



COLOMBIA

SELECTED ISSUES

May 2016

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COLOMBIA

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Approved By
**The Western Hemisphere
Department**

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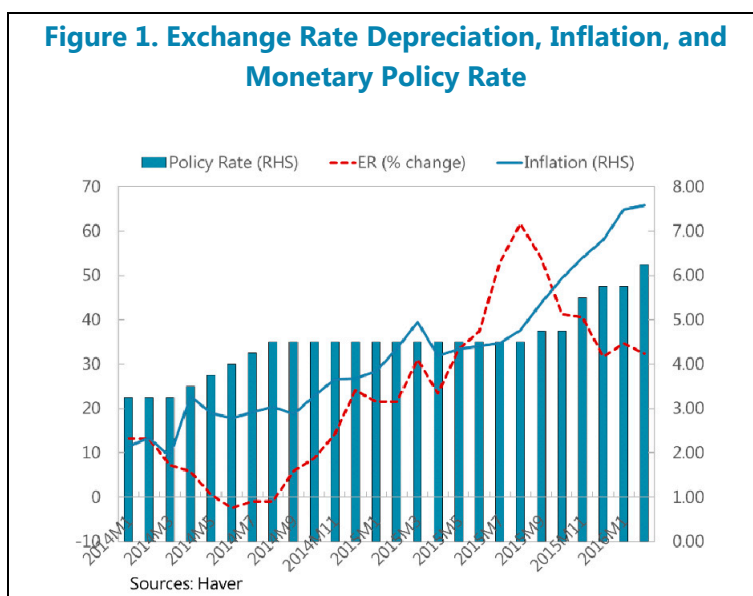
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MONETARY AND FINANCIAL CONDITIONS IN COLOMBIA¹

This paper presents an assessment of the monetary policy stance and broad financial conditions in Colombia, which provides insights about macro-financial linkages. First, we estimate the nominal neutral interest rate, and find a positive monetary policy gap.² Second, we study two traditional indices based on interest rates and spreads (monetary and financial conditions indices) and a more recent one (Macro-Risk Premium) that can be related to intermediaries' balance sheet data. We conclude that while the former suggest that financial conditions in Colombia have loosened since mid-2014, the latter suggest otherwise—in line with our assessment of a moderation in credit and domestic demand growth.

A. Introduction

1. Monetary policy has tightened since inflation breached the upper limit of the target range in 2015. Mostly due to the oil price shock, the Colombian exchange rate depreciated around 76 percent since 2014Q2, which contributed to push inflation by end-2015 outside of the target range at 6.4 percent. To contain inflation pressures and ensure that expectations remain anchored, the authorities have raised monetary policy rates by 200 bps to 6.5 percent since September 2015 (Figure 1).



¹ Prepared by Francisco Roch.

² The difference between the nominal neutral interest rate and the actual monetary policy rate.

2. This paper assesses the monetary policy stance and broad financial conditions in

Colombia. We use different methodologies to estimate the neutral policy interest rate to assess the current monetary policy stance. In broad terms, the neutral policy rate is defined as the level that depicts stable inflation within a closed output gap. However, changes in the monetary policy rate represent only one channel through which monetary policy affects financial conditions, and, in turn, economic activity. Assessing overall financial conditions requires looking at the different channels of transmission of monetary policy to other key financial variables (e.g., lending rates, exchange rate, asset prices, etc.) that influence the state of the economy.

3. We present a set of monetary and financial conditions indices to explore the link between financial conditions and real activity.

First, we construct a Monetary Conditions Index (MCI), which combines interest and exchange rates in a single indicator of the monetary policy stance. Second, we construct a Financial Conditions Indicator (FCI), which captures the effects of current financial conditions on real GDP growth. Finally, we study the role of balance sheet indicators in the business cycle through the determination of risk premia.

4. We find that overall current monetary and financial conditions were accommodative in 2015, but have moved toward a more neutral stance in 2016Q1.

Both the MCI and the FCI point to the sharp depreciation of the currency as the main driver of the recent monetary easing, together with a slow response of lending spreads to the monetary policy tightening. However, the analysis on the macro risk premium suggests that it has been increasing since the third quarter of 2014. This suggests that the risk appetite of financial intermediaries is decreasing as their balance sheets tighten, and is consistent with a slight moderation of credit growth and our envisaged slowdown of aggregate demand.

5. The paper is organized as follows. Section B presents the estimates of the neutral interest rate. Section C presents the MCI. Section D provides an overview of the methodologies for calculating the FCI. Section E presents the FCI, and discusses its forecasting properties. Section F analyzes the relation between the MRP and banks' balance sheets. Section G draws conclusions from the above.

B. Neutral Interest Rate

6. Staff estimates suggest that the nominal neutral interest rate for Colombia ranges between 5.9 and 8.4 percent.

Following Magud and Tsounta (2012), different methodologies are used to estimate the neutral interest rate: the first takes advantage of the uncovered interest parity condition; the second uses a Taylor rule augmented for inflation expectations; the third solves a standard consumption-smoothing model; and the fourth applies a Hodrick-Prescott (HP) filter to the interest rate series. The current nominal monetary policy interest rate of 6.5 percent is within the

neutral range, but slightly below the average estimated neutral monetary policy rate.³ Hence, with inflation outside the target range and the risk that expectations may become unanchored, the central banks has room to further increase the monetary policy rate.

Table 1. Estimates of the Neutral Interest Rate

Method	Neutral Real Interest Rate (NRIR)	Neutral Nominal Interest Rate (NNIR)	Expected Inflation
			Actual Monetary Policy Rate
			4.5
			6.5
Uncovered Interest Parity	3.1	7.6	110
Expected-Inflation Augmented Taylor Rule	1.3	5.8	-66
Consumption Based CAPM	3.9	8.4	190
HP-Filter	1.4	5.9	-60
Average	2.4	6.9	43.5

Sources: Staff calculations.

C. Monetary Conditions Index

7. A Monetary Conditions Index (MCI) can also be used to assess the overall stance of monetary policy. The MCI is defined as a weighted average of deviations of a short-term interest rate and the exchange rate from values in a baseline quarter:

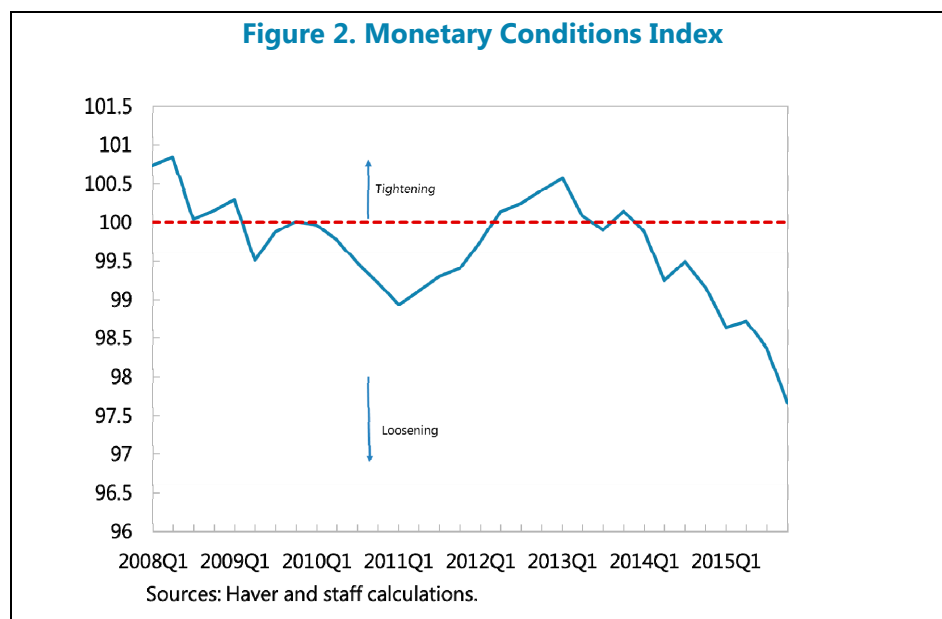
$$MCI_t = 100 + a_1(r_t - r_0) + a_2(q_t - q_0)$$

where r is a real short-term interest rate and q is the real effective exchange rate. The reference period is 2005Q1. The ratio a_1/a_2 captures each variable's relative impact on GDP. We use a ratio of 3, which is derived from a VAR analysis and is consistent with estimates in the literature.

8. The MCI points to an accommodative monetary policy stance in 2015. According to the MCI, monetary conditions in Colombia have been easing steadily since the first quarter of 2014 (Figure 2). Furthermore, despite the recent hikes in the policy rate, monetary conditions eased in the last two quarters of 2015 due to the sharp depreciation of the currency.⁴

³ As noted by Magud and Tsounta (2012), and by the wide range above, it is difficult to have a precise estimate of the neutral rate. Moreover, the results of some of the methodologies are too sensitive to changes in the underlying parameters.

⁴ One difficulty associated with the MCI (and to some extent with the FCI) is that it does not capture that the real exchange rate varies over time. Thus, it cannot distinguish whether the depreciation of the currency reflects easing monetary conditions or the appropriate response to a shock to fundamentals (e.g., terms of trade shocks).



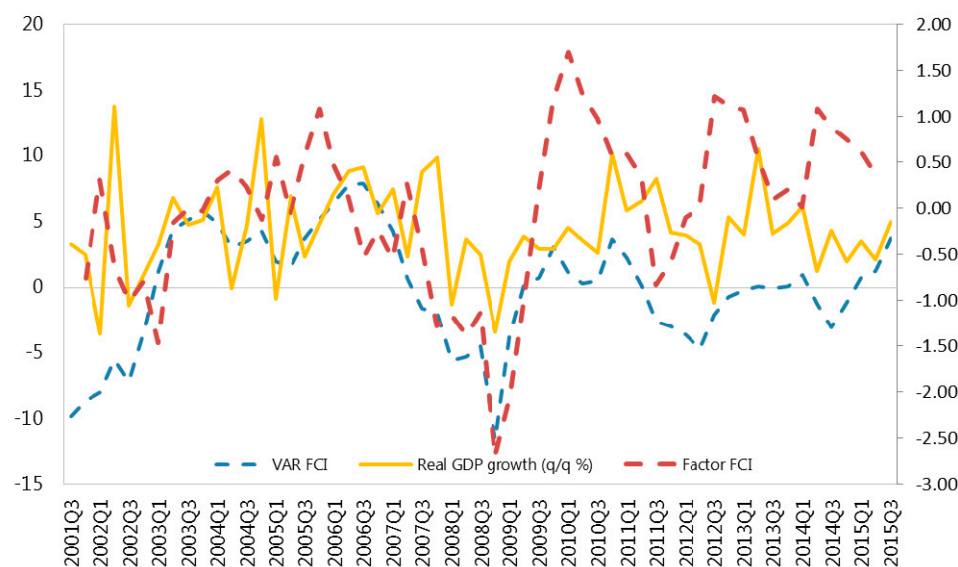
D. Financial Conditions Index

9. There are two prominent approaches to the construction of FCIs in the literature: a vector autoregressive (VAR) and a principal-component approach.⁵ In the first approach, the weights of each financial indicator are assigned according to the estimated impact on real GDP growth in a VAR or structural macroeconomic models (VAR-FCI). The second approach is based on the principal component analysis, whereby a common factor is estimated from a group of several financial variables and interpreted as the unobserved common variable underlying the variation of all the financial variables included in the index (PC-FCI).

10. The two estimated indices are highly correlated with GDP growth (Figure 3). The contemporaneous correlation of the VAR-FCI with annualized quarter-on-quarter growth over the period 2001Q3-2015Q2 is 0.46, and the correlation with two-quarter-ahead growth is 0.34. The principal-component FCI is uncorrelated with contemporaneous growth but it is correlated with *future* growth. For example, correlation with two-quarter-ahead growth rate is 0.33, suggesting potential forecasting power for the PC-FCI.

11. The two FCIs broadly follow the same trajectory, and point to accommodative financial conditions by the end of 2015 (Figure 3). An upward movement of the index implies more accommodative overall financial conditions, whereas a decline indicates tighter financial conditions. The FCI also suggests that financial conditions eased continuously from the third quarter of 2014 until the third quarter of 2015, reaching its highest level since 2010.

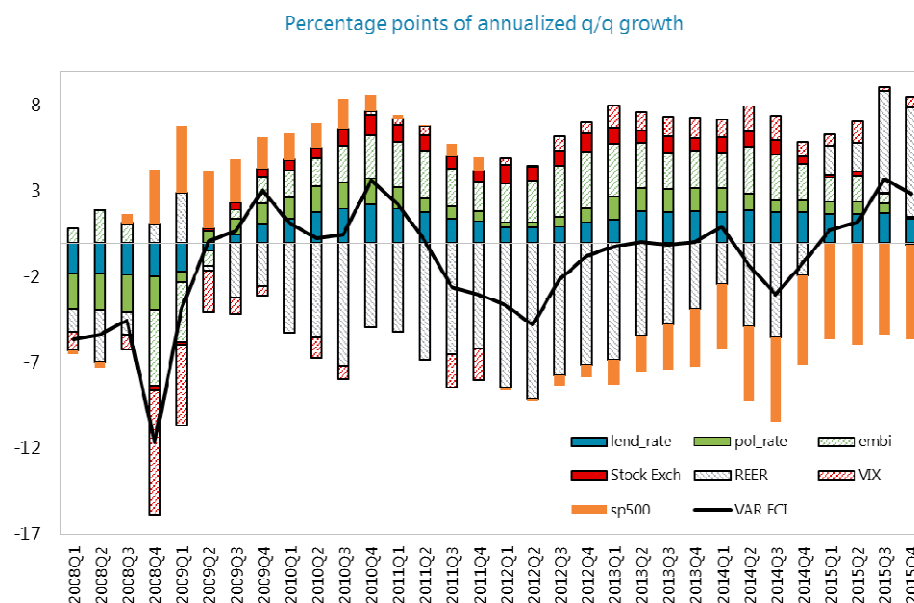
⁵ See Annex I for more details on the methodologies.

Figure 3. FCI and GDP Growth, 2001Q3-2015Q3

Sources: Haver and staff calculations.

12. The VAR-FCI can be decomposed into relative contributions of various financial variables. While the movements in FCIs provide a gauge on overall financial conditions, relative contribution of each financial variable provides information on the drivers of financial conditions. The loose financial conditions reflect largely the depreciation of the currency, in line with the results from the MCI (Figure 4). By the end of 2015, financial conditions began reacting mildly to the recent policy rate hikes.

13. The VAR-FCI correlates with GDP growth better than any individual indicator (Table 2). Also, the weighted-sum FCI tends to correlate the most with one- and two-quarter ahead growth rates, suggesting potential predicting power for near-term growth. Among the domestic financial variables, bank-lending rates and the EMBI spread have the highest contemporaneous correlation with GDP growth. Among external variables, the VIX index has the highest contemporaneous correlation with GDP growth, reflecting Colombia's exposure to global risk aversion.

