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FISCAL MULTIPLIERS IN MEXICO[1]

As fiscal consolidation begins in Mexico, the question of the size of fiscal multipliers becomes highly relevant. Estimates of fiscal multipliers—obtained from state-level spending—fall within 0.6–0.7 after accounting for dynamic effects. However, the size of multipliers varies with the output gap. Point estimates for the cumulative multiplier can exceed one when the output gap is sufficiently negative, while they decline and even turn statistically insignificant when the output gap is above 0.5 percent. The planned fiscal consolidation—under the estimated multipliers—is projected to subtract on average ½ percentage points from growth over 2015–2020. However, there are offsetting effects. The consolidation is partly a consequence of lower oil prices, which have helped bring down electricity prices. The positive growth impulse of lower costs on manufactured goods production is estimated to reach ½ percentage point in 2015 and 2016, largely offsetting the impact of fiscal consolidation on growth in the near term.

A. Inferring Fiscal Multipliers from State-Level Public Spending

1. Mexico established the Fiscal Coordination System (FCS) in 1980 with the main goal of harmonizing public finances. Each state signed agreements with the treasury of the Federation adhering to the FCS. Adherence implied that the states would get a share in revenues collected by the Federal Government—"Participaciones"—in exchange for eliminating or suspending local taxes that were deemed incompatible with the newly created VAT. In 1997, Mexico expanded the system of federal transfers to accommodate a de-centralization of federal activities, including in the areas of basic education, health, social infrastructure, and security. These decentralized responsibilities are financed through a system of earmarked transfers—"Aportaciones"—to states and municipalities.

2. After the FCS, Federal transfers have represented a large fraction of state-level fiscal revenues—about 90 percent over the last two decades--and are therefore little influenced by local economic conditions. This institutional setting allows the estimation of fiscal multipliers with reduced concerns about reverse causality—by which causality would go from growth to spending and not the other way around—often an important econometric obstacle.[2] This is confirmed in simple correlations between the real growth in total revenues with state real GDP growth, which are statistically insignificant.

[1] Prepared by Fabian Valencia. The author thanks Ivan Arias, Marcos Chamon, Alex Klemm, Dora Iakova, Petia Topalova, and seminar participants at the Mexican Ministry of Finance and the Central Bank of Mexico for insightful comments and suggestions and Alexander Herman for outstanding research assistance.

[2] Blanchard and Perotti (2002) argued that when using annual data, it is more likely to run into reverse causality concerns because discretionary spending has had time to adjust to changes in real GDP growth. If this is the case, fiscal revenues at the state level would be correlated with local economic conditions—so that expenditures adjust in anticipation to higher revenues derived from better economic conditions. However, weak historical correlations between state fiscal revenues and local real GDP growth reduce concerns about this problem.

Correlation Matrix Between State-Level Fiscal Revenues and Economic Conditions

	Real growth in total revenues	Real growth in total revenues (demeaned)
State real GDP growth (demeaned)	-0.004	0.013
	(0.927)	(0.741)
Lagged State real GDP growth	-0.003	0.0144
	(0.934)	(0.727)

Source: IMF staff calculations.
Note: pairwise correlations between the real rate of growth of the column variable with the row variable. P-values in parenthesis.

3. The methodology involves estimating panel regressions relating state-level real GDP growth and real growth of public spending. Stronger economic activity at the national level and any other common factor are controlled for through a time fixed effect while time-invariant state characteristics are controlled for through state fixed effects. The estimation equation is the following:

$$\Delta y_{i,t} = \alpha_0 + \alpha_1 \Delta y_{i,t-1} + \alpha_2 \Delta g_{i,t} + TIME + \sigma_i + \mu_{i,t},$$

where $y_{i,t}$ denotes the natural logarithm of real GDP in state i in year t; $g_{i,t}$ denotes the natural logarithm of real public expenditures in state i in year t, deflated by the state GDP deflator; TIME denotes time fixed effects; σ_i denotes state fixed effects; and Δ denotes the first difference of the corresponding variable. The sample covers annual data over 1994–2013 for 31 states and the Federal District.[3]

4. The methodology leaves some simultaneity concerns unaddressed, possibly biasing estimates downwards. For instance, natural disasters could cause both lower GDP growth and higher spending in reconstruction in the same year. This would bias estimates of the contemporaneous multiplier downwards because spending increases in the same year that growth declines. Estimates resulting from the methodology employed here should then be interpreted as a lower bound of fiscal multipliers for Mexico.

B. Estimation Results

5. Estimates of the contemporaneous multiplier fall in the 0.5–0.6 range while the cumulative multiplier rises up to 0.7 after accounting for dynamic effects. The table shows the estimated coefficient on fiscal expenditure growth. To recover the multiplier—defined as the percent increase in output per one-percent-of-GDP increase in public spending—it is necessary to adjust the

[3] The data on state-level public expenditures comes from INEGI and exclude debt service.

coefficient for the share of public spending in GDP.[4] The adjustment leads to a contemporaneous multiplier between 0.5 and 0.6, with the cumulative multiplier peaking between 0.6 and 0.7 by the third year after accounting for dynamic effects—small autoregressive coefficients imply negligible effects after the third year. The table shows stable coefficients under different specifications—including when the sample is restricted to after 2003, when a new system of national accounts was introduced.

Baseline Results

	(1)	(2)	(3)	(4)	(5)
Dep. Variable: $\Delta y_{i,t}$	Sample period: 1994-2013				2003-2013
	Fixed Effects		GMM		
$\Delta y_{i,t-1}$	0.158	0.121	0.115	0.116	0.169
	(0.070)**	(0.047)***	(0.049)**	(0.048)**	(0.060)***
$\Delta y_{i,t-2}$				0.060	
				(0.044)	
$\Delta g_{i,t}$	0.039	0.046	0.046	0.042	0.035
	(0.010)***	(0.010)***	(0.012)***	(0.012)***	(0.014)**
$\Delta g_{i,t-1}$			0.008	0.014	
			(0.015)	(0.014)	
α_0	0.039	0.050	-0.082	0.007	-0.001
	(0.009)***	(0.006)***	(0.015)***	(0.004)*	(0.004)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Fiscal multiplier 1/					
Contemporaneous	**0.53**	**0.62**	**0.62**	**0.57**	**0.47**
Cumulative (t,t+3)	**0.63**	**0.71**	**0.70**	**0.64**	**0.57**
R^2	0.73				
N	551	532	551	522	308

Source: IMF staff calculations.
Note: Column 1 reports fixed effects regressions. Columns (2)-(5) report GMM regressions using Blundell and Bond (1998) estimator. * p<0.1; ** p<0.05; *** p<0.01. Robust standard errors in parentheses.
1 / Obtained from multiplying the coefficient on the real growth of fiscal spending by the inverse of the share of fiscal spending in GDP (1/0.074=13.5).

6. The estimated multipliers are within the range of values found in many studies. To put the estimates above into perspective, the table below shows selected studies with the corresponding estimated multipliers. Differences cannot be attributed only to country heterogeneity since endogeneity is dealt with differently across studies. For instance, several of the cited studies focus on defense spending because it is not related to local or national economic conditions to get around the reverse causality problem.

[4] The average value for state fiscal spending in the sample is 7.4 percent of GDP. To obtain the fiscal multiplier, the coefficients must be multiplied by 1/0.074=13.5.

Selected Empirical Estimates of Fiscal Spending Multipliers		
Study	Multiplier estimate	Description
Time-series Studies Based on Defense Spending		
Barro (1984)	≈ 0.6	U.S. defense spending increases in WWI, WWII, Korean War.
Ramey (2011)	0.6-1.2	U.S. defense spending, 1939-2008, short-run versus long-run.
Barro and Redlick (2011)	0.4-0.8	U.S. defense spending, 1917-2006, short- run versus long-run.
Hall (2009)	≈ 0.5	U.S. defense spending, 1930-2008.
Owyang, Ramey, Zubairy (2013)	≈ 0.6-0.9	U.S. (1890-2010) and Canada (1922-2011) defense spending.
Time-series Studies Based on Aggregate Spending		
Blanchard and Perotti (2002)	0.6-1.8 (peak)	U.S. government expenditure over 1947-1997.
Auerbach and Gorodnichenko (2012)	-0.33 (cumulative, expansion) 2.24 (cumulative, recession)	U.S. government expenditure over 1947-2008
Panel-data or Cross-sectional Studies		
Kraay (2014)	0.5-0.7	Uses timing of World Bank loan disbursements to 29 developing countries, 1985-2009, short-run.
Nakamura and Steinsson (2014)	≈ 1.5	U.S. defense spending across U.S. states, 1966-2006, responses of state real GDP over two years.
Blanchard and Leigh (2013)	>=0.8 Europe 0.5-1 advanced economies	Fraction of growth forecasts errors explained by change in fiscal stance.

C. State-Dependent Fiscal Multipliers

7. Multipliers can exceed one when the output gap is sufficiently negative, but can turn statistically insignificant when the output gap is positive. Consistent with findings in the academic literature—for instance, Auerbach and Gorodnichenko (2012)—the multipliers in Mexico can vary depending on the level of the output gap.[5] The table below shows the baseline regression augmented with the interaction between the lagged output gap at the state level[6] (column 1) and at the national level (column 2) with the real growth of public spending. The coefficient on the interaction in both regressions is negative and statistically significant, implying that the more positive the output gap, the lower the fiscal multiplier, and viceversa. The point estimate for the contemporaneous multiplier—shown graphically below— is around 1 for values of the output gap between -2 and -1 percent of potential output, around 0.5 for values of the output gap closer to

[5] One of the arguments for the multiplier to vary over the business cycle is the presence of excess capacity during downturns which reduces the crowding out of private investment following a government spending shock. To mitigate reverse causality concerns derived from the endogeneity of the output gap—as argued by Baum and others, 2012—we include in the regression the lag of the output gap at the state level, but also check if the results hold when the national output gap is included, which is much less likely to drive state level fiscal spending.

[6] Output gaps at the state level are computing using the HP-filter, applying the same smoothing coefficient to all the series.

zero, and statistically insignificantly different from zero when the output gap is 0.5 percent or larger. The cumulative multiplier shows a similar pattern, with point estimates of up to 1.5 when the output gap is -2 percent—although not statistically significantly different from one.

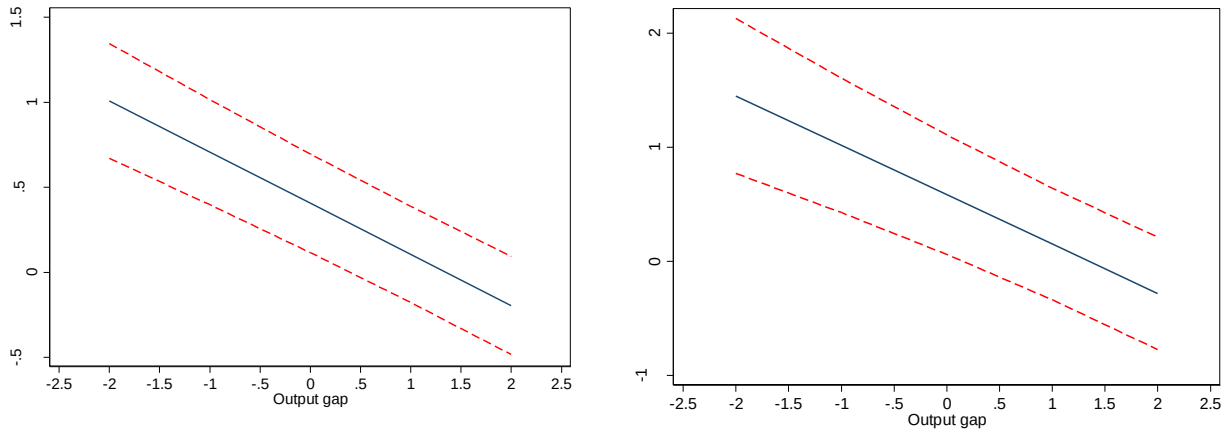
State-Dependent Regressions

	GMM	
Dep. Variable: $\Delta y_{i,t}$	$\tilde{y}$ =State output gap	$\tilde{y}$ =National output gap
$\Delta y_{i,t-1}$	0.311	0.130
	(0.048)***	(0.049)***
$\Delta g_{i,t}$	0.030	0.027
	(0.013)**	(0.013)**
$\Delta g_{i,t} * \tilde{y}_{i,t-1}$	-0.022	-0.004
	(0.003)***	(0.002)**
α_0	-0.032	-0.108
	(0.010)***	(0.014)***
Time fixed effects	Yes	Yes
N	532	532

Source: IMF staff calculations.
Note: GMM regressions using Blundell and Bond (1998) estimator. * p<0.1; ** p<0.05; *** p<0.01. Robust standard errors in parenthesis.

Contemporaneous and Cumulative State-Dependent Fiscal Multipliers

a) Contemporaneous multiplier **b) Cumulative over t-t+3**



Source: IMF staff calculations.
Note: Multipliers are constructed using the regression with state-level output gaps interacted with changes in real public expenditure, after adjusting the regression coefficients for the share of public spending in GDP. 95-percent confidence bands are shown in red (dashed lines).

D. Growth Implications from the Fiscal Consolidation

8. The planned fiscal consolidation would subtract from growth close to ½ percentage points over 2015–2020 on average. For 2015, the projected reduction of ½ percent of GDP in the PSBR stems in part from a better-than-expected yield of the 2013 tax reform, which should have only a marginal impact on growth as its effect on private investment and consumption decisions

must have taken place before 2015. The negative growth impulse for 2015–16 is related to the significant compression of primary expenditure in these years. The drag on growth, however, should diminish over the medium term, as reductions in spending moderate and the output gap closes.

9. As consolidation is in part driven by lower oil prices, its impact on growth is largely offset by the positive effects of lower energy costs on manufacturing production. Lower oil and natural gas prices heavily influence electricity prices for industrial users in Mexico as about 70 percent of electricity generation relies on natural gas and oil derivatives. In turn, lower electricity prices stimulate manufacturing production (Alvarez and Valencia, 2015). Empirical estimates of the elasticity of manufacturing production to electricity prices are around -0.3. The observed decline in electricity prices (on average close to 25 percent for industrial users by mid-2015 relative to one year earlier) imply a boost to overall GDP growth of close to 0.6 percent in 2015 and 2016. This impulse would largely offset the near-term growth effect of fiscal consolidation.

E. Conclusions

10. The estimated fiscal multipliers, and the positive impulse from manufacturing from lower energy prices, imply manageable effects on growth from fiscal consolidation. Accounting for state-dependent multipliers, fiscal consolidation would subtract on average about ½ percent from growth per year over 2015–2020. However, there are mitigating factors. Lower oil prices—an important driver of the required fiscal consolidation—have positive effects on manufacturing production through lower electricity prices. In the near term, this positive impulse would largely offset the effects of fiscal consolidation on growth. In addition, the fiscal consolidation would ensure a sustainable path for public debt and would help support investor confidence, which will also have a positive impact on growth.

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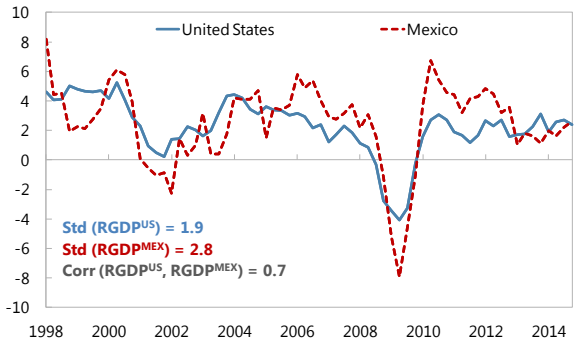
TRADE AND FINANCIAL SPILLOVERS TO MEXICO[1]

Economic activity in emerging markets has slowed down in recent years, which has been partly attributed to less favorable external conditions. For Mexico, close linkages with the U.S. has benefited Mexico over the years, but also exposes the country to fluctuations in U.S. economic activity and changes in U.S. monetary conditions. Moreover, the open capital account and large foreign holdings of Mexican assets expose Mexico also to financial spillovers, including the possibility of abrupt changes in capital flows. A Structural Bayesian VAR analysis for the period of 2001Q3–2015Q2 suggest that while increases in U.S. growth are transmitted over one-for-one to Mexico (a cumulative impact of 1.22 percent after 8 quarters), an increase in emerging market risk premiums are transmitted less than one-for-one (a cumulative impact of -0.65 percent after 8 quarters). The results suggest that Mexico could outgrow a negative shift in market sentiment toward emerging markets if accompanied by a pickup in US growth. Moreover, by using a decomposition of the U.S. long-term interest rates we find that a rise in U.S. bond yields that is not accompanied by higher U.S. growth has a negative effect on Mexico's output.

A. Introduction

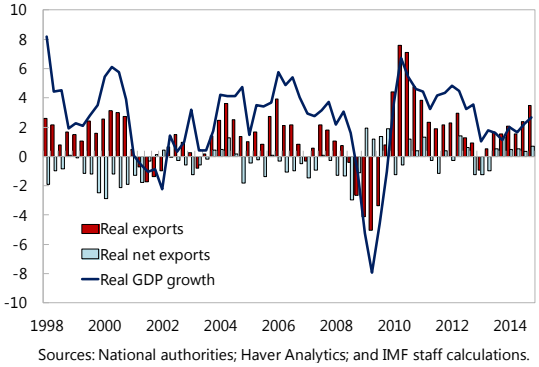
1. Mexico has close trade and financial ties with the global economy, and especially with the United States. The U.S. is by far the largest recipient of Mexico's manufacturing and agricultural exports, and is also the main source of portfolio and foreign direct investment flows to Mexico, possibly explaining the close correlation of the business cycles of the two economies. Export growth has been a key driver of economic activity in Mexico, with significant spillovers to domestic demand. Focusing on financial linkages, international investors held about half of total government debt in mid-2015 (including 36 percent of local-currency government bonds), as well as a large share of corporate bond debt. Mexico's gross portfolio investment liabilities account for 37 percent of GDP, of which 25 percent of GDP are debt securities.

U.S. and Mexico Real GDP Growth
(In percent)



Sources: National Authorities; and IMF staff calculations

Contribution to Real GDP Growth
(In percent)



Sources: National authorities; Haver Analytics; and IMF staff calculations.

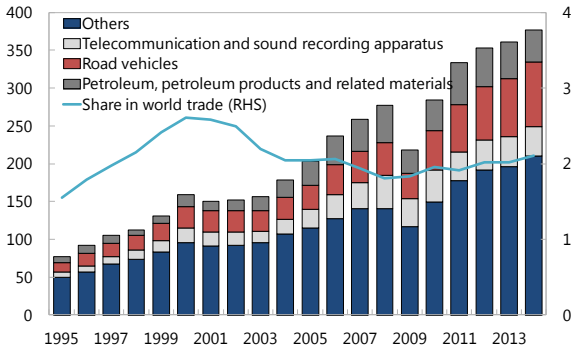
[1] Prepared by Juliana D. Araujo and Alexander Klemm. The authors thank Dora Iakova and Fabian Valencia for valuable comments and suggestions and Alexander Herman for outstanding research assistance.

2. This study quantifies the spillover effects of external shocks on Mexico's economic activity. The next two sections describe in more detail the trade and financial linkages between Mexico and the United States. After that, a Bayesian vector autoregression is estimated to evaluate the impact of external shocks (real and financial) on Mexico's GDP and other domestic variables. Finally, the paper uses a decomposition of the drivers of changes in U.S. long-term interest rates into real, monetary, and risk shocks, and looks at the differential effects of these shocks on Mexico's growth and long-term interest rates.

B. Trade Linkages

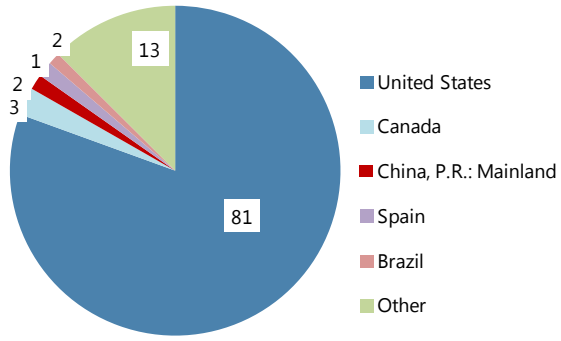
3. Since the signing of the North American Free Trade Agreement (NAFTA) in 1994, Mexican exports have increased nearly fivefold. The automobile industry and the telecommunication sector accounted for a large part of the expansion. Mexico's share of world exports also increased somewhat after NAFTA, and has stabilized around 2 percent more recently. The U.S. remains Mexico's main trading partner, accounting for 80.5 percent of total exports. Canada accounts for 2.7 percent, and the next three largest partners, Spain, China, and Brazil account for about 1½ percent each.

Total Exports of Goods
(USD, billion)

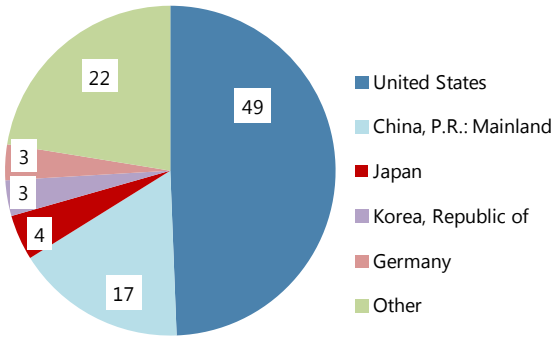


Sources: UNCOMTRADE; and IMF staff calculations.

