	18,086
Uruguay	53.8	3.4	15,748
Sample Total	**4,668.0**	**557.1**	**…**
Sample Average	**245.7**	**29.3**	**8,380**
LATAC Region	5,052.5	615.8	8,205
Sample Total in percent of LATAC Region	92.4	90.5	…

Source: WEO (April 2016).

[10]   Some information about the readers of these reports can be gleaned from some partial download statistics provided by eight country authorities in the sample. Among the set of reports for which download data are available, each report has been downloaded on average 1,600 times. The number of downloads varies significantly across countries and time, frequently exceeding 10,000 in Brazil and rarely exceeding 1000 in smaller economies. Most downloads seem to come from domestic users: the local language versions tend to be downloaded more frequently than the English versions, and – when this information is available – most downloads appear to be made to domestic IP addresses (a high number of downloads from foreign IP addresses has been observed, however, in Trinidad and Tobago).

[11]   As of October 2018, Nicaragua has reinstated the publication of FSRs, with the 2017 report available online.

The group also includes three countries with significant offshore financial activities (Barbados, Panama, and The Bahamas), eight highly dollarized economies, with a significant share of bank deposits and/or loans denominated in foreign currencies (Figure 1), and three fully dollarized economies (Ecuador, El Salvador, and Panama) that use the U.S. dollar as legal tender.

Figure 1
Foreign Currency Loans and Deposits (percent; end-2015)
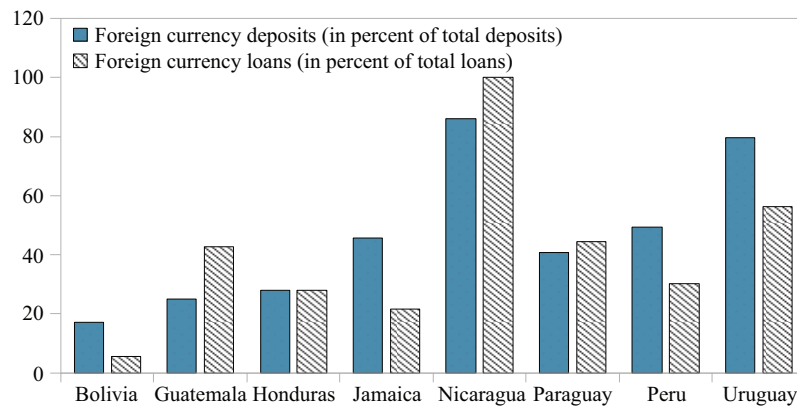
Sources: Monetary and Financial Statistics Database (MFS); country authorities; and authors' estimates.

The size and structure of the financial sector also varies widely among these countries (Figure 2). Measured by the sum of total banking assets, stock market capitalization, and bond issuance,[12] Brazil has the largest financial sector in the region (US$5.7 trillion), followed by Mexico (US$1.6 trillion) and Chile (US$0.8 trillion), also reflected in the depth of their capital markets and the significant presence of foreign investment. Chile has the largest financial sector in proportion to the size of the economy (more than three times its GDP), followed by Brazil and by the three offshore centers. Among the other countries, Colombia, Argentina, and Peru have a comparatively large financial sector (with total assets between US$200 and US$600 billion), and in Peru, Bolivia, Honduras, and Uruguay broad money and private sector credit exceed 40 percent of GDP; in the other countries the financial sector is much smaller.

Figure 2
Size and Structure of the Financial Sector (average 2010–15; percent of GDP)[13]
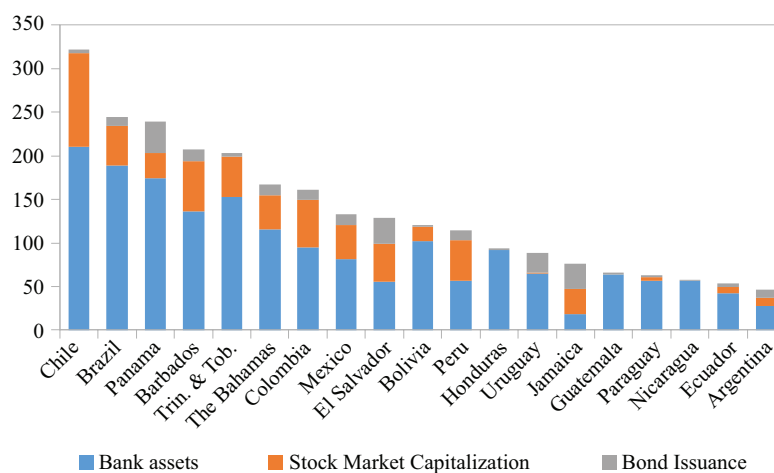
Sources: WEO; IMF VESD database; IMF Monetary and Financial Statistics database; World Federation of Exchanges; and authors' estimates.

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[12]   Average data for the period 2010-15; data compiled by IMF staff on the basis of information provided by country authorities and market data.

[13]   Sum of total banking assets, stock market capitalization, and outstanding bonds issuance.

The number of banks (including credit unions, cooperative, and microfinance institutions) ranges from less than 20 (in Nicaragua and Uruguay) to more than 100 (in Mexico, Peru, Trinidad and Tobago) and more than 1,000 in Brazil.[14] Countries also differ markedly in terms of financial sector penetration. The number of branches of commercial banks (arguably a more significant indicator of financial inclusion in geographically large countries with a large population than it is in smaller states) ranges from 5.3 per 100,000 inhabitants in Jamaica to 253 in Colombia; it is comparatively high in Brazil, Ecuador, Guatemala, and the Bahamas, but relatively low in the other countries (less than 25 per 100,000 inhabitants).

4. WHO ISSSUES FSRS?

Countries in the region tend to share financial stability oversight across different agencies. Of the sample countries reviewed in the paper, roughly 37 percent have institutional arrangements of financial stability that involve multiple authorities within a jurisdiction, with Mexico having as many as four agencies (Table 2). The authorities typically include the central bank, a committee within or outside the central bank, the bank supervisory agency, or another authority such as the deposit insurance agency. In fact, the 2018 IMF Macroprudential Policy Survey indicated that unlike other regions where central banks play strong roles, the LAC region had the lowest percentage of jurisdictions reporting the central bank as one of the macroprudential authorities.

Table 2
Latin America and the Caribbean: Financial Stability Reports

Country	Macroprudential authority					Producer of FSRs		
	Central bank	Committee within the central bank	Committee outside the central bank	Supervisory agency (other than the central bank)	Other	Central Bank	Supervisor Agency	Financial Stability Committee
Argentina	✓				✓	✓		
Barbados	✓			✓		✓		
Bolivia			✓	✓		✓		
Brazil					✓	✓		
Chile	✓					✓		
Colombia	No entity is specifically responsible					✓		
Ecuador	No entity is specifically responsible						✓	
El Salvador		✓				✓		
Guatemala	✓						✓	
Honduras	✓			✓	✓	✓		
Jamaica	✓	✓				✓		
Mexico (CESF)	✓		✓	✓	✓			✓
Mexico (CB)						✓		
Nicaragua	No entity is specifically responsible					✓		
Panama	No entity is specifically responsible						✓	
Paraguay	No entity is specifically responsible					✓		
Peru					✓	✓		
The Bahamas	✓					✓		
Trinidad and Tobago	No entity is specifically responsible					✓		
Uruguay	✓	✓	✓			✓		
Total	**9**	**3**	**3**	**4**	**5**	**16**	**3**	**1**

Source: Central bank and other authorities' websites; IMF Macroprudential policies Survey. In Mexico, two FSRs are published, one by the Central Bank, "Mexico (CB)," and one by the Financial System Stability Council (CESF), "Mexico (CESF)."

[14] FAS data for 2014.

Despite the institutional arrangements for macroprudential policy, FSRs from the region are predominantly issued by central banks. The exceptions are Ecuador, Guatemala, Panama and Mexico. In Mexico, both the central bank and CESF, the other agency responsible for financial stability, publish FSRs: both FSRs are reviewed in this study (Box 2). Given the existing institutional arrangements, collaboration between the central bank and the macroprudential authorities would be important to ensure that there is clarity and transparency about financial stability issues, accountability for policies, as well as a strategy for communicating emerging risks and vulnerabilities.
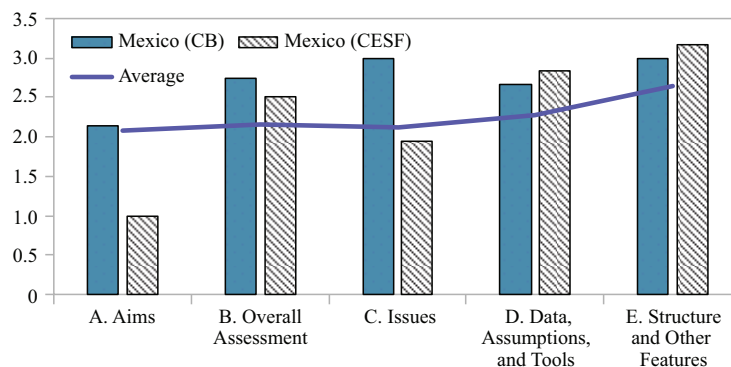

Box 2. Financial Stability Reports in Mexico

Mexico is the only country in this sample where two FSRs are published by two different institutions.

• The Bank of Mexico has published a "Financial System Report" since 2006. It is published annually in the fall.
• The Council for Stability of the Financial System (CESF) has published an annual report on financial stability and the Council's activities every spring since 2011. The CESF, which was created in 2010, is chaired by the Ministry of Finance and includes representatives from the Bank of Mexico, the financial supervisory authorities (bank, insurance, and pension supervisors), and the deposit insurance authority.

Box Figure 1
Mexico: Comparison of FSRs

Source: Authors' Estimates.

Despite the different names, both reports cover financial stability issues and publish similar stress tests. Based on the evaluation criteria used in this study, the report by the Bank of Mexico (Mexico (CB)) is overall stronger. In particular, the Bank of Mexico report clearly spells out its aims and has a more comprehensive coverage, including banks, investment funds, insurance companies, households, and non-financial corporations while the CESF report focuses on banks. The CESF report provides a better justification of the assumptions underlying stress tests and has maintained a more consistent structure (the structure of the Bank of Mexico's report was changed without explanation in 2015). In other categories, the quality of the two reports are similar although neither provides a definition of financial stability. Both reports provide a strong overall assessment (Bank of Mexico with the added advantage of a risk map), identifying clearly the main macro-financial risks confronting the Mexican economy.
The 2016 FSAP has recommended making the CESF the main forum for communicating stability assessments. Simply moving to a single report without other institutional changes could, however, have some drawbacks. In particular, the Bank of Mexico is an independent institution, and should be able to express its views on financial stability. The CESF, on the other hand, is chaired by the Ministry of Finance, and all its members apart from the Bank of Mexico are run by boards that include representatives from the Ministry of Finance. Unless financial supervisors become more independent – as also recommended by the FSAP – abolishing the Bank of Mexico report would remove an important independent assessment of financial stability.

5. RESULTS

The average overall composite score for the entire sample of 20 FSRs is 2.23[15] (out of a maximum of 4); no report rises above 3, and three-quarters lie below 2.6 (Table 8). This score is broadly in line with the average comprehensive rating[16] for emerging market economies assessed by Cihak et al. (2012), which is 2.24 (Figure 3), lower than the average for advanced economies (3.04) but higher than that of low income countries (1.67. These data are, however, only partly comparable, not only because they refer to different periods, but also because the criteria used are based on a subjective assessment that includes a degree of judgment. nevertheless, the broadly similar score among emerging market economies suggests that as a group, these economies face the same challenges in publishing financial stability assessments.

Figure 3
Average Composite Scores of FSRs (score scale from 1 to 4; 4 = full compliance)
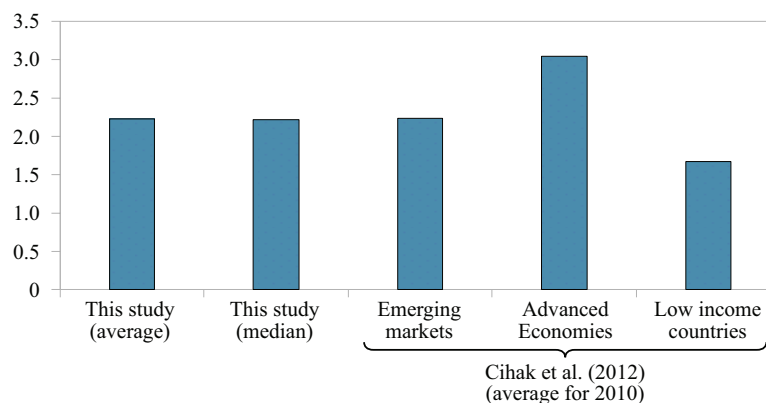
Source: Authors' assessment.

The overall composite score, however, masks significant differences across countries (Table 3; Figure 4). The top group includes the six best reports (Brazil, Chile, Colombia, Jamaica, Mexico (CB) and Trinidad and Tobago), with overall scores between 2.5 and 3. The middle group includes seven reports (Argentina, Barbados, Bolivia, Honduras, Mexico-CESF, Paraguay, and Peru) that obtained an overall score between 2 and 2.5; and the bottom group includes seven reports (Ecuador, El Salvador, Guatemala, Nicaragua, Panama, The Bahamas, and Uruguay) that obtained an overall score below 2 (but higher than 1.5).

Table 3
Quality Rating of FSRs (Comprehensive and by Element): Summary Statistics

|	Mean	Min	Max	Lower Quartile	Upper Quartile	Weight
Overall	2.22	1.58	3	1.86	2.6	1
A	2.09	1	3.71	1.11	2.96	0.21
B	2.15	1	3	2	2.69	0.2
C	2.11	1.35	3	1.71	2.35	0.17
D	2.27	1.33	3	1.83	2.63	0.3
E	2.65	1.67	3.33	2.33	3	0.12

Sources: Authors' estimates.

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[15] The median value is equivalent at 2.22. If equal weights are used for all elements, the average score increases to 2.25.

[16] In the Cihak et al. papers, the average overall score is called the "comprehensive rating." The sample in the paper included only four countries in Latin America, with an average overall score of 2.04; the same countries in this study have an average overall score of 2.61. This would reflect – within the limits of comparability between these two assessments – some positive effects from learning-by-doing for these four countries.

Figure 4
Composite Scores of FSRs by Country (score scale from 1 to 4; 4 = full compliance)
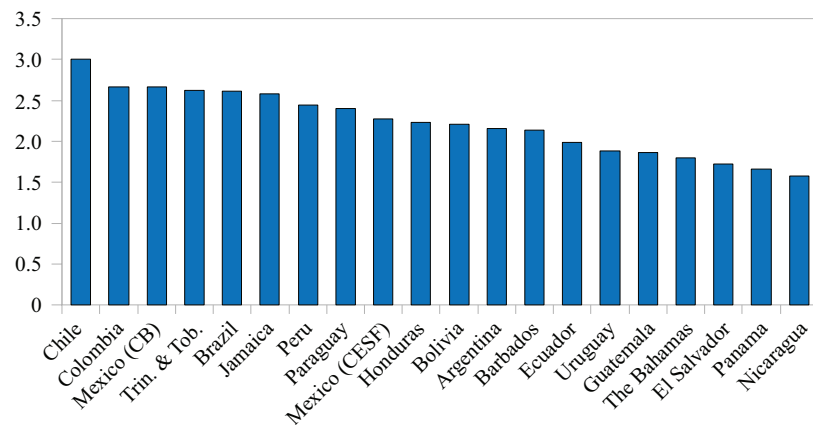
Source: Authors' assessment.

In addition, the reports that score a higher rating on one element tend to be better also on the others. In particular, performance on elements B, C, D, and E (overall assessment, coverage of issues, use of data and tools, structure) is correlated across reports, while scores along A are more independent (Table 4). Among these elements, the FSRs score lowest in A, B and C, suggesting these reports could state more clearly their objectives and improve the quality of their overall assessment and their coverage of issues. In general, countries do better at getting the structure and other logistical features of the report right than in providing more in-depth analytical content.

Table 4
Correlation between Country Scores of Different Elements

	A	B	C	D	E
A	1				
B	-0.09	1			
C	0.16	0.63	1		
D	0.26	0.4	0.52	1	
E	0.39	0.38	0.4	0.51	1

Sources: Authors' estimates.

That being said, the region is not unique in facing challenges in communicating financial stability issues. The average score of the FSRs in the region is comparable to the estimates obtained by Cihak et al. (2012) for the group of emerging market economies. Breaking down by element, despite the lack of clarity in defining the objectives of the FSRs, the region still does better in this area (A) compared to other emerging economies. But the quality of their overall assessment (B) and coverage of issues (C) is still weak by comparison (Figure 5).

Figure 5
Average Composite Scores by Region (score scale from 1 to 4; 4 = full compliance)
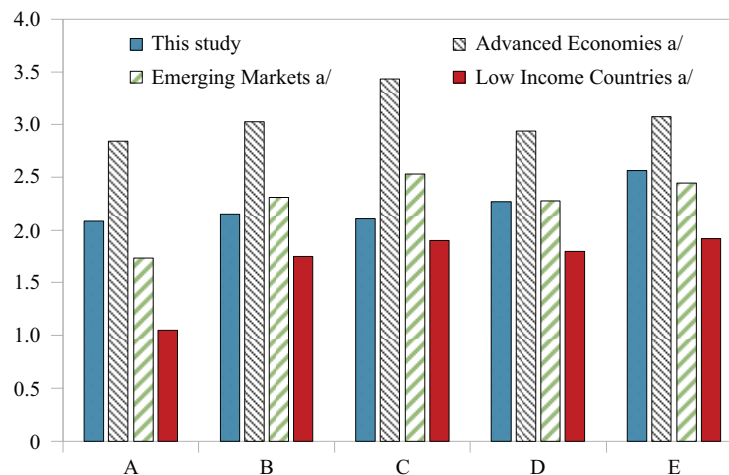
Sources: Authors' assessment; and Cihak (2012); data for 2010.

5.1. Detailed Results

5.1.1. Element A: Reasons, Aims, and Objectives of the Reports

An effective communication of the authorities' assessment of the conditions and resilience of the financial system requires clarity about the aims of the analysis and how the authorities define financial stability. To this purpose, each FSR should contain, at the beginning and in a conspicuous place (e.g., preface or introduction), an explicit statement of its aims and a clear definition of financial stability: "clarifying the definition of financial stability helps the reader understand the FSR's statement on financial stability." (Cihak et al., 2012) Any changes in the aims of the report should be clearly explained and justified.

The definition of financial stability should cover both the *absence* of a crisis and *resilience* to systemic shocks.[17] This distinction is important, as a financial system that is highly vulnerable to shocks or fragile[18] cannot be considered stable; a stable financial system must be capable of withstanding normal sized-shocks to which it is exposed and in mitigating the impact if a crisis were to occur. Typically, countries use a range of indicators, information, and methods as operational targets to guide the actual implementation of the strategy, for instance, ensuring a well-capitalized and liquid banking system, imposing large exposure limits to mitigate contagion risk, maintaining an efficient and well-functioning payment system, running regular stress tests, providing a lender-of-last-resort facility, and promoting a strong supervisory culture and regulatory framework.

What should FSRs aim for? While the ultimate purpose is to improve the stability and efficiency of the financial system, the more proximate aims of the report should include (i) informing stakeholders about new trends in financial markets and their potential benefits and risks; (ii) encouraging an informed debate on issues concerning financial stability, (iii) making the authorities accountable for the policies and actions they take to enhance resilience and mitigate risks; and (iv) provide information that can be used by participants in the financial sector to assess risks and make informed decisions.