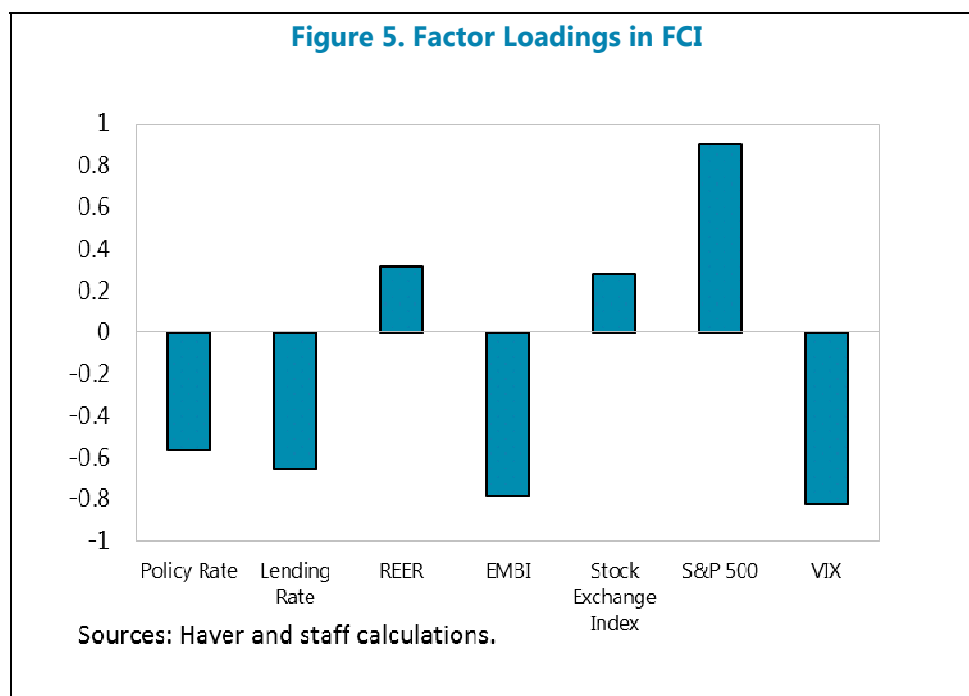
Figure 4. Contributions to FCI, 2008Q1–2015Q4**Table 2. Correlations of Financial Variables and Real Activity (2001Q3-2015Q2)**

Variable	Real GDP (annualized QoQ percent change)				
	t	t+1	t+2	t+3	t+4
FCI	0.45	0.36	0.34	0.26	0.30
Lending Rate	-0.17	-0.15	-0.14	-0.10	-0.05
Policy Rate	-0.06	-0.14	-0.18	-0.19	-0.18
Real exchange rate	-0.04	-0.06	-0.10	-0.09	-0.08
EMBI	-0.33	-0.13	0.00	0.05	0.10
SP500	0.10	-0.04	-0.12	-0.16	-0.23
Stock Exchange	0.13	0.05	-0.02	-0.05	-0.10
VIX	-0.40	-0.26	-0.15	-0.21	-0.13

Sources: Haver and staff calculations.

14. The principal-component FCI is largely driven by the S&P 500 and VIX indices, with factor loadings of more than 80 percent. Figure 5 shows the factor loadings. These loadings reveal the signs and magnitudes of variables included in the index. For example, a factor loading of 0.8 for the EMBI spread implies that the common factor explains 80 percent of the variance in Colombia's sovereign spreads—i.e., a substantial part of the factor-based FCI reflects developments in Colombia's EMBI spreads. Higher S&P 500 index and lower VIX are associated with easier financial conditions. Among domestic variables, the EMBI spread, lending rate and policy rate are the most

significant for the factor-based FCI. Lower policy and lending rates, lower EMBI spreads, and REER appreciation are associated with better financial conditions.

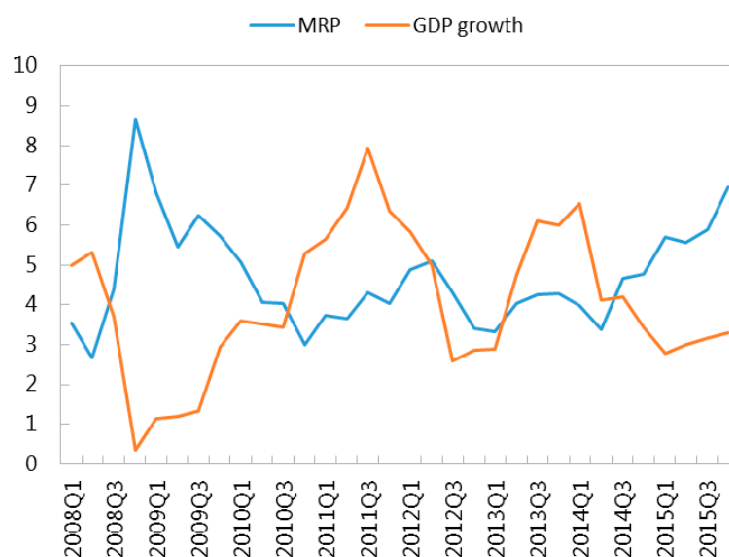


E. Macro-Risk Premium

15. Adrian, Moench, and Shin (2010) argue that financial intermediaries that actively manage their balance sheets play an important role in the business cycle. Their argument is based on the relationship between rapid growth of banks' balance sheets, lower risk premiums, and higher real activity. They argue that banks actively manage their balance sheets to keep enough capital to meet regulatory and other risk management benchmarks (e.g., value-at-risk constraints), which induces fluctuations in the price of risk in the economy (the macro risk premium). They show that when intermediaries are less capital constrained, their risk appetite increases, and the macro risk premium decreases. As a result, credit supply is increasing when the risk premium falls, as banks are tempted to search for new borrowers they can lend to.

16. We find that such relationships exist in Colombia. First, we estimate a "Macro Risk Premium" (MRP) by correlating risk premia with GDP. Second, we regress the MRP on different measures of credit growth (total credit, commercial credit, consumer credit, and mortgages). We find that the MRP is negatively correlated with GDP growth, and that higher credit growth is associated with lower MRP (Figure 6 and Table 3).⁶

⁶ See Annex II for more details on the methodology.

Figure 6. MRP and Real GDP Growth

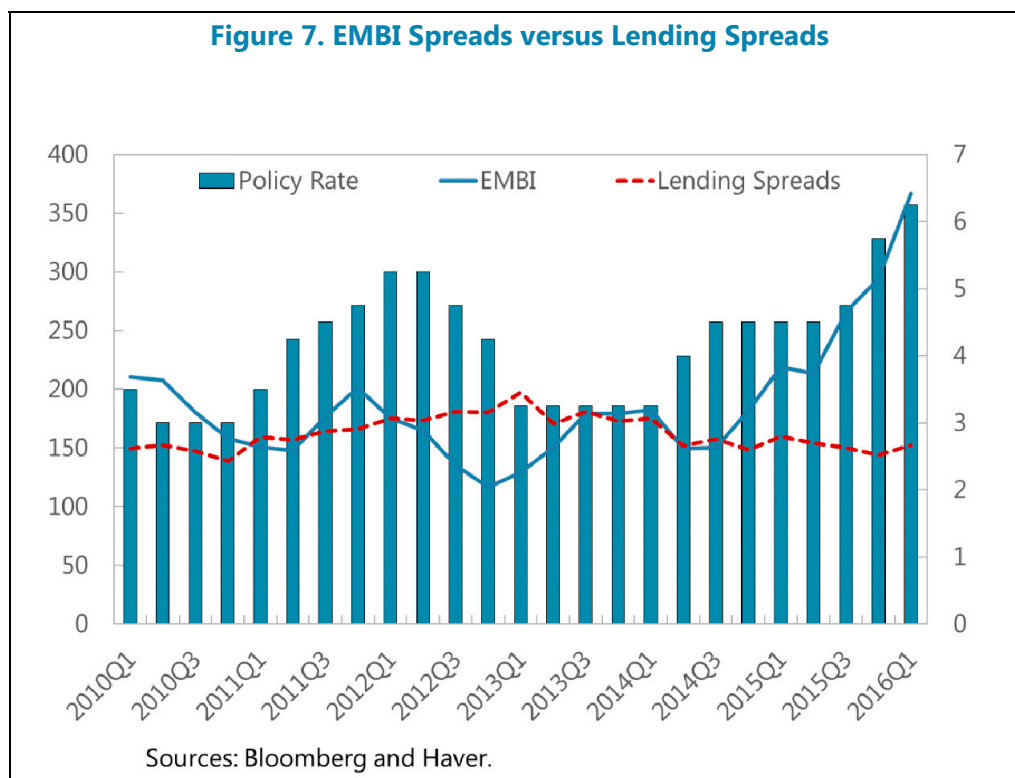
Sources: Haver and staff calculations.

Table 3. MRP on Different Categories of Credit Growth

	1	2	3	4
Total Credit	-0.04***			
Commercial Credit		-0.03***		
Consumption Credit			-0.03***	
Mortgage Credit				-0.07**
Constant	2.39	2.24	2.21	3.02
R-sq	0.35	0.25	0.41	0.16

Sources: Staff calculations.

17. The MRP has been increasing since the third quarter of 2014. Higher sovereign spreads and policy rates, together with a steeper yield curve have contributed to this result. Moreover, this increase in spreads is associated with decreases in the slack of financial intermediary balance sheet capacity and tends to reduce the supply of credit. These results are consistent with the recent moderation in credit growth. Moreover, in contrast with sovereign spreads, lending spreads have remained broadly stable, containing the increase in the MRP (Figure 7). Thus, we expect a further slowdown in credit growth as the ongoing monetary policy tightening continues reducing the risk-taking capacity of the banks and lending spreads increase.



F. Conclusion

18. Overall, despite the recent monetary policy tightening, traditional monetary and financial conditions indices suggest an accommodative situation in 2015 that has started to be reversed in early 2016. However, these indices summarize information in financial price variables which makes them useful for forecasting economic activity at high frequencies. But they tend to miss the information in balance sheet data and, at least in the current juncture, they give too much weight to exchange rates, which are performing an important role in the current adjustment process in Colombia. Thus, the MRP analysis overcomes this problem as it excludes the exchange rate and add balance sheet data to the usual price information. We find that the MRP has been increasing since the third quarter of 2014. This suggests that the risk appetite of financial intermediaries is decreasing as their balance sheets tighten, and is consistent with a slight moderation of credit growth. Moreover, the ongoing monetary policy tightening will further affect the risk-taking capacity of the banks and contribute to the slowdown of credit growth in line with the envisaged slowdown in aggregate demand in 2016.

Annex I. Financial Conditions Index: Methodologies

VAR – Method

1. **We estimate the VAR-FCI as a weighted average of financial variables.** The weights reflect the relative importance of each of these financial variables on output as derived from a VAR model, in line with earlier work by Go and Lu (2013) and Onsorio et al. (2011). Specifically, the FCI in period t is calculated as:

$$FCI_t = \sum_{j=1}^n w_j (x_{jt} - \bar{x}_j)$$

where x_{jt} is the value that the financial variable x takes in period t , w_j denotes the weight attached to the financial variable, and \bar{x}_j is the mean of the variable over the sample period (2001Q3–2015Q2). Thus, financial variables enter the FCI as deviations from the mean, as a way of capturing shocks to the variables at each point in time.

2. **The weights measure the relative importance of each financial variable in terms of its impact on growth.** The financial variables considered are: lending rates, policy rates, EMBI spread, VIX, S&P 500, real effective exchange rate, and the domestic general stock exchange index. To construct the weight of each financial variable we use the cumulative impulse responses (between 2–4 quarters) of GDP growth to a one-unit shock to x_{jt} . It is estimated from a recursive VAR model consisting of all the financial variables, plus quarterly GDP growth and the GDP deflator. The identification of structural shocks is achieved through a Cholesky decomposition.

Factor Analysis

3. **The PC-FCI index is constructed in two steps.** First, by extracting a common factor that captures the greatest common variation in a group of financial variables. Specifically, the model is:

$$X_t - \mu = \beta F_t + U_t$$

where X_t is a vector of financial variables, F_t is the unobserved common factor, and U_t is a vector of errors assumed to be orthogonal to the common factor. The common factor summarizes the information contained in current financial variables. Second, by regressing the common factor on

economic activity variables, and taking the residuals. This addresses the endogeneity problem caused by the fact that financial variables partially reflect economic activity. Specifically, we regress:

$$F_t = A(L)y_t + \epsilon_t$$

where $A(L)$ is the lag operator that captures both current and lagged GDP growth rates, y_t denotes the year-on-year GDP growth rate, and ϵ_t is the error term, which is uncorrelated with y_t as well as its lagged values. Therefore, we use ϵ_t as the FCI which reflects only exogenous developments in financial conditions that influence future economic activity.

Annex II. Macro Risk Premium: Methodology

1. **We follow their proposed two-stage methodology.**⁷ First, we estimate a “Macro Risk Premium” (MRP) by correlating risk premia with GDP. Thus, the MRP is defined as the component of GDP that is contemporaneously correlated with different financial spreads. In particular, we run the following linear regression:

$$y_t = \alpha + \beta_1 Embi_t + \beta_2 SpLen_t + \beta_3 TermPr_t + \beta_4 5yr_t + \beta_5 PolRate_t + \varepsilon_t$$

where y_t is real GDP growth, $Embi_t$ are EMBI spreads, $SpLen_t$ is the bank lending-deposit interest rate spread, $TermPr_t$ is the term premium (slope of the yield curve), $5yr_t$ is a 5 year yield, and $PolRate_t$ monetary policy rate. We use quarterly data from 2003 until 2015. We obtain an estimate of the MRP as the fitted value of the regression. Thus, the estimated MRP is a weighted average of spreads where the weights are given by the regression coefficients. Following their approach, we use a linear transformation of the regression coefficients to construct the MRP so as to match the average level and the volatility of the EMBI spreads. Second, we explain the MRP with changes in financial intermediaries’ balance sheet data. In particular, we run the following linear regression:

$$MRP_t = \alpha + \beta_1 credit_t + \varepsilon_t$$

where MRP_t is the estimated MRP, and $credit_t$ is credit growth for each measure of credit (total credit, commercial credit, consumption credit, and mortgages).

⁷ See Adrian, Moench, and Shin (2010) for more details.

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Adrian, T., E. Moench, and H. Shin, 2010, "Macro Risk Premium and Intermediary Balance Sheet Quantities," IMF Economic Review, Vol. 58, No. 1.