Total Exports by Destination, 2014
(In percent of total)



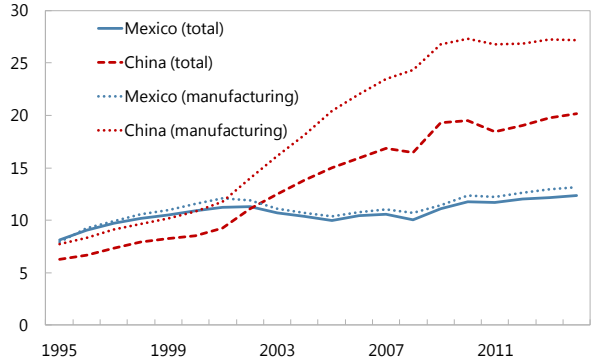
Total Imports by Origin, 2014
(In percent of total)



Source: Direction of Trade Statistics; and IMF staff calculations.

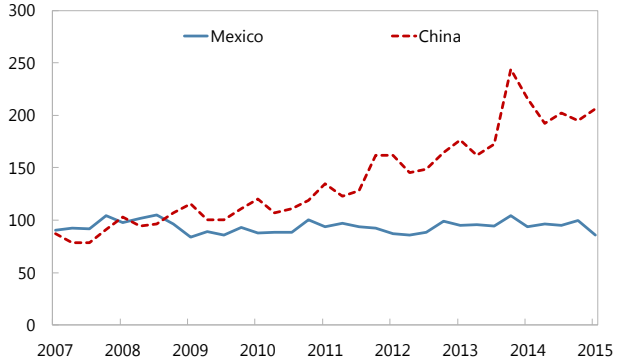
4. Mexico's total share in the U.S. market has been stable at around 10 percent. There has been a temporary decline in the early to mid-2000s, when China started gaining market share in the U.S. after entering the World Trade Organization (Chiquiar, Fragoso and Ramos-Francia, 2008). However, Mexico has regained market share in recent years, partly due to changes in relative labor costs in favor of Mexico.

U.S. Trading Partners
(Share of U.S. imports)



Sources: UNCOMTRADE and IMF staff calculations.

Unit Labor Cost
(Index, 2008=100)



Sources: National authorities; Haver Analytics; and IMF staff calculations.

5. Industrial production has been very highly correlated with the United States, reflecting Mexico's integration in the North American production value chains. The detailed breakdown of sectors suggests strong integration in manufacturing production, and especially in chemicals and machinery. Bank of Mexico (2015) shows high correlation between Mexican exports and U.S. industrial production. Moreover, the analysis shows that Mexican and American industrial production are cointegrated and follow a common cycle.

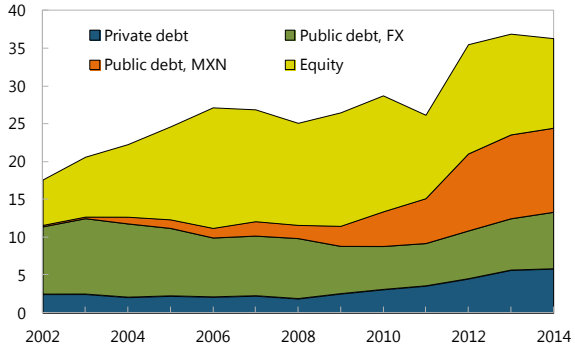
Mexico and U.S. Industrial Production

Sector	Correlation
Total	**0.94**
Mining	**-0.25**
Utilities	**0.89**
Electric power	0.90
Manufacturing	**0.93**
Paper	-0.85
Printing	-0.38
Petroleum and coal	0.66
Chemical	0.88
Plastics and rubber	0.30
Nonmetallic minerals	0.01
Primary metal	0.47
Fabricated metals	0.64
Machinery	0.73
Computer and electronics	0.26
Electrical equipment and appliances	0.00
Furniture	0.34

C. Financial Linkages

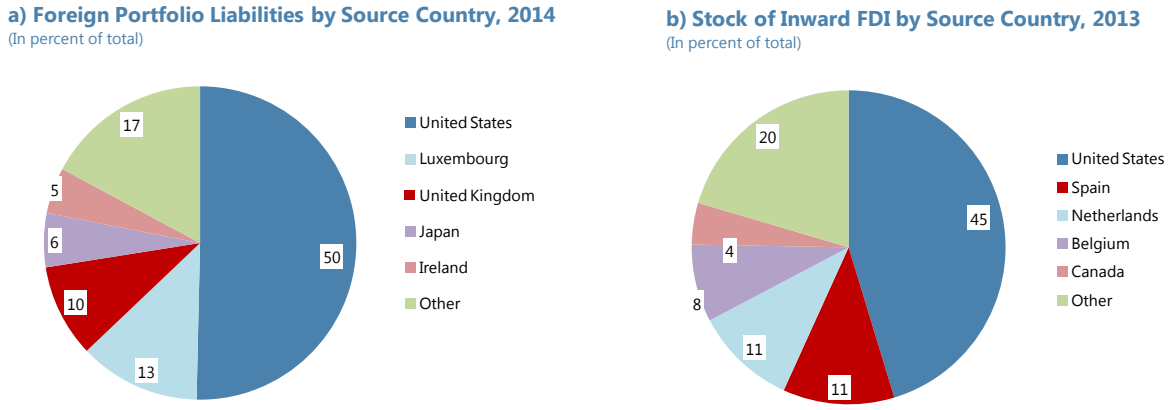
6. Foreign portfolio liabilities have risen steadily over the years. The greatest increase in foreign holding occurred in domestic peso-denominated bonds, of which nonresidents now hold about 11 percent of GDP (USD 144 billion). There has also been an increase in private sector bonds issued abroad from 2.5 percent of GDP in 2002 to 5.8 percent of GDP (USD 75 billion) in 2014. To some extent this reflects a substitution of external loans by bond debt, as total private sector debt rose more slowly from 8.7 percent of GDP in 2002 to 10.5 percent in 2014. Nonresident holdings of Mexican equity also doubled since 2002, reaching almost 12 percent of GDP in 2014. About half of foreign portfolio and direct investment liabilities are held by U.S. investors.

Nonresidents' Holdings of Portfolio Liabilities
(In percent of GDP)



Sources: National authorities; and IMF staff calculations.

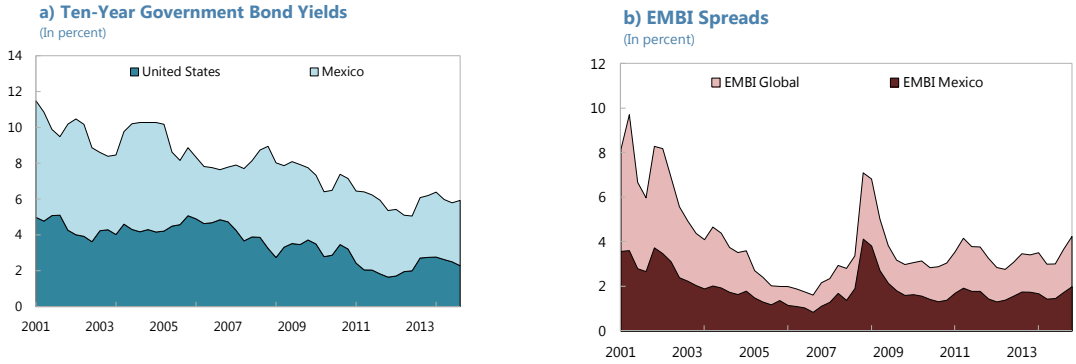
Foreign Liabilities



Sources: Coordinated Portfolio Investment Survey (2014); and Coordinated Direct Investment Survey (2013).

7. Mexican long-term interest rates and spread dynamics are influenced significantly by external developments. Long-term yields on 10-year domestic-currency government bonds in Mexico have fallen from 11 ½ in 2001 to around 6 percent by mid-2013. During this period, U.S. yields also dropped from around 5 ½ percent to 3 ½ percent.[2] Nonetheless, since mid-2013, while U.S. yields continued to drop, Mexican yields rose, in part as global attitudes to risk, as approximated by EMBI global spreads, affected also Mexico's risk spreads.

Bond Yields and Spreads



Sources: Bloomberg L.P.; Haver Analytics; and IMF staff calculations.

8. Mexican interest rates react strongly to changes in U.S. rates.

- The 2014 Article IV Report on Mexico presented results from a vector error correction model, suggesting that changes in long-term U.S. interest rates transmit more than one-to-one to Mexican domestic sovereign bond yields. A 100-basis point shock to 10-year U.S. rates boosts

[2] While higher U.S. rates have coincided with wider spreads on foreign-currency debt in EMs (Arora and Cerisola (2001), Uribe and Yue (2006)), increased foreign investment in local bond markets could have contributed to greater linkages between U.S. and domestic yields in Mexico (see next paragraph for a discussion).

Mexican yields by 140 basis points. A variance decomposition analysis shows that 50 percent of fluctuations in Mexico's 10-year yields are explained by innovations in U.S. rates.

- The IMF's 2015 Spillover Report shows more generally that U.S. (and euro area) monetary developments affect bond yields elsewhere. In case of pure monetary shocks, a 100-basis point increase in U.S. interest rates leads to a rise by about 30 basis points in emerging markets and non-systemic advanced economies interest rate after three months, combined with a small capital outflow. An interest rate increase that occurs as a result of stronger U.S. growth would boost yields in emerging markets and non-systemic advanced economies by about 40 basis points. In this case, however, it would be accompanied by capital inflows.

- The IMF's 2014 Regional Economic Outlook for the Western Hemisphere finds that on average increases in U.S. rate boost yields by about half as much, although spillovers can be much larger than one-to-one during exceptional times. This occurred, for example, following the taper tantrum episode, which occurred when interest rate where at all-time lows in many countries and suddenly snapped up. In the specific case of Mexico, yields rose by about 200 basis points, and more than half of the increase appears to be the result of a reaction to the U.S. monetary shock. Moreover, the report shows using a full-fledged macro model, that a positive U.S. growth shock would have a positive impact on Mexican GDP, even if there is a simultaneous increase in emerging market risk premiums.

- Ebeke and Kyobe (2015) consider the impact of U.S. rates on emerging markets depending on the participation of foreign investors in local government bond markets. They find that if foreign holdings exceed 35 percent of the market—as is the case in Mexico—the transmission of a 100-basis point shock to U.S. rates is amplified and results in a rise in emerging market yields of 140 basis points (compared to just 40 basis points for countries where foreign ownership is below the 35 percent threshold).

D. The Impact of Foreign and Domestic Factors on GDP

9. A structural BVAR is estimated to quantify the size of growth spillovers and the impact on various transmission channels (trade and financial). Following the approach used in WEO April 2014 (Chapter 4), this allows an estimation of the domestic and external factors in explaining output growth. The Bayesian VAR approach is particularly suited, because it allows the handling of a large number of variables and lags in a relatively small sample. The sample covers the quarters from 2001Q3 to 2015Q2.

10. External variables aim to capture key external shocks to the Mexican economy while domestic variables aim to capture the transmission mechanisms. External variables include the U.S real GDP growth, the 10-year U.S Treasury bond rate, and the composite emerging market economy bond spread (J.P Morgan Emerging Market Bond Index (EMBI)). As domestic variables, we consider Mexican real GDP growth, real exports, the rate of change of the real exchange rate against the U.S. dollar, ten-year local-currency sovereign bond spreads and gross portfolio inflows as a

share of GDP. The inclusion of domestic ten-year spreads constrains the starting point of the analysis as Mexican Bonos were first issued in July 2001.

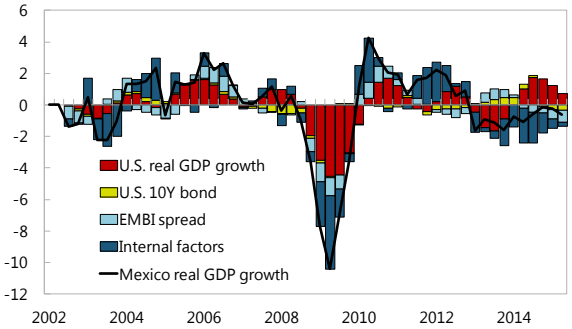
11. The SBVAR is identified using the Cholesky decomposition. The ordering of the endogenous variables y_t follow:

$$y_t = [\Delta y_t^{US}, i_t^{US}, EMBI_t][\Delta ex_t^{MEX}, \Delta y_t^{MEX}, pf_t^{MEX}, RER_t, i_t^{MEX}] \quad (1)$$

The first three variables constitute the external block and the remaining variables the domestic block. The external variables are assumed to not respond to the internal variables contemporaneously. All variables enter the model with four lags.[3]

12. A historical decomposition of real GDP suggests that external factors explained more than 2/3 of the sharp dip in Mexico's growth during the global financial crisis. Given the estimates from the reduced-from VAR, growth can be expressed as the sum of initial conditions and all the structural shocks in the model. The sum of the shocks from the identified external factors provides the contribution of all external factors.[4] A historical decomposition of growth shows how external factors played a large role in explaining the Mexican real GDP growth in the past years (explaining 70 percent of the sharp dip in Mexico's growth during the global financial crisis). The historical decomposition shows the deviation of Mexico's growth from average where the average is computed as quarterly growth for the period of 2001Q3–2015Q2 (2.5 percent). The increase in the contribution of a factor is measured by the change in its level relative to the previous quarter.

Historical Decomposition: Mexico Real GDP Growth
(Deviations from average, in percent)



Source: IMF staff calculations.

13. The role of internal factors has increased over 2013–14. The historical decomposition of real GDP growth also suggests that external factors do not explain the slowdown in domestic growth in recent years (explaining only 20 percent of the overall negative contribution to growth in 2013Q1–2015Q2).[5] This finding suggests that the role of internal factors could have risen in the past

[3] Modified "Minnesota priors" (Litterman, 1986) were used where each variable is assumed to follow a first-order autoregressive process with independent, normally distributed errors and coefficients of 0.8. The relative weight of the prior, as in Sims and Zha (1998), was set to $\left[1 - \frac{(T-p)}{2(kp+1)}\right]$, where T is the number of observations, k is the number of endogenous variables and the p is the lag length.

[4] The remaining shocks are treated as residual and are termed internal. As such, the residual shocks could also partly embody other factors such as common or exogenous shocks (e.g., natural disasters).

[5] By conducting a similar exercise but including U.S. and Mexico Industrial Production instead of real GDP growth, we might better capture trade linkages across both economies. The exercise yields similar qualitative results but it suggests a lower positive contribution of external factors in the last 5 quarters of the sample period (see Appendix I).

two years.[6] Interestingly, this phenomenon seems to be common to other large emerging markets (e.g., Brazil, China, India) where external factors could not account for the slowdown in growth in the recent years (WEO, 1014). Very recently, the negative contribution of external factors to growth started to increase. Moreover, in recent months, a stabilization of oil production has been observed and the construction sector began to recover since the second half of 2014. Thus, in 2015, a faster growth of domestic demand is registered.

14. Increases in U.S. growth are transmitted over one-for-one to Mexico. On impact, a 1 percentage point shock in U.S. growth (equivalent to 1.8 standard deviations) raises Mexican growth by 0.5 percentage point. The cumulative effects remain positive beyond the short term and reach 1.22 after 8 quarters. The result is somewhat in line with the average impact of world growth on Latin America (Osterholm and Zettelmeyer, 2007). Despite a different dynamic, the cumulative impact of an increase in U.S. growth on Mexico is similar to the response of U.S. growth with respect to its own shock, also reflecting the effect of the propagation of the shock through the U.S. economy.

15. Meanwhile, increases in emerging market's risk premia are transmitted less than one-for-one. A 100-basis point increase in the composite EMBI spread (equivalent to 2.2 standard deviations) reduces Mexico's growth by 0.62 on impact**.** The cumulative effects remain negative beyond the short term reaching -0.65 after 8 quarters. The analysis suggest that with a pickup in U.S. growth, Mexico could outgrow the impact of "some" negative shift in market sentiment toward emerging markets.

Impact of External Shock on Domestic Growth

(Percentage points)

		One Percentage Point Shock	
	Response	U.S. Real GDP Growth (1 STD=0.56)	EMBI Spread (1 STD=0.46)
Domestic Real GDP	On Impact	0.50	-0.62
	Average growth (yoy), quarters 1-4	0.94	-0.78
	Average growth (yoy), quarters 5-8	0.28	0.13
	Cumulative impact after 8 quarters	1.22	-0.65

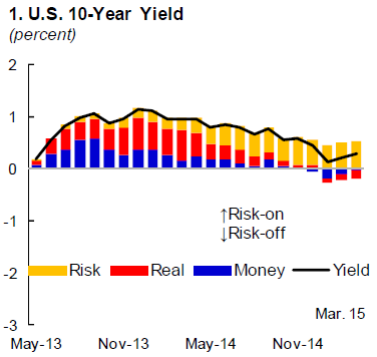
Source: IMF staff calculations.

Note: Impulse Responses.

[6] Some Mexico specific factors that could have helped explain the deceleration in activity, which are expected to revert going forward, include the reduction of oil production in 2013 and 2014 as well as the decrease in housing construction due to financial problems in some housing development companies.

E. A Closer Look at Changes in Monetary Conditions in the U.S.

16. U.S. long-term interest rates reflect the expected path of U.S. monetary policy, expected U.S. economic performance, and general risk attitudes. Each of these components may affect Mexico differently; therefore, we consider a decomposition of the U.S. 10-year bond yield into real, monetary, and risk shocks following Buitron and Vesperoni (2015), which allows the identification of these shocks controlling for changes in risk-appetite.[7]



Source: Buitron and Vesperoni (2015).

17. The role of money shocks in explaining U.S. 10-year bond yield, which peaked after the taper talk, faded by end-2014. The decomposition highlights the relative contribution of money shocks in the aftermath of the taper talk in May 2013. Prospects of a better economic outlook seem to have played a greater role by end-2013 during the subsequent taper announcement (see WEO, 2014).

18. We assess the differential impact of money and real shocks in economic activity and financial variables. The model described above is estimated now considering the following external variables—real shocks, money shocks, VIX—while keeping the same set of domestic variables.[8]

19. U.S. monetary policy shocks spill over into Mexican yields and initially dampen Mexican growth, while U.S. real shocks are positive for Mexican growth and have a smaller impact on yields. Figure 1 shows the responses of a 100-bps increase in the U.S. bond yield, with the red (blue) line displaying the impact of real (money) shocks. Unexpected stronger economic prospects in the U.S. associated with an increase in the U.S. yield leads to higher spreads and improved economic activity. The shocks also boost investors' risk-appetite, which causes capital to flow to Mexico and the currency to appreciate in real terms. Money shocks are followed by higher domestic bond spreads in Mexico, a (small) real depreciation of the currency, a decrease in gross portfolio inflows, and lower real GDP growth.

F. Conclusions

20. External factors played an important role in driving the drop in growth during the global financial crises but less so in recent years. Shocks idiosyncratic to Mexico during 2013–14,

[7] Here we focus on the impact of changes in monetary conditions in the U.S. although euro area shocks are also computed. In a first stage, stock prices and bond yields in the U.S. are stripped out from risk-appetite shocks measured by the VIX. In a second stage, real and money shocks within the U.S. are identified as in Matheson and Stavrev (2014).

[8] We convert the identified monthly shocks to quarterly frequency by summing the shocks within each quarter. The sample period is 2001Q3-2014Q4.

such as the contraction of construction activity in 2013, and lower oil production, are possible explanations. Looking ahead, Mexico remains well placed to gain from a pickup in U.S. growth.

Figure 1. Mexico: Response to a 100bps Shock in 10-Year U.S. Bond Yield

Source: IMF staff calculations.