Of the 20 reports analyzed in this study, only 9 explicitly state their aims, usually in the preface or in the introduction; 8 do not contain any statement of aims; some of these contain a brief description of their content, which is not sufficient because it does not describe the function of the report; other reports provide a statement of the mandate and objectives of the authority that issued

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[17]   Financial crisis is defined as an event in which substantial losses at financial institutions and/or their failure cause, or threaten to cause, serious dislocations to the real economy. See Borio and Drehmann (2009).

[18]   A financial system is said to be fragile if normal-sized shocks are sufficient to produce a financial crisis.

them, which is also not fully satisfactory because it does not explain what the authorities intend to achieve, specifically, by issuing the report (Figure 6, A1); and in two cases, the aims of the report are described on the central bank website, but not in the report itself, and may thus be missed by a reader who does not review, or have access to, the website.

Figure 6
Element A: Distribution of Scores (score scale from 1 to 4; 4 = full compliance)
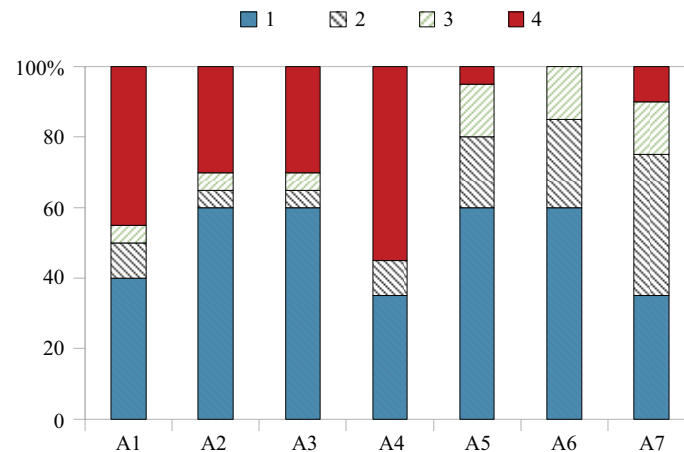
Sources: Authors' assessment.

The reports that obtained a high overall score usually include an explicit statement of their aims. Several reports stand out (e.g. Argentina, Chile) in describing their aims:

> *"Provid[ing] information…* on recent macroeconomic and financial events that could affect the financial stability of the Chilean economy. In addition, the Report presents *the policies and measures* that support the normal operation of the internal and external payment system, with the objective of *promoting general knowledge and public debate* with regard to the Bank's performance in fulfilling this function (emphasis added).

> the [Central Bank of Argentina] *communicates its vision of the state of the financial system*, the initiatives aimed at its development, and its assessment of its stability. In the FSR, the [Central Bank] pays special attention to identifying and analyzing any systemic risks and to explain the action it takes to prevent or mitigate them. This publication *helps the different actors make their decisions* with more and better information, facilitating a proper management of their activities. The FSR is thus *an instrument to stimulate the debate* over issues related to financial stability *and, in particular, over the action of the [Central Bank] in this area*" (our translation; emphasis added)."

The majority of the reports (12 out of 20) do not provide a definition of financial stability, and those that do, provide a generic definition relating to the financial sector's role to intermediate funds and promote an efficient allocation of resources from savers to investors. In one case, the definition is posted elsewhere on the website, and in another buried in the glossary of the report (Figure 6, A2). Only two reports define financial stability in sufficiently detailed *static* and *dynamic* terms (absence of a crisis and resilience; Figure 6, A5), although – like the other reports – they tend to avoid using the word "crisis," perhaps out of concern that focusing the readers' attention on severe tail events could in and of itself be destabilizing.

None of the reports includes a clear operational definition of financial stability (Figure 6, A6). However, in two reports (Colombia and Jamaica) reference to the mandate of the central bank provide some operational guidance on how financial stability is conceived from an operational perspective:

"The tasks that the (Colombia) Bank of the Republic performs with a view to promoting financial stability are as follows: first, the Bank is responsible for *ensuring the proper functioning of the payment system used in the Colombia economy*; second, as the issuer of currency it *provides for the liquidity of the financial system through its monetary operations and by exercising its constitutional authority as lender of last resort*; third, the Bank, together with the Financial Supervision Authority of Colombia, in its capacity as a lending authority c*ontributes to the design of financial regulatory mechanisms that reduce the incidence of instability episodes*; finally, the Bank of the Republic *performs careful monitoring of economic trends that could jeopardize financial stability*.

The (Jamaica) central bank's mandate to maintain financial stability entails "making sure that financial institutions, in particularly banks, *are sound... overseeing the efficient and smooth determination of asset prices*, making certain that participants are able to honor their promises to *settle market transactions and preventing the emergence of systemic settlement risk arising* from financial imbalances that may develop within individual institutions in the system."

There is consistency over time in how reports define their aims and definition of financial stability (Figure 6, A4). Reports that state their aims in the latest issues have also included it in their previous issues (the converse is also true: reports who do not state their aims in the latest issues usually have not stated them in previous issues either). Similarly, the definition of financial stability is generally provided (or omitted) consistently over time and is usually found (where it is available) in the same place in different issues (Figure 6, A3).

5.1.2. Element B: Overall Assessment

To convey effectively the authorities' assessment of financial stability and policy messages, FSRs should provide a clear and candid overall assessment of the situation in an executive summary. A well-articulated executive summary requires strong analysis and a comprehensive coverage of issues in the rest of the report. The executive summary should discuss all significant risks and vulnerabilities, including politically sensitive risks, pointing out the main macro-financial transmission channels and how risk exposures have evolved over time. In this perspective, the overall assessment provided in the executive summary should have a forward-looking lens: it should anticipate new threats, identify possible trigger points, and discuss the likelihood and impact of negative shocks. Finally, the executive summary should be succinct and written in an easy-to-digest manner. This would allow the FSRs to reach a wider audience, beyond the financially sophisticated readers to the "man or woman on the street".

With two exceptions,[19] all the reports examined in this study provide an overall assessment in the form of an executive summary, a preface/introduction or, in one case, a concluding chapter. The quality of these assessments varies considerably (Figure 7). In some reports the assessment covers key financial sector developments and their implications for financial stability, as well as a discussion of specific risks. For example:

• Chile's report notes that while existing capital levels are sufficient to absorb shocks under a severe stress scenario, capital buffers have been reduced over time;
• In Mexico (CB) the executive summary brings together the various pieces of analysis developed in the rest of the report to present a comprehensive view of potential risks and vulnerabilities;
• Trinidad and Tobago's report identifies specific risks related to persistently low oil prices, a sharp house price correction, sovereign debt restructuring in the Caribbean, and a spike in US interest rates.

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[19] Argentina and Panama.

Figure 7
Element B: Distribution of Scores (score scale from 1 to 4; 4 = full compliance)
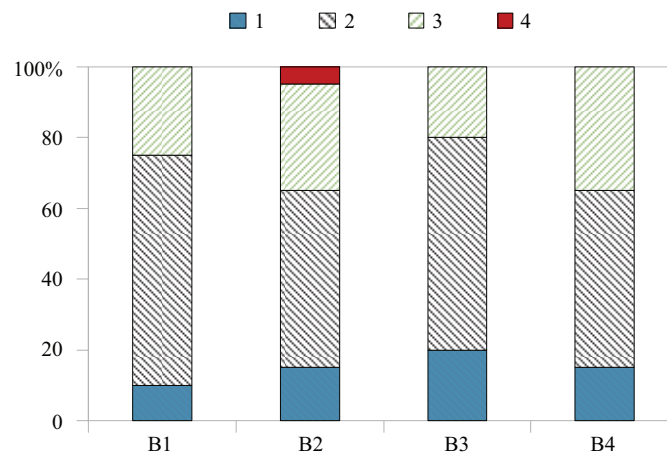
Sources: Authors' assessment.

In other reports the discussion of risks is more limited and presents statistics and trends based on financial ratios and indicators without a deep analysis of the underlying causes and implications, and with a stronger focus on describing historical developments than on drawing inferences for the future.

Nevertheless, even in the best reports in the sample, the overall assessment tends to be descriptive rather than analytical (describing recent developments in key variables and indicators without delving into the causes of these developments, their economic significance, and potential implications),[20] backward rather than forward looking. Stress tests are used to support generic statements about the adequacy of liquidity and capital in the banking system, without much elaboration of the underlying context, scenarios, assumptions, and risks (Box 3). They often come across as a "box checking" exercise, done as a matter of routine, rather than as a well thought out framework to assess the financial system's resilience in the face of potential shocks and the authorities' preparedness to respond with contingent policy actions. Few reports make an attempt to connect their assessments over time, following up on previous statements and risks and explaining what changes had occurred in the intervening period.

5.1.3. Element C: Coverage of issues

FSRs should identify clearly the most pressing financial stability issues, extending the coverage as necessary to the main players and stakeholders in the system, the main asset classes, and the channels of transmission between the "real" economy and the financial system, and adequate follow through with consistent analysis of these issues over time. Any lack of coverage in key areas (e.g., non-bank financial institutions, households and corporate sector, payment systems, regulatory changes) should be explained and justified. For example, if the payment system is covered in a separate report, a reference to this should be provided.

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[20]   For instance, the overall assessment may provide quantitative details on the recent evolution of financial variables such as total bank assets, the stock of various categories of deposits, credit to households and enterprises, as well as nonperforming loans, interest rates, and some key indicators such as the capital adequacy ratio; the latest change in these variables may also be compared with their behavior in the previous period. In many reports, however, this information is provided without much analysis of the underlying causes and trends, a discussion of its implications for financial stability, or even a longer historical perspective (for instance, comparing these values with the record of the previous ten years or with specific benchmarks such as the period preceding the most acute crisis).

Box 3. Stress Tests

The vast majority of FSRs routinely include stress tests or sensitivity analyses, but the coverage, methodology, and presentation of stress tests differ widely across reports.

- The coverage is often limited to the impact of credit risk on bank capital. Three FSRs (Jamaica, Nicaragua, and Paraguay) also cover nonbanks, such as securities dealers or financial companies. In addition to credit risk, some FSRs also cover exchange rate, interest, and liquidity risks.
- Some FSRs derive scenarios from macroeconomic or other concrete risks, while others appear to make ad hoc assumptions, for example, by simply assuming shocks to bank variables (such as the value of assets or losses on NPLs).
- The assumptions and methodology are generally explained but rarely justified. Few reports provide adequate justifications for scenarios and parameters. Some relate them to historical values (e.g., standard deviations), but even those would benefit from a discussion of current risks relative to history. Only one report relates assumptions explicitly to risks highlighted elsewhere in the report.
- Most reports devote either a chapter or a specific section to stress tests. In some reports, technical methodological aspects are described in a specific annex or box. The presentation may include detailed charts and discussions, overview tables, or just succinct qualitative statements (e.g., generic statements such as "no bank would fail to meet minimum capital requirements"). Some reports helpfully provide results of past stress tests along with the latest ones.

Justifying the underlying assumptions and choosing the most relevant risks and sectors leads to more effective stress tests. To achieve full integration into the FSR, the stress tests should address the risks highlighted elsewhere in the report or explain, how those risks are reflected in the stress scenarios. Depending on the available resources, the link between macroeconomic shocks and financial variables could be modelled or just explained, but unfortunately some reports just present unjustified ad hoc shocks. While past experience can provide useful guidance (e.g., in terms of distribution, correlation, and extreme value range), the analysis should be justified based on forward-looking discussions of risks, explaining why past values remain relevant. The coverage should depend on the structure of the financial sector (nonbanks should be covered where important), and tests should look beyond solvency and also examine the impact on liquidity and profitability. The results of the tests should be discussed extensively, both in qualitative terms (i.e., their implications for the stability of the financial sector and the appropriate policy response) and in quantitative terms (supported by tables and charts).
Stress tests often appears to be used for the affirmation of resilience, but stress tests could be used for more policy-relevant purposes. While some reports speak of tests being "passed," this will be a function of the assumed size of shocks. More relevant could be an interpretation of findings to spell out which business models, which types of shocks, and which types of asset structures lead to the highest vulnerabilities. This would allow supervisors and institutions to consider possible measures to increase resilience, even if the shocks do not lead to any breach in requirements.

Coverage of issues is by far the weakest area identified in the FSRs (Figure 8). Many reports omit important financial stability risks and do not integrate well the macroeconomic and financial analysis. More specifically,

- All reports avoid politically sensitive issues, which may reflect the preference of the central bank or supervisory agency to maintain arms-length from the government, but, in some cases,

this approach weakens their effectiveness at identifying and communicating political risk that may have major implications for financial stability.[21]

• When risks are flagged, most reports do not discuss their relative importance in terms of their likelihood or impact.

• Macro-financial integration is limited to a cursory discussion of the effects of macroeconomic shocks (e.g., growth, exchange rate) on the financial sector, but rarely considers the feedback loop from the financial sector to the macroeconomy. For example, rapid private credit growth and concentration of exposures to real estate, and dollarization are relevant in several countries, but these issues and their potential feedback loops are not explored in any depth.

• Important issues raised in one report are not followed up in subsequent editions and readers are left wondering whether the exposure to these risks remains significant.

• Some reports focus on the banking sector and cover only marginally, if at all, other important areas of the financial sector such as insurance and pension funds, which are taking on more risks as they search for yield in a low interest rate environment.

• The treatment of financial infrastructure, which includes the payments system, trade clearing and settlement systems, risk management systems of market participants, and the regulatory oversight system, is patchy, with some reports providing good information and others largely ignoring this potential source of risk.

• Global financial spillovers can also have a significant effect on financial stability, and while the larger economies acknowledge and discuss these risks, others do not focus on the challenges in managing volatile capital flows.

Figure 8
Element C: Distribution of Scores (score scale from 1 to 4; 4 = full compliance)
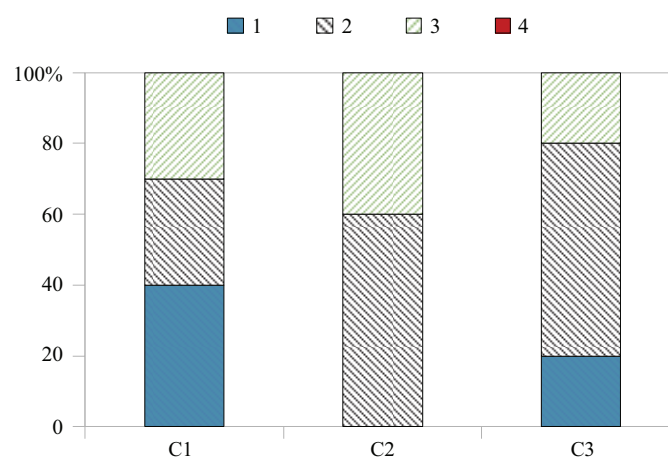
Sources: Authors' assessment.

Reluctance to engage in a frank discussion of sensitive issues and potential risks may stem from a variety of reasons, including fear that an overtly candid discussion could precipitate a crisis, while emphasizing risks that do not eventually materialize, could hurt reputations.

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[21]   For instance, risks posed by "Operation Car Wash", a corruption scandal involving the state-owned oil company and top government officials that emerged in 2014 in Brazil, was discussed in a box in the October 2015 report, which used a contagion model to conclude that the financial system would be able to withstand the impact of the shock. However, there was no detailed follow-up in the subsequent report (only statements that the risk was being monitored) even though the scandal generated major economic uncertainty, weakened the currency, contributed to the recession, and eventually led to the impeachment of the President. Argentina's report for the second half of 2015, published only a few weeks before the elections that marked a major change in government, did not mention any potential spillovers to financial markets of uncertainty about the electoral outcome.

Country authorities may prefer to err on the side of caution and not raise frequent alarms that over time may become uninformative "noise". Furthermore, country authorities whose institutional mandate is neutral and nonpartisan may refrain from tackling politically sensitive issues to avoid accusations of partiality or undue interference in the political process.

5.1.4. Element D: Data, Assumptions, and Tools

FSRs should use appropriate models and analytical tools as well as the full range of available data to enrich the analysis and facilitate comparison across time. A forward-looking assessment of risks should be based on a combination of quantitative and qualitative tools and any data gaps that detract from the assessment should be identified. Stress tests are recommended, but other methods based on well-justified assumptions and macro scenario can also be appropriate.

Most FSRs do indicate data sources and provide a cut-off date, but only a few make the data available electronically online (e.g. Brazil, Chile and Colombia) (Figure 9). Most reports also refer to aggregate developments, rarely venturing beyond a breakdown of results by broad categories of banks or using disaggregated data to analyze macro-financial interconnectedness. No report identifies data gaps even though they are important in several countries, thus missing the opportunity to acknowledge the risk of "unknown unknowns". Most reports use some form of quantitative tools, ranging from basic balance sheet analysis to sophisticated stress tests, but reports could adopt a wider set of qualitative tools, such as discussions on the quality of supervision or the integrity of the regulatory framework, including whether the crisis management framework is equipped to resolve a failed systemically important domestic bank.

Figure 9
Element D: Distribution of Scores (score scale from 1 to 4; 4 = full compliance)
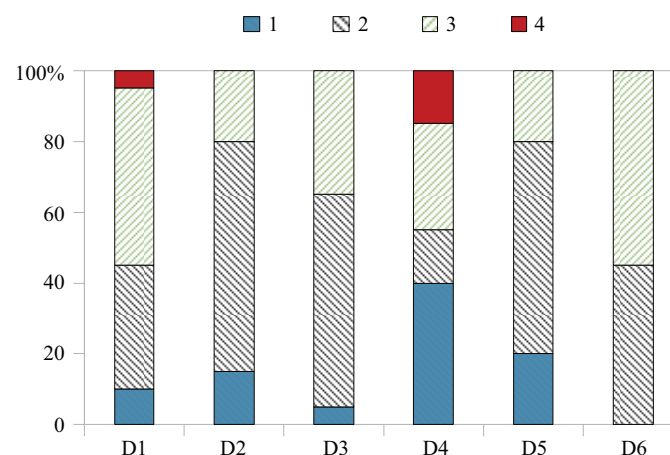
Most reports do not justify their methodology or model assumptions or do so in very general terms. In a few reports, the analytical content is limited to a description of recent developments, such as the change in the non-performing loan ratio, without explaining the reasons behind the change, leaving the reader wondering about its relevance and severity. In a few other cases, the reports use methodologies that are not particularly suitable for the purpose of the analysis, either because the relevant data are not available or ad hoc adjustments are made to the methodology (e.g., in one case the stress test model is a reverse stress test that identifies the maximum shock that would leave the capital level above the hurdle rate without discussing the probability that a shock of this size or bigger could materialize).

5.1.5. Element E: Structure and Other Features of the Reports

How a report is organized – in other words, its structure – can have a significant impact on its effectiveness. A good report should have a logical structure that is consistent over time to make it easier for repeat users to follow, but also flexible enough to allow for a unifying theme to run through the report. When the structure changes, the reasons should be explained. Other features of the report, such as its length, frequency, publication schedule, timeliness, and availability of past publications, all contribute to its effectiveness.