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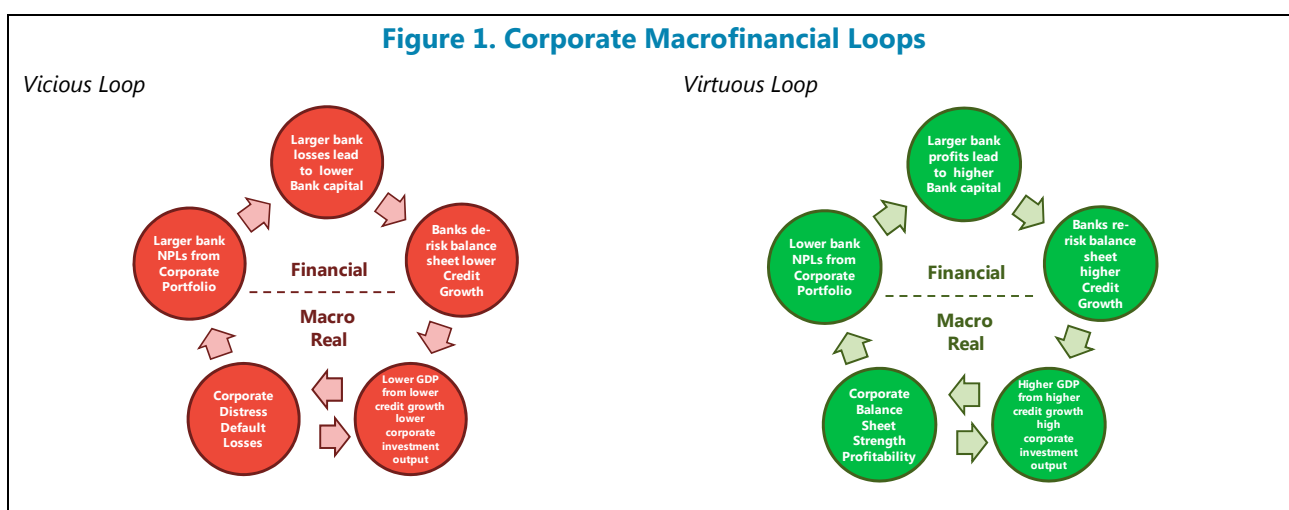
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COLOMBIAN CORPORATE VULNERABILITIES AND MACROFINANCIAL IMPLICATIONS¹

Nonfinancial corporate debt and leverage have increased in recent years, supported by easy access to capital markets, abundant global liquidity, and low interest rates. While some sectors look somewhat more strained than others (oil, gas and airlines) debt-servicing capacity has also improved with recent economic growth. Various static shocks on earnings and FX depreciation for corporates do not impact significantly the soundness of the banking system and overall macrofinancial stability but lead to lower credit growth and would impact GDP. Further enhancement in the quality and coverage of nonfinancial corporate data together with improvements in the quality of bank capital would help improve macrofinancial outcomes as Colombia navigates and lower oil prices and higher FX volatility.

A. Corporate Sector Performance and Macrofinancial Implications

1. The performance of the corporate sector can have a sizeable macroeconomic and financial stability (macrofinancial) impact. The Colombian corporate sector debt represent around 45 percent of GDP while the amount of loans outstanding for the private corporate sector stand at 52 percent of total credit issued by Colombian financial intermediaries (banks and nonbanks). Depending on how well the overall corporate sector (non-financial and financial) performs it can have either vicious or virtuous macrofinancial loops and/or feedback loops with different degrees of amplification through the financial system and different dynamics across different economic sectors (Figure 1).



¹ Prepared by Mohamed Afzal Norat and David Jutrsa (MCM). We would like to thank Jorge Roldos, Daniel Rodríguez-Delgado, Maria Angelica Arbelaiz, Esteban Gomez and Juliana Lagos for useful comments.

2. Macroeconomic shocks influence the corporate sector, which in turn affect macrofinancial stability (Table 1). Macroeconomic shocks impacts the corporate sector and which in turn feedback to macroeconomic variables amplified by financial intermediaries' balance sheets. Typical macrofinancial links for Colombia in this juncture are detailed below (Table 1).

Table 1. Macrofinancial Impacts of Events and Shocks Transmitted by Corporate Sector			
Global & Local Events and Shocks	Corporate Sector Vulnerability	Macroeconomic Impact² (-)/(+) on (Profits, Output, Investment, Trade Balance and Growth)	Financial Stability Impact (-/+) on (Bank Income, Asset Quality, Capital Liquidity Contagion)
Depreciation Shock (COP:USD)	FX debt servicing increase leading to corporate distress. Exporters and corporates import-substitution should benefit	Corporate distress higher(-) FX debt servicing increase (-) Exporters/Import Substitution (+)	Corporate distress (-) FX debt servicing increase (-) Exporters/Import Substitution (+)
Global Monetary Unwind (Higher US interest rates)	Higher FX debt servicing, lower capital inflows, lower demand for Colombian assets, lower investment	FX debt servicing increase (-) Lower net capital inflows (-) Lower investment (-)	FX debt servicing increase (-) Lower net capital inflows (-ve)
Commodity Price Shock (lower oil and other commodity prices)	Oil, gas, metal, mining sectors most impacted. Losses, liquidation and defaults. Lower investment and employee layoffs.	Losses (-) Defaults (-) Liquidation (-) Lower investment (-) Layoffs (-)	Defaults (-) Liquidation (-) Lower Deposits (-)
Interest Rate Rises (domestic interest rates)	Higher loan servicing cost and cost of domestic debt issuance by corporate. Lower investment	Lower demand for new corporate credit for investment or current consumption (-) higher servicing costs for variable rate corporate loans (-)	Change in spreads (-/+) As liabilities re-price faster than assets Lower credit demand (-) Increased Deposits (+)
Lower GDP Growth	Lower demand for corporate products and output, lower employment growth and investment, lower earnings	Lower demand (-) Lower employment (-) Lower investment (-)	Lower credit/loan demand (-) Lower growth (-)

Source: IMF staff calculations.

3. The prospect of a growth slowdown for Colombia could have adverse implications for the corporate sector and consequently negative implications for macrofinancial stability (Table 1). Lower domestic growth would result in lower demand for corporate products and lower

² The terms -/+ refer to negative and positive impact on key macroeconomic variables (profits, output, investment, trade balance and growth) due to impact on corporates. For example, higher corporate distress would have a negative impact on Colombian corporate profitability, output, investment and growth. The impact on exports and import substitution could be positive. Overall the impact could be uncertain.

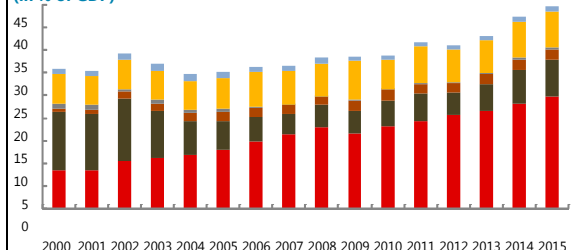
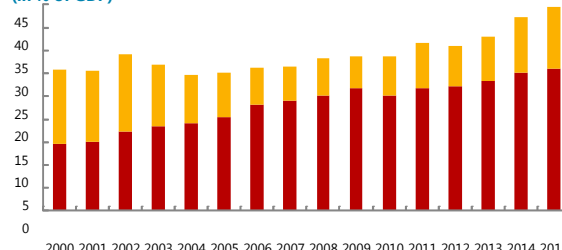
earnings. For some corporates this may mean reducing their output which may entail lower demand for employment and need for investment. This could in turn result in lower national output, income and expenditure. From a financial stability perspective lower growth scenarios would be adverse as bank income would not grow as rapidly. Corporate revenue would grow less in lower growth scenarios resulting in lower corporate deposits at banks and less likelihood of corporates taking out credit or loans for new investment. This would result in both lower returns for banks from their corporate portfolios and lower potential of deposit growth. Greater uncertainty over investment and employment could further restrict bank revenue and increase risks and produce potential for losses on bank portfolios.

B. Colombian Corporate Debt: Stylized Facts³

4. Colombian nonfinancial sector corporate debt has grown but remains moderate by international standards and is mostly domestic. As of June 2015 the debt of private sector corporates rose to around COP 183 billion pesos, which represents about 52 percent of credit institutions total loan portfolio (banks, nonbanks, microcredit balances). Total private sector corporate debt (domestic and foreign, loans and securities) in 2015 was 44.5 percent of GDP (COP 344.5 billion) up 2.2 percentage points since 2014. This reflected higher borrowing from financial institutions both at home and abroad. From 2000 to 2015, the principal sources of funding of the private corporate sector were loans with financial institutions both at home and abroad (Figure 2). The least used sources were bonds issued abroad and from foreign credit providers. However, since 2003 there continues to be a substitution of loans with foreign financial institutions by loans with domestic financial institutions. This suggests a strengthening of domestic macrofinancial linkages of Colombian private corporate sector debt.

5. Colombian nonfinancial corporate debt continues to be peso-dominated though U.S. dollar denominated debt has grown reflecting depreciation effects rather than increased U.S. dollar funding by firms. Since 2004 Colombian private sector corporates have tended to issue debt in pesos (70 percent of total debt equivalent to 31.2 of GDP in 2015 (Figure 2). Since 2013 U.S. dollar indebtedness as a percent of GDP has risen by 3.6 percentage points driven in the main by the devaluation of the Colombian peso over the period against the U.S. dollar (3.4 percentage points out of 3.6) rather than by the increase in funding (0.2 percentage points of GDP).

³ For further details, see Financial Stability Report, Banco de La Republica, September 2015.

Figure 2. Colombian Non-Financial Corporate Debt by Instrument and Currency*Corporate debt increasingly domestic and bank dependent**And largely peso dominated but some growth in US dollar***Private Corporate Sector Debt, by Instrument
(in % of GDP)****Private Corporate Sector Debt, by Currency
(in % of GDP)**

Foreign Providers
 Bonds issued abroad /d
 Credit with foreign financial institutions /c

National providers a/
 Bonds issued in the local market
 Credit domestic financial institutions b/

Debt in U.S. Dollars
 Debt in Colombian Pesos

Sources: Financial Superintendency, Superintendency of Corporates, Banco de la República.

a / Only includes information from companies that report financial statements to the Superintendency of Corporates.

b / Internal commercial financial leasing operations is assumed. This item is composed of loans denominated in local currency

and foreign currency portfolios of commercial and microcredit. c / Includes financial leasing operations. d / The balance of bonds issued abroad is underestimated because it does not include exposures to overseas subsidiaries.

6. Maintaining supervisory surveillance of corporate data and risk management practices would be desirable, especially with respect to determining impact of FX shocks. Given the importance of peso depreciation regarding private sector corporate foreign debt the central bank is able to access information on reported FX-denominated debt obligations (domestic bank or foreign) and is able to use a daily forwards database to create a mismatch indicator for natural hedges against external trade data. Corporate balance sheet information given that it is annual and available with a roughly 5-month lag can be difficult to reconcile with other databases held by authorities, often resulting in a considerable loss of information. Continued supervisory oversight of effectiveness of corporate hedges to mitigate FX risks from shocks will be important.

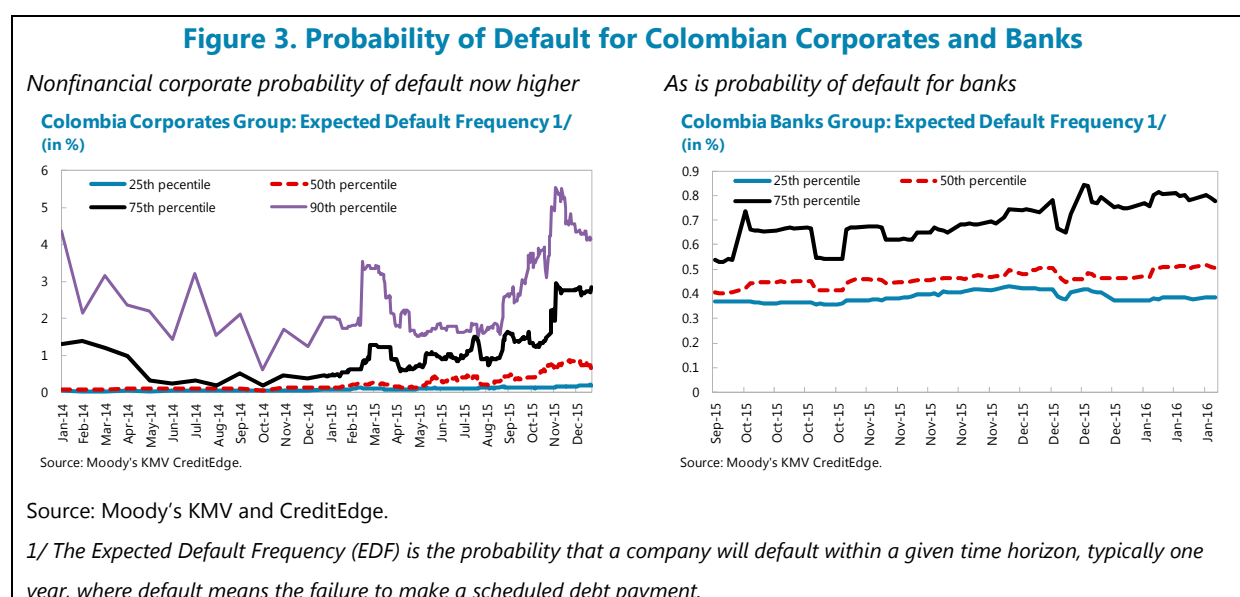
C. Colombian Corporate Debt Metrics⁴

7. Nonfinancial corporate debt has increased in recent years. The evidence from the previous section made clear that Colombian corporate debt has grown in recent years and has been dominated by domestic peso dominated bank loans rather than US dollar securities issuance. This switching to peso-dominated debt (due to depreciation of COP) goes somewhat against the grain of corporate debt in other emerging market economies wherein total corporate foreign exchange exposures (in volume and price terms) have grown due to easier access given low US policy rates, easier global liquidity from unprecedented QE and capital inflows (GFSR, October 2015). However

⁴ The following section utilizes data from private vendors and corporate databases the latest 2015 data for the whole sample of firms is not available at this time. As Colombian corporate nonfinancial corporate switch to reporting on an IFRS basis, the timeliness and quality of corporate data is expected to improve.

the global commodity (lower oil) price shock, significant depreciation of COP and prospects for slower domestic growth are making the Colombian nonfinancial corporate somewhat more vulnerable to distress and default (Figure 3). Nevertheless, the impact on banks' own default frequencies is very mild and is at much lower levels.

8. While equity grew at a faster pace compared to debt for most companies, gross corporate leverage has increased and, after accounting for cash holdings, net leverage has increased further (Figure 4). For large firms, the ratio of total debt to total equity has increased somewhat since 2008. For medium-sized firms, gross leverage has increased more significantly. Sectors with relatively high gross leverage ratios compared to 2008 are Airlines, Gas Utilities and Oil and Gas. Additionally, accounting for cash holdings, net leverage—defined as total debt minus cash, divided by total equity—increased by about 10 percentage points between 2008 and 2014.