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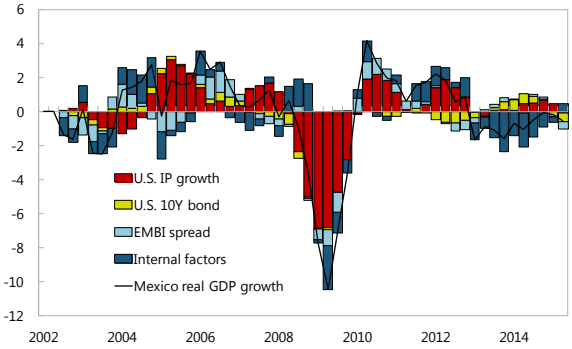
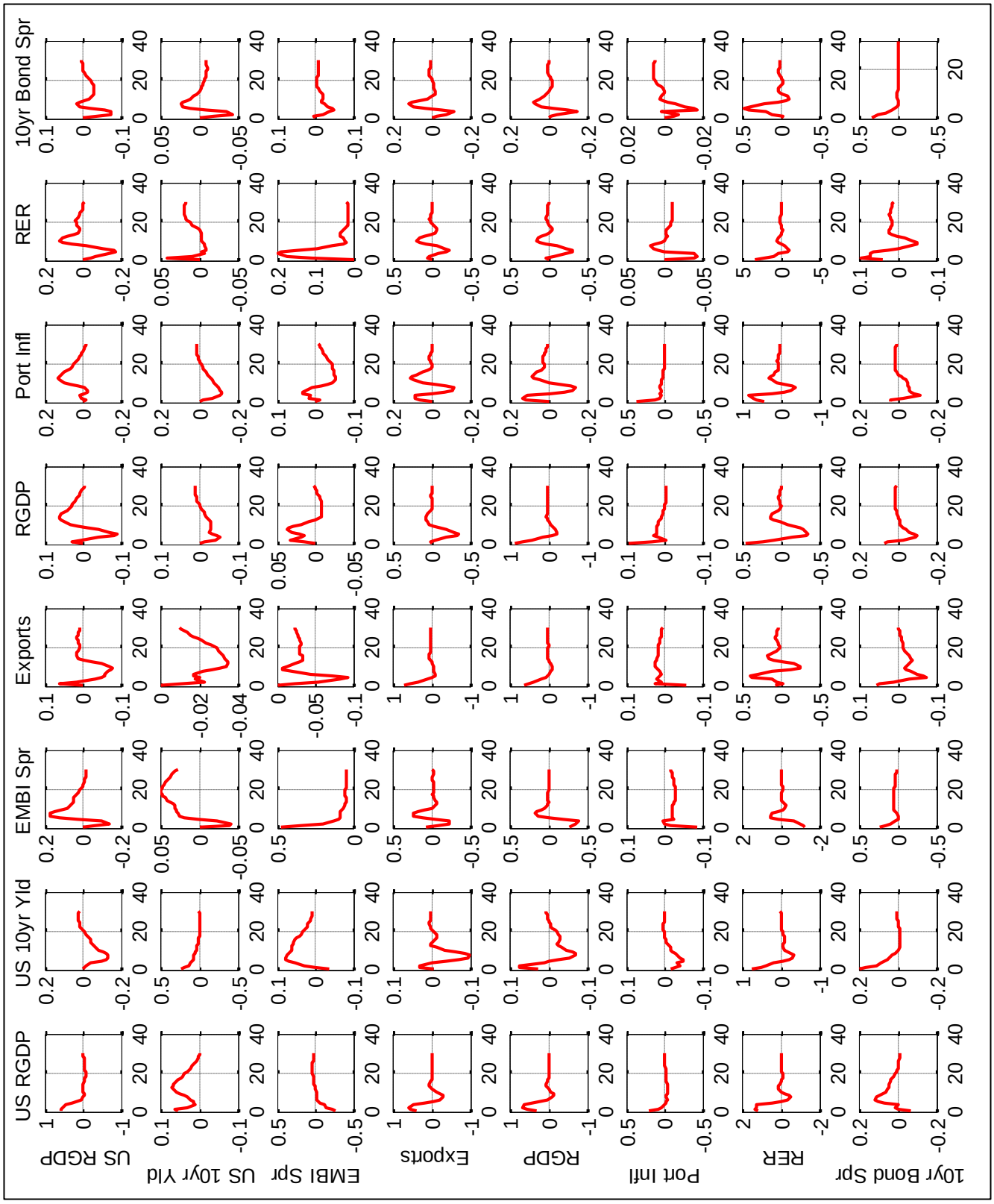
Appendix I. Historical Decomposition of Real GDP Growth (Includes U.S. Industrial Production)

Historical Decomposition: Mexico Real GDP Growth
(Deviations from average, in percent)

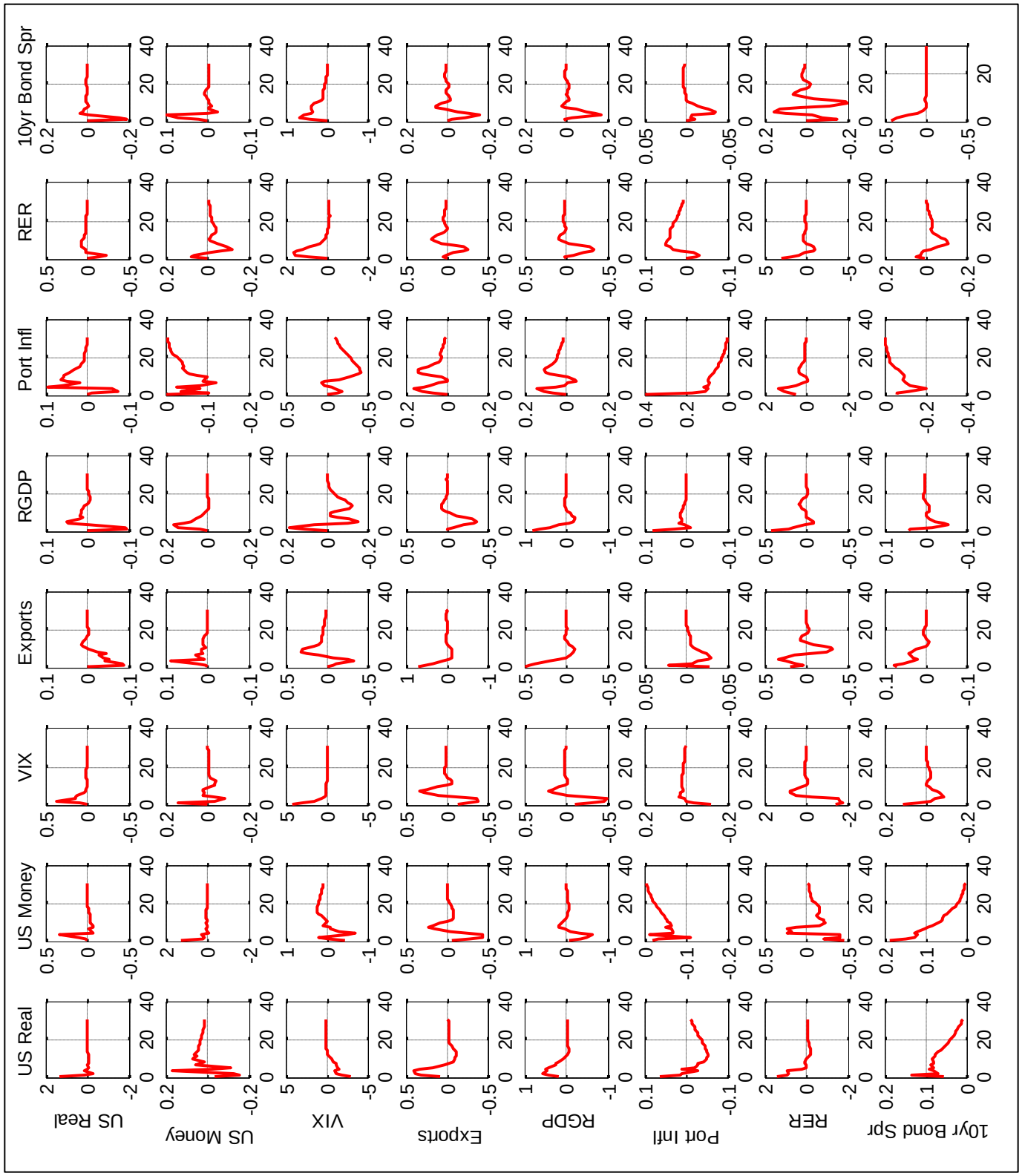


Source: IMF staff calculations.

Appendix II. Impulse Responses (Section D)



Appendix III. Impulse Responses (Section E)



CORPORATE VULNERABILITIES AND IMPACT ON THE REAL ECONOMY[1]

Nonfinancial corporate debt has increased in recent years, supported by easy access to global debt capital markets, ample global liquidity, and low interest rates. While this has contributed to a modest increase in corporate leverage, particularly for large firms, the ratio of corporate debt to GDP at the aggregate level remains low compared to other emerging market countries. Slowing economic growth and external headwinds could weaken firms' debt-servicing ability. However, our sensitivity analysis suggests that most firms have adequate capacity to service debt, even in extreme shocks of a combined 30 percent depreciation in exchange rate, 30 percent increase in borrowing costs, and 20 percent decline in earnings. Banks' buffers are sufficiently strong to withstand any associated rise in defaults. Nonetheless, these shocks could lower real GDP growth by 0.2–0.4 percent through lower corporate investments and bank credit supply.

A. Rising Corporate Debt

1. Nonfinancial corporate debt has increased in recent years. Total corporate debt, including state-owned enterprises, rose from 28 percent of GDP in 2010 to 32 percent of GDP in 2014, a relatively low level compared to other emerging countries (Figure 1). Since the Global Financial Crisis (GFC), easier access to debt capital markets has helped support corporate borrowing, particularly for large firms. Mexico is the second largest corporate bond issuer in the Latin American region, and around two-thirds of the net issuance is denominated in foreign currency. State-owned companies Petróleos Mexicanos (PEMEX) and Comisión Federal de Electricidad (CFE) accounted for one third of total foreign-currency corporate bond issuance, from 2009 to 2014.

2. Along with the growth in bond issuance, corporate borrowing from banks had also increased modestly. Corporate bank loans grew at a compounded annual rate of 8 percent from 2008 to 2014. In 2014, domestic bank loans accounted for 23 percent of total corporate debt, while external borrowing and debt securities issued in the domestic bond market amounted to 57 percent and 20 percent of total debt respectively.[2]

3. The rapid increase in bond issuance has been, in part, used to reduce funding costs and increase the maturity structure of debt. The share of corporate bonds maturing in 2015 and 2016 is only 10 percent of total outstanding debt. The bulk of bonds mature in 2020 or later. It is worth noting that some of the new bonds were issued by the subsidiaries of large multinationals and used for expanding investments outside of Mexico, so they do not count as part of Mexico's external debt in the national statistics.

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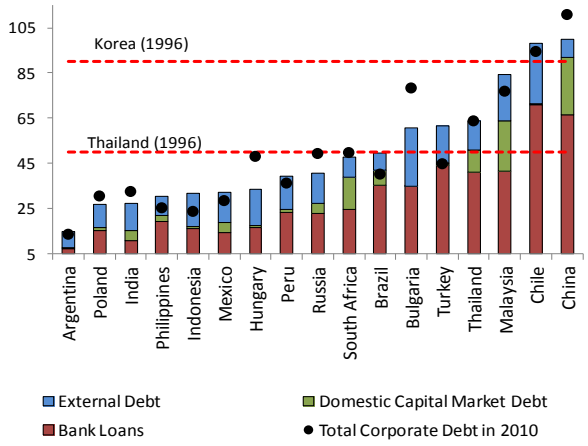
[1] Prepared by Julian Chow and Fabian Valencia. The authors thank Dora Iakova, Pascual O'Dogherty, and seminar participants at the Central Bank of Mexico for insightful comments and suggestions and Alexander Herman for outstanding research assistance.

[2] This is estimated from a combination of sources that include Financial Soundness Indicators (FSIs), Bloomberg and Quarterly External Debt Statistics (QEDS). See Appendix 1.

Figure 1. Corporate Debt

The ratio of corporate debt to GDP has risen slightly but remains relatively low compared to peers.

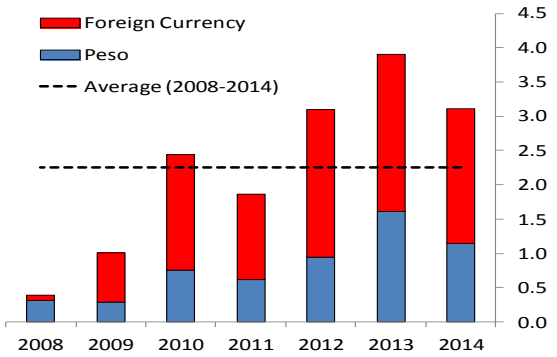
1. Nonfinancial Corporate Debt (in percent of GDP)



Note: Black dots indicate total corporate debt in 2010.

Easy access to international debt markets has enabled firms to increase bond issuance.

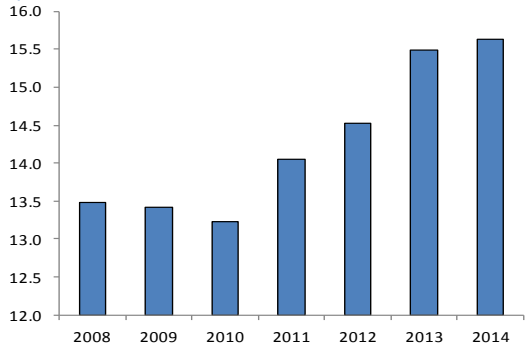
2. **Net Issuance of Corporate Bonds** (in percent of GDP)



Note: This includes bonds issued by holding companies and their subsidiaries in domestic and international markets. PEMEX and CFE comprised one third of total bonds issued in 2008-2014.

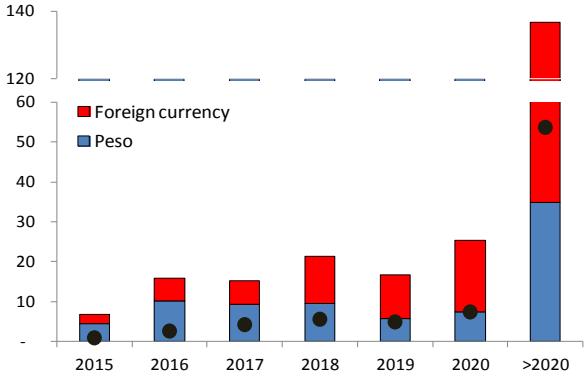
Bank lending has also increased.

3. Bank Lending to Nonfinancial Corporations (in percent of GDP)



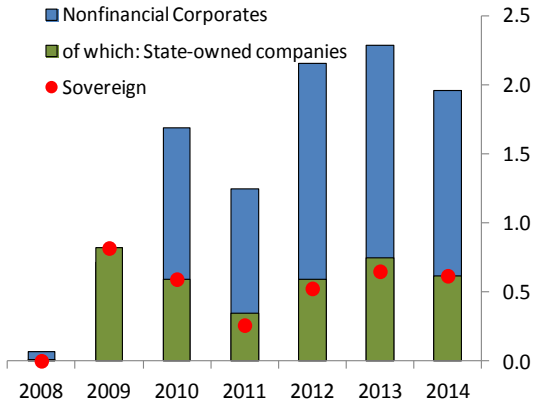
State-owned companies account for a significant share of foreign currency debt …

4. **Bond Maturity Structure** (in US$ billion)

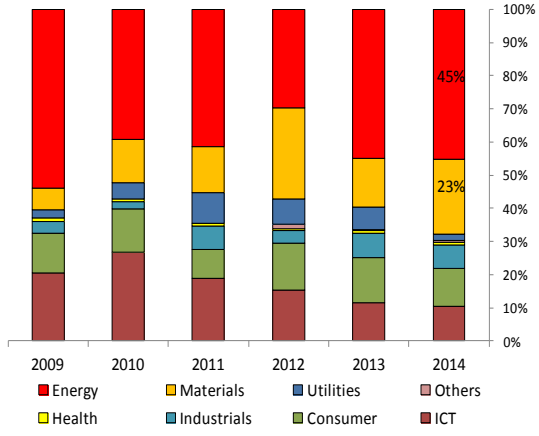


…with the energy sector comprising the bulk of new issuance.

5. Net Bond Issuance in Foreign Currency (in percent of GDP)



6. Corporate Bond Issuance by Sector (in percent of total issuance)

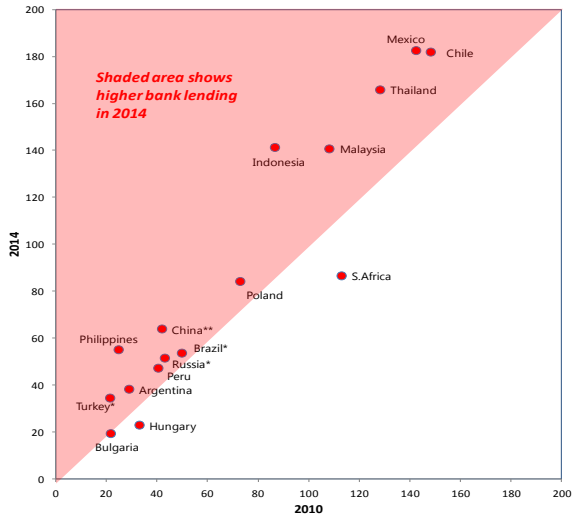


Sources: Bloomberg, L.P.; Orbis; and IMF staff calculations.

Figure 2. Corporate Leverage

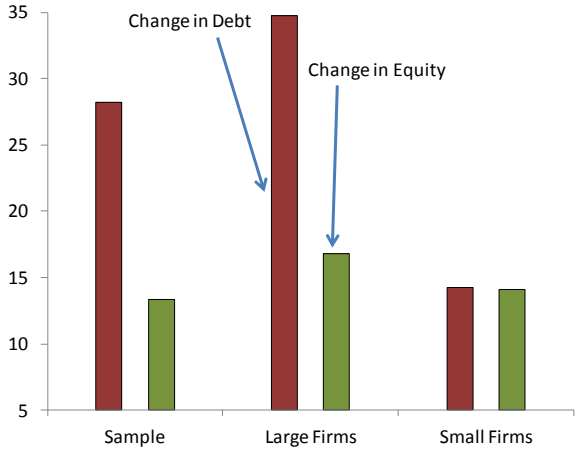
Corporate borrowing from banks has also increased.

1. **Bank lending to Nonfinancial Corporations in Emerging Market Countries** (in US$ billion)



Debt has grown faster than equity, particularly for large firms…

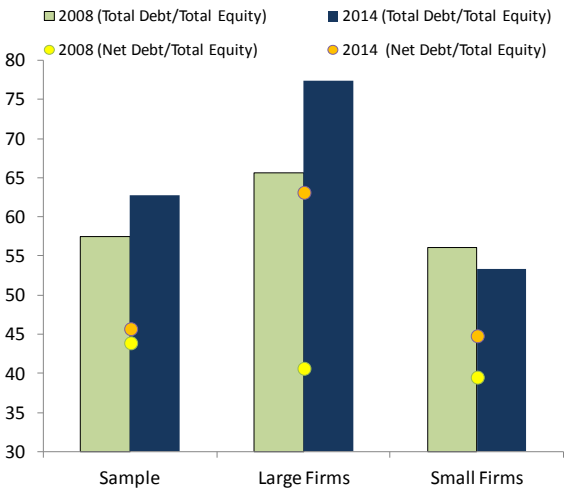
2. **Growth in Equity and Debt** (in percent, median of average year-on-year change from 2008-2014)



Note: Firm size is derived from the asset size of sample firm: Large=Top 25th percentile; Small=Bottom 25th percentile.

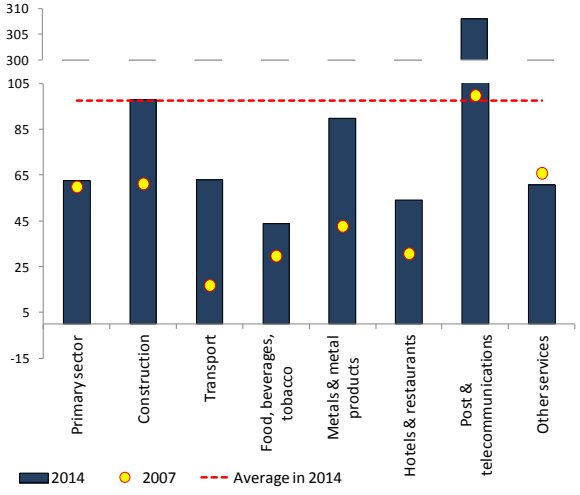
… increasing the gross leverage ratio, particularly for large firms.

3. **Total Debt to Total Equity** (in percent, median)



Leverage is relatively high in telecommunications, construction, and metals.

4. **Total Debt to Total Equity by Sector** (in percent, median)



NOTE: Excludes government-owned entities (PEMEX and Comision Federal de Electricidad).

Sources: Bloomberg, L.P.; Standard Chartered Bank; Orbis; and IMF staff calculations.

4. As debts grew at a faster pace compared to equity, gross corporate leverage has increased, but after accounting for cash holdings, net leverage has risen only slightly (Figure 2). For large firms, in particular, the ratio of total debt to total equity has increased notably. On the contrary, leverage has declined slightly for small firms. Sectors with relatively high leverage ratios (excluding PEMEX and CFE) are telecommunications, construction, and metals and metal products. However, after accounting for cash holdings, net leverage—defined as total debt minus cash holdings to total equity—increased only 2 percentage points to 46 percent between 2008 and 2014.

B. Vulnerabilities

5. Legacy issues from a sharp economic slowdown in 2013 may partly explain a decline in profitability in 2014. Firm-level data suggests that the median returns on equity (ROE) ratio continued to decline in 2014, driven mainly by large firms (Figure 3). Slower growth in Mexico and other countries in which these firms have operations can explain this trend. The pattern is in line with other emerging market countries, where corporate ROEs also weakened in 2014 compared to five-year averages. The decline in corporate profitability in 2014 was broad-based.[3]

6. Lower earnings weakened corporate debt servicing capacity somewhat, although it remains strong for most firms. Interest expense grew at a faster pace compared to earnings from 2008 to 2014, particularly for large firms. Together with the recent weakness in earnings, this has lead to a decline in the interest coverage ratio (ICR), though the median ICR across firms remained strong and sufficient to cover debt interest payments.[4] It is worth noting that while large firms' median ICR had been declining, small firms' median ICR had improved in 2014 due to improvement in earnings and a reduction in leverage. Sectors with low ICRs tend to be those that have relatively high leverage (telecommunications, construction, and metals and metal products).

7. The authorities are actively improving monitoring of corporate risks. In Mexico, the Stock Exchange and CNBV require listed firms to disclose information on their derivative positions on a quarterly basis to enable the identification of risks. In addition, Banco de Mexico has detailed information on derivative transactions where the company's derivative counterparty is a domestic bank or a domestic broker-dealer. In this context, Banco de Mexico conducts foreign currency risk analysis for the nonfinancial corporate sector using available information. Notwithstanding these improvements, access to comprehensive firm-level data on foreign currency risks remains a challenge for Mexico and many other emerging market economies.