All the reports reviewed in this study follow logical and consistent structures, but they tend to adopt a "silo" rather than a thematic approach (Figure 10, E1 and E5). A typical report has a chapter on international and domestic macroeconomic developments, chapters on key segments of the financial sector, users of credit, payment system and regulatory framework. While this structure allows for a detailed discussion of each area of interest, it does not pull the disparate chapters together under an overarching theme. Some reports make a partial attempt through thematic boxes and annexes highlighting relevant cross-cutting issues.[22]

Figure 10
Element E: Distribution of Scores (score scale from 1 to 4; 4 = full compliance)
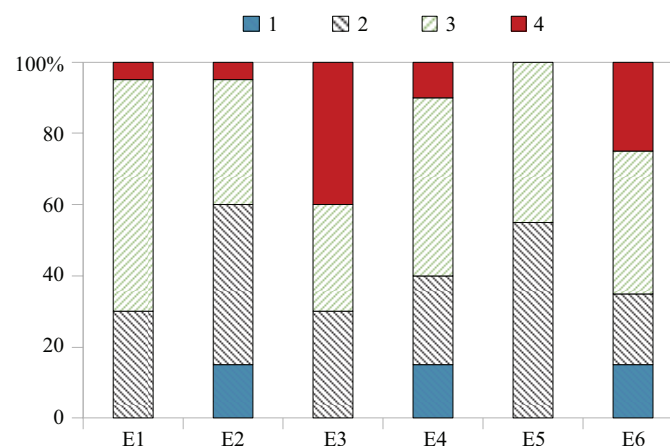
Sources: Authors' assessment.

Accessibility, timeliness, and a fixed timetable of publication convey a stronger signal on the commitment of the issuing authority to conduct regular financial surveillance and to communicate its assessment of financial stability to the public (E2, E4 and E6). All countries except for three have up-to-date webpages dedicated to FSRs under the central bank's or the regulatory agency's website. However, only 11 countries have a regular publication schedule; five countries have an irregular publication schedule or frequency of issues; and in three more, publications are either significantly delayed or have been discontinued. Only Brazil notifies the actual and regular publication dates on its webpage. None of the countries announces future publication dates or a calendar of publication dates. About one third of FSRs are published more than 6 months after the cut-off dates, when the information therein is already outdated. However, four (Argentina, Chile, Colombia and Mexico) countries issue their reports within three months.

The overall communication strategy for the FSR could be significantly improved. Only a few countries (e.g. Chile and Colombia) provide direct access to the underlying data and posts videos and presentation slides (e.g. Trinidad and Tobago) or an audio presentation (Barbados) on their webpages. There is also little evidence of joint communication strategies around financial stability issues even though oversight of the financial sector was shared across different agencies.

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[22] For instance, Brazil's report has a box on the impact of political uncertainty on real sector and its spillover to the financial sector; Peru's has one on the reduction of financial dollarization and its effect on bank solvency; Jamaica's one on de-risking and concentration risk; and Trinidad and Tobago's has one on household indebtedness and cross-border linkages

### 5.2. Does the Macroeconomic Context Matter for Quality?

Given the FSR assessment, is there a connection between the quality of the reports and the country's underlying macroeconomic situation? A look at the correlation between the overall composite score assessed in this study and the specific characteristics of the economy of the country where the report is issued highlight some interesting patterns. It should be emphasized that a high correlation, in and of itself, does not imply the existence of a causal link and, when a link is present, does not provide an indication of the direction of the link. Correlation could stem from a common factor that influences both variables, or – especially in a small sample – could be a "spurious" result of a purely random process that does not reflect any significant underlying relationship.[23] Nevertheless, correlations can provide a useful, if imperfect, signal of what macroeconomic context could be more conducive to producing high quality and candid assessments of financial stability issues.

Bearing these caveats in mind, we observe the following patterns:

• The best reports tend to be issued by the largest and more advanced economies. The overall composite score is positively correlated with the issuing country's GDP, population, and – if offshore centers are excluded – per-capita income; this correlation is not driven by the three largest economies (Argentina, Brazil, and Mexico), and is actually stronger when these countries are excluded from the sample. This correlation may reflect both a larger availability of resources to produce high-quality reports in larger economies, and a stronger demand for accurate and timely financial sector information (Figures 11 and 12), as larger economies have more at stake in preserving financial stability.

Figure 11
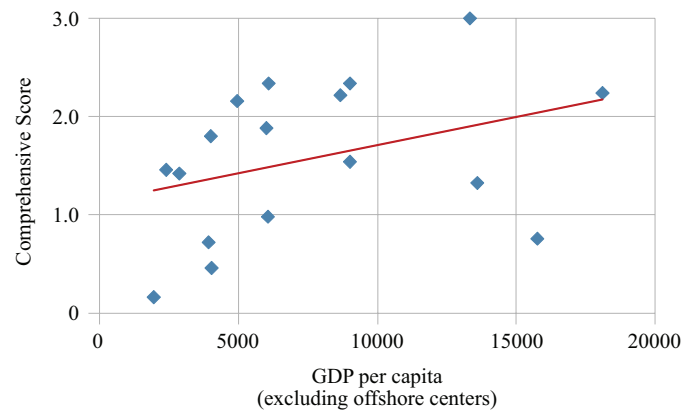Comprehensive Score by GDP (2015) (score scale from 1 to 4; 4 = full compliance)
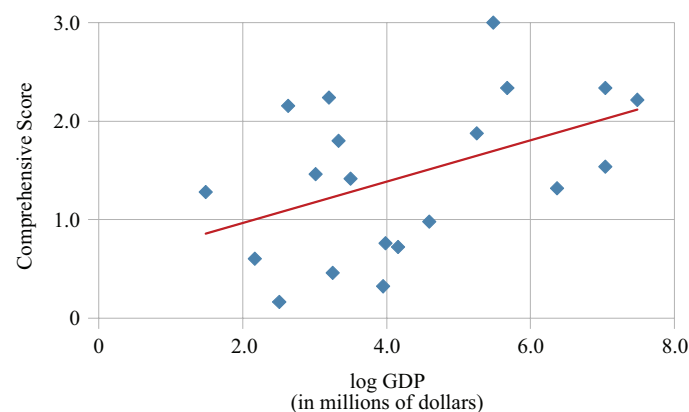
Sources: WEO, April 2016; and authors' calculations.

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[23]   In the limiting case of a sample with only two observations, for instance, the statistical measure of the correlation between any pair of variables is always equal to 1 even when the variables are stochastically independent.

Figure 12
Comprehensive Score by GDP per Capita (2015) (score scale from 1 to 4; 4 = full compliance)

Sources: WEO, April 2016; and authors' calculations.

- The best reports are also issued by countries that have a sizable financial sector (Figure 13). Reports issued by these countries tend to have a more comprehensive coverage of issues (Element C), make greater use of both aggregate and individual bank data, and more sophisticated stress tests with fuller explanations of the underlying assumptions (Element D); and have a more effective structure (Element E).

Figure 13
Comprehensive Score by Size of the Financial Sector (2015) (score scale from 1 to 4; 4 = full compliance)
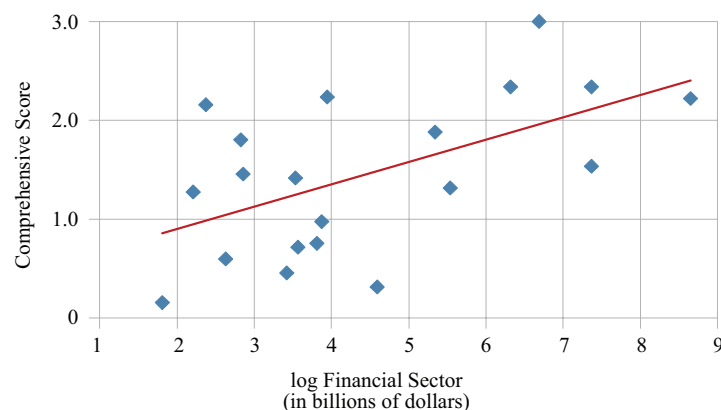

Sources: WEO, April 2016; and authors' calculations.

- Reports issued by central banks tend to be better than those issued by other supervisory authorities, particularly for countries that have floating exchange rates or an inflation targeting framework (Figures 14 and 15). They are more likely to declare their aims and accountability and provide a definition of financial stability within a more effective overall report structure. They are also more candid in their risk assessment and take a systemic view of the financial system. This is because the central banks are usually empowered with an independent mandate to preserve price and exchange rate stability, and in some cases, with an explicit mandate to preserve financial stability. They are therefore held accountable for achieving these objectives, and as a result, more likely to be given access to analytical resources and can justifiably devote a higher proportion of the resources to collecting high-frequency market data and interpreting them, conduct stress tests to monitor emerging threats to the financial system, and consider corrective actions.
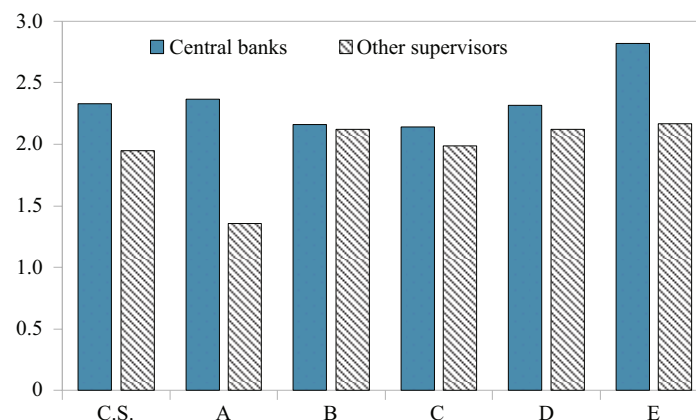
Figure 14
Score by Exchange Rate Regime (score scale from 1 to 4; 4 = full compliance)
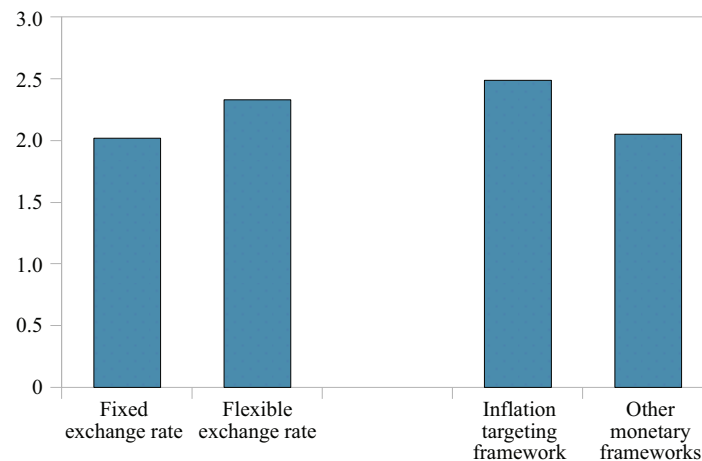
Source: Authors' assessment.

Figure 15
Score by Authoring Institution (score scale from 1 to 4; 4 = full compliance)

Source: Authors' assessment.

- Reports issued by the three offshore centers or dollarized economies do not score as well (Figure 16). There are several possible explanations for this. For one, although in offshore centers the size of the financial sector is large relative to the domestic economy, most of it is "ring-fenced" and has little impact on the domestic financial system.[24] In dollarized economies, the central bank has no independent monetary policy responsibility, and tends to become a think tank that is less involved in day-to-day surveillance, which could adversely affect its capacity to analyze potential risks, especially if the relationship with the supervisor is not strong.

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[24] In Panama, for example, offshore (international licensed) banks are not allowed to receive deposits and lend to residents. In addition, offshore banks can conduct interbank transactions, but the scope of such transactions is very limited. Overall, only 1.3 percent of their assets are held in Panama and domestic liabilities represent only 0.3 percent of total offshore banks' liabilities. See Hadzi-Vaskov (2016).

Figure 16
Score by Dollarization (score scale from 1 to 4; 4 = full compliance)
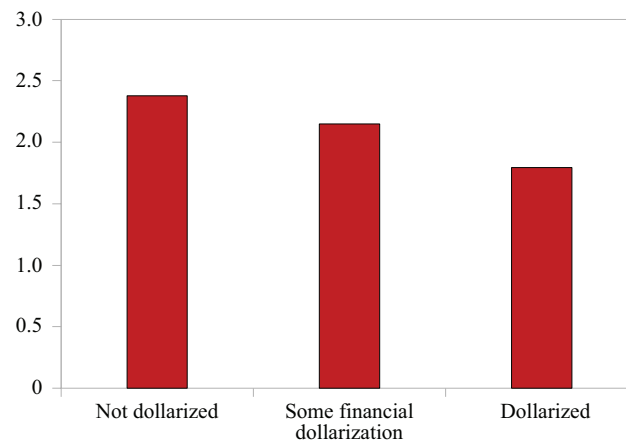
Source: Authors' assessment.

- Finally, the best reports tend to be issued by countries that have a higher stock of government debt and higher public expenditure and revenue relative to the size of the economy (Figure 17).[25] This outcome possibly reflects a stronger motivation to provide credible assessments of financial sector health to investors in order to maintain investor confidence and keep a lid on the cost of refinancing the debt.

Figure 17
Expenditure and Public Debt (2015) (score scale from 1 to 4; 4 = full compliance)
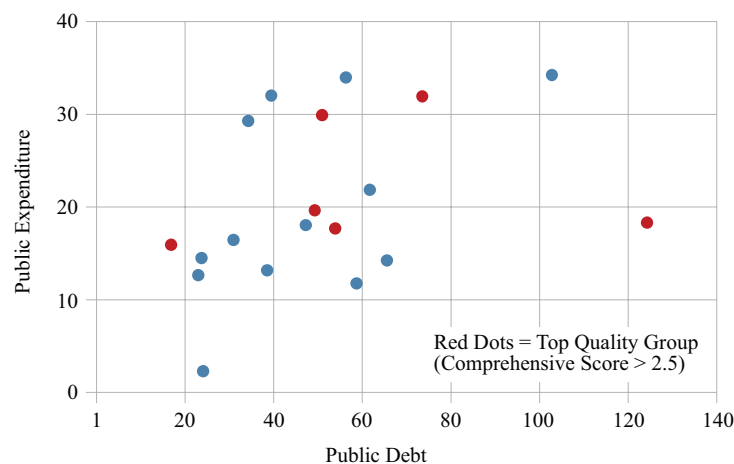
Sources: WEO (Spring 2016); and authors' assessment.

6. CONCLUSIONS

This study shows that there is still considerable room for improvement in the quality of FSRs produced in Latin America and the Caribbean. Using the methodology applied by Cihak (2006) and Cihak et al. (2012), this study reviewed the quality of 20 FSRs published by 19 Latin American countries that account for 92 percent of the region's population and GDP. While there is significant heterogeneity in quality across countries, no report complies fully with the established

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[25]   Of the 7 countries with public debt above 49 percent of GDP and public expenditure above 28 percent, only three did not issue reports in the top-quality group; by comparison, of the 12 countries that do not meet these criteria only one – Chile – issued a report in the top-quality group.

criteria used in this assessment. There is thus significant scope for improving the effectiveness of the region's FSRs as an instrument of surveillance and communication.

Countries with a larger economy and financial sector, and where central banks are the issuing authority, appear, on average, to produce better reports. These results are not surprising, since larger countries should have both larger resources and stronger incentives to produce reports of comparatively good quality. Countries with flexible exchange rates and an inflation targeting framework also produce reports that are, on average, of better quality, possibly reflecting the higher sophistication and capacity associated with these policy regimes, as well as a greater need to keep the public regularly informed. Central banks appear, on average, to produce better reports than other supervisory agencies, possibly reflecting an advantage in terms of independence and mandate, and the synergy from taking a systemic view of both macroeconomic and financial developments. Based on this evidence, there clearly is a role for central banks in producing FSRs, but greater collaboration, including joint publications, with other macroprudential authorities would enhance the credibility of the financial sector assessment and the communication of financial stability risks, particularly during periods of crisis. Greater cooperation between the central bank and other agencies is particularly relevant in countries where there is a shared financial stability or macroprudential mandate

While the areas for improvement vary across countries, some gains can be obtained comparatively rapidly and at low cost. For instance, it would be relatively simple to ensure that all reports include an explicit statement of aims and a definition of financial stability, that the data are made available on the webpage, and that the publication schedule is announced clearly in advance. Explaining and justifying the methodology and assumptions or improving the structure and organization of the reports around specific themes would require more investment but it should be manageable and not too demanding in terms of resources.

Other more substantive improvements to the content of the report will require much more effort. For instance, covering all systemically important areas of the financial system, adopting a forward-looking perspective, computing stress tests with the support of satellite econometric models, and implementing an effective, full-fledged communication strategy will require higher investment in terms of resources and analytical capacity.

At the end of the day, strengthening the quality of the reports will require political resolve and a strong commitment to provide unbiased and transparent communication. These conditions are usually met when the issuing authority has a clear mandate for financial stability, access to data and resources, and operational independence from the government. Most notably, providing a candid and timely assessment of all risks, actual and potential, requires confidence on the part of the authorities, that the benefits of honest communication with the general public outweigh the risks that come with discussing sensitive information, especially in times of stress. It also involves a preparedness to be held accountable for the policy actions the authorities take to mitigate risks, respond to shocks, and enhance long-term resilience. Such accountability is an essential component of a robust and resilient financial system.