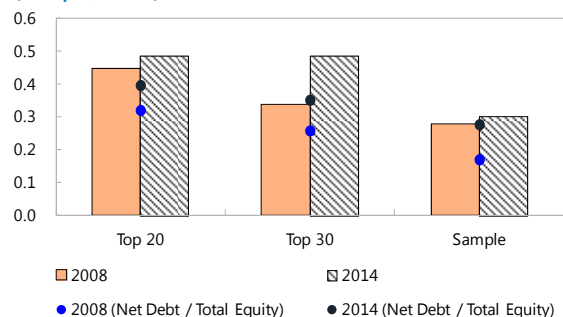
9. While Colombian corporate debt and leverage has increased somewhat, debt servicing capacity has also improved due to much faster earnings growth. Higher earnings have strengthened corporate debt servicing capacity, which remains strong for most firms. Earnings grew at a faster pace compared to interest expense from 2008 to 2014 (Figure 4). This has led to an increase in the interest coverage ratio (ICR), and the median ICR across firms remains strong and sufficient to cover debt interest payments⁵. While most firms' median ICR had been increasing, some sectors that have relatively high leverage (such as Airlines and Utilities) suffer from low ICRs unlike Oil and Gas. These sectors remain sensitive to global commodity prices (oil and gas) and domestic and global growth conditions.

⁵ ICR is computed as EBIT divided by interest expense; EBIT is earnings before interest, and taxes.

Figure 4. Corporate Debt and Earnings

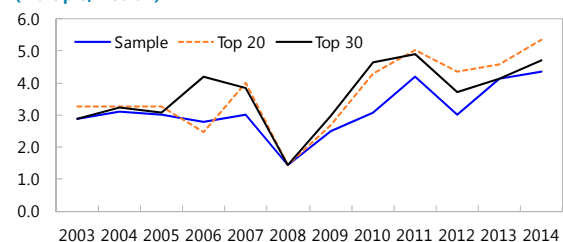
Leverage has slightly increased, while cash has dropped moderately since the Global Financial Crisis ...

Total Debt to Total Equity
(multiple, median)



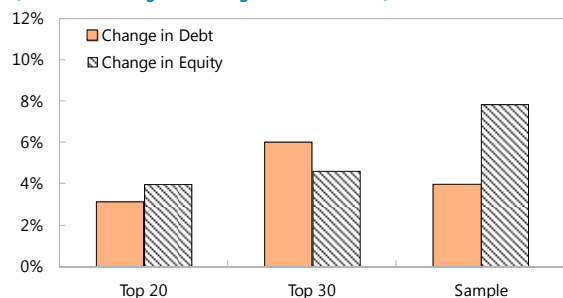
Debt repayment (ICR) has increased across the board...

ICR (EBIT / Interest Expense)
(multiple, median)



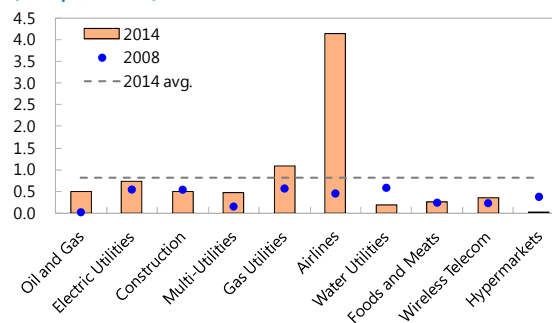
Debt has grown since 2008, but not as much as equity, signaling a more positive leverage outlook for corporates...

Growth in Debt and Equity
(median of average YoY change from 2008-2014)



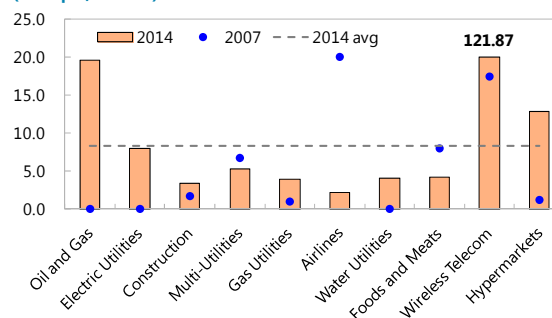
... with red flags in the Airline and less so Oil & Gas industries.

Total Debt to Total Equity by Sector
(multiple, median)



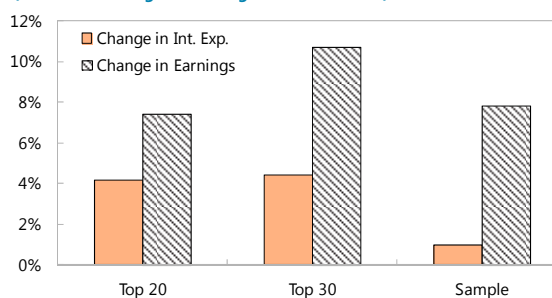
... while Airlines, Multi-Utilities face issues.

ICR (EBIT / Interest Expense) by Sector
(multiple, median)



... supported by strong growth in earnings and a simultaneous sub-par growth in interest expense.

Growth in Interest Expense and EBIT
(median of average YoY change from 2008-2014)



Sources: S&P Capital IQ data, IMF Staff calculations.

10. Debt at Risk measures ($ICR < 2$) for large fragile Colombian corporates have fallen over the period 2008-2014 reflecting robust domestic growth (Figure 5b). Colombian corporate solvency for fragile firms within our sample of large firms has improved over the 2008–14 period having benefitted from robust growth for this period. This evidence is in contrast to a much larger data set utilized by BanRep in its latest financial stability report, which has shown Debt at Risk (DAR) at relatively flat levels of around 25–30 percent.⁶ This is also in line with broader information for other emerging market economies presented in the IMF GFSR (October 2015). The evidence of much lower DAR numbers for our small 100 large corporates sample reflects probably a degree of sample specificities, which includes the firms that have had stronger balance sheets. While data for 2015 was not available allowing earnings growth (10 percent) due to economic growth in 2015 and accounting for further depreciation (30 percent) in 2015 would have seen DAR even for this large corporate sample increase from 5 to 12 percent. For large firms, the Debt/EBITDA ratio has almost doubled from 2008 to 2014, and reflects an increase in leverage, rather than a decrease in overall profitability. Sectors experiencing the most year-on-year growth are Airlines, Utilities, and Oil and Gas. More specifically, the Airlines and Utilities sectors' ratios surpass the commonly suggested level of four. However, ratios higher than four or five typically signal that a firm is less likely to be able to take on additional debt required to grow the business but not necessarily indicative of a risk of distress or default.

11. Debt distributions indicate a growing mass of both highly indebted firms and firms with very little debt. Debt-to-equity and debt-earnings has grown over time since 2008 albeit from lower levels for these larger corporates. The distribution further reveal that the debt/equity ratios show a marked bi-modality in 2014 indicating a growing hump of highly indebted firms and firms which have little debt (Figure 5). In 2008 the proportion of firms with high debt/equity was much less evident. These Colombian nonfinancial corporate debt dynamics have been driven by a sectoral story influenced by both domestic and global factors IMF GFSR (October 2015) that suggested that some economic sectors have had better debt dynamics than other sectors.

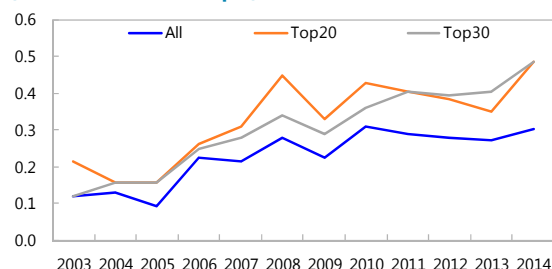
12. Across all firms there has been an improvement in debt servicing capacity. In particular there has been a growing mass of firms with $ICR > 3$ in 2014 compared to 2008 (Figure 5). While this does suggest improved earnings growth, debt servicing capacity is likely to have suffered in 2015, with the FX depreciation and slow growth and continue to deteriorate in 2016.

⁶ Evidence for DAR for a much broader smaller-sized set of fragile firms undertaken by Banco de la Republica in its latest Financial Stability Report indicate much higher levels of DAR (around 30 percent). Our much smaller sample of the larger firms are not comparable as earnings and debt dynamics differ considerably across different sized firms. For the sample of firms analyzed by BanRep, the fraction of fragile firms has been relatively flat around 30–35 percent even under shocks.

Figure 5. Corporate Leverage and Earnings

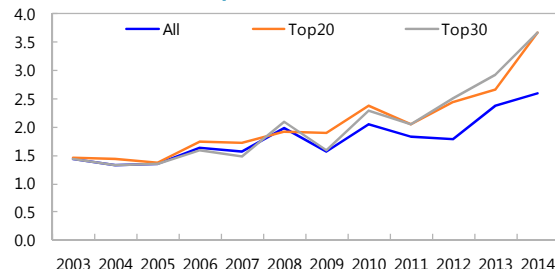
Debt has continued to rise

Debt / Equity, Median
(numbers reflect multiple)



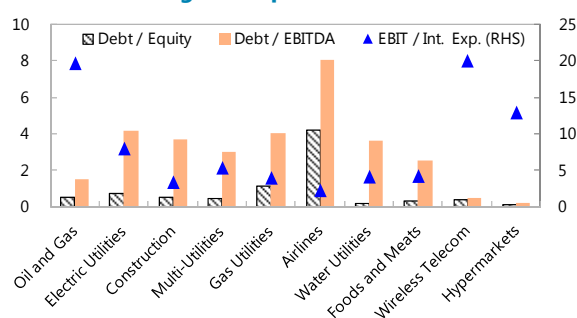
And grown faster than earnings

Debt / EBITDA, Median
(numbers reflect multiple)



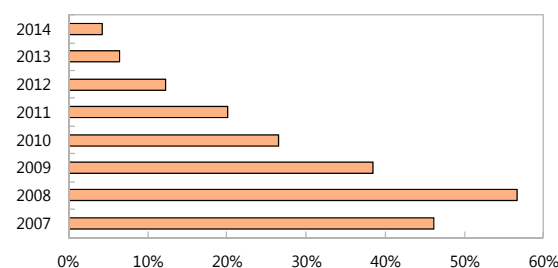
ICR elevated for many sectors including oil upto 2014 but debt also remains elevated across key sectors

Sectoral Leverage Multiples, Median



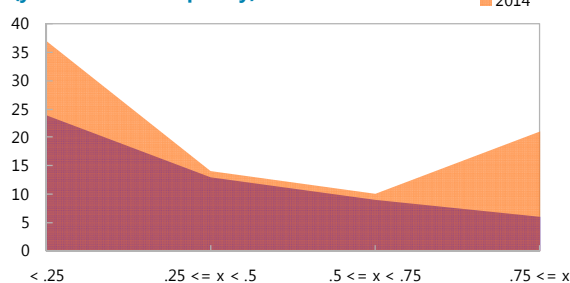
Debt is less at risk over the last few years but more debt now put off to future as firms extend debt maturity

Debt at Risk
(% of Total Corporate Debt where ICR < 2)



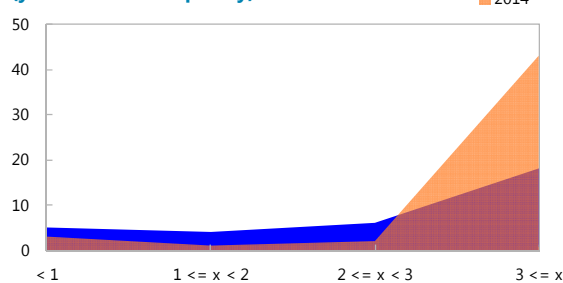
More firms now with both higher and lower debt than before (greater skew and bi-modality)

Debt / Equity Distribution
(y-axis reflects frequency)



More firms have ICRs greater than 3 than previously

ICR Distribution
(y-axis reflects frequency)



Sources: S&P Capital IQ and IMF staff calculations.

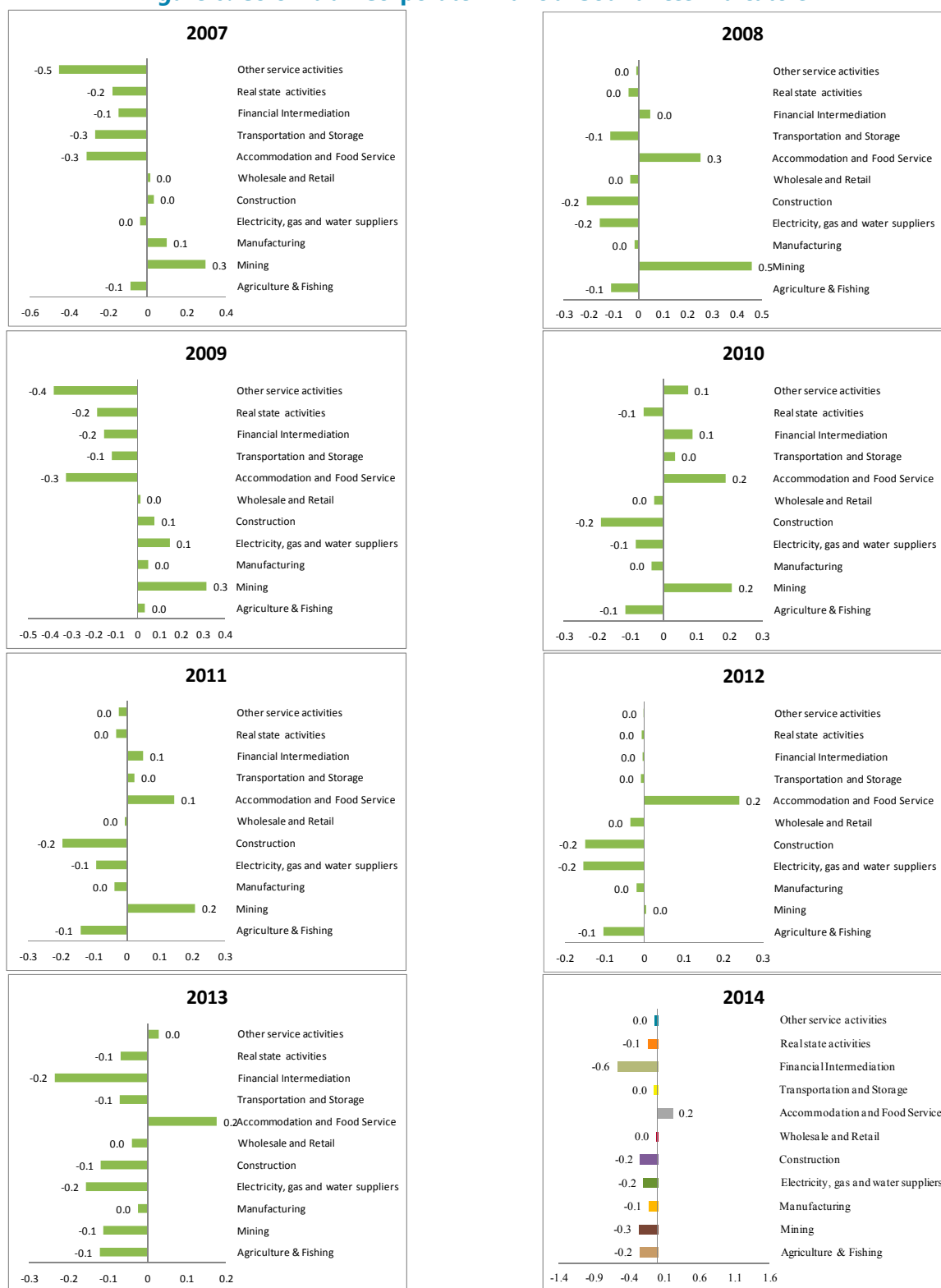
D. Corporate Financial Soundness Index⁷

13. Individual metrics such as debt-to-equity and DAR can monitor and evaluate the credit-worthiness and prospects for corporate distress (default, liquidation, rating downgrades) but they have limitations. Individual metrics may not be able to fully reflect all necessary characteristics, which reflect corporate fragility and/or soundness. At the very least, individual metrics may not be able to fully bring together concerns over corporate debt, leverage, profitability, operating performance, and liquidity and the interactions between them. Such cross interdependencies between individual metrics would not be accounted for. Recent work by Banco de La Republica (BdR) has shown consistency between the composite indicator and credit risk indicators. In this sense a composite indicator would provide a more thorough assessment of corporate sector strengths and vulnerabilities.