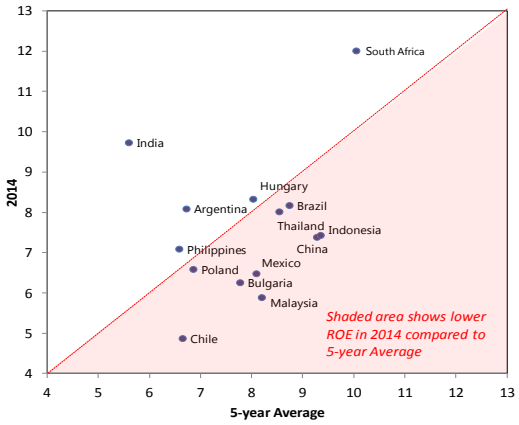
[3] Based a sample from the Orbis database with 123 firms (total assets of 52 percent of GDP and total debts of 28 percent of GDP). The sample was selected based on firms with at least one known value for the financial variables from 2006–2014, and firms with no recent financial data are excluded.

[4] ICR is computed as EBIT divided by interest expense; where EBIT (also known as operating profit) is earnings before interest and taxation.

Figure 3. Corporate Credit Metrics

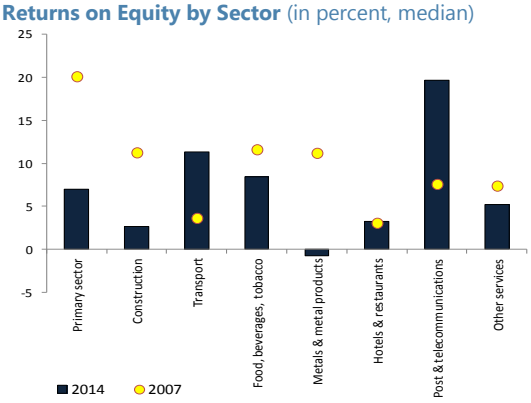
Slowing economic growth is putting pressure on corporate profitability across emerging markets.

1. **Returns on Equity across Emerging Markets** (in percent, median)



Weaknesses are seen across most sectors.

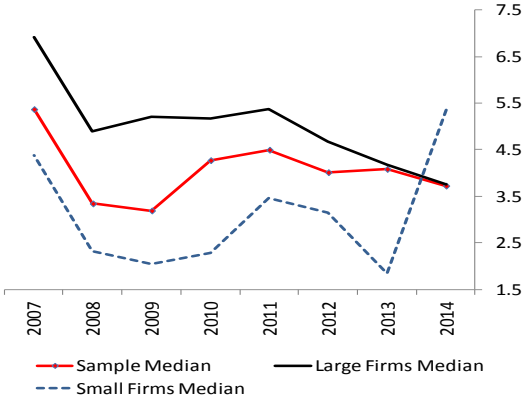
3. **Returns on Equity by Sector** (in percent, median)



*Excludes government-owned entities (PEMEX and Comision Federal de Electricidad).

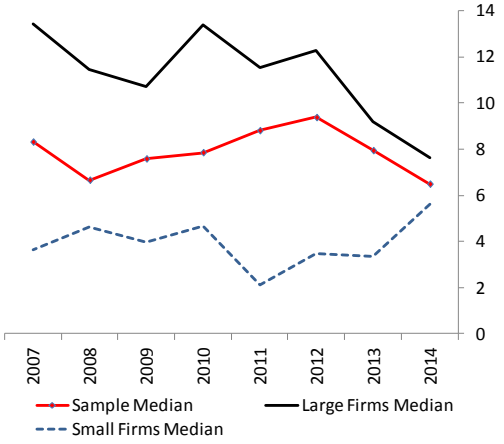
...leading to some decline in debt servicing capacity, although it remains strong.

5. **Interest Coverage Ratio** (EBIT/Interest Expense, median)



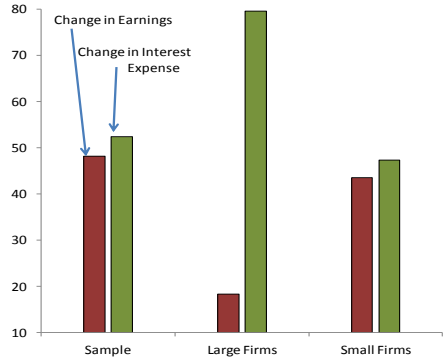
In Mexico, the decline in ROE has been driven by large firms.

2. **Returns on Equity in Mexico** (in percent, median)



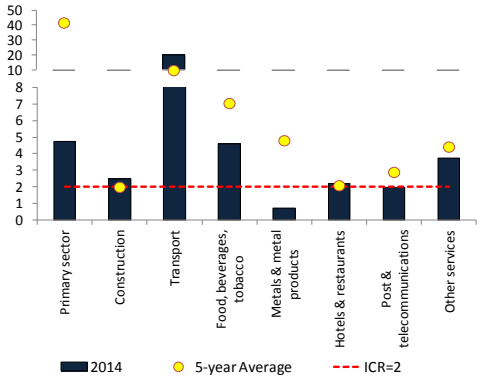
Interest expense has grown faster than earnings, especially for large firms...

4. **Growth in Interest Expense and Earnings** (median of average year-on-year change from 2008-2014, in percent)



Sectors with high leverage also tend to have weak interest coverage ratios.

6. **Interest Coverage Ratio** (EBIT/Interest Expense, median)



Sources: Bloomberg, L.P; Worldscope; Orbis; and IMF staff calculations.

C. Stress Tests

8. To gauge the resilience of firms to a combination of exchange rate, earnings and interest rate shocks, we conducted a stress tests analysis on a sample of firms, based on available balance sheet information.[5] The shocks were derived from the following "severe but plausible" assumptions:

- A 30 percent increase in borrowing costs, similar to the average of median changes in corporate borrowing costs across major emerging market countries during the GFC.[6] In Mexico, the median increase in firm's borrowing costs was 10 percent during the GFC.

- A 20 percent decline in earnings, similar to the median changes in firms' EBIT across major emerging market countries during the GFC. In Mexico, the median decline in firm's earnings was also 20 percent during the GFC.

- A currency depreciation against the U.S. dollar of 30 percent, similar to trends observed in late 1990s, and 15 percent depreciation against the Euro, reflecting a divergence in the monetary policy stance between the U.S. and Euro area. In Mexico, the peso depreciated close to 30 percent against the dollar during the first six months of the GFC.[7]

9. We also took into consideration natural and financial hedges that could mitigate corporate exposure to exchange rate risk. We made the following assumptions:

- Natural hedges were proxied by the ratio of foreign sales to total sales, as data on foreign currency revenues is not available[8] The median foreign sales to total sales ratio was 23.4 percent in 2014.

- Financial hedges were derived based on a simple assumption that 50 percent of FX debt interest expense is hedged through derivatives. This takes into consideration the availability and effectiveness of the hedges.[9]

[5] The sample consists of 123 firms from the Orbis database. See Appendix 1.

[6] These countries include China, India, Indonesia, Malaysia, Thailand, Philippines, Brazil, Mexico, Chile, Argentina, Peru, Russia, Turkey, Poland, Hungary, Bulgaria and South Africa.

[7] The Peso has registered a year-over-year depreciation of 25 percent against the U.S. dollar as of September 2015, very close to the exchange rate shock used in the stress test.

[8] The information is sourced from the IMF Corporate Vulnerability Utility database which uses data from Worldscope.

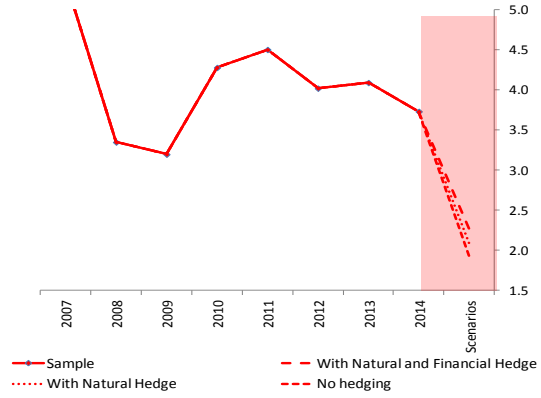
[9] While FX hedging instruments and markets are more developed now than during the late-1990 crises, it is important to note that some of these instruments are complex. For example, some currency hedges would terminate when the exchange rate depreciates beyond a certain "knock-out" threshold, thus rendering the hedge worthless. Moreover, firms are exposed to liquidity and rollover risks when these contracts expire.

10. The results show that a combination of these three shocks would weaken firms' debt servicing capacity, but the corporate sector would remain resilient. Corporate earnings are largely sufficient to service interest obligations under the stress scenarios (Figure 4, panel 2). With natural and financial hedges, the median ICR would decline from 3.7 in 2014 to 2.3. Without hedges, the median ICR would decline by around 2 percentage points, to 1.9. This is in line with the decline in median ICR observed during the GFC (from 5.4 in 2007 to 3.3 in 2008) where the shocks to corporate earnings, borrowing costs, and exchange rate were close to the levels used in this exercise.

Figure 4. Corporate Sensitivity Analysis

Exchange rate, earnings and interest rate shocks weaken debt service capacity, but most firms remain resilient…

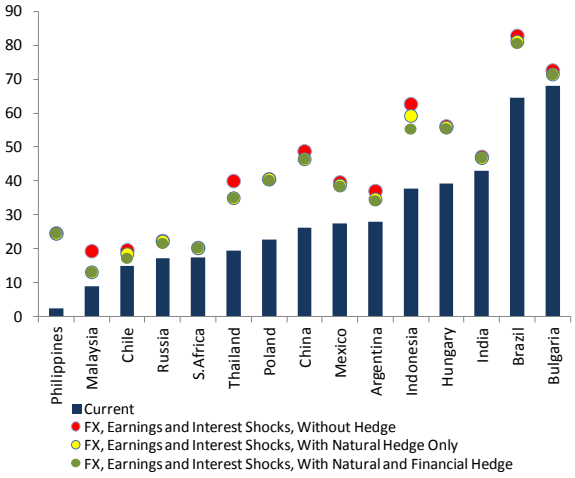
1. Interest Coverage Ratio (EBIT/Interest Expense, median)



NOTE: Excludes PEMEX and CFE.

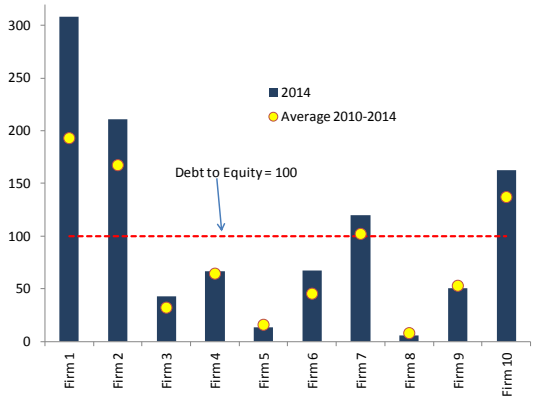
… prompting debt at risk to rise, though it remains at moderate levels compared to most emerging markets.

2. Current and Projected Debt at Risk across Emerging Market Countries (in percent of total debt at risk)



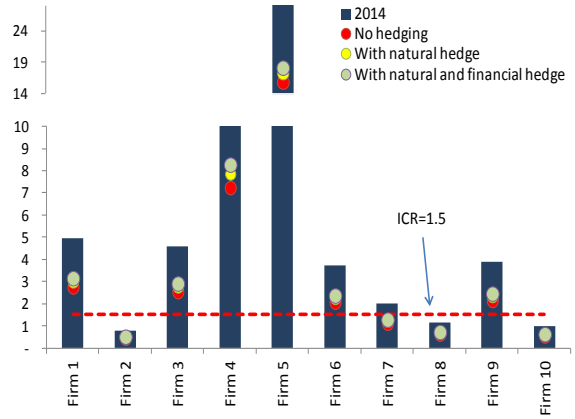
Leverage is high in three of the top 10 largest companies…

3. Top 10 largest Companies: Total Debt to Total Equity (in percent)



… and debt-service capacity is relatively weak three firms.

4. Top 10 largest Companies: Interest Coverage Ratio (EBIT/Interest Expense)



NOTE: Excludes PEMEX and CFE.

Sources: Bloomberg, L.P.; Haver Analytics; Worldscope; Orbis; and IMF staff calculations.

11. A combination of the three shocks would increase debt at risk—mostly at large firms—but it would remain relatively moderate compared to other emerging market countries (Figure 4, panel 3 and panel 4). The simultaneous shocks would raise the corporate debt at risk to

38–40 percent of total debt (5.2–5.4 percent of GDP), from 27 percent of total debt (3.7 percent of GDP) in 2014 (Box 1).

Box 1. Interest Coverage Ratio and Debt at Risk

Interest Coverage Ratio

A firm's capacity to service debt hinges on its interest coverage ratio (ICR), computed as Earnings/Interest Expense, where Earnings is measured by earnings before interest and taxation (EBIT)[1]. The lower the ratio, the more the company is burdened by debt expense relative to earnings. An ICR of less than 1 implies that the firm is not generating sufficient revenues to service its debt without making adjustments, such as reducing operating costs, drawing down its cash reserves, or borrowing more. This analysis uses EBIT as a measure of earnings instead of EBITDA (earnings before interest, taxation, depreciation and amortization) to account for the need to replace assets and reinvest to ensure going-concern.

Debt at Risk

By the time a firm's ICR dips below 1, it may already be in distress. As an early warning signal of potential corporate difficulties ahead, analysts often use an ICR of 1.5 as a threshold. An ICR of below 1.5 also flags potential vulnerability to funding risks, particularly when market liquidity thins in turbulent times. During the Asian Financial Crisis, countries whose corporate sector with median ICR below 1.5 were more vulnerable.[2] Accordingly, we define debt at risk as the debts of firms with ICR below 1.5. The debt at risk for each country is computed as:

$$\frac{\sum Debt\ of\ Firms\ with\ ICR < 1.5}{\sum Debt\ of\ All\ Firms}$$

The share of debt at risk shows how much of these outstanding debts are vulnerable due to the weak debt servicing capacity. A relatively high share of debt at risk shows that the country may be more susceptible to corporate distress from macroeconomic and financial shocks.

Caveat

It is worth noting that the coverage and representativeness of the sample obtained from the Orbis database vary across countries, and therefore sample selection bias can be a problem.

1. Also known as operating profit/loss
2. The median interest coverage ratio in Korea, Thailand and Indonesia were below 1.5.

12. Some of the largest firms have high leverage and low interest coverage. Among the top ten largest companies (by asset size), four of them had total debt to total equity ratios above 100 percent, and three of them had ICRs below 1.5 in 2014 (Figure 4, panel 5 and panel 6). Our stress tests analysis shows that a fourth firm would see its ICR decline below 1.5, bringing the

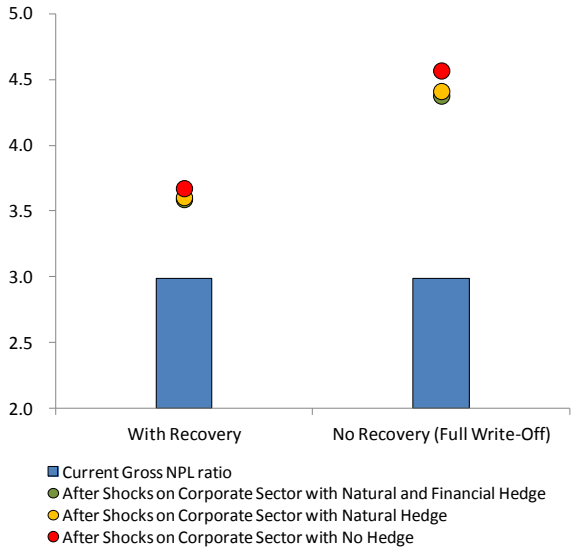
number of firms with ICR below 1.5 to four. The total debt of these four firms is around 3 percent of GDP.

D. Impact on the Banking Sector

Figure 5. Impact on the Banking Sector

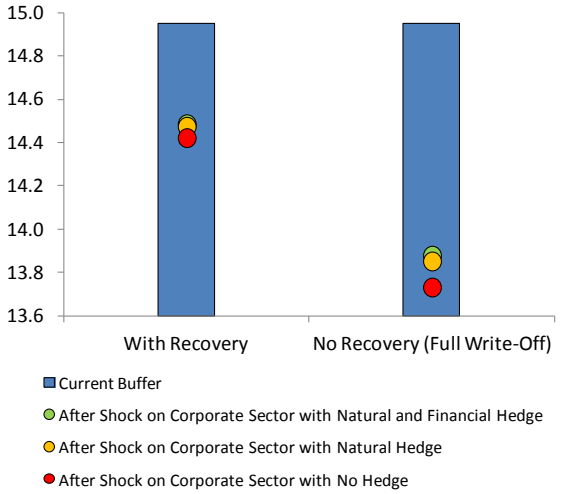
Higher corporate default will increase banks' nonperforming loans…

1. Gross Nonperforming Loan Ratios (in percent of total loans)



…but banks have adequate loss absorbing buffers to withstand the shocks.

2. Loss Absorbing Buffer[1/] (in percent of risk-weighted assets)



1.Consist of Tier 1 capital and excess of loan loss reserves against the current stock of nonperforming loans, normalized by risk-weighted assets.

Sources: Bankscope; Haver Analytics; and IMF staff calculations.

13. Commercial lending comprise a large share of total bank loans, but banks have adequate buffers to absorb shocks in the corporate sector. Lending to nonfinancial corporations account for half of total bank loans. Total gross nonperforming loans (NPL) in the banking sector reached around 3 percent of total loans in 2014, slightly higher in larger banks compared to smaller banks.[10] Loss absorbing buffers comprising Tier 1 capital and excess of provisioning over NPLs are strong, at 15 percent of risk-weighted assets. Our stress tests analysis, which assumes a default probability of 15 percent for corporate debts with ICR below 1.5, suggests that the gross NPL ratio could increase by 1.5 percentage points to 4.5 percent in a scenario where the corporate NPLs are fully written-off (figure 5). In this scenario, the ratio of banks' loss absorbing buffers to risk-weighted assets would decline from 15 percent to 13.7 percent, still above Basel III's minimum Tier 1 capital ratio requirement of 8.5 percent.[11] It is worth noting that commercial banks may be exposed to funding risks in the stress scenario due to potential large deposit withdrawals, particularly from corporations that are facing weaker financial positions.

[10] These include NPLs from households and the corporate sector.

[11] This includes capital conservation buffer of 2.5 percent.

E. Impact on the Real Economy

14. While stress tests reveal that corporate balance sheets appear strong enough to withstand large shocks, there could still be an impact on the real economy. The stress scenarios discussed in the previous section reveal that widespread bankruptcies as a result of the assumed shocks are unlikely. However, the median firm can still decide to retrench investment to rebuild buffers if faced with shocks. Furthermore, firms outside the sample—if financially weaker—could still default and may trigger higher NPLs at banks, which in turn, can curtail credit supply.

15. The median firm could lower investment up to 1.2 percentage points of the capital stock in the most severe stress scenario. To derive the implications of the shocks for leverage, we assume that total debt increases by the valuation loss on the proportion of debt denominated in foreign currency due to the currency depreciation. Using estimates from Li, Magud, and Valencia (2015)—relating investment rates to net leverage—the resulting increase in leverage would lead to a reduction in investment rates between 0.3 and 1.2 percentage points of the capital stock. These authors report an elasticity of real GDP growth to investment rates—measured in percent of a firms' capital stock—of about 0.1. This elasticity implies that the reduction in investment rates could lead to lower real GDP growth in 0.03 to 0.12 percent.

Stress Scenarios and Impact on Corporate Investment Rates

Stress Scenarios	Increase in Net Leverage (Percentage points)	Reduction in Investment rates (Percentage points)	
		High coefficient: 1/ -0.064	Low coefficient: 1/ -0.042
Scenario 1 (With natural hedges)	7.7	-0.49	-0.32
Scenario 2 (With natural and financial hedges)	7.8	-0.50	-0.33
Scenario 3 (Without hedges)	18.8	-1.20	-0.79

Source: IMF staff calculation.
1/ Li, Magud, and Valencia (2015), coefficients estimated in a panel of 11,000 firms from 38 emerging markets, including Mexico, relating 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.

16. Additional real effects from lower supply of bank credit could arise if weaker firms default. Firms in the above analysis are relatively large corporations with access to international financial markets. Lacking firm-level data for the whole corporate sector, we assume—rather conservatively—that firms outside the sample default with a 15 percent probability. This default rate corresponds to Moody's historical estimate for firms with ICR's below 1.5. We extrapolate this default rate to the whole portfolio of bank loans to the corporate sector. The resulting increase in NPL's is treated as a bank capital shock.[12] Additional real effects could then arise from a reduction in

[12] The increase in NPL's would affect capital in the same period only to the extent that they exceed loss loan reserves. However, even if loan loss reserves are enough to cover the increase in NPL's, banks may wish to rebuild buffers.

the supply of bank credit in response to this capital shock. To estimate this effect we ran simple regressions relating bank lending growth to the equity-to-assets ratio, which as the table below shows, gives an estimated coefficient of around 2, similar to estimates for U.S. banks.[13]

17. Higher NPL's at banks could reduce growth by up to 0.3 percent through a reduction in the supply of credit. Empirical studies find elasticities of real GDP growth to bank credit growth ranging from 0 to about 0.4, so a 1 percent reduction in credit growth leads to 0–0.4 percentage points decline in real GDP growth.[14] In times of severe recessions, the elasticity tends to be closer to the upper limit, whereas during normal times it tends to be closer to zero. The elasticity depends also on the degree of credit deepening. Given Mexico's low credit deepening and the absence of a deep recession, the elasticity would tend to be low; therefore, we assume a value of 0.15. The estimated response of bank lending to the assumed shocks (between 1.4 and 1.7 percent) would reduce growth between 0.2 and 0.3, depending on the stress scenario.