Disclaimer

The views expressed in this paper are those of the authors and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

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APPENDIX

Appendix Table 1
Areas of Assessment and their Component Weights

		Weight
A. Aims. Objectives and Reasons		**0.21**
A1	The aims of the report should be clearly indicated	0.03
A2	The definition of financial stability should be clearly indicated	0.03
A3	The definition of financial stability should be a standard part of the report, presented consistently across reports	0.03
A4	The statements of aims should be a standard part of the report, presented consistently across reports	0.03
A5	The definition of financial stability should be cover both the absence of a crisis and the resilience to a crisis	0.03
A6	Financial stability should be defined both in general terms and in operational terms	0.03
A7	The aims of the report should be comprehensive	0.03
B. Overall assessment		**0.20**
B1	The overall assessment should be presented clearly and in candid terms	0.05
B2	The overall assessment should be linked to the remainder of the FSR	0.05
B3	There should be a clear link between the assessments over time, making it clear where the main changes took place	0.05
B4	The overall assessment should cover the key topics	0.05
C. Coverage of issues		**0.17**
C1	The report should clearly identify the main macro-relevant stability issues	0.05
C2	The coverage of issues should be consistent across the reports	0.06
C3	The coverage of the financial system should be sufficiently comprehensive	0.06
D. Data, assumptions, and tools		**0.30**
D1	It should be clear what data are used to arrive at the results presented in the reports	0.05
D2	It should be clear what assumptions are used to arrive at the results presented in the reports	0.05
D3	It should be clear what methodological tools are used to arrive at the results presented in the reports	0.05
D4	The results should be presented in a consistent way across reports	0.05
D5	The report should use available data, including those on individual institutions	0.05
D6	The report should use the available tools	0.05
E. Structure and other features		**0.12**
E1	The structure of the report should be easy to follow	0.02
E2	Other features of the report (e.g., its length, frequency, timing, public availability and links to other central banks reports) should be designed to support its clarity	0.02
E3	The structure of the report should be consistent across time to make it easier to follow for repeat users	0.02
E4	The other features of the report should be designed to support its consistency	0.02
E5	The structure of the report should allow coverage of the key topics	0.02
E6	The other features of the report should be designed to supports its coverage	0.02

Sources: Cihak et al. (2012)

Appendix Table 2
Rating Criteria by Category

Ratings		1	2	3	4
	A. Aims, Objectives and Reasons				
A1	The aims of the report should be clearly indicated.	No aims are indicated in the report. Stating the aims of the authoring agency (i.e., central bank/regulator) is not sufficient.	Aims are not included in the report, but stated elsewhere (e.g., FSR website).	Aims are stated in the report, but expressed in general terms and not specific to financial stability.	Aims are clearly stated as the aim of the report, and makes specific references to the financial stability.
A2	The definition of financial stability should be clearly indicated.	No definition of financial stability is provided.	Definition is not included in the report, but stated elsewhere (e.g., FSR website).	Definition is stated in the report, but it is not upfront and buried in a glossary or footnote.	Definition is clearly stated in the report.
A3	The definition of financial stability should be a standard part of the report, presented consistently across reports.	No definition of financial stability provided.	Definition not included in the report, but elsewhere (e.g., FSR website).	Definitions not consistently included in the reports.	Definitions always included in the report.
A4	The statement of aims should be a standard part of the report, presented consistently across reports.	Aims not included in the report.	Aims not included in the report, but elsewhere (e.g., FSR website).	Aims not consistently included in the reports.	Aims always included in the report.
A5	The definition of financial stability should cover both the absence of a crisis and resilience to a crisis.	No definition of financial stability provided.	Definition in the report covers neither the absence of nor resilience to a crisis (or shocks) OR Definition not included in the report, but elsewhere (e.g., FSR website).	Definition makes reference to either absence of or resilience to a crisis. This includes reference to the system's ability to withstand shocks.	Definition covers both absence of crisis and resilience to a crisis (or shock).
A6	Financial stability should be defined both in general terms and in operational terms.	No definition of financial stability provided.	Definition in the report, but only in general terms OR Definition not included in the report, but elsewhere (e.g., FSR website).	Definition includes both general and operational aspects, and operational definition includes either criteria on resilience to shocks or on the absence of crisis (i.e., clear criteria when to declare crisis).	Definition covers both general and operational (e.g., well-capitalized, liquid, efficient functioning of payment system, absence of wide-spread contagion, LOLR, strong regulatory framework) aspects.

| A7 | The aims of the report should be comprehensive. | Aims not included in the report. | Aims in the report do not include any of the four recommended aims (see rating of 4) OR Some comprehensive aims included, but only on website. | Aims include at least one of the four recommended aims (see rating of 4). | Aims include all four of the following aims: (i) informing stakeholders of potential financial risks, (ii) encouraging debate, (iii) serving as an accountability instrument, and (iv) helping to provide information to be used for risk assessments. |

B. Overall assessment

B1	The overall assessment should be presented clearly and in candid terms.	No executive summary (or equivalent section).	Executive summary (or its equivalent) provides some assessment of risks, but is mainly descriptive and backward looking.	Executive summary provides clear over-view of risks (e.g., heat maps), but it is less candid and the readers have to read between the lines.	Executive summary provides clear and candid assessment, highlighting risks and gaps.
B2	The overall assessment should be linked to the remainder of the FSR.	No executive summary (or equivalent section).	Executive summary summarizes the rest of the report, but does not link together different chapters and mostly backward looking.	Executive summary covers findings of the analysis in the report, and contains some forward-looking components.	Overall assessment puts together the various pieces of analysis, and the picture it presents is comprehensive and forward looking.
B3	There should be a clear link between the assessments over time, making it clear where the main changes took place.	No or limited comparison of indicators or assessment over time.	Coverage centers on backward-looking developments in indicators, and limited references to changes in forward-looking risk assessments.	Overall assessment mentions the di-rection of changes in the risk assess-ment from previous reports, but does not explain why and how it changed.	Overall assessment explicitly explains why and how the main risks and exposures have evolved since the last FSR, making clear the transmission channels.
B4	The overall assessment should cover the key topics.	No or limited discussion of risks.	Overall assessment covers key topic and risks often in the context of key indicators and stress tests, but is mostly descriptive and backward looking, and not focused on potential risks.	Overall assessment covers key topics including macrofinancial developments and their implications on financial stability, and discussions of specific risks.	Overall assessment discusses all significant risks and exposures in the assessment, including potential and politically sensitive risks, and full discussion of vulnerabilities.

C. Issues

| C1 | The report should clearly identify the main macro-relevant stability issues. | Macroeconomic risks identified, but important financial stability risks omitted and macroeconomic and financial analyses not integrated. | Various financial stability risks identified, but no assessment of their relative importance and implications. Macro and financial risks are not well integrated. | Various risks identi-fied as having sys-temic impact, but no in-depth analysis in terms of rela-tive importance and implications. Some integration of mac-rofinancial risks. | Risks with wider systemic impact highlighted and covered both in overall assessment and in some depth. Significant macro financial integration. |

C2	The coverage of issues should be consistent across the reports.	Coverage not consistent over time and changes not explained.	Coverage broadly consistent, but key risks not identified OR Changes to the worse and changes not explained.	Coverage is consistent, special risks are highlighted.	Consistent Coverage, and special risks highlighted. Follows up on previously-raised risks and explanation of newly-added risks.
C3	The coverage of the financial system should be sufficiently comprehensive.	Report covers only banking sector.	Banks and some of the other financial players (e.g., non-banks, payment system, borrowers) covered, but not in depth.	Banks, non-banks and other financial players (e.g., SIFIs, shadow banks) covered, and analyzed them in greater depth.	Banking system covered in depth, non-banks, payment systems, and other issues (e.g. borrowers, regulatory changes) also analyzed. Any lack of coverage is explained and justified.

D. Data, Assumptions, and Tools

D1	It should be clear what data are used to arrive at the results presented in the report.	No cut-off date, data sources not specified, and underlying data not available on the website.	One of the three types of information (see ranking of 1) provided.	Two of the three types of information (see ranking of 1) provided.	Data cut-off date highly visible, sources specified at the bottom of the tables and charts, and underlying data made available as electronic link on the website.
D2	It should be clear what assumptions are being used to arrive at the results presented in the report.	Assumptions for stress tests or any other quantitative analyses not provided.	Assumptions are provided, but are not explained or justified.	Report discusses assumptions and provides some justifications and explanations.	Report discusses, explains, and justifies the assumptions.
D3	It should be clear what methodological tools are used to arrive at the results presented in the report.	No stress test or other forward-looking risk assessment analysis OR The methodology is not explained.	General explanation of methodology that lacks detail.	Methodology is explained, but not in full OR Full explanation, but the approach does not seem suitable for the risk that is being assessed.	Clear and detailed explanation of an appropriate methodology.
D4	The results should be presented in a consistent way across reports.	Analyses and results, either in tables or text, are presented in a very different way across reports OR Lack of analyses and results that could be compared across reports.	Analyses and results, either in tables or text, are presented in a similar structure across reports, but differences in presentation render the comparison difficult.	Analyses and results, either in tables or text, are presented in a mostly consistent way across reports, facilitating comparison. Assumptions are mostly consistent.	Analyses and results, either in tables or text, are presented in a consistent and comparable way across reports, and assumptions are consistent. The stress test results are explicitly compared with those in the previous report.

D5	The report should use available data, including those on individual institutions.	Only aggregate results shown.	Mostly aggregate results, with some breakdown by types of institution/range.	More granular results (e.g., range, reference to individual/types of institutions); analysis is based on both individual and aggregate data.	Both individual and aggregate data used effectively, and both individual and systemic risks analyzed. Important missing data are mentioned.
D6	The report should use the available tools.	Assessment relies mostly on basic financial indicators (e.g., changes in credits, interest rates, and bank balance sheets).	Mostly FSIs and simple quantitative tools presented; no or rudimentary stress tests.	Quantitative tools used (e.g., FSIs and stress tests), but only limited qualitative tools (e.g., regulatory framework, qualitative supervisory information).	Combination of available quantitative and qualitative tools to allow for a forward-looking assessment of risk.

E. Structure and other features

E1	The structure of the report should be easy to follow.	No underlying logic or theme to the structure.	Structure is simple, or not sufficient to cover full range of issues. No unifying themes, and in some cases no executive summary.	Structure allows comprehensive coverage. No unifying theme, but structure allows upfront summary of key issues.	Report has an integrated structure with unifying themes that is well explained.
E2	Other features of the report (e.g., its length, frequency, timing, public availability, and links to other central bank reports) should be designed to support its clarity.	No dedicated webpage for FSRs.	Dedicated webpage for FSRs with current and past reports, but either (i) hard to find, or (ii) not accompanied by any of the following: communication strategy (e.g., press release, presentations, videos), links to other relevant, specific publications, official publication date, and underlying data.	Dedicated webpage for FSRs with current and past reports. The webpage has one of the following: communication strategy, links to other relevant, specific publications, official publication date, and underlying data.	Dedicated webpage specifies communication strategy, underlying data, and specific links to other relevant publications.
E3	The structure of the report should be consistent across time to make it easier to follow for repeat users.	Structure not consistent across past reports.	Structure changed without explanation OR Structure broadly consistent, but has become less comprehensive.	Structure largely consistent; any changes are for the better.	Consistent structure across reports that clearly distinguishes core analysis from special topics.

E4	The other features of the report should be designed to support its consistency.	No predictable timetable; some of the past reports are missing/no publication in some years.	No clear timetable; publication appears somewhat irregular; past reports are available.	No clear timetable; publication dates not specified, but appear regular; past reports are available.	Well-known, regular and predictable timetable; past reports are available.
E5	The structure of the report should allow coverage of the key topics.	There is no logical structure to the report.	Logical structure that allows coverage of key topics, but largely follows silo approach and sections (e.g., executive summary, conclusion, boxes) that allow to bring together themes not utilized well.	Logical structure that allows coverage of key topics. Largely follows silo approach, but boxes and annexes allow for discussions of specific themes, and there are sections (e.g., executive summary, conclusion, boxes) attempting to bring together key messages that emerges from subsectors.	Structure of the report allows for presentation of cross-cutting topics, integrating various sub-sectors.
E6	The other features of the report should be designed to support its coverage.	Report outdated and has not been updated for more than 12 months.	Published within 12 months of the data cutoff date.	Published within 6 months of the data cutoff date.	Published within 3 months of the data cutoff date.

Appendix Table 3
List of the FSRs Reviewed in this Study

Country	Issuing Authority	Name of the Report	First Publication Date	Latest Publication as of July 2016	Frequency
Argentina	Banco Central de la Republica Argentina	Informe de Estabilidad Financiera	2004	July-16	6 months
Barbados	Central Bank of Barbados	Financial Stability Report	2011	Feb-16	Annual, mid-year update
Bolivia	Banco Central de Bolivia	Informe de Estabilidad Financiera	2006	Apr-16	6 months
Brazil	Banco Central do Brasil	Relatório de Estabilidade Financeira	2002	Apr-16	6 months
Chile	Banco Cenral de Chile	Informe de Estabilidad Financiera	2004	June-16	6 months
Colombia	Banco de la República Colombia	Reporte de Estabilidad Financiera	2002	Mar-16	6 months
Ecuador	Superintendencia de Bancos del Ecuador	Reporte de Estabilidad Financiera	2013	June-14	Annual
El Salvador	Banco Central de Reserva de El Salvador	Informe de Estabilidad Financiera	2007	June-16	6 months
Guatemala	Superintendencia de Bancos Guatemala	Informe de Estabilidad Financiera	2007	June-12	Annual
Honduras	Banco Central de Honduras, Subgerencia de Estudios Económicos	Informe de Estabilidad Financiera	2012	2016	6 months
Jamaica	Bank of Jamaica	Financial Stability Report	2005	2015	Annual
Mexico	Banco de México	Reporte sobre el Sistema Financiero	2011	Mar-16	Annual
Mexico	Consejo de Estabilidad del Sistema Financiero	Informe anual sobre el estado que guarda la estabilidad del sistema financiero en México y sobre las actividades realizadas por el Consejo de Estabilidad del Sistema Financiero	2006	Nov-15	Annual
Nicaragua	Banco Central de Nicaragua	Informe de Estabilidad Financiera	2013	Sep-14	6 months
Panama	Superintendencia de Bancos de Panamá, Dirección de Estudios Financieros	Informe de Estabilidad Financiera	2012	2016	Annual
Paraguay	Banco Central del Paraguay	Informe de Estabilidad Financiera	2009	Apr-16	6 months
Peru	Banco Central de Reserva del Perú	Reporte de Estabilidad Financiera	2006	May-16	6 months
The Bahamas	The Central Bank of the Bahamas	Financial Stability Report	2012	Feb-16	Annual
Trinidad and Tobago	Central Bank of Trinidad and Tobago	Draft Financial Stability Report	2008	Jun-16	Annual
Uruguay	Banco Central del Uruguay, Superintendencia de Servicios Financieros	Reporte del Sistema Financiero	2010	Jul-16	Annual

Sources: FSRs; websites of different entities issuing FSRs.

Options Pricing by Monte Carlo Simulation, Binomial Tree and BMS Model: a comparative study of Nifty50 options index

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ABSTRACT

Investment behaviour, techniques and choices have evolved in the options markets since the launch of options trading in 1973. Today, we are entering the field of Big Data and the explosion of information, which has become the main feature of science, impacts investors' decisions and their trading position, particularly in the financial markets. Our paper aims to testing the effectiveness of the most popular options pricing models , which are the Monte Carlo simulation method, the Binomial model, and the benchmark model; the Black-Scholes model, when we ignore/take on account the Moneyness categories and different time to maturities; five months, one year, and two years, in addition to comparing these models, we will then test the effect of each model on the prediction of the current options prices, using the regression analysis, and the Nifty50 option index during the period of 25/07/2014 to 30/06/2016. The result shows that all models are over-priced in all Moneyness categories with a high level of volatility in In-the money category, other finding concludes that the Monte Carlo Simulation method is outperforming when the volatility is lower, while the Black-Sholes model and the Binomial model are outperforming in the entire sample with ignoring the Moneyness.

1. INTRODUCTION

The rapidly growth of the financial innovations such as financial engineering instruments, made the dealing on the forward markets more complexity and risky. The trading volume of financial derivatives has been augmenting more and more than the total economic output of the entire world; although the riskiness of this tools. Derivatives contracts exist on several of financial

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underlying asset like stocks, interest rates, etc. It exists also as commodities such as gold, silver, oil, etc. so risk sharing and risk management are increasingly being viewed as a main provenance of value creation in markets.

The options one of the main contracts on financial derivatives, which mean a contract between two parties (seller and buyer), it gives the holder the right, not the obligation to buy (call option) or sell (put option) the underlying asset at a specified date. Options markets have been growing fastly since the seventies 1973's year when the economists Black Fisher and Myron Sholes presented a formula for pricing European options type, this formula has been a benchmark model, and it is widely applied in many types of researches, although the many criticisms on this model. In 2016, options accounted for 38% of the total volumes traded and futures, 62%. This is a change in 2015, when options accounted for 42% of global volumes traded. Overall, options volumes fell by 8%, while the number of futures contracts traded increased by 10% in 2015 (www, statista. com). This type of contracts has been taking a large part of investigations in the academic world, because of their complex characteristics and degree of risk. Buildings on that many researchers and economists have developed several models in order to pricing options and try to present the perfect pricing model which is evidentially an important theme in the mathematical finance literature and financial industry.

Options trading history back to the seventeenth century, several economist and mathematicians worked on creating a theory of rational options pricing. In 1900 the French Louis Bachelier presented his model which was based on the assumption that the stock prices flow a Brownian motion. In 1973 the Chicago Board Exchange of Options (CBOE) raised when the trading of option contracts has begun on standardized listed options. In the same year, the economists Black Ficher and Merton Scholes proposed a formula for evaluating European option type most popular and fundamental model in mathematical finance is the

Black-Scholes model Miyahara (2012), under may assumptions such as the stock prices follow the geometric Brownian motion; the Constance of the variance as well as the risk-free rate. Over the time the options markets became too complex and characterized by the high volatile on option contracts trading; when the Black-Scholes model is not fully adapted with these fluctuations and exigencies of markets with the unrealistic assumptions of the Constance of volatilityRoman (2004). So a great number of new models have presented after the Black-Scholes model, such as the Cox-Ross-Rubinstein is also known as the binomial model is fully developed and illustrated with both the Monte Carlo method and with pricing trees. Katz and McCO RMI (2005).

The complexity and high degree of riskiness are the main characteristics of options, which led to the development of a variety of option pricing models by the academia and the economists; researchers have developed many models that taking time on consideration, they are namely the continuous time models; such as the stochastic volatility model, realized volatility and GARCH models. The models have been successful in option markets because of the ability to forecasting future volatility; but they can be arduously to implement, because it is very difficult to filter a continuous volatility variable from discrete; these models proved them successful in both markets developing and emerging, which are associated and integrated in the last few years given to requirements of the globalization.

The objective of the current paper is to choose the best model on predicting option prices by making a comparison between three different models; Black-Scholes, Carlo Simulation method which presents the continuous time models Binomial and Monte, which presents the discrete time model, depending on many previous studies which presented a large investigations about the outperform models on options pricing, building on that we are going to use the most important models proposed on the pricing option framework. The rest of this paper is organized as follows: section 2 represent some literature review, section three describe the sample data and the methodology, section four and five introduce the main results and discussion respectively finally, the main conclusion will be present in the sixth section.