14. BdR has constructed a very useful composite indicator for the period 2000–14. This composite indicator brings together 34 metrics grouped into five categories—activity, leverage, profitability, liquidity and size using principal component analysis to identify private corporate sector vulnerability. The construction of such a corporate sector financial soundness index (FSI) is a useful tool for monitoring financial stability concerns. The corporate FSI according to BdR is not constructed at the aggregate level as the methodology does not allow for inter-temporal comparisons. However, the corporate FSI can be constructed at the firm and industry level.

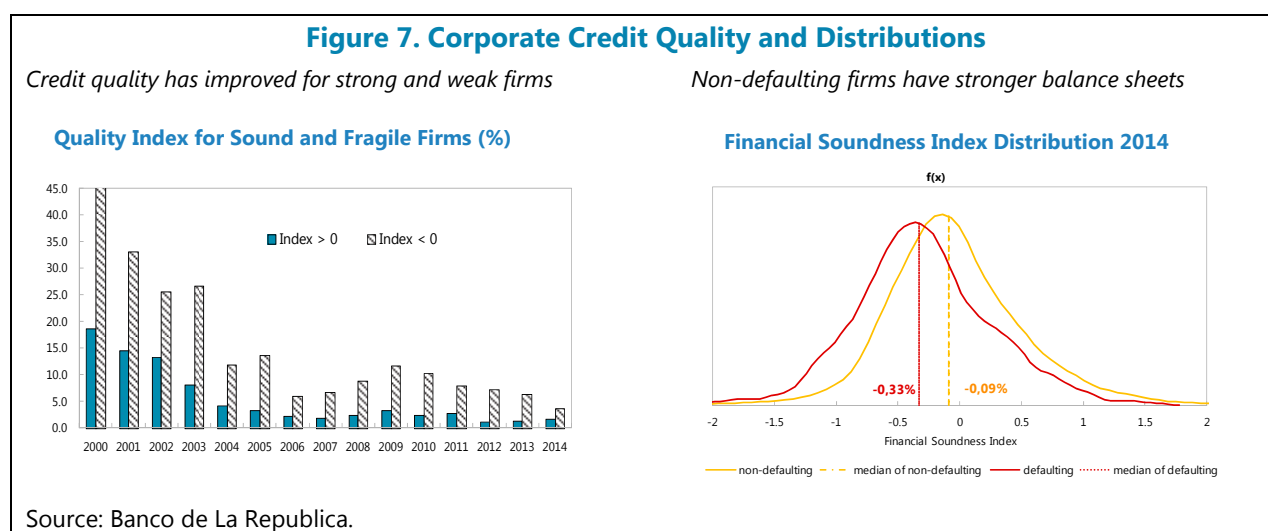
15. Considerable variation exists in the corporate FSI for Colombia by industry for 2014 (Figure 6). As of 2014 latest figures, the FSI calculated by industry shows a strong performance of firms (positive index) for accommodation and food service. Industries that depicted a weaker balance sheet and operating performance were financial intermediation (Agriculture and fishing, mining, manufacturing, real estate activities. and in past), transport and storage and electricity, gas and water supplies. With commodity price shocks and depreciation having continued in 2015 and the possibility of weaker growth going into 2016 against also a weaker global economic growth increased uncertainty in financial markets this overall sectoral weakness suggest diminishing balance sheet scope to absorb macrofinancial spillovers from these shocks.

⁷ Our thanks are due to Esteban Gomez and his team at the Financial Stability department of the Banco de La Republica for the data, construction and calculation of the FSI metrics, validation tests and distributions for defaulting and non-defaulting firms. The data on firms used to construct these metrics account for around 48 percent of the commercial loan portfolio—they are a key set of debtors in the Colombian financial system. The work in this section is based on Lemus-Esquivel et al (2015). Again, in line with 2015 corporate data unavailability until June 2016, the composite metric was not available for 2015.

Figure 6. Colombian Corporate Financial Soundness Indicators

Source: Banco de La Republica

16. For financial stability purposes the study related firms' credit worthiness to banks and other creditor's balance sheets. One would assume that high and positive levels of the corporate FSI would correlate with a low credit risk perception from its creditors, while low and negative levels of the corporate FSI would be related to higher perceptions of credit risk as long as comparisons are done in the same year. For Colombia ex ante credit risk can be measured by a quality index (QI) which is the ratio of risk loans (that firms find difficult to repay or loans they have defaulted on) and total gross loans. As expected (Figure 7) firms with a positive FSI have consistently lower QI (better credit worthiness) than those with a negative FSI this holds true for all years (particularly from 2000–13). This relationship is much less marked in the latest period of 2014 where credit worthiness as indicated by QI of strong and weak firms is now more similar (Figure 7), though at low levels. The QI measure has declined for both sets of firms since 2009. This decline was much less for stronger as opposed to weaker firms. This evidence suggests that as the economy starts to slow credit deterioration could be much greater for weaker as opposed to stronger firms in part due to their limited ability to absorb losses due to weaker balance sheets.



17. FSI empirical distributions can be constructed for both defaulting and non-defaulting firms the evidence finds the distribution of non-defaulting firms are more symmetric (just as likely to be strong or weak) (Figure 7).⁸ As one would expect firms that are defaulting are skewed to being weak (negative FSI). For 2014 the median (50th percentile) for defaulting was lower (-0.33) than non-defaulting firms (-0.09) this suggests firms with positive FSI are on average less prone to default on their obligations. The results for earlier distributions from 2000–13 (not produced here) show the same pattern of findings.

⁸ Defaulting firms are those defined as those moving from higher ratings (A or B) to lower ratings which could be defined as distress ratings (C, D, or E) during a given year. More details are provided in Lemus-Esquivel et. al. (2015).

E. Stress/Sensitivity Tests

18. This section presents a variety of static stress/sensitivity tests. The tests are one-period *what-if* impacts on key financial sector variables such as bank's solvency (capital) and liquidity from a deterioration in Colombian private sector corporate balance sheets. We present evidence of staff's stress tests and summaries of key stress tests undertaken by the BdR Financial Stability Department.

19. The stress tests undertaken here and by the BdR in their latest Financial Stability Report differ considerably both in aggregation (top-down and bottom-up), scope and data. There is no a priori reason that the output of the stress tests should be similar across the two exercises given the very different basis of the tests and shocks. However both exercises together provide a wider more comprehensive array of information on potential deterioration in nonfinancial sector corporate balance sheets and impacts on the financial sector than each of the exercises on their own as they cover a wider set of shocks under a wider set of assumptions than each set of tests on their own.

Staff Sensitivity/Stress Tests

20. In order to gauge the resilience of Colombian corporations to a combination of earnings and exchange rate shocks, we conducted a stress test analysis on a sample of firms, based on available balance sheet information and data provided by the authorities on 10 banks⁹. The shocks were derived from the following "severe but plausible" assumptions:

- A 20 percent decline in earnings, similar to the median changes in firms' EBIT across major EM countries during the Global Financial Crisis (GFC) of 2008.
- Currency depreciation against the U.S. dollar of 70 percent, similar to trends observed around the GFC.
- Corporate EBIT exposure to foreign currency of 60 percent assumed mainly through increased expenses from imports.

21. We also took into account financial hedges that could mitigate corporate exposure to exchange rate risk. Financial hedges were derived based on a simple assumption that 10 percent of EBIT exposure is hedged through derivatives. This takes into consideration the availability and effectiveness of hedges.¹⁰

⁹ Data was provided by the Financial Superintendency of Colombia for the following banks: Bancolombia, Banco de Bogotá, Banco Davivienda, BBVA Colombia, Banco de Occidente, Banco Corpbanca, Banco GNB Sudameris, Banco Colpatria, Banco Popular, and Citibank Colombia. We would like to express our gratitude to Juliana Lagos and her staff for their excellent interaction and communication with the IMF team regarding this information.

¹⁰ It is not always the case that corporates are able to hedge their FX exposure due to very specific nature of risks their exposure involves (in terms of maturity, size, currency and cost). Even if such exposures can be hedged the

(continued)

22. Under these assumptions we then evaluated the Debt-at-Risk (DAR) measure under stressed assumptions, and derived new Non-performing Loans (NPLs). The new NPLs were derived from data on banks provided by the authorities, as well as on the following assumptions:

- A 2.00x Interest Coverage Ratio (ICR) threshold for DAR, matching the non-stressed DAR and following industry conventions for ICR.
- Corporate Loans as 65 percent of Total Loans, derived as the weighted average of the same data in the banking sample.
- Probability of Default (PD) of 25 percent, which we based on World Bank recovery data for Latin America.¹¹
- Loss Given Default (LGD) of 60 percent, based on Banco de Bogota's annual report estimates, which we then applied to the entire sample as a proxy.

Banking Sector Impacts

23. Corporate lending is a sizeable part of the total bank loans for our bank sample, but banks do have adequate buffers to absorb earnings and depreciation shocks. Lending to corporations account for around 65 percent (weighted average) of the 10 banks from our bank data sample. This is skewed in particular by the much larger proportion of corporate loans that form part of the larger balance sheets of domestic and systemically important Colombian banks. Total gross nonperforming loans (NPLs) for the entire Colombian banking system reached 2.83 percent in 2015 rising from very low levels. Total regulatory capital remains well above the minimum requirement of 9 percent at bank and system level. For the banks in our sample, median regulatory capital was around 14.3 percent and NPLs of 2.5 percent. In addition, Colombia also imposes a forward-looking expected loss provisioning approach on banks including a countercyclical provisioning requirement that delivers additional loss absorbency. Countercyclical provisions amounted to around 13–28 percent of total provisions depending on the bank in our sample. The following findings were observed:

hedge could be less than effective due to knock-out thresholds depending on the amount of depreciation (i.e. effective if depreciation is below 30 percent only) and mismatches in maturity of FX derivative instruments (of shorter term) used to hedge compared to longer maturity of the corporate exposure. Moreover, this could also entail additional rollover and liquidity risks as the FX derivatives contract expire while market and credit risks (from margin, collateral re-setting) would exist prior to maturity of the contracts. Surveys of the effectiveness of hedges from derivatives would have to be undertaken for nonfinancial and financial corporate by the Corporate and Financial Superintendencies. Further work by supervisors would help to address the strength of mitigating actions that nonfinancial and financial corporations can take against financial shocks (especially FX shocks).

¹¹ Higher recent PDs have also been recently observed in Latin America from evidence presented: Caceres, C., and F. Rodrigues Bastos (2016) and International Monetary Fund (2016) and Duan et al (2015).

- **Under the earnings shock** – no Colombian bank in our sample falls below the regulatory minimum of 9 percent though all banks suffer a decline in their regulatory capital (Figure 8). Total median capital for all 10 Colombian banks falls to 13.6 percent (from 14.5 percent pre-shock)¹².
- **Under the currency depreciation shock (including Corporate EBIT exposure to foreign currency of 60 percent)** – no Colombian bank in our sample falls below the regulatory minimum of 9 percent though all banks suffer a decline in their regulatory capital (Figure 8). Total median capital for all 10 Colombian banks falls to 12.5 percent (from 14.5 percent pre-shock).
- **Under the earnings and currency shocks jointly** – only two Colombian banks in our sample falls just below the regulatory minimum of 9 percent though all banks suffer a decline in their regulatory capital (Figure 8). Total median capital for all 10 Colombian banks falls to 11.4 percent (from 14.5 percent pre-shock). Indeed BdR static stress test also indicated that one bank falls below the regulatory minimum (Table 2)¹³.
- **Accounting for additional loss-absorbency buffers** – Colombian banks are required to hold robust forward-looking provisions. The rules enable the accumulation of countercyclical specific and general provisions that add to their loss absorbency. Adding in their net-income and these provisions no Colombian banks fall below the regulatory minimum of 9 percent (Figure 8). Total median capital for all 10 Colombian banks rises from 11.4 percent to 13.1 percent. The SFC has also indicated that risk-weighted assets (RWA) are higher than other Latin American (LA) peers. In Colombia RWA represent 80 percent of total assets, while the average in the LA region is approximately 70 percent.

24. While the impacts of static adverse earnings and currency depreciation shocks are manageable for the Colombian banking system it is useful to strike a cautionary note to these findings. First, we have assumed that legacy capital (held before August 23, 2012) held by some large Colombian banks as goodwill or intangibles acts as fully-loss absorbing capital similar to equity capital¹⁴. Under Basel III rules goodwill and intangibles are deducted from bank capital and as previous work in Karpowicz and Norat (2015a) has shown once legacy goodwill is removed capital levels and buffers for Colombian banks are lower and would be lower after stress test shocks. Even

¹² However if earnings were to decline to 40 percent (2 banks become close to regulatory minimum of 9 percent) while total median capital would be lower at around 12.1 percent. If earnings were to collapse to around 60 percent declines 2 banks would be below the regulatory minimum and one other bank close to the 9 percent threshold while total median capital for the banks would be around 11.2 percent.

¹³ While the focus on this paper is on static stress tests the BdR has undertaken dynamic stress tests in the Financial Stability Report, September 2015 in which the deterioration of the corporate portfolio is taken into account.