Stress Bank Lending Response to Bank Capital Shocks

Dependent variable:	Loan growth	Loan growth	Loan growth	Loan growth
Size	0.017	0.024	-0.008	-0.058
	(0.090)	(0.140)	(0.072)	(0.125)
Equity/Assets	2.041	1.888		
	(0.207)***	(0.261)***		
Lagged Equity/Assets			0.927	0.990
			(0.164)***	(0.146)***
Currency depreciation	-0.189		-0.570	
	(0.480)		(0.436)	
Inflation	3.719		-4.180	
	(12.578)		(9.337)	
Time fixed effects	No	Yes	No	Yes
Sample	2001-2014	2001-2014	2001-2014	2001-2014
Constant	-44.640	-54.930	28.297	46.849
	(132.419)	(111.969)	(102.250)	(110.868)
R^2	0.43	0.48	0.18	0.26
N	280	280	242	242

Source: IMF staff calculation.
Note: Fixed effects regressions with robust standard errors in parenthesis. Size denotes the lagged value of the natural logarithm of total assets; Equity/Assets denotes total equity divided by lagged total assets; currency depreciation measures the percentage change in the exchange rate of the Mexican Peso vis-a-vis the U.S. Dollar; Inflation denotes the percentage change in the CPI. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

[13] Hancock and Wilcox (1993, 1994), Bernanke and Lown (1991), Berger and Udell (1994), and Peek and Rosengren (1994), Berrospide and Edge (2010) conducted studies with U.S. data and found coefficients ranging from 0.7 to 2.8, in a variety of specifications.

[14] Estimates vary depending on whether the regressions focus on normal times or periods of financial distress. For instance, Driscoll (2004) finds no statistically significant effects, while Calomiris and Mason (2003) who study the real effects of credit supply shocks around the Great Depression find an elasticity of 0.4.

18. Altogether, the assumed shocks could reduce growth by 0.2–0.4 percent, but in combination with other shocks could lead to larger effects. The total effect reflects the impact of the assumed shocks exclusively through a financial channel, operating both through lower investment by firms in the sample in response to increased leverage and lower supply of bank credit—from impaired loans to firms outside the sample. However, if the assumed shocks happen in conjunction with other shocks—for instance, a negative growth surprise in the U.S.—the effects could be much larger.

Impact of Higher NPLs on Credit Supply

Stress Scenarios	Change in Bank Capital (Percentage points)	Reduction in Loan Growth (Percentage points)	
		High coefficient: 1/	Low coefficient: 1/
		2.041	1.888
Scenario 1	0.74	-1.51	-1.40
Scenario 2	0.76	-1.55	-1.43
Scenario 3	0.84	-1.72	-1.59

Source: IMF staff calculation.
Note: scenarios treat the increase in NPLs as a bank capital shock.
1/ Coefficients correspond to those on the Equity/Assets ratio shown in Table 2.

F. Summary and Conclusion

19. While corporate credit metrics have weakened somewhat as of 2014, particularly among large firms, the corporate sector remains resilient and bank sector buffers are strong. The stress test analysis suggests that most firms have adequate capacity to service debt in a scenario which combines a 30-percent exchange rate depreciation against the dollar, 30-percent increase in borrowing costs, and 20-percent decline in earnings. Under these circumstances, banks' buffers remain strong and are sufficient to withstand the shocks in the corporate sector.

20. Notwithstanding the resilience of the corporate and banking sectors, the shocks could still affect the real economy through lower investment and bank credit supply. Faced with these shocks, firms could retrench investments to rebuild buffers. Weaker firms may default, thus triggering higher NPLs, which could lead to a reduction in bank credit supply. Corporate data disclosure requirements have been strengthened, but data issues still present a challenge for monitoring risks.

Appendix I. Methodology for Corporate Sensitivity Analysis

A. Analytical Approach

A firm's capacity to service debt hinges on its interest coverage ratio (ICR), computed as EBIT/Interest Expense, *where* EBIT is earnings before interest and taxation[1]. The lower the ratio, the greater the debt payment burden of the company. An ICR of less than 1 implies that the firm is not generating sufficient revenues to service its debt without making adjustments, such as reducing operating costs, drawing down its cash reserves, or borrowing more. This analysis uses an ICR threshold of 1.5, which is a benchmark used widely by analysts as an early warning signal. Firms with ICR below 1 may already be in distress.

B. Data Source

The analysis is based on annual firm-level balance sheet information from Orbis. This database has 123 Mexican firms with good data points, covering US$678 billion of assets (52 percent of GDP) and US$359 billion of debt (28 percent of GDP). It includes public and private, large and small companies.

C. Estimating Corporate Debt

As the breakdown of firm-by-firm foreign currency borrowing is not available through Orbis and other in-house databases, FX debt is estimated at the aggregate level, by external debt statistics and other sources as follows:

Sources of Corporate Borrowing	Data
External Debt 1/	Quarterly External Debt Statistics (QEDS) (http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/EXTDECQEDS/0,,contentMDK:20721958~menuPK:4704607~pagePK:64168445~piPK:64168309~theSitePK:1805415,00.html) NOTE: QEDS shows a breakdown of corporate external debt according to debt from affiliates, direct investment and others which include loans, money market instruments, trade credits, bonds and notes.
Domestic Banks	Banking system data from "Financial Soundness Indicators"
Domestic Capital Markets	Bloomberg

1/ While external debt could be in foreign or local currency, most foreign holdings of corporate debt are in hard currencies.

Aggregate corporate debt is estimated as:

External Debt + Loans from Domestic Banks + Borrowings from Domestic Capital Markets

[1] EBIT (also known as operating profit/loss) is used as a measure of earnings instead of EBITDA (earnings before interest, taxation, depreciation and amortization) to account for the need for investment and replacement of assets.

D. Estimating Potential Exchange Rate Losses from Foreign Currency Debts

Potential exchange rate losses from foreign currency debt interest payment due in the current year is estimated as:

$$\text{Share of External Debt } x \textit{ Borrowing Cost } x \textit{ Total Debt } x \left[\left(\begin{matrix}\textit{Share of USD Debt } x \textit{ Nominal Exch. Rate} \\ \textit{Depreciation vs USD}\end{matrix}\right)\right.$$

$$\left. + (\textit{Share of EUR Debt } x \textit{ Nominal Exch. Rate Depreciation vs EUR})\right]$$

The currency breakdown of external debt assumes that the share of EUR-denominated debt is similar to the share of exports to the Euro area (18 percent) while the rest are denominated in US dollar.

E. Accounting for Natural Hedges

FX losses from interest expense and revaluation of foreign currency debt principal and are offset by FX gains from overseas earnings, computed as:

$$\text{Share of Foreign Sales } x \textit{ EBIT } x \left[(\textit{Share of USD Revenue } x \textit{ Nominal Exch. Rate Depreciation vs USD}) + (\textit{Share of EUR Revenue } x \textit{ Nominal Exch. Rate Depreciation vs EUR})\right]$$

Assumptions underlying this estimation:

- Foreign sales are assumed to be in foreign currencies.
- The share of FX revenues is derived from the country trade weights.
- The multiplication by EBIT (operating profit) effectively takes into account foreign currency costs, as it assumes that the share of these costs are in proportion to foreign currency income.

It is worth noting that the effectiveness of natural hedges is an approximation as it may fall short of expectations. Past episodes have demonstrated that overseas revenues could decline in tandem with the depreciating currencies during turbulent periods.

F. Accounting for Financial Hedges

Currency hedging of foreign currency debts could also mitigate potential FX losses. Offset from financial hedging of foreign currency debt principal and interest is computed as:

Hedge Ratio x FX losses from foreign currency debt interest

As information on financial hedging is sparse, this analysis assumes that at least 50 percent of foreign currency debts are hedged, on aggregate basis.

G. Projecting the Increase in Nonperforming Loans

The increase in corporate nonperforming loans is projected from the after-shock corporate debt at risk as follows:

Increase Corporate NPL = Increase in Corporate Loan at Risk x Probability of Default x Loss Given Default

- *Increase in Corporate Loans at Risk:* This is derived from extrapolating the risk of default of firms with ICR's below 1.5 to the entire portfolio of bank loans to the corporate sector. The implicit assumption is that non-listed firms are financially weaker than listed firms.
- *Probability of default:* This is assumed to be 15 percent based on Moody's default probability for corporate debts with interest coverage ratio of 1.5 over a three-year horizon(based on data from 1970-2012).
- *Loss Given Default:* This is computed as an average of 45 percent (Basel II Foundation Approach for senior claims on corporates, sovereigns and banks not secured by recognized collateral[2]) and country-specific LGDs from The World Bank's data on "Resolving Insolvency"[3] (Appendix 1).

The ability of banks to withstand losses will depend on their loss absorbing buffers, which comprise Tier 1 capital and the excess of provisioning over the stock of NPL. The after-shock loss absorbing buffers can be computed as:

$$\frac{\text{Tier 1 capital + Loan Loss Reserves – Existing Stock of NPL – Projected Increase in NPL}}{\text{Risk-Weighted Assets}}$$

[2] See section 287-288 of Basel II Accord (http://www.bis.org/publ/bcbs128.pdf)

[3] See http://www.doingbusiness.org/data/exploretopics/resolving-insolvency

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A CARBON TAX PROPOSAL FOR MEXICO[1]

Mexico has set clear commitments to reduce carbon emissions ahead of the 2015 Paris summit on climate change. A recent reform—pending Senate approval—proposed fixing excises on gasoline and diesel—in lieu of the current system of variable excises—and to allow the domestic price of these fuels to move more closely in line with international prices until they are fully liberalized in 2018. Taking into account climate change, air pollution, and traffic-related negative externalities associated with fossil fuel combustion, this paper finds that the proposed level of excises are close to optimal. However, natural gas and coal would remain significantly under taxed, if taxation is to become the main tool to correct for negative climate change externalities. Setting carbon taxes at optimal levels in Mexico could reduce carbon emissions by 6 percent over the medium term, contributing non-trivially to the goal of reducing carbon emissions in 25 percent by 2030.

A. Introduction

1. Fossil fuels are a critical energy input in industrial production and in final consumption, but their combustion has also harmful environmental and public health impacts. These consequences can have potentially sizable costs to the economy. However, energy prices in many countries are often set at levels that do not reflect these costs or are even subsidized. Given the seriousness of the environmental and public health problems associated with fossil fuel combustion, addressing them with targeted policy instruments is critical.

2. Mexico has been at the forefront among emerging markets in setting clear commitments to address these concerns. Mexico enacted in 2012 a climate change law which aimed at creating a legal framework to ensure the implementation of policies aiming at protecting the environment. It also created the Climate Change National Institute in charge of measuring carbon emissions. In 2013, Mexico released the national strategy for climate change, outlining clear commitments to reduce carbon emissions. In the same year, Mexico introduced a carbon tax on all fossil fuels as part of a broader fiscal reform. Recently, Mexico reiterated its commitments to reduce carbon emissions ahead of the Paris summit on climate change to take place in late 2015.

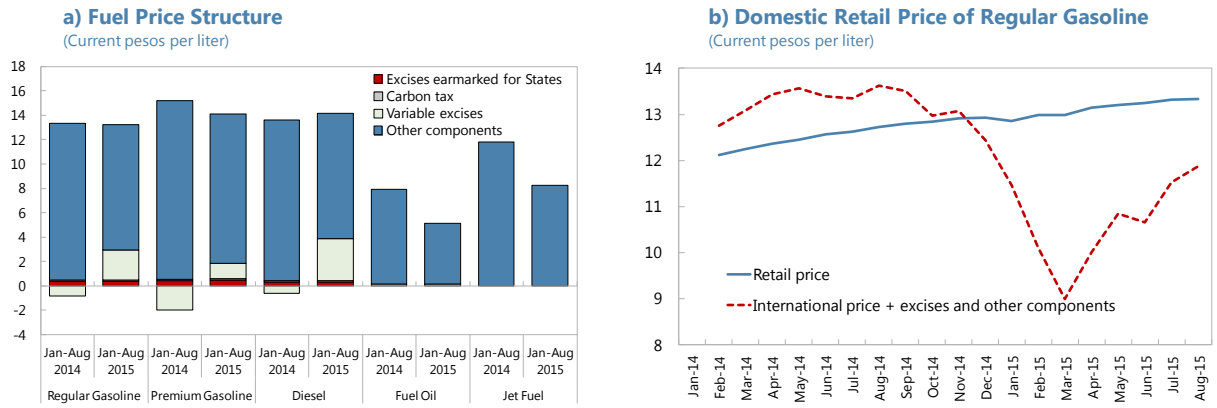
3. Fiscal instruments targeted directly at the sources of environmental harm help address these concerns but also generate fiscal revenues. As long as these revenues avoid increasing other taxes that distort economic activity, environmental protection is achieved at the lowest overall cost to the economy.

[1] Prepared by Fabian Valencia. The author thanks Dora Iakova, Luis Madrazo, Carlos Muñoz, Ian Parry, Glenn Sheriff, and seminar participants at the Mexican Ministry of Finance and the Central Bank of Mexico for insightful comments and suggestions and Alexander Herman for outstanding research assistance. This paper used Parry and others (2014) comprehensive calculations of optimal carbon taxes and updates it to 2015 prices.

B. Mexico's Current Excise Taxes on Fossil Fuels

4. Most fossil fuels in Mexico are subject to excise taxes, including a carbon component. A carbon tax refers to a tax directly linked to the level of carbon dioxide (CO_2) emissions. The tax is often expressed per ton of CO_2 and varies across fossil fuels depending on the amount of emissions they produce when burned. The carbon component of fuel excises in Mexico was introduced as part of the 2013 tax reform, as a special tax on production and services (IEPS) which came to effect in 2014. It covers all fossil fuels-except natural gas and crude oil (IEPS law, art. 8), and Jet fuel[2]—with rates varying depending on the carbon content. A second component of fuel excises in Mexico is earmarked for states and local governments (IEPS law, art. 2o-A II), and affects only gasoline (regular and premium) and diesel. A third component is a variable excise which also affects only gasoline and diesel. It is a residual between an international reference price converted to local currency and the regulated retail price.[3] Since the international reference price co-moves one-for-one with international oil prices, the variable excise component moves countercyclically with the international price of oil, leading to higher fiscal revenues when international oil prices fall.

Fuel Price Structure and Gasoline Prices

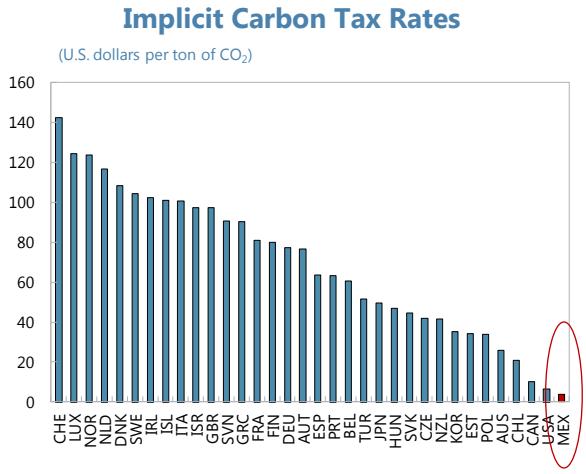


Sources: Secretary of Energy; and IMF staff calculations.

5. As of 2014, fossil fuel excise taxes in Mexico implied the lowest taxation rate among OECD countries. Implicit carbon taxes, defined as all excise taxes on fossil fuels, were low in Mexico, in particular as the variable excise mechanism implied a subsidy on fossil fuels until late 2014.

[2] Natural gas was exempted on account of being the cleanest fossil fuel. A 2013 Presidential Decree exempted Jet fuel from the carbon tax in adherence to international agreements signed by Mexico, which included the exemption of this fossil fuel from taxes.

[3] The regulated retail price includes the carbon tax, excises earmarked for states, VAT, transport costs, distribution margins, and technical losses due to evaporation.



Sources: EIA; and OECD.
Note: Mexico as of 2014, all others as of 2013.

6. The collapse of oil prices since late 2014 turned the variable excise tax positive. Domestic retail prices of gasoline and diesel continued to be adjusted upwards as oil prices declined, although at a much slower pace in 2015 than in the previous year. Therefore; Mexico no longer subsidizes diesel and gasoline given current domestic and international fuel prices. However, if the current variable excise mechanism were to be kept, the variable excise tax could turn into a subsidy again if international fuel prices rise.

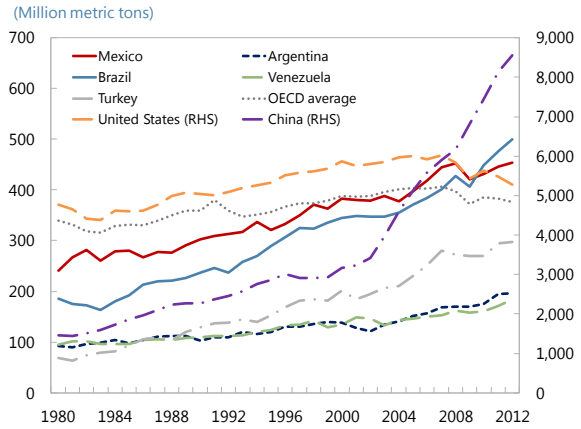
C. In Search for a New Energy Taxation Mechanism

7. A recent reform—pending Senate approval—proposed a mechanism of excise taxes to ensure fuel subsidies are eliminated permanently and smooth the transition to fully liberalized domestic fuel prices. Mexico plans to liberalize domestic fuel prices by 2018, which implies a necessity to replace the current system of excises with a new mechanism. Ideally, this new mechanism should ensure a proper taxation of fossil fuels to reflect environmental and public health costs. The 2016 budget proposed a replacement of the variable component of the excise tax at levels near those observed this year with a fixed excise system. As of the writing of this paper, the proposal had been approved by the lower chamber of Congress. To smooth the transition toward fully liberalized domestic fuel prices, the Ministry of Finance would define a price band during this transition period (2016–2017) that would allow domestic fuel prices to fluctuate more in line with international prices.

8. A fixed excise tax on fossil fuels—equivalent to a carbon tax—is also a viable option to tackle the national climate change strategy goals, which have been reinforced with the recently announced commitments ahead of the 2015 Paris summit on climate change. Mexico has pledged to reduce carbon emissions in 30 percent by 2020, and 25 percent by 2030, relative to baseline projections. A carbon tax is administratively simple since Mexico has already a system in place. Since a carbon tax raises the price of each ton of carbon emitted into the atmosphere, it raises the cost of emissions. Higher costs induce a market response throughout the entire economy, creating incentives for fuel users to shift to alternative ways of production and ultimately lower carbon

emissions. While Mexico's contributions to carbon emissions are still small globally, they have been rising faster than the OECD average over the last decade.

Carbon Dioxide Emissions



Source: OECD.

9. From a fiscal perspective, fixing excise taxes on fuels at an optimal level could help stabilize tax revenues without relying on other, more distortionary taxation. Carbon taxes allow the extraction of a double dividend. Not only do they help correct an important negative externality but they also allow raising fiscal revenues without relying on taxes that tend to distort economic activity. If the variable excise system were maintained, lower tax revenues as international oil prices recover could lead to pressures to make up the shortfall by raising revenues through distortionary taxation. Setting excise taxes at optimal levels can also lead to lower public spending on health in the long-term if lower combustion of fossil fuel leads to a lower incidence of pollution-related diseases, keeping everything else equal.[4]

D. Estimating Optimal Carbon Tax Rates on Fossil Fuels for Mexico[5]

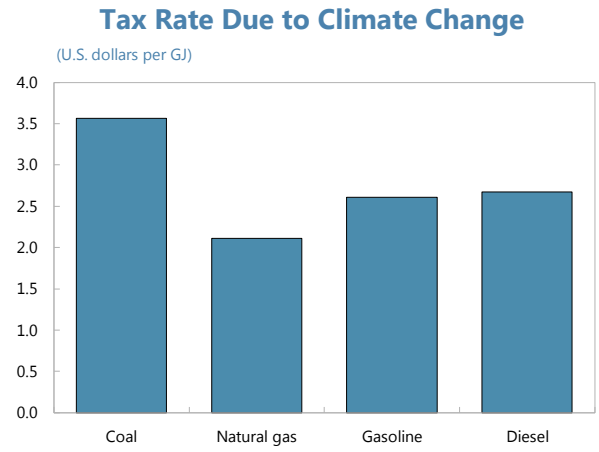
10. The methodology considers three main categories of externalities associated with fossil fuel combustion: climate change, air pollution, and those related to traffic. It relies on country-specific data wherever available and applicable to estimate the social cost of fossil fuel consumption in an attempt to estimate an optimal Pigouvian tax. While for some externalities variation in country-specific factors such as level of income, population density, and traffic congestion lead to different optimal taxes, this is not the case for climate change. For climate change the associated damage from carbon emissions is the same regardless of the fuel combustion

[4] Parry and all (2014) calculate a potential reduction in deaths due to air pollution-related diseases of up to 20 percent for the case of Mexico.