2. LITERATURE REVIEW

Financial option contracts have widely used in the field of finance since 1973 when the benchmark model was presented by Black-Sholes in order to evaluate these contracts which have been the topic of active research. Many researchers examined the various type of mathematical model for pricing different types of options. In this section, we will discuss some past studies which have been investigating on our subject. The study of Bentouir et al (2018) aimed to compare two options pricing models which are the Monte Carlo Simulation method and the Black-Sholes model, using call stock options in Kuwait stock exchange, covering the period of 26/12/2013 to 08/05/2014, with daily data; the main results of this empirical study showed that the Black-Scholes model is outperforming when the volatility is lower; with a positive relationship of prediction the current prices for one year of maturity. Other finding highlighted the validity of Monte Carlo Simulation method to predict the current prices in six and nine months. The investigation of Robentrost et al. (2018), presented a quantum computational finance Monte Carlo pricing of financial derivatives, under many assumptions like the random distribution of the underlying, and the efficiency of the derivative payoff function. This paper showed the possibility of prepared the relevant probabilities in quantum superposition, furthermore, the authors gave a brief summary about B-S Merton options pricing, a classical Monte Carlo estimation, and discussed the European call option and the Asian option which depend on the average asset price before the maturity date. Srivastava and Shastri (2018) investigated on the relevance between the theoretical price under the B-S model and the market price, using a sample of seven stock of companies over the period of 01/01/2017 and 25/01/2017 and the paired simple T test, the main result of this study showed the stocks with lower prices are more consistent because of the lower premium for these options and show a lower volatility, other finding concluded that there is a significant difference between the market price and the value given by the B-S model. Jying et J. e. al (2017), tried in theme study to forecasting Taiwanese stock index option prices: the role of implied volatility index, Taiwan Weighted Stock Index (TAIEX) for a total of 839 trading days from 2 January 2012 to 29 May 2015, using GARCH, GARCHvix and the historical volatility models, they concluded that, both GARCH and GARCHvix models perform better than the historical volatility models for forecasting call value of TXO additionally, the GARCHvix model outperform than GARCH model; furthermore, GARCH model can be effectively improved with the additional information contained in VIX, and the usage of GARCHvix can greatly reduce model mispricing for TXO value, finally Volatility index is important for option traders to efficiently predict TXO option value with GARCH model. While the study of Xia (2017), investigated on pricing exotic power options with a Brownian-time-changed variance gamma process, using S&P500 index over the period of 2 July 2015 to 1 July 2016 with a total number of 253 observations and Brownian-time changed variance gamma model the result showed that pricing for plain-vanilla options is considerably efficient, and an asymmetric power options can be regarded as a plain-vanilla option a new powered price stock and follows the same pricing mechanism, other finding showed that Symmetric power options can be priced in two approaches, with infinite series expansion and the other with some advanced functional, finally, the estimator of the log stock price at a fixed time point is asymptotically unbiased, and pricing through simulations readily available. Using Fractional Black-Scholes and Li&Chen models Flint and Maré (2017), focused on the Fractional B-S Option Pricing, Volatility Calibration and Implied Hurst Exponents in South African Context with 529 weekly observations of IV skews for listed Futures options on the FTSE/JSE Top40 Index over the period of 2005–2015, and 146 weekly observations of IV skews for listed futures options on (USD/ZAR) exchange rate during 2013–2015. This investigation concluded that FBSI model fits the equity implied volatility very well, and the decomposition of IV into long memory and fractional volatility components provides one with more detailed information on the true uncertainty in the underlying asset price process; thus, The calibrated

FBSI volatility surface still manages to capture most of the traded surfaces characteristics with the added benefit of being fully analytic; an important consideration when valuing exotic derivatives under local volatility. Swishchuk and Shahmoradi (2016), which untitled by pricing crude oil options using levy processes European style crude oil futures options in NYMEX index during 2015 to 2016 under the Normal Gaussian Process, Jump Diffusion Process, Variance-Gamma Process. This examination deduced the crude oil prices Show significant jumps that are very frequent, also, crude oil price returns show skew as well, in addition, in the case of JDM, the volatility of size of the -jumps is bigger than volatility of the diffusion part other finding showed, the VG process results in slightly smaller volatility than JDM as well as the mean of the jump component size implied by JDM, and skew parameter of VG process both indicate existence of right-skew in crude oil price returns but the NG process implies that the density of returns are skewed to the left. Čirjevskisa and Tatevosjans (2015), tested the real option in the real Estate market, in order to analysis of investment project "Sun village", during the period of 2008 to 2013 using three real option valuations methods; Tomato Garden, Black-Sholes and Binomial option pricing models, the main results which were founded by the authors are; the option to sell current project is inefficient, and the existence of the uncertainty concerning the project outcome due to high volatility level, finally both of the Black-Sholes and the Binomial model proves their efficiency to predict approximately the same result of option value. The study of Girish and Rastogi (2013), examined the efficiency of the European call/put S&P CNX Nifty index options during the period of 1/1/2002 to 31/12/2005 using high-frequency data and Box-spread strategy, the findings highlighted that the internal option market is efficient over the years for the S&P CNX Nifty index option. Black and Scholes (1973); presented a paper untitled by the pricing of options and corporate liabilities, under the principle of the options are not correctly priced in the markets. They developed a theoretical valuation formula for European call/put options that can be executed only on the expiry date, the formula given under the assumption of the ideal conditions in the market, so the value of the option depending on the stock price and the option life, and the variables that are taken to be know and constant as well as the volatility and the risk-free rate. Cox et al. (1979), presented a simple discrete time model for the valuing options; they took on account the principle of option pricing by arbitrage method, this approach gave some assumptions, which are the stock prices follow a multiplicative binomial process, the rate of return on the stock can be upward or downward, thus the absence of the taxes and the transaction costs. This approach concluded that the options can be priced solely on that basis of arbitrage considerations.

Our sample of previous studies tried range between the fundamental papers which gave a different model and mathematical formulas on options pricing, and investigations which tried to find the outperform models under different samples and periods since the creation of the benchmark model (Black-Scholes), till this day the researchers couldn't identify the models which can be used in all of options markets or give a lower level of mispricing, because of the substantial differences of these markets and investors behavior, in addition to other crucial factors which have a big influence.

3. DATA AND METHODOLOGY

The present paper is based on secondary data that is collected from the IVolatility.com, and the National Stock Exchange of India websites, our data consists the European call options data under the Nifty50 index during the period of 25/07/2014 to 30/06/2016, with 463 contracts, the historical prices were collected from the Finance yahoo website, such as the risk free rate that is obtained from the federal reserve bank.

We divided our data into two categories; the first one by the Moneyness (In the Money (ITM), At the money (ATM) and Out of the money (OTM)) and into times to maturities (5 months, one year, and 2 years).

Where the moneyness range between the following interval (ITM, ATM, OTM) respectively:

$$1.2 \leq M < 1.9$$

$$0.9 \leq M < 1.2$$

$$0.8 \leq M < 0.9$$

Moneyness "M" defined by:

$$M = \frac{S}{K} \tag{1}$$

We also use the Ordinary Least Square (OLS) regression to examine the relationship between the current price and the theoretical prices.

$$C(s,t) = \alpha_0 + C_{Tp} + \varepsilon_t \tag{2}$$

Where: $C(s,t)$ is the option current price, and C_{Tp} are the theoretical prices

3.1. The mathematical models

3.1.1. The Black-Sholes model

The geometric Brownian motion model or the Black-Sholes model, it is the benchmark model in options pricing model, which presented in the early 1970s when Fisher Black, Myron Sholes and Merton achieved a major model in the pricing of European stock options Hull (2015), under many assumptions as follow:
– The risk-free rate is known and constant, as well as the variance rate;
– The stock price follows a random walk in continuous time;
– The log-Normal distribution of the stock prices;
– The absence of the dividends or other distributions;
– The option is European;
– There are no transaction costs;
– There are no penalties to short selling.

The Black-Scholes formula
The Black-Sholes formula was given as follows:
We start by the differential equation formula for the value of the option;

$$w_2 = rw - rxw_1 - 0.5v^2x^2x_{11} \tag{3}$$

With the "t^*" is the maturity date and c is the strike price and x is the spot price we can right this next formula:

$$w(x,t^*) = x - c, \quad x \geq c$$
$$= 0, \quad\quad\quad x \prec c \tag{4}$$

To solve the differential the following illustration was given as follow:

$$w(x,t) = e^{r(t-t^*)}\left[(2/v^2)(r - 0.5v^2)\left[\ln x/c - (r - 0.5v^2)(t - t^*)\right], - 2/v^2 (r - 0.5v^2)^2 (t - t^*)\right] \quad (5)$$

Where: v^2 is the variance, $(t-t^*)$ is the time to maturity.

After that the differential equation becomes:

$$y_2 = y_{11} \tag{6}$$

This equation is the heat-transfer equation of physics, and it solution was given as follow:

$$y(u,s) = 1\big/\sqrt{2\pi} \int_{-u/\sqrt{2s}}^{\infty} c\left[e^{(u+q\sqrt{2s})(0.5v^2)/(r-0.5^2)} - 1\right]e^{-q^2/2}\,dq \tag{7}$$

From the equations (3) and (5) the option value formula becomes:

$$w(x;t) = xN(d_1) - ce^{r(t-t^*)}N(d_2) \tag{8}$$

Where: $w(x;t)$ is the theoretical price of option.

$$d_1 = \frac{\ln x/c + (r + 0.5v^2)(t^* - t)}{\sigma\sqrt{(t^* - t)}}$$

$$\tag{9}$$

$$d_2 = \frac{\ln x/c + (r - 0.5v^2)(t^* - t)}{\sigma\sqrt{(t^* - t)}}$$

or $d_2 = d_1 - \sigma * \sqrt{T}$ Ser-Huang and Stapleton (2005)

Where: "w" is the option price, "x" is the spot price, "c" the strike price, t^* is the maturity time, $N(d)$ is the cumulative normal density function. Black and Scholes (1973)

3.1.2. The Binomial model

Cox, Ross and Rubinstein presented a simple discrete time option pricing formula in 1979, where the fundamental economic principles of option pricing using arbitrage method are shown in this work. This approach includes the Black-Scholes model as a special limiting case, by taking the limits in a different way, wherein, the economic arguments used in the CRR model about the relationship between the value of the options and the stock price is precisely the same as those advanced by B-S in 1973.

Assumptions of the model
a – The stocks prices follow a multiplicative binomial process over the discreet period;
b – The rate of return on the stock have two cases; $u - 1$ with probability q, or $d - 1$ with probability P;
c – Stock prices at the end of the period will be up or down;
d – The interest rate constant;
e – There are no taxes or transaction costs or margin requirements.

The Binomial pricing options formula

Presentation of the simplest situation of the call option:

$$c\begin{bmatrix} c_u = Max[0; Su - K]q, \\ c_d = Max[0; Sd - K]p. \end{bmatrix} \tag{10}$$

This simple presentation shows the movement of the option value depending on the changes in the stock prices.

Supposing that there is a portfolio includes Δ shares of stock and B is the amount in riskless bonds, we get this situation:

$$\Delta s + B\begin{bmatrix} \Delta uS + rB \xrightarrow{\text{with}} p \\ \Delta dS + rB \xrightarrow{\text{with}} q \end{bmatrix} \tag{11}$$

We can get:

$$\Delta uS + rB = Cu$$
$$\Delta dS + rB = Cd \tag{12}$$

Solving this equation; finding the hedging portfolio;

$$\Delta = \frac{Cu - Cd}{(u - d)S} \tag{13}$$

$$B = \frac{uCd - dCu}{(u - d)r} \tag{14}$$

From this entire, if there are no riskless arbitrage opportunities, we can write this equation:

$$c = \Delta S + B = \frac{Cu - Cd}{u - d} + \frac{uCd - dCu}{(u - d)r} = \left[\left(\frac{r - d}{u - d}\right)Cu + \left(\frac{u - r}{u - d}\right)Cd\right]/r \tag{15}$$

This equation can be simplified by the following formula: Jhon et al. (1979)

$$C = [pCu + (1 - p)Cd]/r \tag{16}$$

Where:

$$p = \frac{r - d}{u - d} \quad \text{and,} \quad 1 - p = \frac{u - r}{u - d} \tag{17}$$

P is the probability of the option price movements (up or down).

3.1.3. The Monte Carlo simulation method

Monte Carlo simulation (MCS) has a long history in sciences such as physical science, when it used to estimate the expected value of a random variable, and it also used in other sciences for solving analytically intractable integral calculus problems, as well as it used in finance field in order to solve pricing problems, through the determination of the expected value of function of one or many underlying securities.

Options pricing by Monte Carlo Simulation

Monte Carlo Simulation method can be applied for the European option, but can't apply for the American option style; wherein we can simulate possible paths for a stock price over the life of option from "t" to "T".

Generating the stock price using Monte Carlo Simulation

The stock price in this method follows approximately a Geometric Brownian Motion, random walk, the equation below represents the generation of the stock price:

$$S_{(t_J+1)} = S_{(t_J)} * e^{\left[(r-0.5\sigma^2)*\sqrt{\Delta} + \sigma*\sqrt{\Delta}\in_J+1\right]} \tag{18}$$

Where: $S_{(t_J)}$ is the initial stock price, and $\in_J+1$ is the IID N (0, 1).

The simulation of the option value based on the present value of the average of payoff:

For call option   *Max* = [*S_K*;0]

For put option   *Max* = [*K_S*;0]
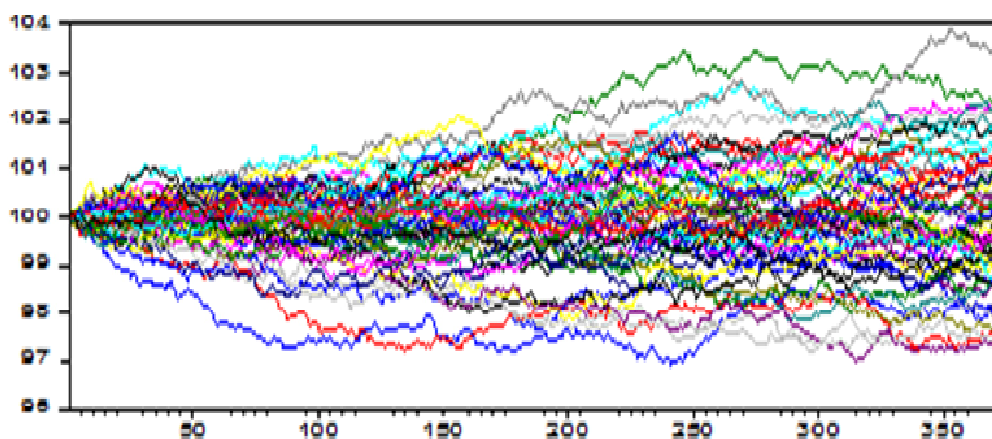
S is the spot price and *K* is the strike price.

The present value is given by the following formula: Crack (2009)

$$PV = Average * e^{-r*t} \tag{19}$$

Graph 1 shows the simulation of the stock price of a call option depending on time to maturity.

Graph 1.
Simulation of stock prices using Monte Carlo Simulation

Sources: Authors.

4. RESULTS

In order to understand and know the characteristics of our data and the outputs of all models, we will show the descriptive statistics of each category and each period.

Table 1 shows the descriptive statistics of the current and theoretical prices of call options and their characteristics, in three different categories of Moneyness. The standard deviation indicates a higher fluctuation in their prices in In-the money category than the other categories, while the Black-Sholes prices show high volatility comparatively by the Monte Carlo Simulation and the Binomial model prices respectively. A small deviation has appeared in the category of

At-the money from the mean value, when the Monte Carlo Simulation prices have a lower fluctuation comparatively by the current prices, followed by the Black-Sholes and the Binomial model respectively. The third category Out-of the money appears a lower variation from their mean, the Monte Carlo Simulation prices compared to the B-S and the CRR respectively. The Skewness is positive and different to zero that indicates a right tail and non-normal distribution of prices, which confirmed by the Kurtosis that is different to 3.
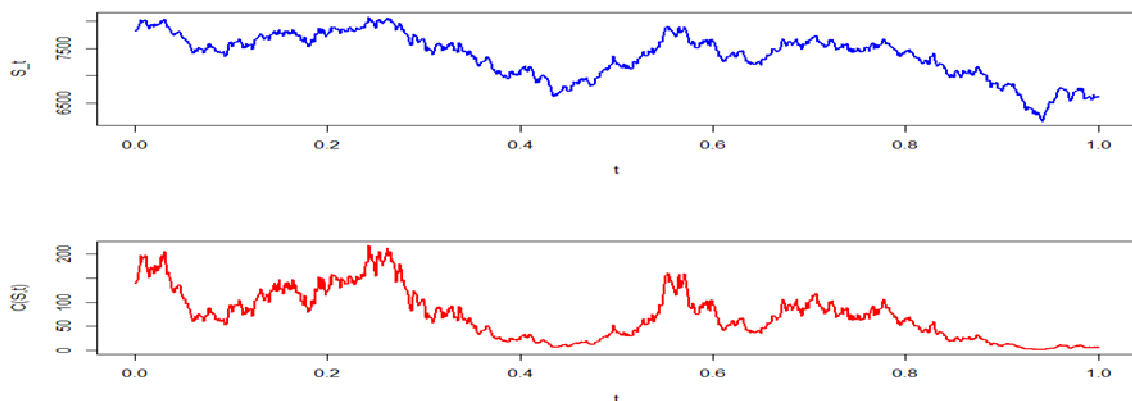
Table 1.
Descriptive Statistics of Market Price and Theoretical Prices of Option

	Mean	Std. Dev	skewess	kurtosis
In the money				
Current prices	773.6049	1303.590	1.526940	4.256135
B-S prices	3176.204	1086.576	0.243180	1.987604
CRR prices	3130.269	1145.297	0.317479	2.157465
MCS prices	2993.505	1092.879	0.292912	1.946116
At the money				
Current prices	292.7176	428.4764	1.350441	3.759105
B-S prices	826.5163	502.2075	0.313788	2.373334
CRR prices	631.4867	639.3497	0.080637	2.530264
MCS prices	561.7042	494.5747	0.451466	2.051019
Out of the money				
Current prices	8.464407	24.16100	3.798360	17.92294
B-S prices	123.1321	157.8379	1.638303	5.285195
CRR prices	-929.4692	508.1874	0.069445	2.384516
MCS prices	6.537937	31.54199	6.390141	49.32185

Source: Authors.

The Graph 2 shows the changes of the call options depending on the spot price during option life.

Graph 2.
The sensibility of the call options to the stock prices

Source: Authors.

Table 2 presents the estimation of the current price of call options on the theoretical prices in the case of In-The money.

Table 2.
Regression results of the relationship between current price of call options on the theoretical prices (ITM)

	Coefficient	S.d.v	T. statistic	P. value
Constant	809.0117	268.6611	3.011272	0.0030
B-S	1.880985	0.693708	2.711495	0.0073
CRR	-3.696228	0.481602	-7.674862	0.0000
MCS	1.857484	0.418042	4.443291	0.0000
R-Squared	0.334670	F. Statistic	30.68386	
Adj-R	0.323763	P. Value	0.000000	

Source: Authors.

The table 2 shows the relationship between the current price and the theoretical prices under three different categories In-the money (ITM), At-the money (ATM), Out-of the money (OTM), we used the Least Ordinary Square (OLS), Regression Analysis in order to examine the effect of each model (Black-Sholes, Binomial and the Monte Carlo Simulation method) on the current price, after the estimation the result appears that the theoretical prices of three different models in the case of In-the money have a significance at 1%, 5%, 10% level, to predicting the current prices, while the coefficient of the B-S and the Monte Carlo Simulation models have a positive relationship with the current price except for the Binomial model which have a negative relationship; the R-square and Adjusted-R are near to 0.33 that means 33% of the prediction of the current prices can be explained by the theoretical prices, and 77% of the variation explained to other factors, the hole model was accepted depending to Fisher probability.

Table 3 shows the estimation of the current price of call options on the theoretical prices in the case of At-The money.

Table 3.
Regression results of the relationship between current price of call option on the theoretical prices (ATM)

	coefficient	Std. Dev	T. statistic	P. value
constant	452.5450	89.75094	5.042232	0.0000
B-S	-1.134002	0.234547	-4.834865	0.0000
CRR	0.235757	0.206171	1.143503	0.2546
MCS	1.119034	0.131451	8.512964	0.0000
R-Squared	0.416461	F. Statistic	36.87354	
Adj-R	0.405167	P. Value	0.000000	

Source: Authors.

Table 3 reveals the effect of the theoretical prices on the current prices in At-the money category, the result indicates that the theoretical prices of B-S and MCS models have a significance at 1%, 5%, 10% level, to predict the current prices, except the Binomial model the coefficient of the B-S model has a negative relationship with the current prices, while the coefficient of MCS method has a positive relationship; the R-square and Adjusted-R are near to 0.42 that means 42%

of the prediction of the current prices can be explained by the theoretical prices, and 58% of the variation explained to other factors, the hole model was accepted depending to Fisher probability.

Table 4 highlights the estimation of the current price of call options on the theoretical prices in the case of Out-of-The money.

Table 4.
Regression results of the relationship between current price of call option on the theoretical prices (OTM)

	coefficient	Std. Dev	T. statistic	P. value
constant	35.66629	6.200938	5.751757	0.0000
B-S	-0.026483	0.018586	-1.424908	0.1569
CRR	0.025016	0.004870	5.136388	0.0000
MCS	-0.105504	0.082835	-1.273659	0.2054
R-Squared	0.195511	F. Statistic		9.234938
Adj-R	0.174340	P. Value		0.000016

Source: Authors.