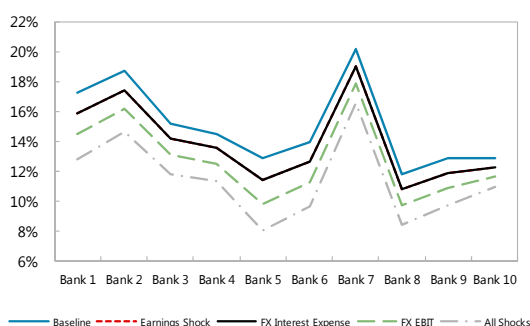
¹⁴ SFC regulations since 23 August 2012 have made clear that all intangibles whenever it was registered are to be deducted by credit institutions from capital and do not act as fully-loss absorbing capital.

though since 2013 Colombian bank capital has been improved further transitioning to the Basel III capital definition by replacing legacy goodwill and intangibles and sequencing the moves to fully implement Pillar 2, systemic and countercyclical capital would add further loss absorbency and resilience to the Colombian banking system from corporate vulnerabilities. According to SFC's exercises, the deduction of intangibles registered before August 2012 would reduce the total capital ratio by 0.7 percent and all credit institutions will continue fulfilling the minimum capital ratios. Regarding Pillar 2 it should be noted that the Decree 2392 of 2015 empowered the SFC to require additional capital levels based on the result of self-assessments of capital adequacy that institutions should perform and on the supervision process. Moreover, recently the SFC issued instructions about the stress test framework that institutions must follow which will be very useful in their self-assessment of capital adequacy. Secondly, as was outlined by the BdR (2015) liquidity stress tests, credit and market risk shocks impacting on Colombian corporates could affect Colombian banks funding and liquidity resilience through other financial entities (Table 2).

Figure 8. Corporate Stress Test Impacts on Bank and System Solvency

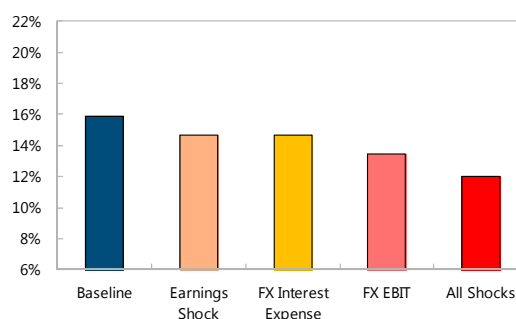
Adverse shocks impact some banks capital more

Bank-Level Shocks
(in % of CAR)



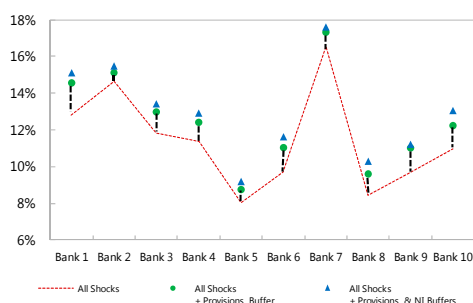
...at system level capital well above 9 percent minimum

System-Level Shocks
(in % of CAR)



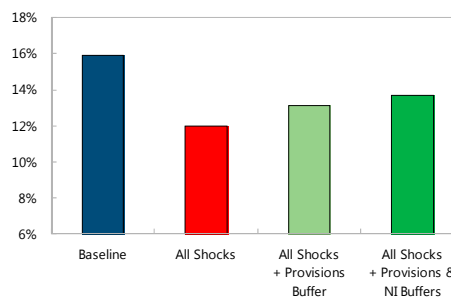
Robust provisioning and net income provide capital boost

Bank-Level Shocks, with Buffers
(in % CAR)



...with capital buffers even larger at system level

System-Level Shocks, with Buffers
(in % CAR)



Sources: Staff calculations, S&P Capital IQ, SFC.

25. Recent work by rating agencies has shown that focusing on standardized higher-quality capital measures (tangible common equity to risk-weighted assets) across Latin American banks stress shocks indicated greatest vulnerability to Brazilian and Colombian bank solvency.^{15,16} Under such standardized measures that exclude goodwill Colombian bank capital tends to be at lower starting positions than many of the Latin American peers (Karpowicz and Norat (2015)). Under a severe stress scenario the Colombian banking system is the second worst performer (low-levels of post stress solvency) after Brazil. The Colombian banking system is disadvantaged under the low standardized measure of capital (low starting points) relatively higher credit costs (loan loss provisions over gross loans), limited efficiency (high cost-to-income) but still high earnings generation capacity. Post the severe stress test a sharp rise in past due loans and contraction in profitability would be particularly damaging to Colombian bank solvency. Notwithstanding the rating agency adjustments and stress tests, it is worth highlighting that the additional loss absorbency is built into credit institutions buffers through robust provisioning which incorporate countercyclical provisions (CIC), higher risk weights and forward-looking risk-based supervision, which has been upgraded in recent years. A study made by the SFC showed that if loans' risk weights are changed by the reported average in LA, deducting all intangibles assets from CET1 and switching the CIC (0.8 percent of RWA) for the Basel III countercyclical capital buffer then the capital ratio might improve by 3.6 percent.

¹⁵ See Moody's Investor Service (2015a) and Moody's Investor Service (2015b).

¹⁶ Tangible common equity is a standardized definition of capital used by Moody's in its stress tests to ensure comparability across its rating universe of 900 banks in 80 banking systems. It differs from regulatory capital measures of capital such as common equity tier 1 (CET1).

Table 2. Banco de La Republica Static Stress Tests

From	Test Type	Details	Impact on Variables	Impact on Bank Solvency
Banrep	Corporate	4.796 fragile firms ICR < 2 After a 25% shock to numerator/denominator 6.682 fragile firms ICR<2 to capture increasing debt and less capacity to service it.	Fragile firms increase from 24.3% to 33.8% of sample. Debt of fragile firms increase from 30.1% to 41.1%	The impact on solvency of these fragile firms is evaluated jointly with households and other fragile firms, as explained below.
Banrep	Static credit and market risk test	Impact of downgrade of rating of loans to fragile corporates and households (credit cards and auto loans), increase in provisions and lower interest income, lower capital and reserves but RWA net of provisions is lower	All fragile corporate rating downgrades by one grade. 10% of consumer portfolio downgrade by one grade. Also 200 bp increase in TES and private debt curve and loss in value of shares of 20%.	Bank System solvency reduced by 0.5% (15.45% to 14.98%) 1 bank is below reg minimum, nonbanks, financial cooperatives; finance companies improve capital by 0.04%-1.11%. Impact on ROA more severe.
Banrep	Static Liquidity	Liquidity risk indicator (IRL) over a thirty-day horizon, defined as the ratio of liquid assets adjusted by exchange risk and market liquidity, and the net liquidity requirement for 30 calendar days.	Liquidity Impact from market and credit risk shock leads to lower asset collateral and cash inflows. Biggest decline in IRL was for banks when. Withdrawals by collective investment funds were also considered.	Under joint materialization of shocks, banks' IRL falls from 295 to 258. Liquid assets more than 2.5 times net liquidity requirement for banks.
Source: Banco de La Republica (2015).				

26. The authorities are intensifying their surveillance of the financial sector by enhancing their stress testing capabilities. The authorities continue to make great strides in stress testing, linking real sector (corporate and household) vulnerabilities with financial sector solvency concerns into liquidity impacts and contagion assessments. Advanced model development using DSGE and network models allied to more straight-forward balance sheet assessments, including more focused specific (thematic) liquidity and contagion stress testing will enable interconnected and systemic risks to be accommodated and identifying weaknesses in financial institutions business models and plans. The Fund is continuing to provide Technical Assistance (TA) on stress testing developments on such high-priority work.

F. Impacts, Spillovers and Feedbacks to Real Sector

27. The nonfinancial corporate debt and leverage metrics presented earlier have shown that corporate balance sheets have started to become more strained especially in some sectors. This could have adverse impacts on banks but stress tests indicate resilience to these shocks. Nonfinancial corporate sector distress, whether in the form of greater balance sheet stretch with worsening debt metrics or through outright default and corporate bankruptcies can lead to firms retrenching investment and deposits from the financial sector to meet obligations and maintain stronger cash flows. While corporate sector distress in the form of lower earnings, losses from depreciation shocks are also likely to lead to higher NPLs at credit institutions (banks and nonbanks) which can lower bank and nonbank capital and curtail credit supply as credit institutions seek to maintain capital levels and buffers.

Table 3. Stress scenarios and Impact on Corporate Investment Rates and GDP 1/			
Stress scenario	Increase in Net Leverage (percentage points)	Reduction in investment rates (percentage points) High Coefficient (-0.064)	Reduction in investment rates (percentage points) Low Coefficient (-0.042)
Depreciation Shock	7.85	-0.50	-0.33
Source: IMF staff calculations. 1/ Li, Magud Valencia (2015) coefficients estimated in a panel of 17,000 firms in 38 emerging market countries, including Colombia. The study relates investment rates defined as capital expenditure divided by the capital stock—to net leverage, defined as total debt minus cash stocks divided by total equity.			

Impacts of Corporate Stress on Investment and GDP

28. As leverage increases this increases credit risk on the corporate which faces higher borrowing costs (higher spreads) lowering borrowing and investment. Colombian corporate increase in debt and leverage could lower investment between 0.33–0.5 percentage points of the capital stock using estimates derived by Li, Magud and Valencia (2015) (Table 3). The authors also report an elasticity of real GDP growth to investment rate— measured in percent of a firms capital stock of about 0.1 across emerging markets. In this context a reduction of investment rate between 0.33–0.5 would lower real GDP between 0.033–0.05.

Bank Capital and Credit Growth and GDP Impacts

29. The relationship between bank capital and credit supply is not clear-cut and both theoretical and empirical studies have shown both a positive and negative relationship between bank capital and credit growth, Martynova (2015) (Annex A). Some papers have focused on observed capital ratios and have found a positive relationship between bank capital and lending. Berrospide and Edge (2010), Carlson et al. (2013) among others use bank-level data to estimate the impact of capital on lending and found small positive effects on credit dynamics; more detailed quantitative results on the impact of bank capital fluctuations on lending is provided below

(Table 4). Note that this heterogeneity could come from non-linear effects between capital and lending. Repullo and Suarez (2013) show banks under any regulatory regimes will hold positive capital buffers in order to preserve their future lending capacity.

Table 4. Bank Capital and Quantitative Impact on Loan and Credit Growth

Paper	Effect of a 1-ppt shock to	Dependent Variable	Impact (ppt)
Bernanke & Lown (1991)	Bank capital ratio	Bank lending growth	+2-3
Berrospide & Edge (2010)	Bank capital-to-asset ratio	BHC lending growth	+0.145
Carlson et al (2013)	Total capital-to-asset ratio	Bank lending growth	+0.13-2
Francis & Osborne (2012)	Surplus bank capital ratio	Bank lending growth	+0.060
Gambarcorta & Mistrulli (2004)	Excess regulatory capital-to-assets ratio	Bank & credit cooperatives lending growth	+0.0744

Source: Gabone and Lame (2014) and IMF Staff calculations.

30. The earnings and depreciation shocks studied before adversely impact NPLs and bank capital by around 1.48 percentage points and this may reduce bank credit (loan) growth by 0.09–4.44 percentage points¹⁷ Utilizing the quantitative impact assessment from above (Table 4) we can see there is a wide variation in terms of impact on credit growth from bank capital. Previous studies have found that the impact can be greater in recessions relative to normal times reflecting the upper limit of 4.44 percentage points. A midpoint (between 0.09–4.44ppt) assessment of the impact of a reduction in bank capital would impact credit growth by 1.19 percentage points.

31. A reduction on average of 1.19 percentage points in Colombian bank credit growth due to a combined earnings and depreciation shock would have a marginal impact on real GDP. Calomiris and Mason (2003) have found have elasticities between real GDP and bank credit growth ranging from 0–0.4 percentage points. With a 1.19 average reduction in bank credit growth in Colombia real GDP based on such empirical estimates could decline anywhere in the region of 0–0.48 percentage points. Adding the investment impact on GDP could add at maximum 0.05 percentage points to this figure to give a value of 0.53.

32. There is reason to believe a 0.53 percentage point GDP impact could be an underestimate but the final impact would still be small. First, the earnings and depreciation shocks could be larger. Second, the credit growth reduction is assumed in our stress test exercise to arise from banks only. However taking account of solvency impacts for other credit institutions would imply larger credit growth and real GDP impacts. Third, the corporate earnings and depreciation shocks impact have been determined through a single round of macrofinancial linkages (corporate shocks impact financial sector that affect GDP), considering second round effects

¹⁷ This includes all earnings and FX shocks as well as offsetting impact on loss-absorbency and capital from running down provisions and net income.

could have larger overall GDP impact. Finally, the stress tests undertaken take account of single or combined static shocks for earnings and depreciation. If these were to occur in a dynamic setting together with an adverse macroeconomic scenario then impact on bank and nonbank capital, credit growth and real GDP would be larger over a longer period.

G. Conclusions

33. It has been evident from a variety of individual and composite debt, leverage, balance sheet and income statement metrics that domestic macrofinancial linkages for Colombian nonfinancial corporate sector has been growing between 2003–15. The analysis presented here makes clear the importance of increased and enhanced macrofinancial surveillance of the nonfinancial corporate sector. Authorities could:

- Increase the quality and coverage of Colombian nonfinancial corporate data tracked by the Corporate Superintendency. Increasing timeliness and removing data gaps would further enhance the calculation of individual and composite data metrics. In part some of this may be addressed by the move to IFRS accounts by firms.
- Increase the supervisory capacity of the Corporate Superintendency to investigate nonfinancial corporate sector data and determine their macrofinancial implications especially on other sectoral balance sheets of the economy (government, financial, external, and households). This work should be undertaken with other stakeholders such as the BdR, and Financial Superintendency to further enhance the quality of nonfinancial corporate sector analysis within the Financial Stability Report.
- The BdR should regularly update their work on the corporate financial soundness index (FSI) to help link data from individual corporates to a composite nonfinancial corporate vulnerability indicator at both firm and industry level. A more detailed and granular industrial breakdown of the FSI could also be helpful especially if adjusted small-sample problems in calculating the index for a particular sub-sector are overcome.

34. Static stress tests undertaken have clearly shown that credit institutions particularly banks are able to absorb adverse nonfinancial corporate sector losses without compromising individual or bank system solvency. This provides some confidence that current adverse macrofinancial impacts are likely to be contained from growing nonfinancial corporate vulnerability. This indicates that:

- A strong and flexible macroeconomic policy framework that has constrained public debt and enabled flexible policy levers (exchange rate) to work has sustained a positive robust growth profile in recent years. This has helped to support nonfinancial corporate earnings and debt servicing capacity.
- Colombian authorities' progress in improving the effectiveness of the regulatory and supervisory framework for Colombia has resulted in greater loss absorbency within the financial sector,

higher risk awareness through maintenance of existing higher risk weights and improved the forward looking risk based framework for financial institutions Karpowicz and Norat (2015b). This helps the financial sector to absorb nonfinancial corporate losses.

35. Notwithstanding the positive evidence from stress tests there is a need to avoid complacency:

- There would be falls in bank credit growth of 4.44 percentage points and growth of 0.53 percentage points which would have further adverse macrofinancial impacts.
- Bank capital should be increased early if called for from risk-based supervision. Colombian authorities' introduction of regulations allowing Basel III compliant hybrid bonds in 2015 (Decree 2392, December 2015) is helpful¹⁸. However the raising of equity capital through issuance or through organic growth of capital by reducing banks dividend payout would add higher quality loss absorbency (Karpowicz and Norat 2015a). The Financial Superintendency has powers to further limit dividend payout for Colombian banks which would increase organic growth of capital (they have higher payouts than Latin American peers).
- In the context of lower growth for longer and the potential for larger changes in nonfinancial corporate earnings, depreciation shocks and global uncertainty—bank solvency could be much lower. Moreover, the funding linkages between collective investment funds and banks in the Colombian financial system implies the potential for solvency concerns to transform into liquidity problems and raise contagion worries. The resulting vicious nonfinancial corporate macrofinancial loop (Figure 1) would be very damaging. There is a need for continued flexible and coordinated policy action, which addresses multiple areas of economic and financial imbalances in the economy. Specifically timely and robust policy actions that strengthen the real, fiscal, external and financial sector would strengthen nonfinancial sector corporate balance sheets that would reinforce a virtuous macrofinancial stability loop (Figure 1).