[5] This section briefly summarizes the methodology followed in Parry and all (2014) to compute Mexico's suggested carbon tax rates. Further details and data sources can be found in Parry and all (2014) while theoretical underpinnings of fuel taxation can be found in Parry and Small (2005) and more general issues on optimal environmental taxation in the presence of other taxes in Bovenberg and Goulder (1996).

process or where emissions are released. The methodology then assumes a uniform cost across countries, per unit of carbon emissions. More specifically, each externality is dealt with as follows:

- **Climate change is assumed to lead to a monetary cost of US$ 38 per metric ton of CO_2.** The assumed cost is within the range of estimates provided by the US Interagency Working Group on the Social Cost of Carbon (2013 update), obtained from simulations of a range of models, under different discount rate assumptions.[6] These estimates, however, vary widely. As an illustration, the average estimated cost for 2015 ranges from US$12 per metric ton of CO_2, if the discount factor is set to 5 percent, to US$38 and US$58 per metric ton of CO_2 if the discount factor is lowered to 3 and 2.5 percent respectively. This assumption, together with data on carbon content of fossil fuels, allows deriving carbon charges for all fossil fuels that would reflect the cost of climate-change externalities.

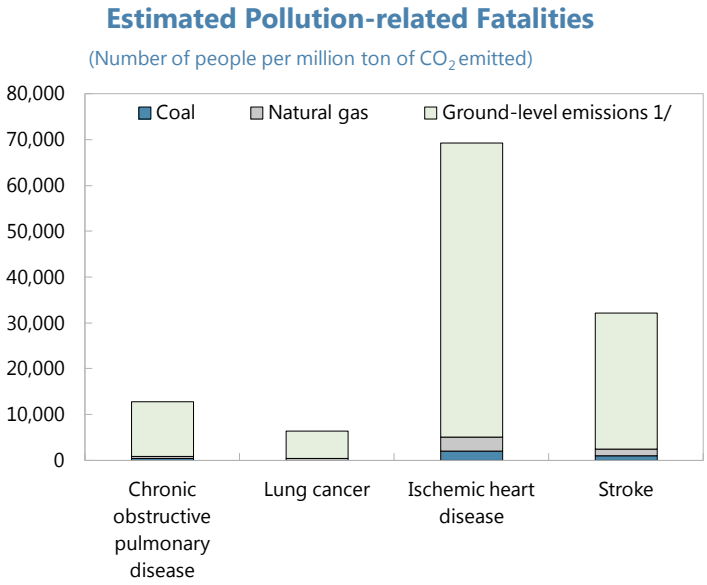


Sources: Parry et al. (2014); and IMF staff calculations

- **To estimate the cost of air pollution, the approach uses empirical information on the link between exposure and incidence of pollution-related diseases**. Local air pollution can lead to a wide array of harmful environmental consequences. However, to focus on those that are most severe, the analysis centers on premature human mortality. The methodology first determines how much polluted air is inhaled by exposed population. Relying on existing empirical evidence, it then assesses how this pollution exposure affects mortality risks, accounting for factors, such as the age and health of the population, which determine the vulnerability of the exposed population to pollution-related illness. The next step is the monetization of health effects. This

[6] Quantifying climate change costs is subject to a great deal of uncertainty due in principal to three features of climate change. The first is the highly uncertain effect of emissions on specific climate outcomes; the second is the unknown form of human adaptation to problems building up over decades and centuries; and the third is the differences of opinion about the appropriate analytical procedure for aggregating effects occurring over long time intervals.

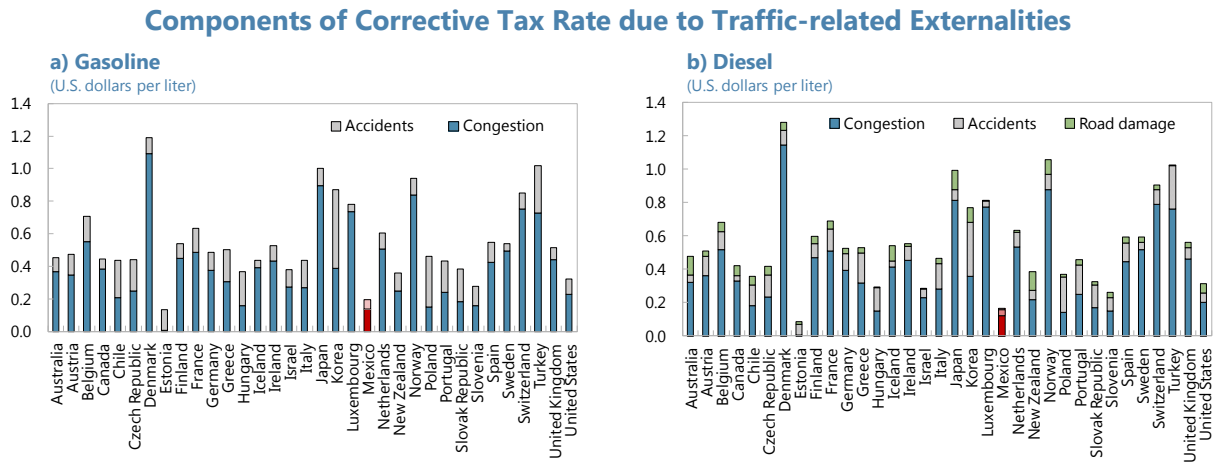
monetary value is used to express the resulting damage in terms of unit of fuels, taking into account the carbon content of each fuel.[7]



Sources: Parry et al. (2014); and IMF staff calculations.
1/ Includes motor fuels and heating fuels.

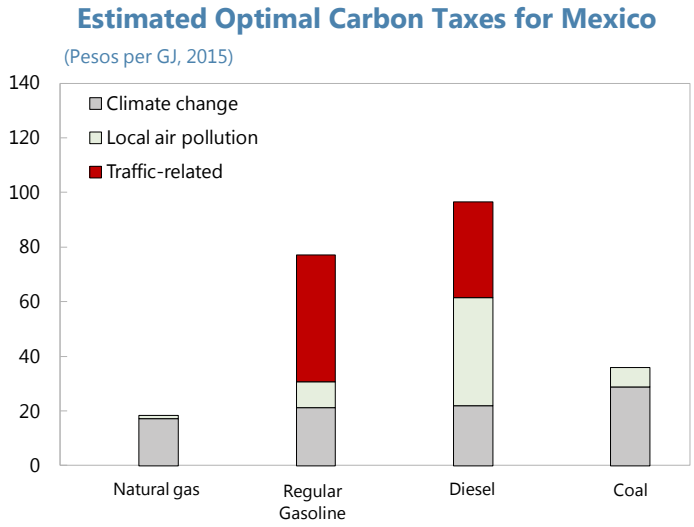
- **The cost associated with externalities derived from traffic congestion involves three components: congestion costs, accident costs, and road damage.** Congestion costs stem from the value of travel time. This is obtained first from estimating the average added travel delay to other road users and then converted into a monetary cost related to local wage rates, using city-level and country-level data (Parry and others, 2014). Therefore, countries with high income level will face a greater cost through value of travel time per unit of time. Accident costs take into account country-specific road-fatality risks as well as other components of accident risk (property damage, medical costs, and nonfatal injuries). Road damage is estimated by attributing a portion of road maintenance expenditures to trucks, though these costs are modest in relative terms.

[7] The population exposure uses an "intake fractions" approach, defined as the average pollution inhaled per unit of emissions released. This exposure is computed taking into account the population residing in regions within certain distance of emission sources; the change in the ambient concentration of pollution, for instance, per cubic meter; meteorological factors; and the emission rate of the pollutant in question (i.e. gasoline, diesel, coal, natural gas). Increased mortality rates from air pollution rely on empirical estimates on the link between intake fractions and mortality risks derived from pollution-related diseases. A controversial next step, but necessary to come up with a monetary cost of pollution, is to estimate how much people value mortality risk. Studies outside advanced economies are scarce. For this reason, the methodology takes an estimate of US$3 million from an OECD study (OECD, 2012) and adjusts it for differences in income levels to come up with country-specific values after updating the above benchmark to 2015 dollars. These monetary costs are ultimately expressed in terms of damage per ton of carbon emissions.



Source: Parry et al. (2014).

11. Estimates of an optimal carbon tax for Mexico reach, quoted in MEX$ per GJ, 18 for natural gas, 77 for regular gasoline, 97 for diesel, and 36 for coal.[8] Local air pollution and traffic-related are the dominant externalities for gasoline and diesel. Natural gas, being a much cleaner fossil fuel, requires only a small tax to correct for air pollution externalities from its combustion, but it still requires a significant tax to correct for climate change externalities as its combustion releases significant carbon dioxide into the atmosphere. Coal, on the other hand, requires a higher tax than natural gas on account of both, air pollution and climate change externalities.



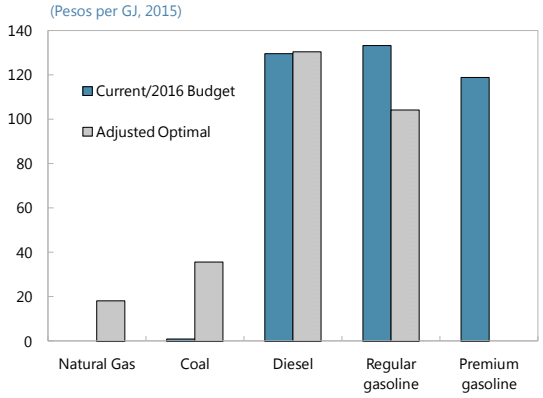
Sources: Parry et al. (2014); and IMF staff calculations.

[8] The estimates are computed in current US dollars, converted to MEX$ using purchasing power parity exchange rates, as recommended by Parry and others (2014). Purchasing power parity exchange rates take into account the local price level and thus reflect more accurately than market exchange rates people's ability to purchase goods or pay out of their own income for risk reductions.

12. Estimated tax rates are likely to be underestimated and should be interpreted as a lower bound. Models with richer micro-foundations, taking into account the interaction of carbon taxes with labor income taxes, can lead to higher carbon tax rates (Parry and Small, 2005). In the specific case of regular gasoline in Mexico, these interactions can lead to a carbon tax 35-percent higher than the one shown above (Anton-Sarabia and Hernandez-Trillo, 2014). Moreover, the methodology employed in this paper considers only premature human mortality when assessing the consequences of air pollution. However, there are other non-fatal consequences that can also have important economic costs. For instance, there is empirical evidence suggesting that increased pollution reduces labor supply (Hanna and Oliva, 2015); it lowers labor productivity (Graff and Nidel, 2012); and it affects children's learning (Sanders, 2012).

13. Proposed excise tax levels are close to optimal. In an attempt to correct for some of the underestimation of optimal tax levels by the baseline methodology, the estimated taxes are scaled up by 35 percent—roughly the estimated contribution of interactions with labor income taxes discussed above. For simplicity, it is assumed that the scaling factor is the same for diesel and gasoline. The resulting "adjusted" Pigouvian tax is shown in the next figure together with the proposed taxes in the 2016 budget—in the case of gasoline and diesel—and those currently in place for coal and natural gas.[9] The methodology employed here offers no specific tax for premium gasoline, but its higher energy content would suggest lower taxes than regular gasoline. Natural gas and coal are significantly under taxed—if their externalities were to be addressed entirely through taxation—but the proposed levels for gasoline and diesel are close to optimal. Note that the assumed adjustment to the estimated Pigouvian tax still has unaccounted factors, such as the impact of pollution on labor productivity and supply, which implies that the adjusted tax should still be seen as a lower bound.

Estimated Optimal Carbon Taxes in Mexico



Sources: Parry et al. (2014); and IMF staff calculations.

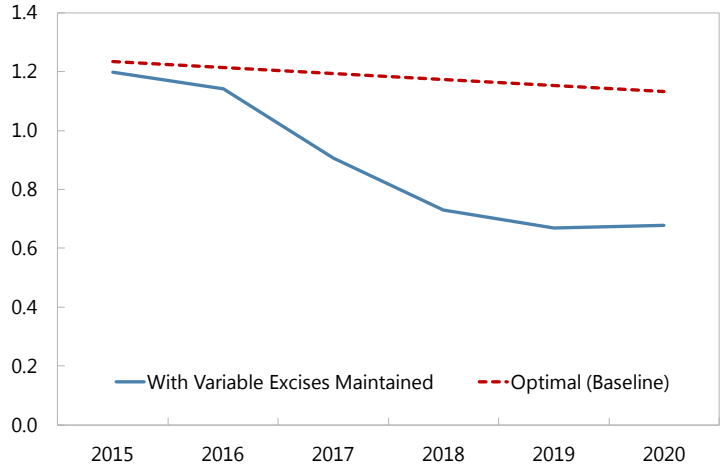
[9] The 2016 budget proposed a reform to the IEPS law which encompasses substituting the variable excise component for gasoline and diesel with a fixed excise equal to the level shown in the graph. The proposed reform does not affect other fossil fuels, with natural gas continuing to be exempted.

E. Impact of Imposing Carbon Tax Rates

14. Fixing excises at the baseline optimal levels would avoid a decline in fiscal revenues of about ½ percent of GDP in the medium term if the current system of excises were kept. In the short-run, fuel demand tends to be highly inelastic. Mexico-specific studies find estimates of price elasticities ranging from -0.1 to -0.2 (Galindo, 2005; Crotte and others, 2010; and references therein).[10] Using the midpoint of this range we estimate the impact on fuel demand—relative to the baseline[11]--from applying the estimated optimal carbon tax rates to the main fossil fuels—gasoline, diesel, and natural gas represent about 80 percent of PEMEX sales. Taking into account the impact of higher energy prices on demand, fiscal revenues from fuel excises would stabilize at around 1.2 percent of GDP.[12] In contrast, the current system of variable excises would imply lower revenues as oil prices recover.

Fiscal Revenues from Excises

(In percent of GDP)



Source: IMF staff calculations.

15. Concerns about short-run costs of higher energy prices need to be weighed against alternative ways to deliver on fiscal consolidation. The government is committed to lower the public sector borrowing requirements from 4.6 percent of GDP in 2014 to 2.5 percent of GDP by 2018. The required fiscal adjustment will likely imply a negative growth impulse in the short run, regardless of the tools used to deliver on this promise. Taxing energy properly does not get around

[10] Elasticities tend to vary across fuels, users, and even geographically; however, lacking enough granularity in projections of fuel consumption across users, regions, and fuel type, estimations are approximated using average elasticities.

[11] The baseline projection for fuel demand is estimated using a value for the elasticity to real GDP growth of 0.3. Estimates of short-run income elasticities of fuel demand tend to be low. The chosen value of 0.3 in the construction of the baseline is within the range of values estimated in Crotte and others (2010).

[12] For simplicity, we set the optimal tax of premium gasoline equal to the one on regular gasoline to compute estimated fiscal revenues.

this implication but it helps achieve this goal without having to rely on other, more distortionary taxation, such as income tax. Furthermore, it creates incentives to move toward cleaner and cheaper sources of energy with positive long-term implications on growth and health.

16. Over the long-run, the suggested taxation can contribute to a reduction of about 6 percent in carbon emissions, relative to our baseline. Mexican-specific studies find long-run price elasticities for fuel demand ranging from below -0.5 to numbers close to -1 (Galindo, 2005; Crotte and others, 2010 and references therein), depending on different econometric methods, geographic level, and time periods. Estimates at the national level fall closer to the -0.5 estimate than to -1. We use then -0.5—also used in Parry and others (2014)—in our calculations to derive long-term implications on carbon emissions. Under this approach, taxation alone can contribute non-trivially to the recent pledge of reducing carbon emissions in 25 percent by 2030.

F. Conclusions

17. The proposed reform to fix excise taxes on gasoline and diesel to eliminate fuel subsidies permanently is a welcome development. The proposed reform—already approved by the lower chamber of Congress but pending Senate approval—would replace the current system of variable excises with a more conventional fixed excise per liter of gasoline and diesel. The reform is an important step in the process of liberalization of domestic fuel prices and developing a true domestic energy market. It also eliminates permanently inefficient fuel subsidies, which were in place until 2014, and avoid a decline in fiscal revenues under the current system once oil prices recover.

18. From an environmental perspective, the proposed excise levels are close to an optimal Pigouvian tax, and could reduce carbon emissions by 6 percent. This reduction in carbon emissions would contribute non-trivially to Mexico's reiterated commitments ahead of the Paris summit on climate change to take place in late 2015. Needless to say, the estimates are subject to substantial amount of uncertainty and will need to be updated frequently as technology and empirical evidence evolve.

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STRENGTHENING MEXICO'S FISCAL FRAMEWORK[1]

Mexico's fiscal framework has improved significantly in recent years, but some shortcomings remain. This chapter argues that the addition of a nominal anchor, limiting discretion under exceptional circumstances, and a fiscal council can enhance the framework's role as commitment device to fiscal discipline and reduce medium-term fiscal policy uncertainty, particularly after a large negative shock. A new nominal anchor can take the form of an explicit permanent ceiling on the public sector borrowing requirements (PSBR). Setting such ceiling at most at 2.5 percent of GDP would ensure that public debt remains at prudent levels with high probability. Limiting discretion under the exceptional circumstances clause can be achieved by tightening the triggers to invoke it, capping the allowed deterioration in the PSBR, and adding explicit rules about how to return fiscal policy to equilibrium once the clause is invoked. Introducing a fiscal council could help maintain fiscal discipline by providing a non-partisan evaluation of fiscal policy and raising public awareness of the importance of a sound fiscal position.

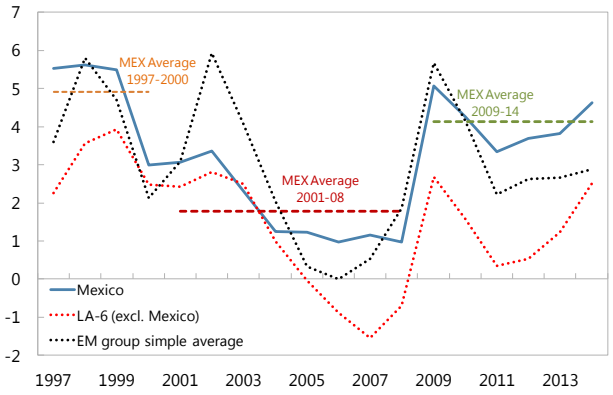
A. Introduction

1. Macroeconomic management in Mexico has improved significantly since the nineties, allowing Mexico to confront the global financial crisis in 2009 with strong fiscal buffers. Unsound banking practices combined with external imbalances, and public debt heavily skewed towards short-term maturities and foreign-currency denomination culminated in the mid-90's with the Tequila crisis. Since then much has changed. On the fiscal front in particular, the years before the global financial crisis were characterized by declining public deficits, prudent public debt levels and composition—largely long-term and domestic-currency denominated—and a new fiscal framework aiming at locking in these gains.

2. These fiscal buffers allowed Mexico to act counter-cyclically in 2009, but the crisis left a legacy of high public deficits. The crisis hit Mexico hard, but Mexico's strong fiscal buffers allowed the country to inject a fiscal stimulus to mitigate the real effects of the shock. However, persistently high fiscal deficits since the crisis suggest that the fiscal framework was effective in allowing flexibility to respond to the global shock but it did not ensure a gradual but steady return to low fiscal deficits in the aftermath of the crisis.

[1] Prepared by Fabian Valencia. The author thanks Carlos Caceres, Dora Iakova, Alex Klemm, Luis Madrazo, Robert Rennhack, and seminar participants at the Bank of Mexico and the Ministry of Finance for valuable comments and suggestions and Alexander Herman for outstanding research assistance.

Overall Public Sector Deficit
(In percent of GDP)



Sources: IMF World Economic Outlook; National authorities; and IMF staff calculations.
Notes: LA-6 excluding Mexico is comprised of Brazil, Chile, Colombia, Peru, and Uruguay. EM comparator group is comprised of India, Indonesia, Poland, Russia, Thailand, and Turkey.

B. Mexico's Fiscal Framework: Recent Improvements and Pending Tasks

3. Important aspects of the fiscal framework have improved in recent years, including the addition of new fiscal targets and the creation of a sovereign wealth Fund. The fiscal responsibility law, enacted in 2006, aimed at locking in the low fiscal deficits that characterized fiscal performance prior to the crisis. It did so by introducing a zero-balance target on the traditional measure of the deficit. However, the traditional fiscal balance did not reflect properly public debt dynamics (Box 1). As a result, the 2014 amendments to the fiscal responsibility law added the PSBR as a target, a much more comprehensive measure of the public deficit, and introduced a cap on the real growth of current structural spending to limit procyclicality in a framework with a headline deficit target. In addition, the amendments changed the way oil revenues are managed. Starting in 2015, a new sovereign wealth fund, the Mexican Oil Fund, manages all hydrocarbon-related wealth, which should help better insulate public spending from transitory fluctuations in oil revenues.

Box 1. The Fiscal Responsibility Law: Main Features

The 2006 fiscal responsibility law (FRL) aimed at locking in low deficits and providing a framework for smoothing the spending of oil revenues over the commodity cycle. Over 2004-2006, Mexico maintained fiscal deficits—measured by the traditional balance—close to zero. The FRL aimed at locking in this performance by introducing a zero-balance target on the traditional fiscal deficit measure. It also introduced a reference oil price to be used for revenue projections to smooth the impact of short-term fluctuations in oil prices in the budget. Excess oil revenues were to be used in part to compensate for certain budgetary overruns (e.g., higher interest costs, and the higher fuel bill of the state electricity company) and in part saved into several stabilization funds (to be used in case of shortfalls), but only up to certain limits.