Table 4 presents the effect of the theoretical prices on the current prices in Out-of-the money category, the result highlights that the theoretical prices of B-S and MCS models don't significant at 1%, 5%, 10% level of significance, and have a negative relationship depending on the coefficient, except the Binomial model which has a positive relationship and a significant at 1%, 5%, 10%; the R-square and Adjusted-R are near to 0.18 that means 18% of the prediction of the current prices can be explained by the theoretical prices, and 82% of the fluctuation explained to other determinants, the model was accepted depending to Fisher probability.

In table 5 we will show the estimation of the current price of call options on the theoretical prices by ignoring the Moneyness.

Table 5.
Regression results of the relationship between current price of call option on the theoretical prices ignoring the moneyness

	coefficient	Std. Dev	T. statistic	P. value
constant	514.5884	101.6758	5.061071	0.0000
B-S	-1.366015	0.254555	-5.366283	0.0000
CRR	1.341658	0.199614	6.721278	0.0000
MCS	0.160767	0.103631	1.551333	0.1215
R-Squared	0.150023	F. Statistic		27.00491
Adj-R	0.144468	P. Value		0.000000

Source: Authors.

The table 5 widens the significance of the B-S and the Binomial model at 1%, 5%, 10% level of significance the coefficient reveals to the negative/positive relationship with B-S model and the CRR models respectively, except the MCS method, which doesn't significant; the R-square and Adjusted-R are lower than the other category with 0.15 that means just 15% of the prediction of the current prices can be explained by the theoretical prices, and 85% of the variation explained to other factors, the model was accepted depending to Ficher probability.

Graph 3.
The convergence between the current price and the theoretical prices.
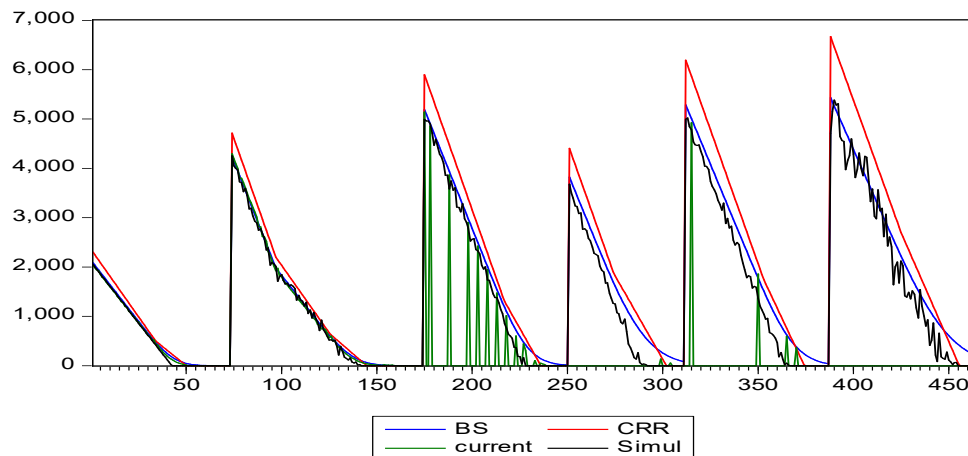
Source: Authors.

The Graph 3 shows the convergence of the theoretical prices with the current prices during the period of study, it indicates that the different three models are converging to the current prices in 2014, but in the period of 2015–2016 the current prices are under-valuated comparatively by the different models.

The Greek letters
We selected three times to maturity for this presentation: (5 months, one year, and 2 years during the period of study (2014–2016).

Table 6.
Descriptive statistics of the Greek letters for three times to maturity

|	Delta	Gamma	Vega	Theta	Rho
5 months					
Mean	0.731067	0.000138	6.622110	-1.317195	15.65745
Std. Dev	0.350482	0.000157	7.385587	0.554785	7.200706
Kurtosis	-0.885222	0.608855	0.628232	-0.198473	-0.517308
Skewness	2.126890	1.794396	1.823952	1.964403	2.140762
One year					
Mean	0.695900	0.000157	13.59714	-1.467636	26.52644
Std. Dev	0.296844	0.000120	9.556276	0.393346	9.129574
Kurtosis	-0.498458	-0.174795	-0.247079	-0.100875	-0.745896
Skewness	1.722060	1.504454	1.456722	1.598148	2.197324
2 years					
Mean	0.823922	0.000112	0.180956	-0.937720	0.777467
Std. Dev	0.217836	0.000119	0.177274	0.244980	0.178663
Kurtosis	-0.960192	0.441672	0.299442	0.338547	-0.284195
Skewness	2.465201	1.624731	1.352943	1.898206	1.733451

Source: Authors.

This table 6 presents the Five Greek letters or (parameter of sensibility) Delta, Gamma, Vega, Theta and Rho in order to analyze the situation of the call option contact under three different time to maturity 5 months, one year and two years; Delta values range between 0.69 and 0.82 depending on it mean, these high values indicate the possibility of the execution of the contract is higher and the change of 1% on the stock price leads to the change in the call option value between 69% and 82%, Gamma value range between 0.000112 and 0.000157 means that the delta is efficient to take the decision of the execution of the contract. Vega value range between 0.180956 and 13.59714 with higher fluctuation 9.55% comparatively with the other parameters, the Skewness values present the right tail of Vega and a Non-normal distribution, Theta ranges between -0.93 and -1.46, the last parameter Rho rang between 0.77 and 26.52 Skewness of Theta and Rho shows the right tail and non-normal distribution which is confirmed by the Kurtosis value that is different to zero. The following graphs emphasize the numerical results of the Greek letters, wherein we arrange the values of the parameter of sensibility depending on their indicators; Delta with stock prices, Gamma represents the sensibility of the delta on the stock prices changing, Vega depending on the return volatility, Theta with the time to maturity and Rho arranged depending on the risk-free rate using R program, which gave the next graphs.

Greek Letters graphs for three times to maturity (5 months, one year and 2 years)
The graphs 4, 5 and 6 present the Greek letters for three times to maturities.
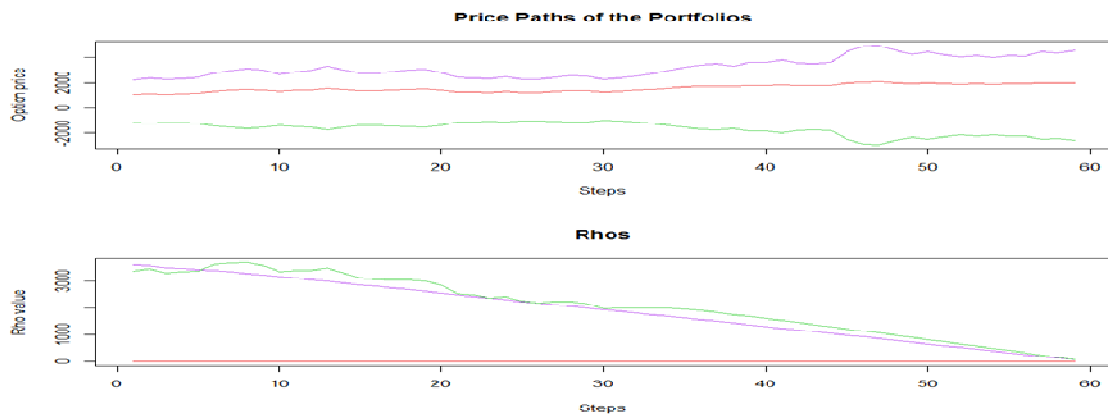
Graph 4.
Greek Letters Graphs for 5 months
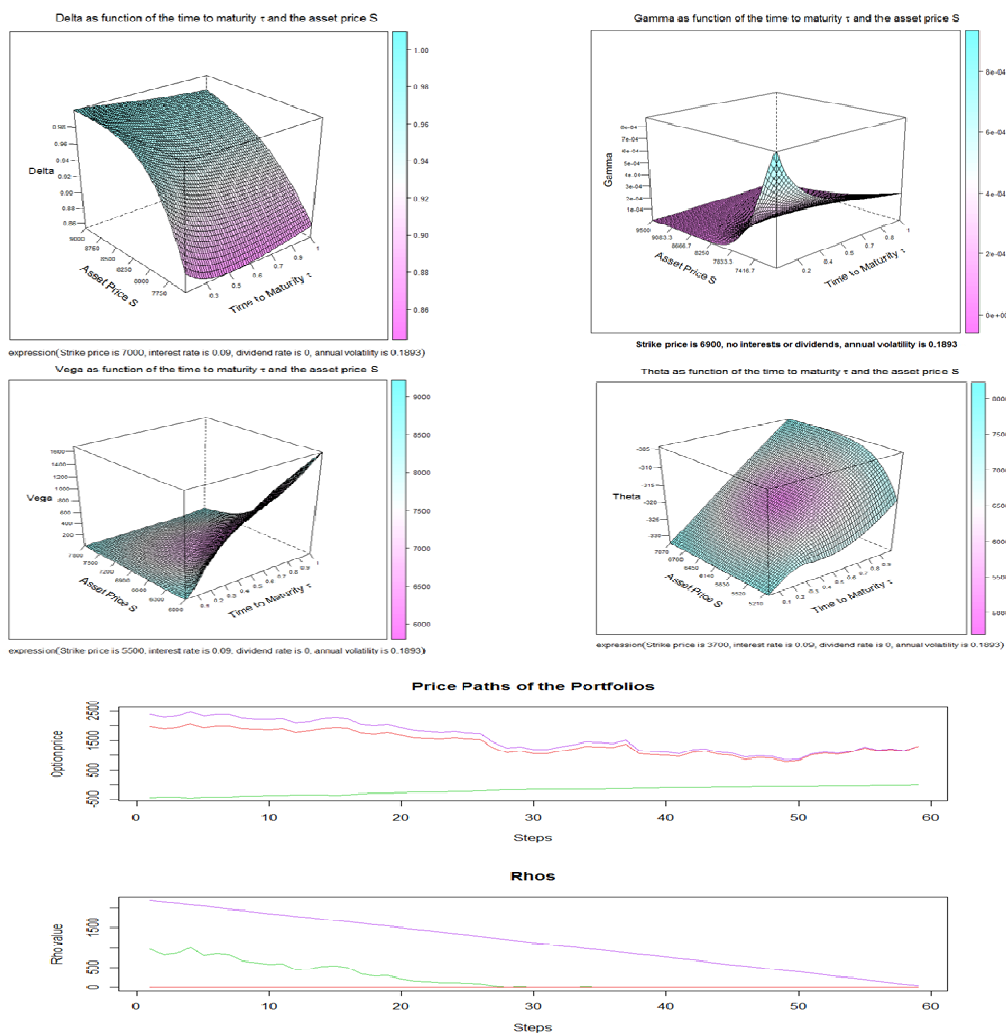
Source: Authors based on Franke J., et al. (2015) codes.

Graph 5.
Greek Letters Graphs for one year
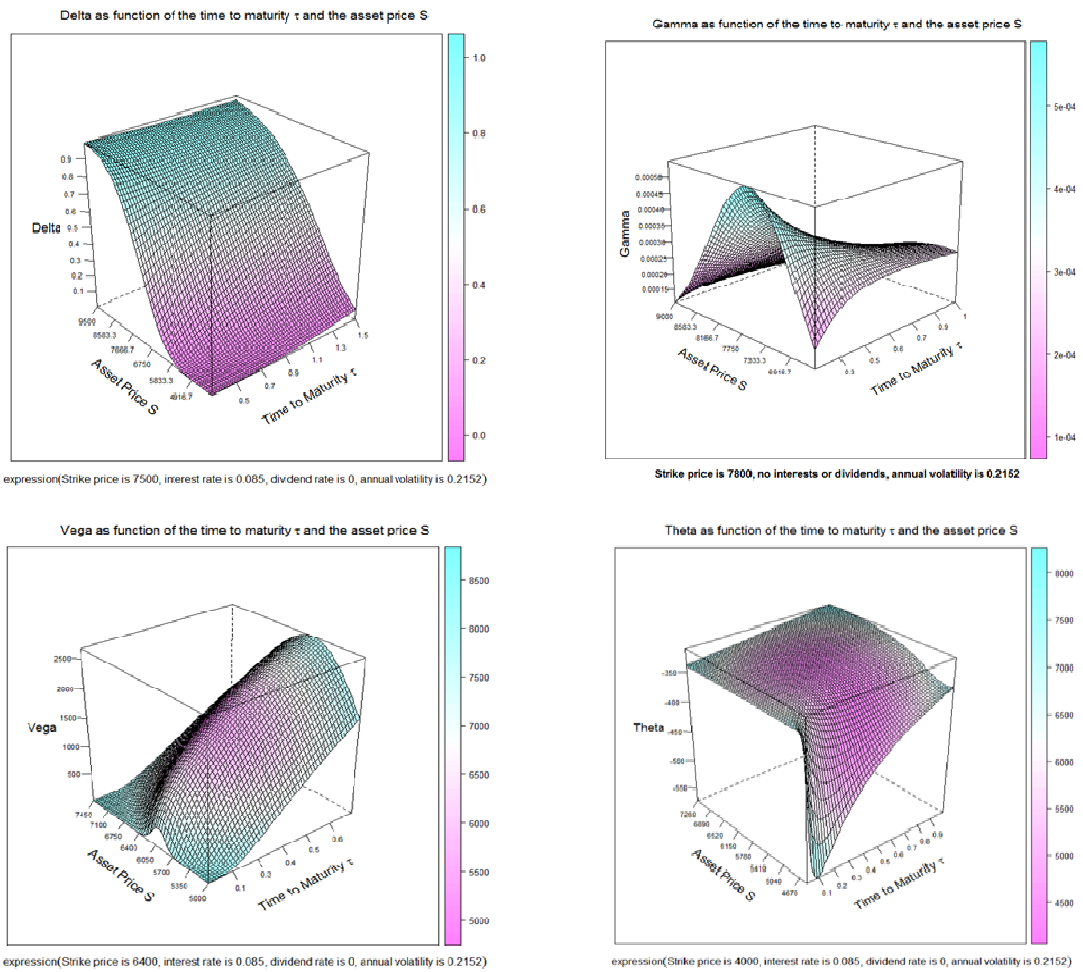
Source: Authors based on Franke J., et al. (2015) codes.

Graph 6.
Greek Letters Graphs for two years
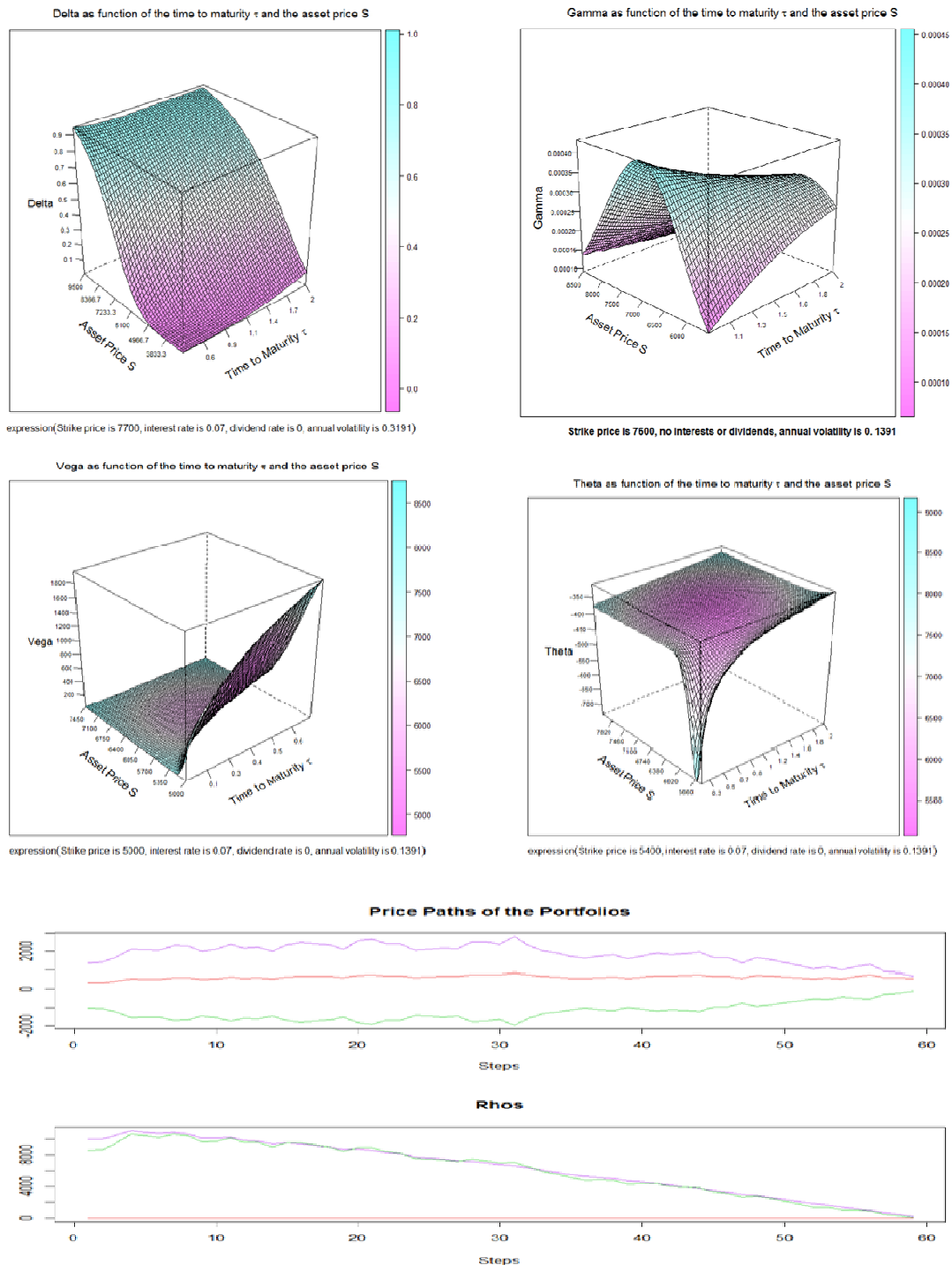
Source: Authors based on Franke J., et al. (2015) codes.

5. DISCUSSION

After showing the result of the descriptive statistics of the current and theoretical prices; we can explain the high volatility in the first category by the high sensibility of the options prices to their underlying asset prices and the rest determinants of the option (time to maturity, risk free rate, volatility, ex.) in addition to other factors influencing on option pricing like options market determinants such as the number of option contract traded, open interest rate, and other

fundamental factors such as the behavior of the traders and theme purposes from the option contracts, which play a big role to predicting the current prices, so we can also explain the high fluctuation in In-the money category by the speculation purposes, which lead to the over-pricing of the theoretical call option prices than the current prices; the macroeconomic variables also have an impact to predicting the current prices like, stock markets, supply of money, the benchmark indexes and other factors. Other finding concludes that the Black-Sholes and the Binomial model are over-priced comparatively the Monte Carlo Simulation Method on three different categories of Moneyness.

The result of the estimation unfold an important fact that the theoretical prices have an impact on the current prices in In-the money category, and the Monte Carlo Simulation model is outperform than the other models when the volatility is lower, the same result was showed in the case of At-the-money when the Monte Carlo Simulation method proved its performance comparatively by the Black-Sholes model, in Out-of-the money only the Binomial model shows a Significance positive relationship with the current prices; as a result we can say the Binomial model is performs when the option I Out-of-the money. When we ignored the Moneyness, the result highlighted that the Black-Sholes model and the Binomial model are outperforming with lower volatility. As a conclusion of this estimation, all of these models are perform when the volatility is not higher.