¹⁸ The regulatory decree strengthened the criteria for debt instruments to be recognized as capital Tier 1 and Tier 2.

Annex I. Bank Capital and Credit Growth Study Summary

1. **Determining the size and sign of the impact of bank capital to credit growth using various statistical regression or panel estimations does not yield a uniform message.** Some studies suggest a strong positive impact, others a negative impact and other studies no relationship at all.
2. **The positive relationship between bank capital and credit growth was most strongly evident during the recent financial crisis, banks with strong balance sheets were better able to maintain their lending.** The study by Albertazzi and Marchetti (2010) uses Italian data in 2007–09 and finds evidence of a contraction of credit supply associated with low bank capitalization. Kapan and Minoiu (2013) employ a sample of more than 800 banks from 55 countries during 2006–10. They show that bank capital played a cushioning role: better capitalized banks (with lower leverage ratio) that were exposed to the financial market shocks decreased their supply of loans less than other banks. In conclusion, all studies referred to above suggest that higher capital makes the provision of credit more stable and robust even in economic downturns. More capital also allows banks to better withstand financial and real shocks. Bank capital increases the capacity to raise non-insured debt and thus banks' ability to limit the effect of a drop in deposits on lending (Ashcraft, 2001). Indeed, using data for Italian banks in 1992–2001, Gambacorta and Mistrulli (2004) show that well-capitalized banks can better absorb temporary financial difficulties on the part of their borrowers and preserve long-term lending relationships.
3. **However, studies that focus on banks in advanced economies during the 2008 crisis alone often come to different conclusions.** Using OECD data Huang and Ratnovski (2009) find no relationship between pre-crisis bank capital and performance during the crisis. For their sample of European banks, Camara et al. (2010) report that well-capitalized banks took more risk before the 2008 crisis. Using a sample of 36 major global banks, the IMF's GFSR (2009) finds that banks that received government support during the crisis had statistically higher capital metrics before the crisis. To sum up, empirical evidence fails to provide a definitive answer on whether higher capital will always and everywhere enhance financial stability. However in this paper we side with the view that higher capital will increase banks' resilience, support credit to productive sectors of the economy and will reduce losses in a crisis period.

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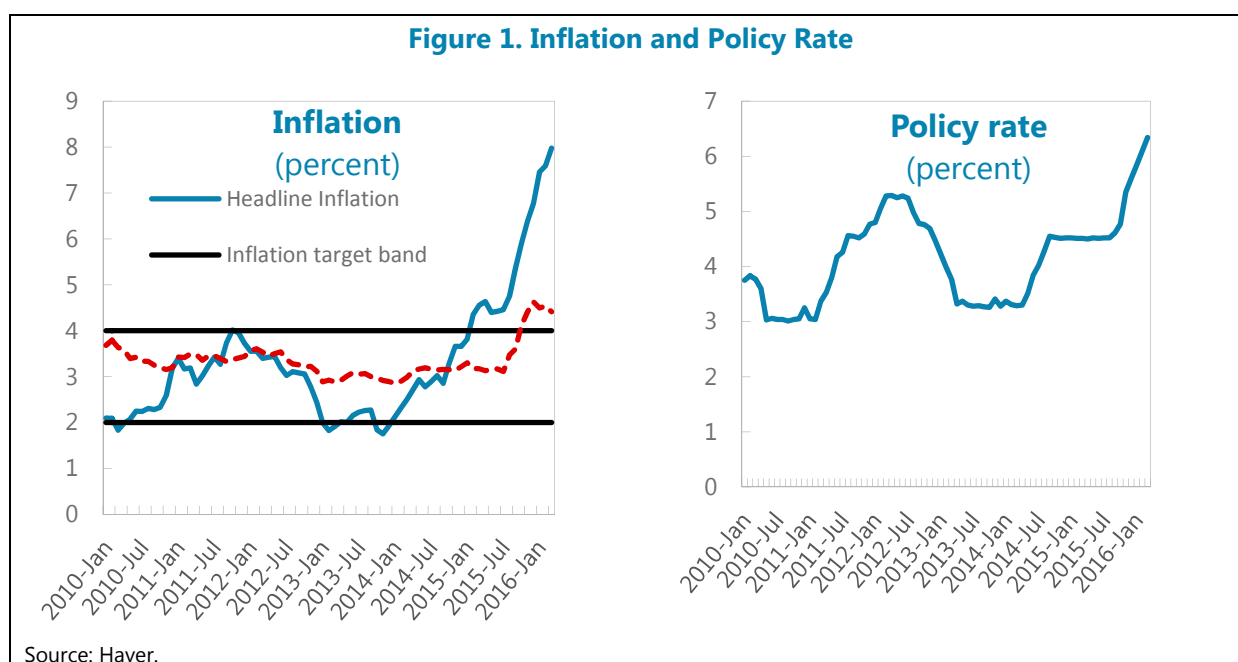
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INFLATION DYNAMICS IN COLOMBIA¹

A. Introduction

1. Inflation has been outside the central bank's target band since early 2015. Coinciding with the decline in commodity prices and exchange rate depreciation, inflation breached the upper band of the inflation target (4 percent) in February 2015 and has remained above 7 percent since the beginning of 2016. Twelve-month-ahead inflation expectations stand at 4.4 percent but 24-month-ahead expectations remain within the target band. Market-based measures yield expectations of up to 4.9 percent. The central bank reacted to increasing inflation with cumulative interest rate hikes of 200bps since August 2015. Understanding the underlying forces behind the increase in inflation is important to design an appropriate policy response.

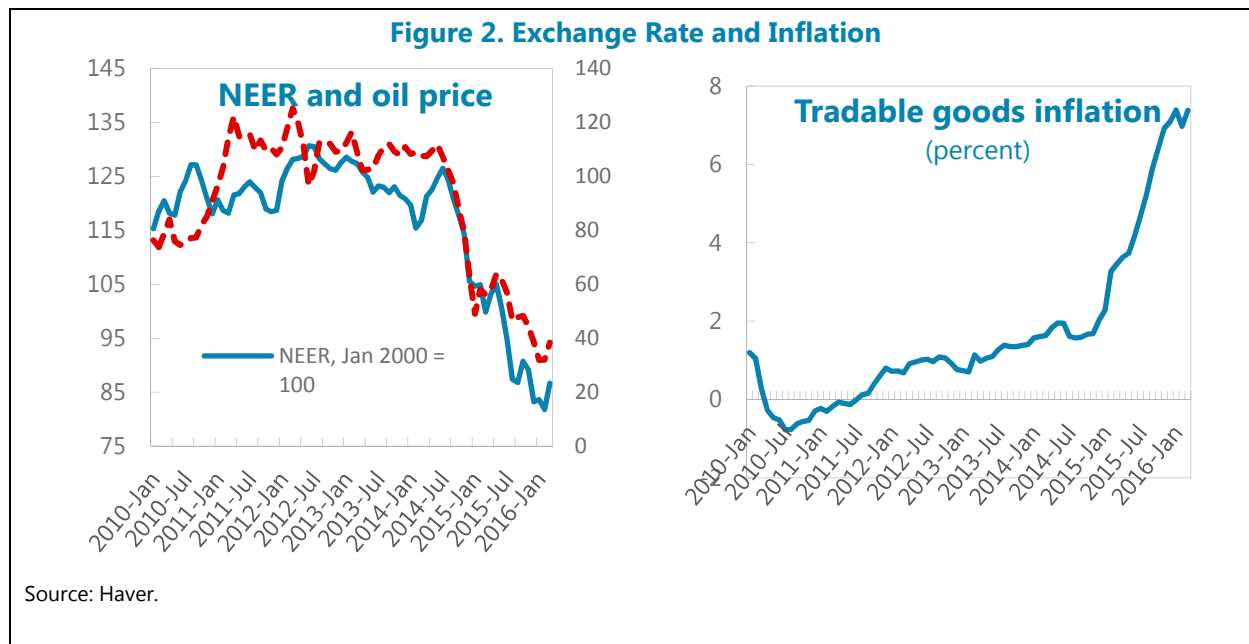


2. This paper explores three possible drivers of inflation dynamics in Colombia: exchange rate pass-through, the El Niño meteorological phenomenon, and wages. The results indicate the first two factors have contributed very significantly to the surge in inflation but their effects are expected to subside in coming months. So far, wages do not seem to have been an important driver of inflation.

¹ Prepared by Sergi Lanau and Christina Kolerus. We thank the staff of the central bank for their useful comments.

B. Exchange Rate Pass-through

3. The Colombian peso depreciated in line with the decline in oil prices, pushing up tradable-goods inflation. The trade-weighted exchange rate depreciated 30 percent since July 2014,² making imported goods more expensive. Since commodity prices are projected to remain low for an extended period, a significant part of the depreciation is likely to be permanent. In response to the large depreciation, tradable goods inflation has been in the 5–7 percent range since August 2015.



4. This section estimates exchange-rate pass-through (ERPT) coefficients for Colombia in a stylized framework to gauge the contribution of the peso depreciation to inflation.

Following a well-established literature (e.g., Campa and others 2005), we use econometric tools to establish the effect on inflation of a one percent depreciation in the NEER. The result of the estimation is the so-called ERPT. It is important to note that, unlike Forbes (2015) and others, we do not have a formal model to identify the different shocks that give rise to endogenous depreciations. This is an important limitation since the response of inflation to the NEER is endogenous to the state of the economy and can vary substantially depending on the sources of the shock. The exercises below are agnostic on the source of NEER changes: the responses of inflation to depreciations we compute should be interpreted as capturing the effects of a combination of shocks that affected the NEER in the estimation sample. In other words, they are averages of the conditional response of inflation to changes in the NEER as a result of a variety of structural shocks that were estimated in reduced form.

² According to the JP Morgan broad nominal trade-weighted exchange rate index as reported by Haver.

5. The results from three different methodologies point to a moderate ERPT of

0.04–0.07 in Colombia (Figure 3).³ This is in line with the estimates from international banks (BBVA and Credit Suisse) and IMF (2016). Rincon and Rodriguez (2015) find an ERPT of 0.04 in a linear VAR model. Earlier studies by Rincon (2000) and Rowland (2003) using mostly pre-inflation-targeting samples find higher ERPT coefficients in the range of 0.1–0.2. The results in this paper are based on two commonly used VAR approaches and a local projections approach to estimate the ERPT.

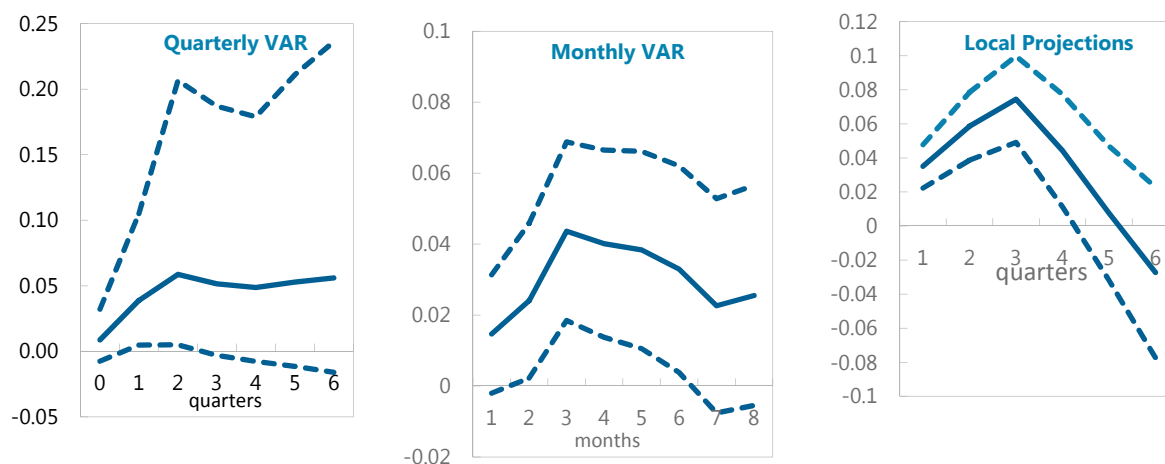
- The first VAR follows the approach of Albalgi and others (2015). We estimate a monthly VAR over 1992–2015 including the IMACO activity index, the y/y change in the NEER, y/y inflation, and the policy rate. The change in the price of oil is included as an exogenous variable. Shocks are identified by a Choleski decomposition according to the exogeneity order above. The estimated ERPT peaks at 0.04 in three months and is significant for up to six months.
- The second VAR approach follows Ca' Zorzi and others (2007). We estimate a quarterly VAR over 2000–15 with oil, output gap, policy rate, q/q NEER, and q/q seasonally-adjusted inflation. Shocks are identified by a Choleski decomposition according to the exogeneity order above.⁴ The estimated ERPT peaks at 0.05 in two quarters.
- The third exercise uses the local projections method by Jorda (2005).⁵ The regressions cover the period 1994–2015 and are based on q/q seasonally-adjusted inflation. In addition to the NEER, we control for two lags of: GDP growth, the policy rate, inflation, and the first principal component of a number of external variables (U.S. growth and policy rate, price of oil, and price of non-fuel commodities). The estimated ERPT peaks at 0.07 in three quarters and is significant for one year.⁶

³ A much simpler measure based on actual data between July 2016 and January 2016 yields a pass-through of 0.042. Over the period, the partial elasticity of the tradable CPI excluding food and regulated items to the NEER weighted by nontraditional trade was 4.2 percent. We are grateful to the authorities for pointing us to this simple and transparent method.

⁴ The results are robust to alternative orderings.

⁵ The local projection method obtains impulse response functions from running a series of linear regressions for k time horizons: $\pi_{t+k} - \pi_t = \beta^k \Delta NEER_t + Controls_t + u_t$. The coefficients $\{\beta^1, \dots, \beta^k\}$ are the impulse response function to a shock to the NEER.