The framework also increased accountability and transparency of fiscal policy. The law called for annual budgets to be presented in the context of a long-term quantitative framework, with projections for the next five years, and mandated an assessment of the fiscal costs associated with new legal initiatives. Other provisions to strengthen expenditure management included greater transparency and controls over the use of trust funds, greater accountability in the selection of investment projects and social programs through cost-benefit analyses, and steps toward performance-based budgeting, requiring the establishment of indicators to measure program outcomes.

The original target, however, had shortcomings. It was too narrow to conduct an appropriate assessment of the fiscal stance and to reflect properly public debt dynamics. Moreover, the target was later relaxed to exclude PEMEX capital investment and more recently to exclude also investment by the state-owned electricity company, CFE, and some strategic projects.

The fiscal framework did not insulate fully public spending from temporary oil-price fluctuations. In principle, the intention of the framework was to save temporary oil windfalls and smooth policy over the oil price cycle. In practice, only a small fraction of the oil revenue windfall was saved (IMF 2013).

The 2014 amendments added new fiscal targets. They include the PSBR, a more comprehensive measure of the fiscal deficit and thus more relevant for debt dynamics, and a cap on the real rate of growth of structural current spending, set initially at 2 percent and equal to potential output growth from 2017 on. The amendments also introduced targets for PEMEX and CFE, consistent with their new legal status.

A Mexican Oil Fund was also created to manage hydrocarbons-related revenues. The fund now manages all oil-related revenues and payments (except for taxes). The Federal Government no longer receives oil-revenues directly from PEMEX, except for income taxes, also applicable to private oil companies, and instead receives transfers from the Mexican Oil Fund for up to 4.7 percent of GDP. Once long-term savings in the Mexican Oil Fund reach 3 percent of GDP, part of the additional inflows will be spent. The previous budgetary revenue stabilization fund (FEIP) and the states revenue stabilization fund (FEIEF) will continue to operate and will be the first line of defense in case of temporary and unexpected declines in revenues. Long-term savings in the Mexican Oil Fund can be used to cover temporary, but persistent declines in revenues only after the FEIP and FEIEF have been exhausted.

4. But the framework still needs an adequate nominal anchor while limited discretion under exceptional circumstances could reduce fiscal policy uncertainty in the aftermath of a large shock. One shortcoming is rooted in how much discretion the framework allows once a shock hits, through the exceptional circumstances clause, both in terms of when and how much the fiscal stance can deteriorate and how it should be brought back to equilibrium. Once in equilibrium, a nominal anchor guiding fiscal policy in normal times would help strengthen the role of the framework as a commitment device to fiscal discipline. In the original framework, the permanent zero-balance target on the traditional measure of the deficit meant to serve as a nominal anchor. However, its effectiveness was eroded by revisions to its definition and the narrowness of its scope.

C. Dealing with Exceptional Circumstances

5. The case for countercyclical fiscal policy is stronger when large shocks—like the global financial crisis—hit the economy. Art. 17 of the FRL allows for ex ante deviations from the traditional balance target under exceptional circumstances. But ideally, only large shocks should trigger the exceptional circumstances clause. The main rationale is that only in those circumstances one can be certain that a large negative output gap has opened up. Countercyclical fiscal policy can therefore help, provided there is policy space. Under small shocks, the need for counter cyclical fiscal policy is weaker due to the inherent uncertainty surrounding estimates of potential output and downward rigidities in spending, which may make it difficult to reverse increases in expenditure.

6. Tighter triggers to allow invoking the exceptional circumstances clause would ensure fiscal policy discretion is only used when it is strictly necessary. The FRL's regulation includes specific triggers for the exceptional circumstances clause. However, some of these triggers can be reached even under mild shocks.[2] The triggers could be adjusted so that the clause is triggered, for instance, only after a 1–2 standard-deviation temporary shock. In some countries, there are no numerical triggers, but invoking exceptional circumstances is constrained by requiring approval by a supermajority in Congress (Switzerland) or severe economic downturns (European Union's fiscal compact).

7. Once exceptional circumstances are justified, the fiscal framework would also benefit from tighter rules on guiding the return of fiscal policy to equilibrium. This could include limiting the fiscal deterioration allowed in the case of a large shock. For example, in Panama and Peru, the exceptional circumstances clause allows relaxing the deficit ceiling temporarily from 1 percent of GDP up to 3 percent of GDP and 2.5 percent of GDP, in each respective country (Budina and others, 2012). Complementing the framework also with well-specified rules of how to return to equilibrium would ensure a gradual but steady reduction in the PSBR in the aftermath of a large shock. There are several options to achieve this goal. In the case of Peru, the fiscal framework

[2] Examples of triggers include a decline in tax revenues for 2.5 percent in real terms and a 10-percent decline in oil prices, both representing only slightly less than half a standard deviation shock (computed on the annual changes in both variables over 1996-2014).

requires an improvement of at least 0.5 percent of GDP per year until the deficit falls below the 1 percent target. Germany and Switzerland have so called "debt brakes," which involve recording deviations from the deficit ceiling in a notional account until the cumulative balance crosses a predetermined threshold. When this threshold is crossed, the balance needs to be brought down to zero within three annual budgets (Switzerland) or when the economy is recovering (Germany).[3]

D. A New Nominal Anchor

8. Outside exceptional times, a permanent ceiling on the PSBR could serve as a natural new nominal anchor. Current legislation does not specify a particular ceiling for the PSBR but instead requires that a target for the current year and the medium-term is specified in the budget documents. Current medium-term fiscal targets include reducing the PSBR to 2.5 percent of GDP by 2018 and maintaining it at that level at least until 2021 (the last year of the current projection).

9. The implication of alternative ceilings on the PSBR on the probability distribution of public debt is explored through stochastic simulations. Lacking consensus in the literature on a debt threshold beyond which growth prospects are hurt (IMF, 2012), current debt levels are used as benchmark. Mexico's public debt-to-GDP ratio is projected to rise slightly above 50 percent but under the baseline scenario, public debt would fall back to 50 percent by 2020. This level of public debt is also within the range of debt ceilings introduced by several countries into legislation (Box 2). The simulations also assume that the PSBR ceiling can be relaxed up to 2 percentage points of GDP—when real GDP growth is one standard deviation below the mean—but it is brought down to below the ceiling within 3 years. These assumptions help derive implications for public debt not only from imposing a permanent ceiling as proposed but also from limiting the use of the exceptional circumstances clause.

10. A permanent ceiling of 2.5 percent of GDP would keep public debt below 50 percent with high probability in the baseline scenario.[4] The simulations are initialized in 2018. Two scenarios are considered, a baseline scenario in which potential GDP growth stays at 3.3 percent over the long term—corresponding to staff's medium-term potential growth projections—and one in which it is only 2.5 percent, roughly the average growth over the last two decades. Under the baseline scenario, a ceiling of 2.5 percent of GDP would keep public debt below 50 percent with

[3] In Germany, only those deviations that did not result from errors in real GDP growth projections enter the notional account, whereas in Switzerland all misses count.

[4] Public expenditures are assumed to remain constant as a fraction of GDP at 2018 levels, except when the deficit ceiling binds, in which case expenditures are adjusted as needed to meet the PSBR ceiling. The GDP deflator is assumed to grow 3 percent per year, the permanent inflation target of the Bank of Mexico. Fiscal revenues and real GDP growth are treated as stochastic variables. To this end, a linear regression model is estimated relating fiscal revenues growth in real terms to its lagged value and real GDP growth. Similarly, an ARMA (1, 1) model is estimated with real GDP growth data where the constant term is adjusted so that the unconditional mean of real GDP growth equals 3.3 percent under the baseline scenario or 2.5 percent under the low growth scenario. Random draws are obtained from the empirical distribution of the error term in both empirical models to construct 500 paths of 25 years each for the stochastic variables.

82 percent probability over the next 25 years. Setting the ceiling at 2 percent or 1.5 percent of GDP would increase this probability to 95 percent and 97 percent respectively. These probabilities correspond to the whole path of the public debt-to-GDP ratio remaining below 50 percent of GDP. The median debt path shows an average debt level—after 25 years—of about 44 percent of GDP, 39 percent of GDP, and 32 percent of GDP, depending on whether the PSBR ceiling is set at 2.5, 2, or 1.5 percent of GDP, respectively.

Box 2. Examples of Fiscal Rules with Explicit Debt Ceilings

European Union: In 2012, 25 members of the European Council signed the Fiscal Compact agreeing to adopt in legislation national rules that limit annual structural deficits to a maximum of 0.5 percent of GDP and a commitment to continuously reduce the public-debt-to GDP ratio to the 60 percent of GDP threshold, among other elements.

Panama: The Fiscal social Responsibility Law limits the deficit of the nonfinancial public sector at 1 percent of GDP and a debt ceiling of 40 percent of GDP to be reached by 2017.

Indonesia: The State Finance Law and Government Regulation limits the consolidated national and local government budget deficit to 3 percent of GDP and public debt to 60 percent of GDP.

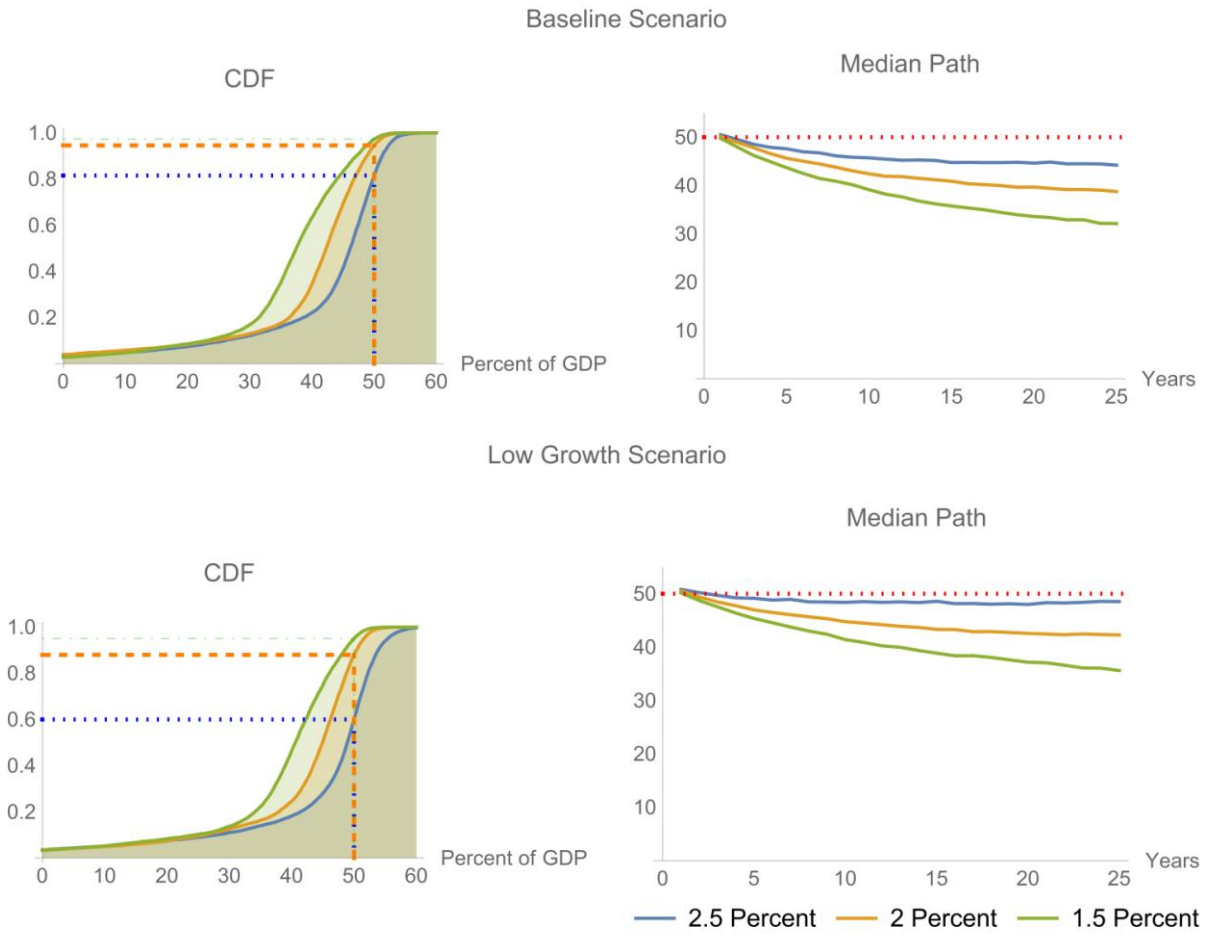
Hungary: The Constitution establishes a debt limit of 50 percent of GDP and public debt must be reduced until this debt ceiling is achieved except when real GDP contracts.

Preemptive Action Triggers

Debt thresholds trigger actions before the debt reaches the ceiling to minimize the risk of breaching it. Examples include Poland and Slovakia, both with debt rules setting a debt ceiling of 60 percent of GDP. In Slovakia, when debt reaches 50 percent of GDP, the Minister of Finance is required to explain to parliament and suggest corrective measures. At 53 percent of GDP, a package of measures is to be passed and wages are frozen. At 55 percent, automatic expenditure cuts for 3 percent and an expenditure freeze for the subsequent year come into effect. At 57 percent of GDP, a balanced budget is required.

11. Under pessimistic potential growth assumptions, only a ceiling of at most 2 percent of GDP would ensure public debt remains below 50 percent with high probability. Under the low potential growth scenario, a PSBR ceiling of 2.5 percent of GDP would imply a 60 percent probability of public debt remaining below 50 percent of GDP over the 25-year simulation period. However, a ceiling of 2 percent or tighter would keep public debt below 50 percent of GDP with 90 percent probability or higher. For this low growth scenario, the median debt path shows an average debt level—after 25 years—of about 48 percent of GDP, 42 percent of GDP, and 36 percent of GDP, depending on whether the PSBR ceiling is set at 2.5, 2, or 1.5 percent of GDP, respectively.

Figure 1. Probability Distribution of Public Debt Under Different PSBR Ceilings



Sources: National authorities; and IMF staff calculations.

Note: CDF= Cumulative Distribution Function. The simulation is implemented by first estimating empirical models on real GDP growth and fiscal revenues, which are used to simulate 500 paths of 25 years each. The key underlying assumptions include constant public expenditure in percent of GDP, and annual percent change of GDP deflator equal to 3 percent. The use of exceptional circumstances clause is embedded by relaxing the ceiling in 2 percentage points when real GDP growth is 1 standard deviation below the mean, but it is required to bring it back to below the permanent ceiling within three years. The plots show the unconditional distribution of public debt and the median public debt path across all 500 simulations.

E. Fiscal Council

12. The introduction of a non-partisan fiscal council can help making the proposed modifications to the fiscal framework more effective.[5] There is a growing interest worldwide in strengthening institutional frameworks through empowering independent watchdogs (Hagemann, 2011; OECD, 2013; IMF, 2013). Fiscal councils contribute to the policy debate by disseminating analyses, opinions, recommendations, and forecasts. Once they have an established reputation, fiscal councils' opinions and recommendations can help improve fiscal performance. The general idea is that enhanced transparency improves democratic accountability; raises public awareness about the consequences of unsound policy actions; and increases the reputational and electoral costs of reneging on fiscal commitments.

13. There is empirical evidence suggesting that fiscal councils contribute to improved fiscal performance. Evidence from country-specific case studies (Belgium, Chile, Hungary, and United Kingdom) looking at fiscal performance before and after the establishment of a fiscal council suggests that fiscal councils contributed to improve fiscal performance (Hagemann, 2011; Lebrun, 2006; Coene, 2010). Cross-country evidence based on EU countries survey data also suggests fiscal councils can improve fiscal performance in particular when a numerical fiscal rule is in place (Debrun and Kumar, 2007). However, Debrun and Kinda (2014), using an econometric approach in a sample of 58 advanced and emerging markets over 1990–2011, find that the mere existence of fiscal councils is not by itself conducive to stronger fiscal balances. It depends on the characteristics of fiscal councils. Those fiscal councils with either legal independence, adequate human resources, or in charge of monitoring adherence to a numerical fiscal rule, assessment and/or production of forecasts, costing government measures, and those with high media impact are often associated with better fiscal outcomes. Debrun and Kinda (2014) also find that fiscal councils and their key characteristics are associated with lower forecast errors on projections of fiscal outcomes.

14. A non-partisan fiscal council with an explicit mandate to assess the sustainability of public finances could help enforce the proposed modifications to the fiscal framework. The mandate of the fiscal council can be gradually broadened as the council establishes its reputation as a non-partisan and unbiased institution (Box 3 provides examples of mandates). The council could issue assessments and recommendations on the appropriate fiscal policy stance, on compliance with the fiscal framework, and on the sustainability of public finances more broadly. Even if the recommendations are not binding, they could force the fiscal authority to follow a comply-or-explain approach. It could even provide inputs directly into the budget process, for instance by being in charge of macroeconomic and fiscal revenue projections or calculating potential output.

[5] Fiscal councils, broadly defined, refer to an independent public institution informing the public fiscal debate without partisan influence. More specific definitions narrow down the functions of a fiscal council to comply with this overarching objective and elaborate on what independence means. IMF (2005, p. 4) suggests that a council's main functions could include the provision of independent analysis on fiscal policy developments, the preparation of unbiased projections, and the issuance of "normative judgments" (recommendations) on fiscal policy. OECD (2013) clarifies that the notion of "independence" relates to the non-partisan nature of the council's analysis, and that the work of the council should be forward-looking in essence.

Box 3. Examples of Fiscal Council Mandates[1]

Some fiscal councils prepare budgetary forecasts ranging from projections that are mandatorily used in the budget process to just a technical review of the budget assumptions. For instance, the Dutch government uses the macroeconomic, revenue, and expenditure forecasts prepared by the fiscal council. In the United Kingdom, the Office of Budget Responsibility (OBR) produces 5-year economic and fiscal forecasts, with the Treasury subject to a "comply or explain" clause. In the United States, Canada, and Denmark, the fiscal council's forecasts only serve as a comparator to official projections. In some countries (Colombia and Chile), the fiscal council is responsible to verify the calculation of potential output or the estimation of the reference price of commodities such as oil and copper.

A number of councils produce also medium- to long-term fiscal projections. The US Congressional Budget Office forecasts typically cover a 10 year period, while the British, Canadian, Korean, and Dutch councils produce longer-term projections (over 40- to 75-year horizons) often in the context of a specific mandate to analyze the sustainability of public finances.

Councils also conduct cost analyses of policy measures. These range from simple reviews of tax and spending estimates used in the budget to an extensive costing of specific policy initiatives. The latter approach is often seen in countries where the fiscal council is associated with the legislative branch (e.g. Canada, Korea, and the United States). The Dutch fiscal council routinely responds to requests from line ministries regarding new policy initiatives and provides cost-benefit analysis of major infrastructure projects. In the United Kingdom, the OBR must review the tax and spending estimates produced by government ministries as part of the draft budget proposal, but it does not cost specific policy initiatives. In Australia and the Netherlands, assessments extend also to the economic and budgetary impact of political platforms prior to elections.

Councils can carry out other functions including the analysis of efficiency of public expenditure and fostering coordination among the various entities of the general government. In Korea and Slovenia, the council makes recommendations for improving the efficiency and effectiveness of government programs (existing or planned). Several councils have also an explicit mandate to examine fiscal issues related to state and local governments and/or public enterprises (e.g. Portugal and Austria).

[1] Further details can be found in IMF (2013).

F. Conclusions

15. The global financial crisis and its aftermath uncovered strengths and weaknesses in Mexico's fiscal framework. The fiscal framework was effective in allowing flexibility to respond to the crisis and allowed Mexico to act countercyclically in response to the shock. However, it was not very effective in ensuring a gradual but steady return to low fiscal deficits.

16. Going forward, a new nominal anchor, limited discretion under exceptional circumstances, and a fiscal council, can make the fiscal framework more effective. A new nominal anchor, such as an explicit permanent ceiling on the PSBR, could help enhance the fiscal framework's role as a commitment device to fiscal discipline. Limiting the use of the exceptional circumstances clause to only large shocks; and limiting discretion under exceptional circumstances—by capping the allowed deterioration in the PSBR and specifying explicitly in the framework the adjustment path towards equilibrium—would also reduce fiscal policy uncertainty in the aftermath of a large shock. Furthermore, a fiscal council could help enforce the proposed modifications to the framework and strengthen fiscal discipline by providing assessments and recommendations on fiscal policy.

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THE EFFECTS OF FX INTERVENTION IN MEXICO[1]

FX Intervention in Mexico takes place through a rules-based approach. Over the last year there have been three major changes to these rules. This background note estimates the effect on the Mexican peso following these announcements. The results suggest that the March and the July 2015 announcements led to an appreciation of the peso by 3 and by 2 percent respectively, in their immediate aftermath. The results on volatility are more mixed. While volatility does decline following these announcements, the effect is not as robust as the one for the level.

A. Introduction

1. Mexico's FX Intervention takes place through a rules-based approach. Pemex is required to sell the foreign exchange from its export proceeds as well as from its net foreign borrowing to the central bank, which in the absence of FX sales yields a steady accumulation of reserves. The Foreign Exchange Comission (Comisión de Cambios), with members from the Ministry of Finance and central bank, sets the rules for FX intervention.