The descriptive statistics of the Delta shows a high possibility of execution for three times to maturities, it range between 0.69 and 0.82 which mean if the stock price rise with 1% the call option price will increase by the delta value (69% or 82%), in this case, the holder should buy 6959 or 8239 of stocks to cover his position, but if the stock price decrease the delta value also will decrease, and the holder sell a part of these stocks. Gamma is an indicator to measure the sensibility of the delta to the stock prices, the result shows that Gamma range between 0.00011 and 0.00015 means the efficiency of the Delta to take a decision about the execution and that the holder should own stocks of each number of call option contracts. The sensibility of the call option price to the volatility of stock prices presented by Vega which has a positive relationship between Sigma and the theoretical prices, men when the volatility of the stocks increase by 1% the option value will increase by the Vega value. while Theta presents the effect of time to maturity on theoretical call option prices, it has a negative relationship with the prices because it takes on account the time value; when the contract is near to the settlement date (In-the-money) the call option price will decrease by Theta value; the last parameter Rho, which relates to strike price and time to maturity, when the risk-free rate increase the call option price will in increase by the value of Rho.

6. CONCLUSION

This current paper aims to examine the efficiency of three different options pricing models by comparing the current call prices using the NIFTY50 options Index, with the theoretical prices from the different models which are Monte Carlo Simulation method, Black-Sholes model and the Binomial model, in addition to testing the effect of these models on the market option prices, to predicting the current prices.

Our result highlights that the effect is variable depending on the different type of Moneyness In-the-money, At-the-money and Out-of-the money. The descriptive statistics elucidates all models are overpriced than the current prices in all categories especially in In-the money category because of the high level of fluctuation, that lead to conclude the investors use the option contracts for speculation purposes that confirm the study of Srivastava and Shastri (2018) which it showed a significant difference between the market prices and the theoretical prices.

We can also explain this high volatility by the augmentation of trading volume and that the expectations of traders are overlooking to the fluctuation on stock prices Srivastava and Shastri (2018).

Moreover, the regression analysis focus to examine the best model to predicting the current prices, when the estimation shows that the Monte Carlo Simulation method is out-perform when the volatility is lower, and the Binomial model is performed in Out-of-the money category, Both of the models Black-Scholes and Binomial proved their efficiency in the case of In the money to determined the which finally both of the Black-Sholes and Binomial models perform when ignoring the Moneyness. Other finding highlights the hedging position that is clear from the Greek Letters delta and gamma for the option's seller because of the high possibility of execution of the contract by the buyer.

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The Banks Profitability and Economic Freedom Quality: Empirical Evidence from Arab Economies

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ABSTRACT

This study empirically examines the impact of economic freedom quality and global financial crisis on the banking sector profitability in the Arab region. The analysis is performed by employing system GMM estimation in panel data comprising of 14 Arab countries over the period 1985–2016. The study constructed an economic freedom index based on the economic freedom indicators. The findings indicate that greater economic freedom has positively influenced the profitability of the Arab banking sector. The results also suggest that the more profitable banks are those that have lower operating expenses against asset and income, better capitalized, more diversified and concentrated at economies having growth in the GDP. Furthermore, the global financial crisis in 2008 negatively impacted the profits of Arab banks.

JEL classification: G210, G280, C23.

Key words: Profitability, Economic freedom, Global financial crisis, Arab economies.

1. INTRODUCTION

During the last decade, deposit growth rates in a number of Arab countries were weakened by the downward trend of global oil prices, however the banking sectors are continuing to perform positively in this region. In 2008, the financial crisis and global recession have tested the strength of the financial institutions and regulatory structures in the Arab region as well as the world. In the Arab region, several developments are implemented to improve the infrastructure of the banking sectors including legislation and regulation to fulfil latest Basel standards, particularly on liquidity risk, enhancing the governance and transparency and set up measurements to be more responsive to latest international developments[2]. Before the global financial crisis, the development in economic freedom in the Arab region has remained stable and almost steady, witnessed increasingly as very close to the same rate as the world average. However, the recent

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[2] Arab Monetary Fund. (2016).

figure of the average score of the Arab region has exhibited a slight but noticeable decline and this is a considerable achievement given the challenges that the region has faced in past years[3].

Considering these major developments in the Arab region, there is no doubt that could be reflected on the profitability and performance of the banking sectors that are operating in the region. As a sound and profitable banking sector is better able to contribute to the stability of the financial system and diversify the economy, which are governments' goals, therefore, examining the determinants of bank profitability is essential to the policies makers and banks managers in this transformational business environment.

Numerous researches on banking sectors mainly focus on the regions of North and South America, East Europe, Africa and Asia (Demirguc-Kunt et al., 2000, Berger and Mester, 2003, Francis, 2013, Islam and Nishiyama, 2016, Logan, 2016 and Combey and Togbenou, 2017). There is little attention in the research on the Arab banking sector, especially, on the nexus between economic freedom and profitability; this could be due to lack of reliable data compared with other regions. There are banks profitability studies that focus only on Gulf Cooperation Council countries (GCC), the Middle East and North Africa (MENA) region or an individual Arab country[4]. Although these studies show that it is possible to conduct a meaningful analysis of bank profitability, there are few issues not dealt with sufficiently and estimated results could be biased (Al-Omar and Al-Mutairi, 2008, Bennaceur and Goaied, 2008, Amba and Almukharreq, 2013, Mokni et al., 2014, Alkhazaleh and Almsafir, 2014, Murthy Y and Al-Muharrami, 2014, Caporale et al., 2016, Ghosh, 2016, Abdullah et al., 2017). First, the literature principally considers determinants of profitability with no comprehensive selection for the variables set, countries in the sample under investigation and the short time dimension of the panels used in the estimation. Second, the results could be inconsistent due to the use of the econometric methodology that does not adequately account for some features of bank profits (e.g. persistence) or omitted variables. In addition, since the countries in the sample have different features, thus, the data in the panels may raise the issue of country-specific effects, hence, using an estimation that overcomes this problem is essential.

This study fills in the gap and contributes to the existing literature by taking into account the economic freedom while empirically investigates the determinants of banking sector profitability in 14 Arab economies[5] over the period from 1985–2016 and using a wide range of variables including bank-specific factors with other important variables such as global financial crisis (GFC). For econometric analysis, this study employs system GMM (Arellano-Bover/Blundell-Bond) techniques to deal with issues related to endogeneity, omission of relevant variables, measurement error, sample selectivity, or simultaneity. The study adequately addresses the issue of unit root properties of the variables. What makes this study have a singularity is that it develops an overall index from the five individual indicators of economic freedom by computing their weighted average, taking factor loadings in principal components analysis (PCA) as weights, to avoid testing partially correlated indices against each other, which makes this study have advantages compared to others.

This comprehensive empirical analysis attempts to answer the following research questions: What is the impact of economic freedom on the banking sector profitability in the Arab region? Do the efficient protection of privately-owned property, even-handed enforcement of contracts, refrain of creating barriers to trade, and relying fully on markets mechanisms play an important role for the banking profitability? How important is the bank size, credit risk and operation cost

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[3] The Economic Freedom of the World Reports (2007, 2014 and 2017).

[4] The League of Arab State comprises 22 countries (Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, UAE and Yemen).

[5] This study focuses on 14 countries due to data limitation, they are: Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Syrian, Tunisia, United Arab Emirates, and Yemen.

to the profitability for the banks that are operating in the Arab region? What is the impact of GFC along with other economic variables on Arab bank profitability?

This paper is formulated as follows: Section 2 describes the methodology. Section 3 presents the summary statistics and correlation. Section 4 discusses the empirical results. Section 5 concludes and provides policy implications.

2. METHODOLOGY

2.1. Data and Variables

For the empirical analyses, this study utilises panel data of 14 Arab countries over the period 1985–2016: Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Syrian, Tunisia, United Arab Emirates, and Yemen. Appendix Table A.1 provides information about the sources of data and definition. This study constructs a variable to capture the economic freedom quality by calculating a quality index using principal components analysis (PCA) technique.

2.1.1. Bank Profitability

The study uses return on assets ratio as a measure for bank profitability. The ratio of return on assets shows the profit earned per dollar of assets and, most importantly, reflects the management ability to utilize the bank's financial and real investment assets to generate profits, thus it is encompassing both management decisions and policy objectives (Sufian and Habibullah, 2009). This study selects to focus on return on assets ratio as measurement for profitability, rather than the return on equity ratio because as Admati et al. (2013) states the use of return on equity becomes problematic when comparisons are made across different capital structures. The data for return on assets is from the World Bank's Global Financial Development Database.

2.1.2. Economic Freedom Quality

In order to measure the economic freedom quality of the Arab region, this study employs data from the Fraser Institute. Economic freedom[6] measures the degree to which the policies and institutions of countries are supportive of economic freedom. There are many channels that the economic freedom positively impacts bank profitability. First, economic freedom strongly promotes investment and the coemption between firms in the economy, as a result, this increases the lending activities and leads to more income for banks (Al Ismaily and Al-Busaidi, 2017). Second, greater economic freedom attracts more foreign companies and financial institutions, thus, better income diversification and risk minimization for the banking system. Third, better economic freedom can enhance the productivity of overall businesses that boost the economic growth, this in turn is positivity reflected in banking profitability (Asteriou et al., (2016).

The economic freedom has five indicators including the size of government, legal system and property rights, access to sound money, freedom to trade internationally, and regulation of credit, labour, and business[7]. These help to measure the contribution of economic institutions more

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[6] In order to receive a high economic freedom rating, a country must provide secure protection of privately-owned property, even-handed enforcement of contracts, and a stable monetary environment. It also must keep taxes low, refrain from creating barriers to both domestic and international trade, and rely more fully on markets rather than government spending and regulation to allocate goods and resources (Gwartney et al., 2018).

[7] Each indicator has a different number of sub-components. Size of government indicator consists of average number of the sub-components: government consumption as a share of total consumption, transfers and subsidies as a share of GDP, government enterprises' production as share of total output and top of marginal tax rates. Legal system and property rights indicator is based on the levels of judicial independence, impartial courts, protection of property rights, military interference in rule of law and politics, integrity of the legal system, legal enforcement of contracts, regulatory restrictions on the sale of real property, reliability of police and business costs of crime. Access to sound money indicator is money

thoroughly and to distinguish it from political, climatic, locational, cultural, and historical factors as determinants of growth and development (Gwartney et al., 2014). To obtain the overall index, the study calculates a weighted average of the five individual indicators of economic freedom, taking factor loadings in principal components analysis (PCA) as weights[8]. Higher values reflect better economic freedom institutional quality.

2.1.3. Bank-specific characteristics and others Control Variables

The study includes key control variables for the model to reflect the determinants of bank profitability as per the existing literature to overcome the lack of consistency in the selection of bank and industry specific characteristics. To address this issue, the study selects several bank-specific and macroeconomic variables to represent a comprehensive set of control variables for the test.

For the bank-specific variables first is the bank size which is the deposit money bank assets scaled by gross domestic production. A larger size is expected to have a positive effect on bank performance due to the benefits obtained from increase in profitability and service quality (Lema, 2017). Second, bank liquidity is the ratio of loans as a share of total deposits. This ratio shows the extent that the bank has lent its deposits. Bank loans are assumed to be the main source of profitability and are expected to affect profitability positively. If more deposits are transformed into loans, the interest margin and profit will be higher. However, it could be negatively impacting the profitability during the weak economic conditions that are likely causing the borrowers to default on loans. Higher loan-deposit ratio could lead to higher credit risk and higher non-performing loans, resulting in lower returns with liquidity problems (Spathis et al., 2002, Sufian and Kamarudin, 2012).

Third, the overhead cost is the ratio of operating expenses of a bank as a share of the value of all assets held. This cost represents total amount of wages and salaries, as well as the costs of running branch office facilities. Since the reduction of overhead expenses will raise profits, the ratio of these expenses to total assets is expected to be negatively related to profitability and can reflect the level of a bank's management efficiency (Athanasoglou et al., 2008, ElKelish and Tucker, 2015). On the other hand, the literature is also suggesting that high profits earned by banks could be attributed to the higher payroll expenditures paid to more productive human capital (Sufian and Habibullah, 2010). Thus, the coefficient of this variable could be negative or positive.

Fourth, bank concentration is the assets of the five largest banks as a share of the assets of all commercial banks in a given country. This is a common variable that is used as a proxy for market structure to represent the banking sector's concentration. According to the structure-conduct-performance (SCP) hypothesis, higher concentration may lead to greater bank efficiency because maybe the banks in a highly concentrated market tend to collude, and therefore earn monopoly profits. However, this state of collusion may have a negative impact on smaller banks profitability when they are facing tougher competition that result from this monopoly condition. On the other hand, if the industry concentration results from tougher inter-bank competition, the impact of the market structure might turn negative. Thus, the theoretical relationship between concentration and bank performance is ambiguous and to be answered empirically (Berger, 1995, Garza-García, 2012, Sufian and Kamarudin, 2012, Chan et al., 2015).

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supply growth rate, standard deviation of inflation, the rate of inflation and freedom to own foreign currency bank accounts. Freedom to trade internationally indicator is based on the levels of tariffs rates, regulatory trade barriers, black-market exchange rates and controls of the movement of capital and people. Regulation indicator is based on the freedom levels of credit market, labour market and business activities regulations (Gwartney et al., 2018).

[8] This way maximises variation and avoid testing partially correlated indices against each other. Using PCA lets the structure of the data determine how components are pooled to form separate indices instead of forcing a specific organisation on the data (Busse and Groizard, 2008). For more about PCA see: Kuhn and Johnson, 2013 and James et al., 2015).

Fifth, income diversification is a bank's income that has been generated by noninterest related activities as a percentage of total income. Non-traditional banking activities enable banks to offer wide range of products and services and spread the lending risk across a large number of asset categories, thereby reducing monitoring costs. It is expected to have a positive impact on bank profitability (Reddy, 2011).

Sixth, credit risk is the ratio of defaulting loans to total gross loans. Increasing in the expenses of loan or interest payment loss can reduce the overall profitability levels (Sufian, 2012). The percentage of credit risk may increase after periods of increased lending often. When bank managers are under the pressure of a competitive market, they maybe employ less rigorous lending standards to satisfy short-term profit targets which could cause a negative impact on profitability (Liu and Wilson, 2010).

Seventh, cost efficiency is operating expenses of a bank as a share of operating income. It measures the impact of operating efficiency on bank profitability. Due to the fact that cost minimization leads to profit maximization, the most cost-efficient banks produce services and products at lower costs. A lowering of a bank's cost ratio and hence higher managerial efficiency is expected to increase profitability if bank managers are choosing highly profitable assets and low-cost liabilities. The superior management and technology factors can be efficiently utilized by the banks to increase the profit. This ratio is expected to negatively affect bank profitability (Liu and Wilson, 2010, Djalilov and Piesse, 2018).

Eighth, capital strength is the ratio of bank capital and reserves to total assets. Strong capital structure is essential to provide additional strength to the bank during unstable macroeconomic conditions and soundness of higher management quality. In addition, lower capital ratios in banking imply higher leverage and risk due to the greater need to go for external funding, which in turn increases their borrowing costs and lowers their profit. Thus, the relatively better capitalized banks should exhibit higher profitability level (Rekik and Kalai, 2018).

For the macroeconomic variables that are encompassed by this study are the percentage growth of gross domestic production (GDP), inflation rate is the annual percentage change in consumer price index (CPI), financial development is bank domestic credit to private sector as percentage of GDP banking, global financial crisis (GFC) is dummy variable for the presence of global financial crisis in 2008 which takes the value of 1 for the years 2009 to 2016 zero otherwise (Akinkunmi, 2017, Turgutluk, 2014).

The data on bank size, liquidity, overhead cost, bank concentration, income diversification, credit risk, cost efficiency, capital strength and financial development are from the World Bank's Global Financial Development Database. The data on GDP growth and inflation rate are from the World Bank's World Development Indicators. The data on global financial crisis (GFC) is the author's calculation.

2.2. Econometric Estimation

This study employs the system GMM estimator of Arellano-Bover/ Blundell-Bond. It takes into account the presence of unobserved country-specific effects and any possible bias of omitted variables that are persistent over time. The empirical model is as follows:

$$y_{it} = \delta\, y_{i,t-1} + \beta\, x_{it} + u_{it} \qquad i = 1,\dots,N \qquad t = 2,\dots,T \tag{1}$$

where y_{it} is return on assets, δ is a scalar, x_{it} is a $1 \times K$ vector of explanatory variables and β is a $K \times 1$ vector of parameters to be estimated. The error term u_{it} is composed of an unobserved effect and time-invariant effect μ_i and random disturbance term v_{it}.

$$u_{it} = \mu_i + v_{it} \tag{2}$$

where $\mu_i \sim IID\left(0, \sigma_\mu^2\right)$ and $v_i \sim IID\left(0, \sigma_v^2\right)$ independent of each other and among themselves. The dynamic panel data regressions described in above equations (1) and (2) are characterized by two sources of persistence over time i.e. autocorrelation due to the presence of a lagged dependent variable $y_{i,t-1}$ among the regressors and individual effects characterizing the heterogeneity among the individuals μ_i.

Arellano and Bond (1991) suggest first-differencing Equation (1) to eliminate the unobserved effect since the disturbance μ_i does not vary with time as follow:

$$y_{it} - y_{i,t-1} = \delta(y_{i,t-1} - y_{i,t-2}) + \beta(x_{it} - x_{i,t-1}) + (v_{it} - v_{i,t-1}) \tag{3}$$

GMM helps overcome endogeneity by using lagged-values of the explanatory variables as instruments. However, first-differencing generates a new statistical issue that the constructed differenced error term v_{it} is now correlated with the dependent lagged variable $y_{i,t-1} - y_{i,t-2}$ which is included as a regressor. As a solution, Arellano and Bover (1995) and Blundell and Bond (1998) proposed a system GMM estimator that uses moment conditions in which lagged differences (Equation 3) are used as instruments for the level equation (Equation 1) in addition to the use of moment conditions of lagged levels as instruments for the differenced equation. However, the use of system GMM depends on two conditions, first is the validity of these additional instruments, second is the absence of second-order autocorrelation for . To assess these two conditions, Arellano and Bond (1991) and Arellano and Bover (1995) propose the Sargan test of over-identification and the Arellano-Bond AR (2) for autocorrelation. The Sargan test of over-identification tests the validity of the instruments. When the Sargan test is insignificant, this means the instruments are not correlated with the residuals; thus, these instruments are valid. Arellano-Bond AR (2) autocorrelation tests for the absence of second-order autocorrelation and its result must be insignificant to indicate that there is no second-order autocorrelation in the residuals.

3. SUMARY STATISTICS, CORRELATION AND STATIONARITY TESTS

Table 1 illustrates summary statistics for variables. Economic freedom quality variable has lowest mean of -0.176, while return on assets variable has the lowest standard deviation of 0.177. The inflation variable has highest mean of 96.199, while the liquidity variable has highest standard deviation of 38.525.