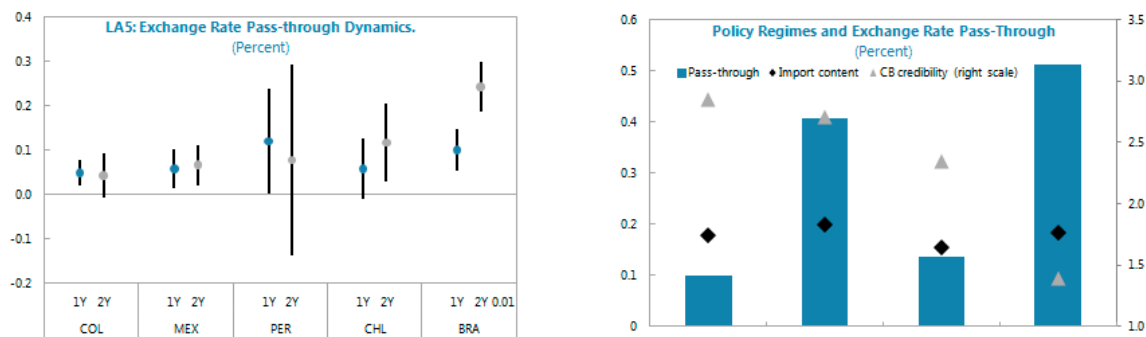
⁶ Structural changes in the period 1992–2015 such as the transition to a currency band in 1992–94 and the flotation of the exchange rate in 1999 could bias the estimates.

Figure 3. Exchange Rate Pass-Through Estimates 1/

Sources: Haver and IMF staff calculations.

1/ Dashed lines indicate 95 percent confidence intervals.

6. Colombia's ERPT is low in regional perspective (Figure 4). IMF (2016) applies a local projections method to estimate the ERPT across Latin America. At the one-year horizon, Colombia's ERPT is the lowest among LA5 countries. In a larger EM sample, they also find that the ERPT is much lower for EMs that target inflation.

Figure 4. Exchange Rate Pass-Through in International Perspective

Source: IMF Western Hemisphere REO, April 2016.

Note: The chart shows the average cumulative exchange rate pass-through to headline consumer prices one and two years after a one-percent increase in the nominal effective exchange rate estimated over [January 2000 and December 2015]. The vertical black lines denote 90 percent confidence intervals

Source: IMF Western Hemisphere REO, April 2016.

Note: The chart shows the average cumulative exchange rate pass-through to headline consumer prices two years after a one-percent increase in the nominal effective exchange rate from panel regressions by group of countries estimated over [January 2003 and December 2015]. "IT" refers to countries with an inflation targeting framework in place; "EME" denotes emerging market economies. "CB credibility" is the average central bank credibility index, as described in Annex 4.1, for each group of countries. "Important content" as defined in figure 4.[4].

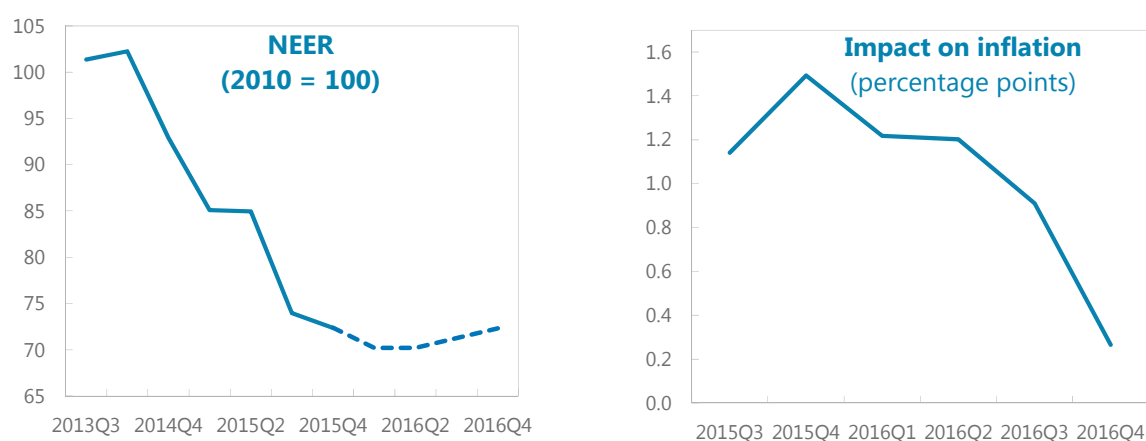
7. The literature suggests the ERPT is higher for large permanent depreciations but also finds that inflation-targeting regimes lower the pass-through. An important issue concerning

the estimation of the ERPT in Colombia is that depreciation spells were minor from 2000 and up until very recently. This raises the possibility that the estimated ERPT is relatively low since domestic prices may be very rigid downwards (i.e., as the currency appreciates and imports get cheaper, domestic prices do not fall and firms' margins increase). Caselli and Roitman (2016) explore the possibility of asymmetric ERPT in a large sample of EMs. They find that the depreciation ERPT is four times larger than the appreciation ERPT. The ERPT is also higher for large and permanent depreciations. Importantly, though, they find that, all else equal, the ERPT is lower in inflation-targeting regimes. Gonzalez and others (2010) study the specific case of Colombia and also find evidence of asymmetric ERPT (higher for depreciations and in periods where inflation is high).

8. Recent work by the Colombian central bank highlights the time-varying nature of the ERPT in Colombia. Rincon-Castro and Rodriguez-Niño (2016) find that the ERPT varies substantially depending on the state of the economy. For instance, the ERPT is higher when inflation is high and volatile or when the exchange-rate appreciation/depreciation accelerates. When exchange rate volatility is low and firms expect depreciations to persist, the ERPT is higher. The authors conclude that a specific policy rule to react to depreciations would be hard to implement since the response of inflation is highly endogenous to economic conditions.

9. Based on the estimated ERPT coefficients, the depreciation contributed around 120 bps to inflation in 2016Q1 but its effects are expected to vanish quickly (Figure 5). Given the actual and projected path of the NEER, the impulse response function derived from the local projections method indicates that the NEER path up until end-2015 would have contributed around 120 bps to inflation in 2016Q1. Going forward, the NEER is projected to appreciate slightly in line with stabilizing oil prices. As the effects of past depreciations fade away, the contribution of the ERPT to inflation is expected to drop sharply in the second half of 2016 and converge to the target band in early 2017.

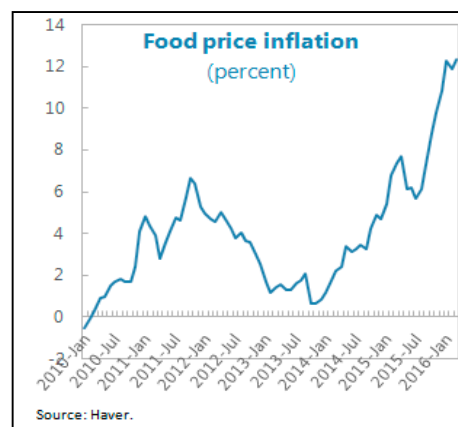
Figure 5. Impact of Depreciation on Inflation



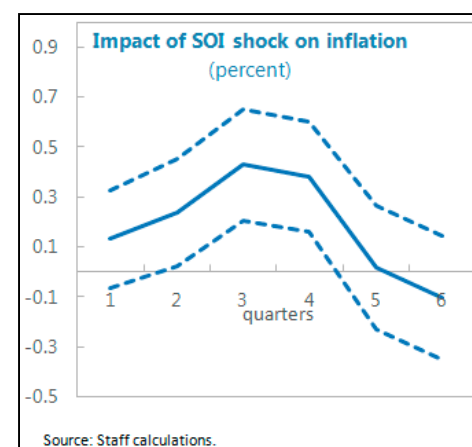
Sources: Haver and IMF staff calculations.

C. El Niño

10. An intense El Niño episode began last year, bringing a severe drought to Colombia and sharply increasing food prices. El Niño is a band of above-average ocean surface temperatures that periodically develops off the Pacific coast of South America, and causes major climatological changes around the world. In Colombia, it results in severe droughts that reduce agricultural production and increase food prices.

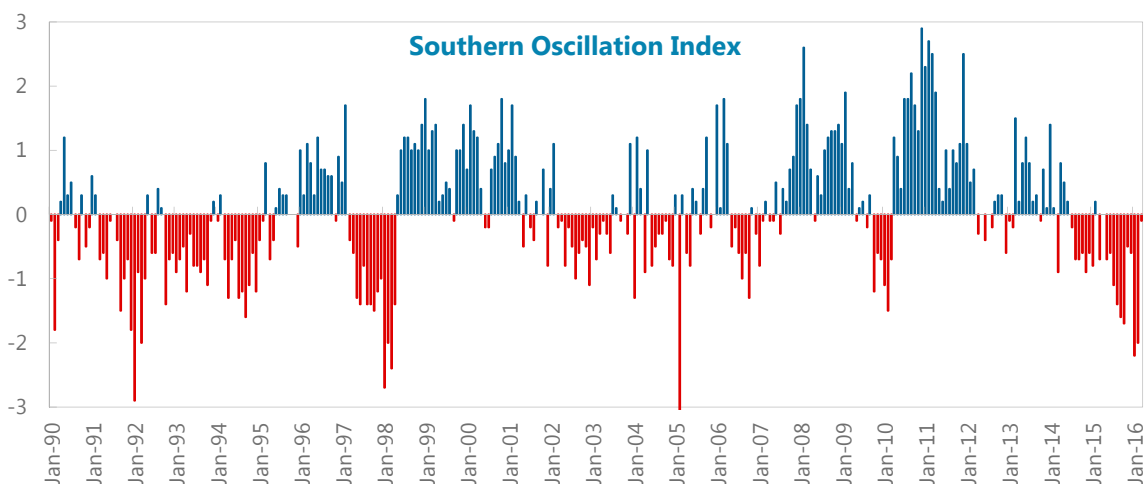


11. Econometric analysis reveals a tight relationship between El Niño episodes and inflation. As in Cashin and others (2015), we use the Southern Oscillation Index (SOI) as a measure of El Niño episodes. The SOI is a standardized index based on the observed sea level pressure differences between Tahiti and Darwin, Australia. The SOI is one measure of the large-scale fluctuations in air pressure occurring between the western and eastern tropical Pacific during El Niño episodes. SOI values persistently below -1 indicate a high likelihood of El Niño. We estimate the impact of the SOI on Colombian inflation using the local projections method. We model y/y quarterly inflation as a function of the SOI and lags of the NEER and wages. A negative one-standard deviation shock to the SOI has an impact on inflation lasting four quarters. The magnitude of the effect is within the range estimated by Cashin and others (2015), who use a GVAR framework with 21 countries (not including Colombia).



12. The current El Niño episode may be contributing 125–200 bps to inflation. The SOI reached persistently negative values starting in mid-2015 (Figure 6). The impulse response function estimated above indicates that the SOI path in 2015 added 125bps to inflation in 2015. A simpler econometric approach where y/y inflation is regressed on contemporaneous wage and NEER growth, and the lagged SOI would yield a 200bps impact of El Niño on inflation in 2016Q1. Since El Niño is a highly cyclical phenomenon, its influence on inflation is very likely to vanish in the second half of 2016.

Figure 6. Southern Oscillation Index



Source: National Center for Environmental Information.

D. Wages and Indexation

13. The 7 percent increase in the minimum salary in 2016 and the existence of indexation mechanisms may be other relevant drivers of inflation. A number of services such as education, health, and rents are indexed to inflation and could prolong the inflationary spell Colombia is experiencing. The increase in the regulated goods CPI in January-February is consistent with the idea that indexation is exerting some pressure on inflation.

14. There is no clear correlation between average wages in the economy and the minimum wage. Since 2005, average wages in the retail and industrial sectors have often grown less than the statutory minimum wage increase, making it difficult to establish a simple link between the minimum wage, average wages, and inflation dynamics. This section attempts to estimate such a possible link more systematically.

Figure 7. Regulated Goods Inflation and Wages

15. In the inflation-targeting period wages do not appear to be a significant driver of inflation but other indexation mechanisms may be at work. The role of wages is explored estimating a stylized mark-up model (Brouwer and Ericsson 1998, Goodfriend 1997). In the mark-up model inflation is a function of domestic costs and the cost of imported inputs. The former is captured by wages and the latter by the NEER. In the model, the following relationship can be derived

$$\Delta\pi = \alpha\Delta w + (1 - \alpha)\Delta NEER$$

where $\Delta\pi$ is y/y inflation, Δw is y/y industrial wage growth, and $\Delta NEER$ is the y/y percent change in the NEER. We estimate the equation at quarterly frequency for the inflation-targeting period and a longer sample covering the period 1990–2015. Wages are not significant in the inflation-targeting period but they do play a role in the longer sample (Table 1). The ERPT implied by this model in the inflation-targeting period is statistically significant and of similar magnitude to the estimates in the previous section. The results should be interpreted with caution since the model does not include a variable to measure real economic activity and does not allow for a lag structure.

Table 1. Stylized Mark-Up Model

	Full sample	IT period
Wages	1.11***	-0.20
NEER	-0.10**	-0.05***
R ²	0.21	0.36
Obs	96	64

16. Inflation expectations play a key role in explaining the behavior of inflation in Colombia. An ad-hoc augmentation of the mark-up model with inflation expectations measures has significant explanatory power (Table 2). In column (1), inflation at time t is explained by 12-month ahead inflation expectations at time $t-4$. Column (2) uses expectations at $t-1$ to explain inflation at time t . The results underscore the importance of inflation expectations as an input to the monetary policy process.

Table 2. The Role of Inflation Expectations

	(1)	(2)
NEER	-0.048**	-0.048***
Expectations _{$t-4$}	0.786***	
Expectations _{$t-1$}		1.400***
R ²	0.23	0.64
Obs	45	48

E. Conclusion

17. Inflation rose sharply in 2015 and remained at 8 percent in March. 24-month-ahead inflation expectations are within the central bank's target band (2–4 percent) but 12-month ahead expectations are not. Market-based expectations are also above the target band. In response, the central bank initiated a tightening cycle that brought the policy rate to 6.5 percent in March, up from 4.50 percent a year earlier. Their objective is to ensure the convergence of inflation to the target band in 2017 and reduce the current account deficit. The central bank raised rates weighing continued price pressures and the activation of indexation mechanisms against the risk of a more pronounced slowdown in domestic demand.

18. The pass-through from exchange rate depreciation and El Niño episode are adding up to 320 bps to inflation, albeit on a temporary basis. Staff estimates indicate that the sharp depreciation in 2015 contributed around 120bps to inflation in the first quarter of 2016. As the exchange rate bottoms out in the course of 2016 in line with stabilizing oil prices, its impact on inflation is expected to recede quickly. El Niño is exerting pressure on food prices, with an estimated impact on headline inflation of 125–200bps. Food prices are expected to fall sharply when the wet season begins in the second half of the year.

19. Indexation mechanisms may amplify inflationary shocks but under staff's projections inflation is expected to start declining in the second half of 2016 and converge to the target band next year. There is no evidence of a strong link between minimum wage increases and inflation but indexation mechanisms for a number of items such as health services are increasing the CPI early in the year with persistent effects on projected inflation rates in coming months. The persistence of the depreciation shock may also affect the prices of nontradable goods and inflation expectations. Nevertheless, staff projects inflation to gradually converge to the target band as a result of tighter monetary policy and declining price pressures from depreciation and El Niño.

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