Table 1.
Summary Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Return on assets	290	1.261	0.177	1.076	1.456
Economic freedom	174	0.176	0.860	-3.842	2.875
Bank size	391	1.391	8.484	-88.996	31.914
Liquidity	428	77.471	38.525	15.016	199.772
Overhead cost	291	1.633	0.625	0.060	6.460
Bank concentration	263	83.154	13.831	48.180	100.000
Income diversification	243	0.398	5.895	-22.682	25.000
Credit risk	188	9.245	5.841	2.000	19.300

Variables	Obs.	Mean	Std. Dev.	Min	Max
Cost efficiency	258	43.271	12.189	22.716	146.853
Capital strength	160	9.872	2.961	5.600	13.700
GFC	448	0.250	0.433	0.000	1.000
GDP growth	410	4.174	6.396	-42.451	38.200
Inflation	382	96.199	12.344	82.001	111.478
Financial development	425	42.840	24.109	3.014	107.246

Note: Obs. is observation. Mean is mean. Std. Dev. is standard deviation. Min is minimum. Max is maximum. Refer to Appendix Table A.1 for definition of variables. Return on assets is the banks net income to total assets (percentage). Bank size is deposit money bank assets scaled by gross domestic production. Liquidity is the ratio of loans as a share of total deposits. Overhead cost is the ratio of operating expenses of a bank as a share of the value of all assets held. Bank concentration is the assets of the five largest banks as a share of the assets of all commercial banks in a given country. Income diversification is bank's income that has been generated by noninterest related activities as a percentage of total income. Credit risk is the ratio of defaulting loans to total gross loans. Cost efficiency is operating expenses of a bank as a share of operating income. Capital strength is the ratio of bank capital and reserves to total assets. Global financial crisis is dummy variable for the presence of global financial crisis in 2008. Global financial crisis (GFC) is dummy variable for the presence of global financial crisis in 2008. GDP growth is the percentage growth of gross domestic production (GDP). Inflation rate is the annual percentage change in consumer price index (CPI). Financial development is bank domestic credit to private sector as percentage of GDP.

Table 2 illustrates the correlation matrix between the variables. There is high correlation between several variables: overhead cost and cost efficiency (0.806); bank size and capital strength (0.523); credit risk and capital strength (-0.689); cost efficiency and capital strength (-0.530); GFC and inflation (0.681). The study will not include highly correlated variables together in the same model.

Table 2.
Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Return on assets	1													
2. Economic freedom	-0.10	1												
3. Bank size	-0.11	-0.06	1											
4. Liquidity	0.26	-0.02	0.11	1										
5. Overhead cost	-0.30	0.24	-0.07	0.17	1									
6. Bank concentration	0.41	0.25	-0.06	0.15	-0.20	1								
7. Income diversification	0.01	0.16	-0.06	0.12	0.17	0.12	1							
8. Credit risk	-0.58	0.28	-0.11	-0.38	0.29	-0.35	0.03	1						
9. Cost efficiency	-0.59	0.17	0.05	-0.06	0.80	-0.39	0.04	0.51	1					
10. Capital strength	0.57	0.13	-0.07	0.48	-0.25	0.52	0.09	-0.68	-0.53	1				
11. GFC	0.01	-0.41	0.10	0.10	-0.29	-0.16	-0.12	-0.34	-0.18	0.19	1			
12. GDP growth	0.24	0.09	-0.48	-0.11	-0.05	0.09	0.08	-0.08	-0.04	-0.07	-0.29	1		
13. Inflation	0.03	-0.41	-0.06	-0.05	-0.12	-0.04	-0.13	-0.39	-0.12	0.11	0.68	-0.07	1	
14. Financial development	-0.20	0.07	0.23	0.21	-0.05	0.01	0.08	-0.16	0.10	0.08	-0.05	-0.02	-0.08	1

Note: The column number corresponds with the row titles. Refer to Appendix Table A.1 for definition of variables. Return on assets is the banks net income to total assets (percentage). Bank size is deposit money bank assets scaled by gross domestic production. Liquidity is the ratio of loans as a share of total deposits. Overhead cost is the ratio of operating expenses of a bank as a share of the value of all assets held. Bank concentration is the assets of the five largest banks as a share of the assets of all commercial banks in a given country. Income diversification is bank's income that has

been generated by noninterest related activities as a percentage of total income. Credit risk is the ratio of defaulting loans to total gross loans. Cost efficiency is operating expenses of a bank as a share of operating income. Capital strength is the ratio of bank capital and reserves to total assets. Global financial crisis is dummy variable for the presence of global financial crisis in 2008. Global financial crisis (GFC) is dummy variable for the presence of global financial crisis in 2008. GDP growth is the percentage growth of gross domestic production (GDP). Inflation rate is the annual percentage change in consumer price index (CPI). Financial development is bank domestic credit to private sector as percentage of GDP.

Table 3 shows the panel unit root test Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS) and Fisher-type test (Fisher) results. The null hypothesis of unit root is rejected for the variables; in other words, the variables are stationary.

Table 3.
Panel Unit Root Tests

Variables	LLC	IPS	Fisher	Decision
Return on assets	-3.050* (0.001)	-2.075* (0.019)	-6.941* (0.000)	Stationarity
Economic freedom	-6.089* (0.000)	-3.961* (0.000)	-7.771* (0.000)	Stationarity
Bank size	-6.701* (0.000)	-6.947* (0.000)	-6.915* (0.000)	Stationarity
Liquidity	-3.053* (0.001)	-2.929* (0.001)	-7.839* (0.000)	Stationarity
Overhead cost	-2.734* (0.003)	-2.431* (0.007)	-7.218* (0.000)	Stationarity
Bank concentration	-2.687* (0.003)	-2.001** (0.022)	-5.735* (0.000)	Stationarity
Income diversification[a]	-11.117* (0.000)	-6.886* (0.000)	-10.006* (0.000)	Stationarity
Credit risk	-1.844** (0.032)	-3.073* (0.001)	-6.140* (0.000)	Stationarity
Cost efficiency	-3.289* (0.000)	-4.808* (0.000)	-8.622* (0.000)	Stationarity
Capital strength	-0.135** (0.056)	-1.945** (0.025)	-5.125* (0.000)	Stationarity
GFC	-2.125* (0.000)	-1.498*** (0.067)	-1.863** (0.031)	Stationarity
GDP growth	-4.956* (0.000)	-8.794* (0.000)	-11.658* (0.000)	Stationarity
Inflation	-5.689* (0.000)	-2.303* (0.010)	-6.358* (0.000)	Stationarity
Financial development	-1.528** (0.053)	-2.167* (0.015)	-7.762* (0.000)	Stationarity

Note: LLC is Levin-Lin-Chu (Adjusted t*), IPS is Im-Pesaran-Shin (w-t-bar) and Fisher is Fisher-type (Invers normal Z). For LLC the null hypothesis: panels contain unit root, while the alternative Ha: panels are stationarity. IPS: all panels contain unit root, Ha: some panels are stationarity. Fisher: all panels contain unit roots, Ha: at least one panel is stationarity. Therefore, LLC tests for common unit root, while IPS and Fisher tests for individual unit roots. P-values in brackets. *, **, *** denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively for p-values. Refer to Appendix Table A.1 for definition of variables. The measurement for stationarity is if the variable passes the three tests, then it is considered stationary. [a]: first difference state.

4. EMPIRICAL RESULTS

Tables 4 reports the results of Arellano-Bover/Blundell-Bond GMM estimation for various versions of equation (1). Table 4 illustrates the results of banks profitability represented by the return on assets as the dependent variable along with the independent variable of economic freedom and other control variables.

The empirical finding suggests that economic freedom has a positive and statistically significant impact on the profitability of Arab banks. Banks that operate in a business environment that protects investors and offers individuals the option to decide their own production and consumption decisions are able to generate higher income. Economic freedom is key to the creation of an environment that allows for a freedom to enter markets and compete, enhances the innovation and protects privately-owned property, as a result, they could gain faster economic growth. This result is in line with Sufian and Habibullah (2010) but in contrast with Sufian and Zulkhibri (2012) and Turgutluk (2014) who find the economic freedom variable is not statistically significant.

Table 4.
Banks Profitability and Economic Freedom Quality (System GMM Estimation)

Independent	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	1.173* (0.000)	0.990* (0.000)	0.141 (0.491)	0.540* (0.000)	1.083* (0.000)	1.987* (0.000)	0.956* (0.000)
Economic freedom					0.042* (0.000)	0.036* (0.018)	0.029** (0.053)
Bank size	0.306*** (0.063)	0.009* (0.019)	0.002** (0.033)				0.004* (0.000)
Liquidity	0.001* (0.009)	0.001* (0.000)	0.002* (0.000)	0.007* (0.003)		0.001*** (0.074)	0.006* (0.004)
Overhead cost		-0.065* (0.007)	-0.063** (0.028)	-0.038** (0.034)			-0.227* (0.000)
Bank concentration			0.006* (0.000)	0.003* (0.000)	0.007*** (0.077)	0.007*** (0.085)	
Income diversification		0.002*** (0.073)	0.002** (0.030)	0.003** (0.030)			0.004* (0.000)
Credit risk				-0.004** (0.021)	-0.022* (0.000)	-0.018* (0.000)	
Cost efficiency					-0.006* (0.000)	-0.007* (0.000)	
Capital strength							0.065* (0.000)
GFC					-0.099* (0.001)	-0.069** (0.030)	-0.113** (0.022)
GDP growth	0.005* (0.000)	0.005* (0.009)	0.008* (0.002)	0.006* (0.001)	0.010* (0.001)	0.004*** (0.072)	0.025* (0.000)
Inflation			0.004* (0.000)	0.006** (0.028)			
Financial development					0.0003 (0.825)	-0.001 (0.233)	0.010* (0.000)
Observation	247	212	165	161	87	91	87

Independent	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wald Chi2	1533.07* (0.000)	61.34* (0.000)	93.20* (0.000)	219.32* (0.000)	134.48* (0.000)	130.78* (0.000)	232.13* (0.000)
Sargan test	157.75 (1.000)	262.52 (0.812)	190.64 (0.671)	222.20 (0.146)	97.46 (0.253)	110.91 (0.235)	127.46 (0.167)
Arellano–Bond test AR (1)	-3.00* (0.036)	-6.95* (0.000)	-3.75* (0.000)	-5.60* (0.000)	-1.87*** (0.061)	-2.34* (0.019)	-3.19* (0.001)
Arellano–Bond test AR (2)	0.51 (0.607)	1.21 (0.226)	-0.75 (0.455)	0.86 (0.392)	-0.77 (0.439)	-1.07 (0.284)	-1.29 (0.197)

Note: return on assets is dependent variable. Arellano-Bover/Blundell-Bond econometric estimation. *, **, *** denote significance at the 1%, 5% and 10% levels, respectively for p-values. Refer to Appendix Table A.1 for definition of variables. The lagged dependent variable is positive and significant in model 2, 4 and 6 only, the results are omitted for brevity.

The bank size variable has a significant and positive effect on the bank profitability. Banks with large financial assets can earn more profit as interest from loans is one of the main sources of a bank's profit. The explanation for this positive relationship between size and profit could be explained by the benefit from scale or scope economies. Moreover, large banks may be able to exert market power through stronger access for providing financial services or implicit regulatory protection, too-big-to-fail. Abnormal profits obtained through the exercise of market power in wholesale or capital markets may also contribute to a positive size-profitability relationship (Goddard et al., 2004). This result is in line with Agustini and Viverita (2012) and Hasanov et al., (2018).

The liquidity variable is positive and has a significant impact on profitability. Since high loans-to-deposits ratio refers to better asset-liability management, thus, higher the ratio indicates the bank is effectively utilizing its funds to generate higher profit. The banking system that has adequate amount of liquidity with high-level of intermediation capacity is operating more efficiently. Although it is possible for banks to face a problem associated with this scenario, with sound risk management the efficient manager can balance the funds in the bank to meet liquidity requirement based on future needs. This finding is in accordance with Abdelaziz et al., (2011) and Yao et al., (2018).

Overhead cost is negative and insignificant which implies that the reduced expenses ratio improves the efficiency of banks and consequently raise their profitability level. This result is consistent with Sun et al., (2017). Bank concentration is positive and significant which approves that the concentration means lower competition in the banking sector that can lead to high bank profitability. In such highly concentrated financial markets, banks tend to collude and therefore earn monopoly profits. This result indicates that the Arabic banking market is not fairly competitive. This result is consistent with Moutsianas et al., (2016) and Zheng et al., (2017).

The empirical results show that the income diversification variable is positive and significant which imply that the banks can generate a sizable portion of their total income from off-balance sheet activities (non-interest-bearing sources, including fees, commission, etc.), have better efficient profitability state. This result is in line with Islam and Nishiyama (2016) and Mohiuddin (2017).

The capital strength variable has a significant and positive effect on the bank profitability. Sufficient capital is providing better safety to the bank that follows better regulatory conditions if compared to those with lower capital strength. A higher capital ratio indicates that the bank is less risky and can borrow at lower interest rate for funding due to the reduction in the expected costs of financial distress, including bankruptcy. Moreover, banks with higher level of equity can absorb the potential losses more easily in order to continue a better economic life in the competitive

hardship environment of an economy. This result is in line with Shahabadi and Samari (2013) and Combey and Togbenou (2017).

The cost efficiency variable is negative and significant which confirms that the efficiency in delivering banking services is considered as an important determinant of the profitability. Banks that have more efficient cost management can achieve higher profitability. This result is consistent with Liu and Wilson (2010), Sahyouni and Wang (2018)

The credit risk variable is negative and significant. This is consistent with the view that banks with higher ratio of loan loss provisions to total loans are less profitable and banks may incur additional expenses to intensify their monitoring and following up defaulters beside their loss in the payments of principal or interest. Thus, the greater the exposure of financial system to high risk loans, the higher would be the accumulation of unpaid loans and profitability would be lower. This finding is consistent with Gropper et al. (2015).

The GFC dummy is negative and significant which imply that the Arabic banks' profitability has been affected by the latest global financial crisis in 2008. The GFC caused collapsing and instability for the financial system over the world. Due to the GFC, the overall industry's business volume reduced and impacted the total banks operations, affecting borrowers' ability to repay loans, forcing the banks to reduce costs and make provisions for credit losses, hence, lowering the profitability. This result is in accordance with Agustini and Viverita (2012), Moutsianas et al., (2016), Caporale et al., (2016) and Islam and Nishiyama (2016), but in contrast with Sufian and Kamarudin, (2012) who find positive and insignificant impact and with Turgutluk (2014), positive but insignificant.

The GDP growth variable is positive and significant. This implies that banks that operate in countries with a high level of GDP growth rate are in a more profitable position. When the country is in prosperous economic conditions, this encourages the lending and borrowing activities with expecting a lower level of provisions. Moreover, banks can earn from dealing with more operational activities including non-interest bearing services during the economic growth. This in turn leads to more income resources for the bank and impact the profit positively. This finding is consistent with Coccorese and Girardone (2017) and with Yao et al., (2018).

The Inflation variable is positive and significant that means banks are able to manage the inflation expectation to increase revenue. Banks managers anticipated the inflation rate and they adjust their interest rates properly in the sense that their profit will be higher than what they will lose from the increase in costs caused by the inflation. This result is in line with Hasanov et al., (2018) and Antoun et al., (2018).

The financial development variable has mixed results, positive in model 5 and negative in model 6 but insignificant in both, however, only in model 7 is positive and significant which indicate that the demand for banking products and services increases in the economies that have well-developed banking sectors, so banks can increase their profitability with effective strategies. This result is in line with Tan and Floros (2012). However, it is in contrast with Coccorese and Girardone (2017) who find a negative and significant impact of financial development variable on bank profitability because operation in such highly competitive and crowded environment can cause a negative impact on the banks' margins and so the profit.

The Arellano and Bond test statistics for serial correlation and the Sargan test for overidentifying restrictions are reported in Tables 4. The Arellano and Bond AR (2) is insignificant, which implies that there is no second-order autocorrelation in the residuals. The Sargan test is insignificant, which means the instruments are not correlated with the residuals; thus, these instruments are valid.

5. CONCLUSION AND POLICY IMPLICATIONS

This study empirically examines the impact of economic freedom on banks profitability in the Arab region. The study argues that better economic freedom quality that offers high protection is able to create a better business environment and impacts banks' profitability. The analysis is performed by employing the Arellano-Bover/Blundell-Bond GMM estimation in panel data comprising of 14 Arab countries over the period 1985–2016.

The results confirm that the economic redeem variable has a positive and significant impact on banks' profitability in Arab economies. This result suggests that less regulatory control enables the banks to engage in diversified activities and generate income from non-traditional sources. The results also show that bank size has a positive and significant impact on bank profitability, that is, banks that have relatively big size in the Arab region benefit from economies of scale. Banks costs and credit risk play a vital role in the profitability; thus, managers should efficiently monitor these variables. Moreover, the results show that banks with a more diversified income tend to have high profitability due to better asset quality and higher earnings. For economic variables, the findings show that the GFC has a negative impact on banks profit, whereas, both growth in GDP and inflation have a positive effect on bank profitability. Positive effect of inflation to bank profitability reflects the ability of bank managers to forecast inflation in their cost structure to realize profits.

The results of this study have several implications for policy makers. Banks managers should search for alternatives that increase the levels of bank capitalization, adopt innovative ways to increase the proportion of noninterest bearing income and effectively manage the deposits when converting them to profit generating activities in the assets, taking into the account liquidity levels. Furthermore, Arab countries need to enhance the local economic freedom quality by reforming regulations to facilitate business operations, encourage investments, and create a better efficient institutional environment that relies on free market mechanisms and a legal system that protects property and individual rights. These reforms and regulations must protect and guarantee investments in the region and should be coherent with global standards to increase confidence and reduce the risk of destabilizing the business environment. Governments need to employ efficient regulatory frameworks that encourage competition and boost the development of the banking sector and overall financial system. Governments and banks need to initiate research bodies that empirically investigate, study and better manage the factors that could impact profitability in the region so they can cooperate for future decisions.

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APPENDIX

Table A.1.
Data definition and sources

Variable	Definition	Source
Return on assets	It is measuring the banks' performance and calculated as the banks' after-tax net income to yearly averaged total assets (percentage).	World Bank's Global Financial Development Database.
Economic freedom	It measuring the level of economic freedom. High score indicates high freedom.	Author's own calculations based, The Fraser Institute.
Bank size	It is the total assets held by deposit money banks as a share of GDP (percentage).	World Bank's Global Financial Development Database.
Liquidity	It is the ratio of loans as a share of total deposits (percentage).	World Bank's Global Financial Development Database.
Overhead cost	It is operating expenses of a bank as a share of the value of all assets held (percentage).	World Bank's Global Financial Development Database.
Bank concentration	It is the assets of five largest banks as a share of total commercial banking assets	World Bank's Global Financial Development Database.
Income diversification	It is bank's income that has been generated by noninterest related activities as a percentage of total income (percentage).	World Bank's Global Financial Development Database.
Credit risk	It is the ratio of defaulting loans to total gross loans (percentage).	World Bank's Global Financial Development Database.
Cost efficiency	It is operating expenses of a bank as a share of operating income (percentage).	World Bank's Global Financial Development Database.
Capital strength	It is the ratio of bank capital and reserves to total assets (percentage).	World Bank's Global Financial Development Database.
Global financial crisis (GFC)	Dummy equal to 1 for the years 2009 to 2016 and zero otherwise.	Authors own calculations.
GDP growth	It is the percentage growth of gross domestic production (GDP) (percentage).	World Bank's World Development Indicators.
Inflation	rate is the annual percentage change in consumer price index (CPI).	World Bank, World Development Indicators.
Financial development	It is bank domestic credit to private sector as percentage of GDP (percentage).	World Bank's Global Financial Development Database.