2. The intervention rules are adjusted based on FX market conditions. There have been four significant changes since 2011, with three taking place over the last year.[2]

- On November 29, 2011, a rule was adopted providing 400 million dollars in FX auctions with a minimum price equal to the previous day benchmark exchange rate plus 2 percent. Thus, actual FX sales would only take place if the peso depreciated more than 2 percent. Since the minimum price in these auctions was set at a fairly large threshold for a one-day depreciation, they were only triggered on a few occasions. This rule remained in place until April 8, 2013.
- On December 8, 2014, that mechanism was reintroduced but reducing the sale amount to 200 million dollars and the one-day depreciation threshold to 1.5 percent.
- On March 11, 2015, daily FX auctions of 52 million dollars until June 8 were announced. These auctions did not have a minimum price, so that was the actual amount of FX sold each day. These sales roughly offset the reserve accumulation stemming from Pemex, in essence amounting to a halt in reserve accumulation. On May 22, 2015, the daily FX auctions were extended until end-September.
- On July 30, 2015, the daily auctions were increased to 200 million dollars. The one-day depreciation threshold for an additional 200 million dollar auction was reduced from 1.5 to 1 percent. On September 28, these measures were extended until November 30, 2015.

B. Peso Response in the Aftermath of Changes to FX Intervention Policy

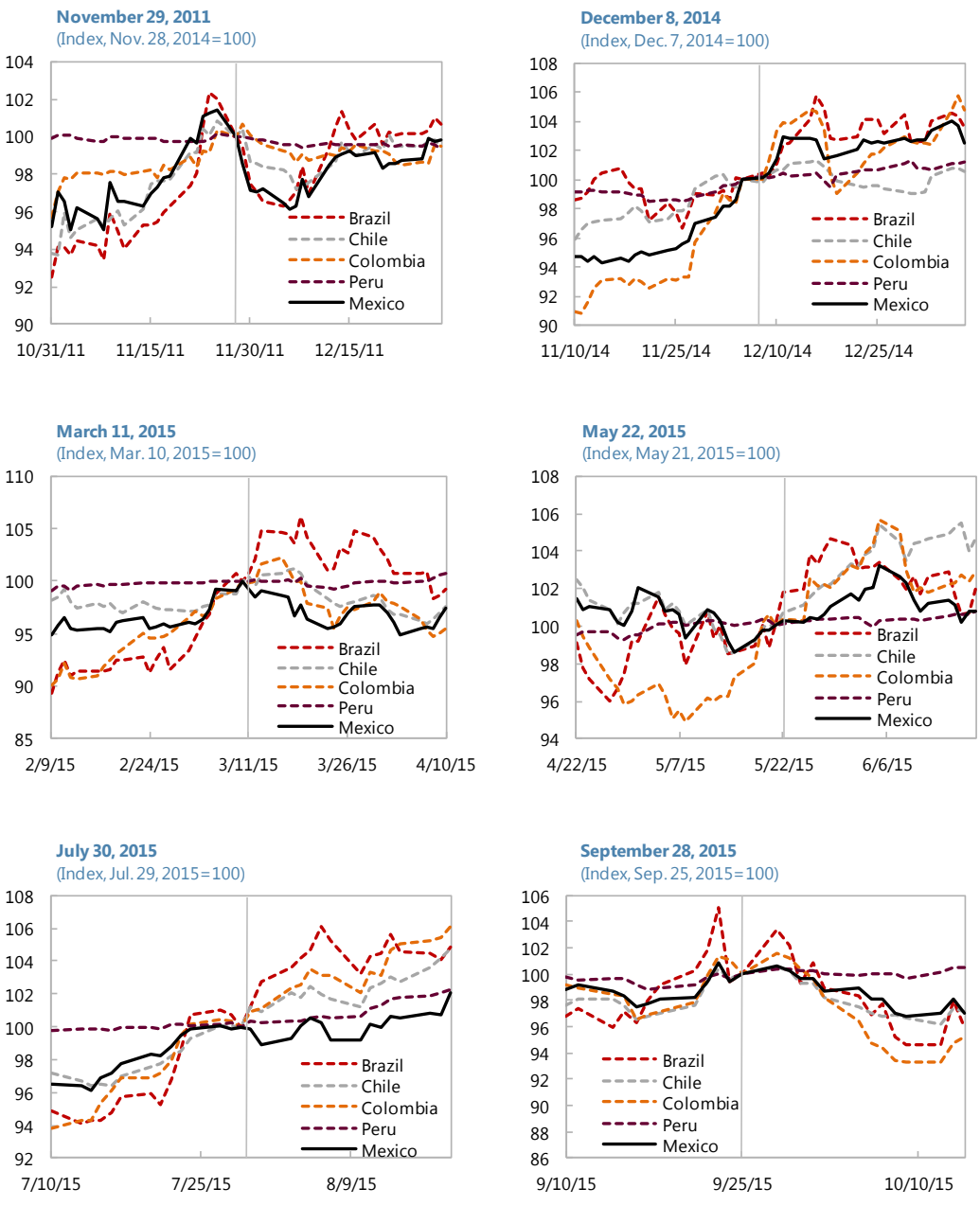
3. The Mexican peso did not appreciate significantly in the aftermath of most announcements, but did tend to outperform comparator currencies (Figure 1). This is

[1] Prepared by Marcos Chamon.

[2] We consider six announcements, two of which were extensions of a previously announced rule.

consistent with the change in rules contributing to a modest appreciation, but being adopted in the midst of depreciation pressures (the usual challenge with assessing the effectiveness of FX intervention). A similar comparison for the evolution of option-implied volatility suggests a more mixed effect (Figure 2).

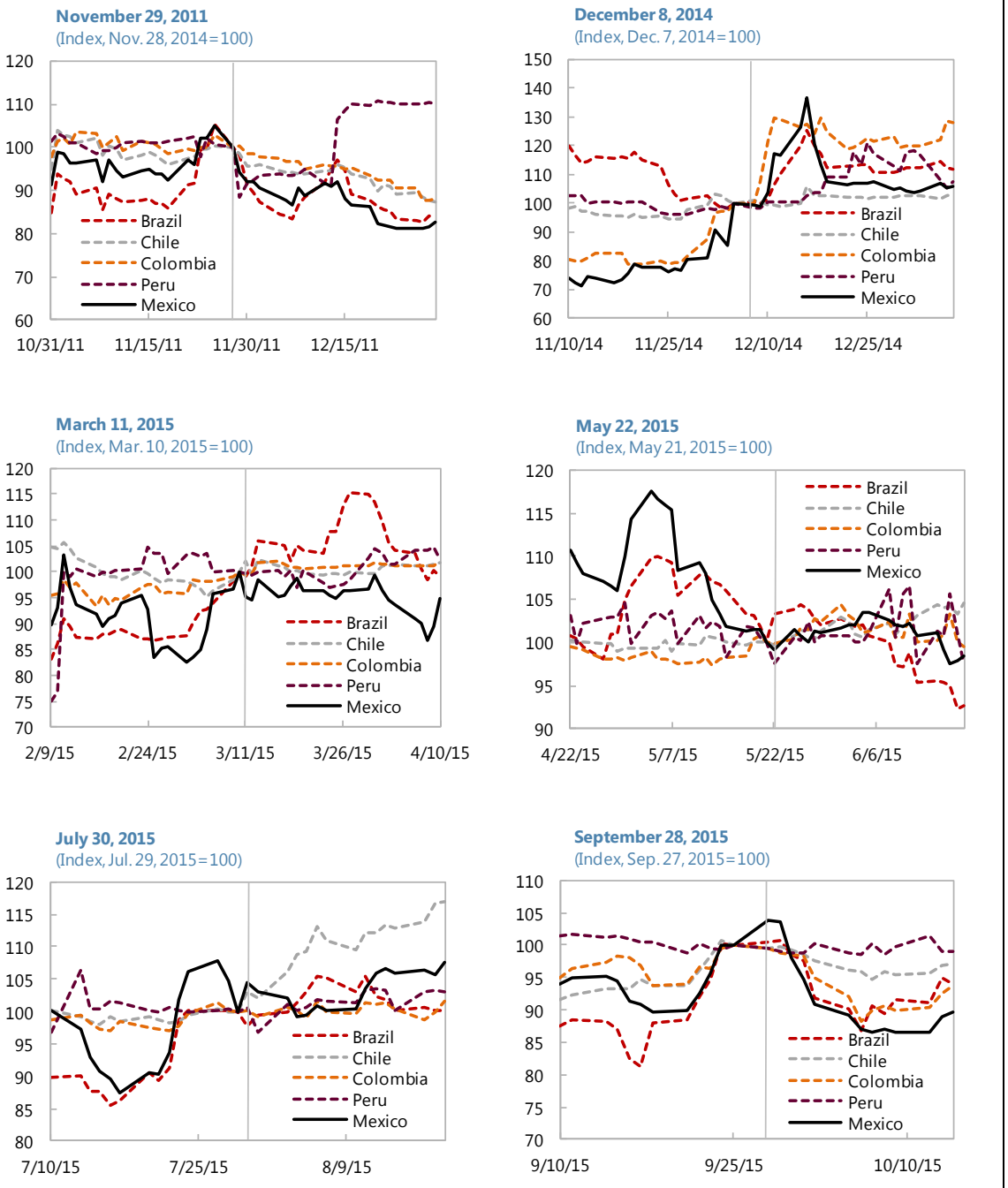
Figure 1: Evolution of the Exchange Rate vis-a-vis the U.S. Dollar Around Foreign Exchange Intervention Program Announcement Dates 1/



Source: Bloomberg L.P.; and IMF staff calculations.

1/ An increase denotes a depreciation.

Figure 2: Evolution of Option-Implied Exchange Rate Volatility Around Foreign Exchange Intervention Program Announcement Dates



Source: Bloomberg L.P.; and IMF staff calculations.

4. We estimate the impact of the announcements controlling for changes in global financial conditions and comparator currencies. We run the following regression for the log change in the exchange rate:

$$\Delta \log e_{MEX,t} = \alpha + \beta_1 \Delta \log e_{CHL,t} + \beta_2 \Delta \log e_{COL,t} + \beta_3 \Delta \log e_{PER,t} + \beta_4 \Delta \log DollarIndex_t + \beta_5 \Delta \log VIX_t + \beta_6 \Delta \log OIL_t + \beta_7 \Delta US10Y_t + \sum_{\tau=0}^{5} \delta_{1,\tau} D_{1,t-\tau} + \sum_{\tau=0}^{5} \delta_{2,\tau} D_{2,t-\tau} + \sum_{\tau=0}^{5} \delta_{3,\tau} D_{3,t-\tau} + \sum_{\tau=0}^{5} \delta_{4,\tau} D_{4,t-\tau} + \sum_{\tau=0}^{5} \delta_{5,\tau} D_{5,t-\tau} + \sum_{\tau=0}^{6} \delta_{6,\tau} D_{6,t-\tau} + \varepsilon_t$$

which includes as explanatory variables the log change in the exchange rates for Chile, Colombia, and Peru, and an index of the value of the US dollar vis-à-vis other major currencies, the log change in the VIX, oil prices, and the change in the US 10 year yield, as well as dummy variables that equal to one on the day in which a change in intervention policy is announced.[3] For example, the dummy D_1 is equal to one on November 29, 2011, and zero everywhere else. We also include the lagged value of these dummies in the regression, which allows us to estimate the effect over a longer time window.[4] Our time sample starts in 2010, and we consider dummies for the six announcements in Figure 1. All of the changes in FX intervention rules took effect on the day following their announcement (except for the March 11th, 2015 announcement which took effect on the same day and the May 22nd, 2015 extension to the daily FX auctions which took effect on June 9th, 2015). Focusing on their immediate aftermath provides a reasonable empirical strategy to quantify the effect, provided these announcements were indeed the major financial news around those dates. The exchange rate is a forward looking variable, and should adjust as the market prices in the expected stream of future intervention. But our estimates may underestimate the full effect if different frictions prevent that adjustment from taking place right away.

5. The regression points to a significant appreciation of the peso following the November 2011, and the March and July 2015 announcements. The table below reports the estimated effects for windows that range from only the day of the announcement (*t*) to windows that include the five working days after the announcement (*t* to *t+5*). The cumulative appreciation by *t+5* was 2.5 and 3.4 percent following the November 2011 and March 2015 announcements, respectively, while the effect from the July 2015 announcement peaks at a 2 percent appreciation at *t+2*. The December 2014 announcement does not seem to affect the exchange rate. The May 2015

[3] We did not include the Brazilian real in the list of explanatory variables. While historically the Mexican peso often commoved with the Brazilian real, the latter has become more volatile in the recent period, being driven by significant home-grown vulnerabilities, which could add noise to our estimation.

[4] For example, the effect on the exchange rate on the day of that announcement is given by the coefficient $\delta_{1,0}$, whereas the cumulative effect including the following day is given by $\delta_{1,0}+ \delta_{1,1}$, and the cumulative effect over the first 3 days is given by $\delta_{1,0}+ \delta_{1,1}+ \delta_{1,2}$.

and September 2015 also have little or no effect, possibly because they involved extensions of an existing rule, which were likely anticipated by the market.[5]

6. We cannot determine whether the estimated effects are permanent or transitory. The standard deviation for daily changes in the peso is around 0.7 percent, while the standard deviation from the residuals from this regression is about 0.5 percent (depending on the sample). Over time, the standard error of the cumulative change increases with the square root of *t*. So estimates that use a horizon beyond a few days will imply standard errors that are wide enough to overwhelm any effect we could plausibly expect from these announcements.

Estimated Effect of the Different Announcements on the Level of the MXN/USD Exchange Rate 1/

	Announcement					
	Nov 2011	Dec 2014	Mar 2015	May 2015	Jul 2015	Sep 2015
Cumulative Change on the Exchange Rate Since Announcement (Percent) 2/						
t	-1.28**	-0.76	-1.25**	-0.19	-0.71	-0.42
	[0.52]	[0.52]	[0.52]	[0.52]	[0.52]	[0.52]
t to *t+1*	-1.64**	-0.56	-1.36*	-0.37	-1.54**	-0.51
	[0.74]	[0.74]	[0.73]	[0.73]	[0.74]	[0.74]
t to *t+2*	-1.61*	-0.92	-1.48	-1.5*	-1.96**	-0.66
	[0.9]	[0.91]	[0.9]	[0.9]	[0.91]	[0.9]
t to *t+3*	-1.55	-0.03	-1.89*	-1.51	-1.28	-0.02
	[1.04]	[1.05]	[1.04]	[1.04]	[1.05]	[1.04]
t to *t+4*	-2.13*	-0.27	-2.18*	-1.39	-1.13	-0.21
	[1.16]	[1.17]	[1.16]	[1.16]	[1.17]	[1.16]
t to *t+5*	-2.53**	-0.42	-3.36***	-0.96	-1.7	0.62
	[1.27]	[1.29]	[1.28]	[1.28]	[1.28]	[1.28]

Source: IMF staff calculations.

1/ Based on a regression of the log change in the Mexican peso exchange rate on the log change in the exchange rate for Chile, Colombia, and Peru, the exchange rate of the dollar vis-à-vis a basket of major currencies, the VIX, oil prices, the change in the U.S. treasury 10 year yield, and dummy variables for the different announcements and their lags. For conciseness, only the cumulative effect implied by the dummies is reported. Standard errors in brackets. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

2/ An increase denotes a depreciation.

7. A similar regression points to more mixed effects on the option-implied volatility. There is a decline in volatility, at least on impact, following the first three announcements. It initially increases before declining in the aftermath of the July 2015 announcement. The results need to be interpreted with caution, since intervention may increase volatility in the very short-term (e.g. as it facilitates a correction) while potentially reducing it over a longer horizon (beyond what can be

[5] It is worth noting that the impact on the exchange rate is not proportional to the size of the intervention implied by the announcement. For example, the estimated response to the July 2015 announcement is smaller than the one for the March 2015 announcement, even though the latter almost quadrupled the amount of daily FX sales from the former. There are many factors that could contribute to a less than one-for-one response, including the possibility that intervention becomes less effective as its size increases.

meaningfully captured by our regressions). More generally, volatility is often associated in the empirical literature to the variance of the shocks, or as in our case, to the option-implied parameter for the standard deviation of the exchange rate stochastic process. But in practice authorities are more likely to be worried about sharp movements in the exchange rate. That risk may be better captured by sizable deviations of the level from its perceived equilibrium rather than traditional measures of volatility (which for the same reasons may be an imperfect measure of disorderly market conditions).[6]

Estimated Effect of the Different Announcements on the Percent Change in the Option-Implied Volatility of the MXN/USD Exchange Rate 1/

	Announcement					
	Nov 2011	Dec 2014	Mar 2015	May 2015	Jul 2015	Sep 2015
Cumulative Change on the Option-Implied Volatility Since Announcement (Percent)						
t	-4.51*	-4.04*	-6.49***	-1.68	2.46	2.26
	[2.39]	[2.39]	[2.39]	[2.39]	[2.39]	[2.39]
t to *t+1*	-2.99	-5.34	-4.7	0.02	1.97	2.59
	[3.38]	[3.39]	[3.37]	[3.37]	[3.38]	[3.37]
t to *t+2*	-2.85	-5.45	-4.25	-4.64	-3.41	-1.78
	[4.14]	[4.2]	[4.13]	[4.14]	[4.17]	[4.13]
t to *t+3*	-4.76	4.07	-6.91	-4.91	-8.05*	-3
	[4.77]	[4.86]	[4.78]	[4.78]	[4.8]	[4.77]
t to *t+4*	-6.14	2.86	-6.5	-3.47	-7.97	-4.78
	[5.34]	[5.43]	[5.35]	[5.34]	[5.37]	[5.34]
t to *t+5*	-7.37	10.59*	-1.56	-3.39	-9.76*	-4.11
	[5.85]	[5.93]	[5.86]	[5.85]	[5.88]	[5.85]

Source: IMF staff calculations.

1/ Based on a regression of the log change in the option-implied volatility for the Mexican peso on the log change of the option-implied exchange rate volatility for Chile, Colombia, and Peru, the exchange rate of the dollar vis-à-vis a basket of major currencies, the VIX, oil prices, the change in the U.S. treasury 10 year yield, and dummy variables for the different announcements and their lags. For conciseness, only the cumulative effect implied by the dummies is reported. Standard errors in brackets. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

8. Signaling effects may have strengthened the effects of FX intervention. There are two main ways through which sterilized intervention can affect the exchange rate: the portfolio balance and signaling channels. By changing the relative supply of domestic and foreign currency assets, intervention can affect the exchange rate through a portfolio balance channel, as investors demand compensation to shift their holdings towards the asset whose net supply the central bank is increasing.[7] In the particular case of FX sales by the central bank, investors would demand a more

[6] A similar regression to the ones above but using the bid-ask spread as the dependent variable does not yield any statistically significant results.

[7] The decision to intervene itself is often a response to changes in investor portfolio allocations.

appreciated exchange rate in order to hold the additional FX being provided. An early literature focusing on FX Intervention in Advanced Economies (AEs), surveyed in Sarno and Taylor (2001), was skeptical about the importance of this channel, since the amount of FX Intervention was very small compared to the size of bond markets. But in the case of Emerging Markets (EMs), FX reserves can amount to a significant share of local bond markets, and this channel can be stronger (although Mexico is not among the most active interveners in the FX market). Intervention can also affect the exchange rate through a signaling channel, by changing market perceptions of fundamentals, and expectations about future policies, including the stance of monetary policy. This channel may be particularly relevant in the case of Mexico, given the market's expectation that the central bank will adjust its policy rate for financial stability reasons in response to changes in U.S. interest rates.

9. Our results suggest FX intervention does have traction in Mexico. Most studies focusing on EMEs tend to find at least some impact of intervention (please refer to Menkhoff 2013 for a survey of that literature). Previous studies on Mexico include Guimarães and Karacadag (2004) and Domaç and Mendoza (2004). Both find an effect of FX sales on the level of the exchange rate, but the former finds that FX sales increase volatility while the latter finds that it reduces it. A more recent study by Garcia-Verdu and Zerecero (2013) finds that FX auctions reduce bid-ask spreads. Overall, our findings are on the stronger side of what is typically found in this literature.

C. Concluding Remarks

10. The FX intervention policy is likely to have contributed to stability in the FX market. It has provided extra FX liquidity at a time of heightened uncertainty in anticipation of the Fed liftoff. It also sent a signal that the central bank is concerned about the speed of depreciation of the peso, and could adjust monetary policy if the depreciation threatens the achievement of the inflation objective.[8] The analysis in this paper finds that the March and the July 2015 announcements led to an appreciation of the peso by about 3 and 2 percent respectively, in their immediate aftermath. The results on volatility are more mixed. While volatility does decline following these announcements, the effect is not as robust as the one for the level.

11. Going forward, the benefits of intervention need to be weighed against the cost of further depleting reserves. While FX intervention is not costly in the sense of implying expected losses, it does deplete the stock of reserves, and the current pace of intervention is not sustainable over the medium-term.

[8] Ostry, Ghosh and Chamon (2012) present the case for using two policy instruments—the policy interest rate and sterilized foreign exchange market intervention—in emerging market countries aiming to meet an inflation target while avoiding currency movements that clearly represent substantial deviations of the exchange rate from its medium-run multilaterally-consistent value.

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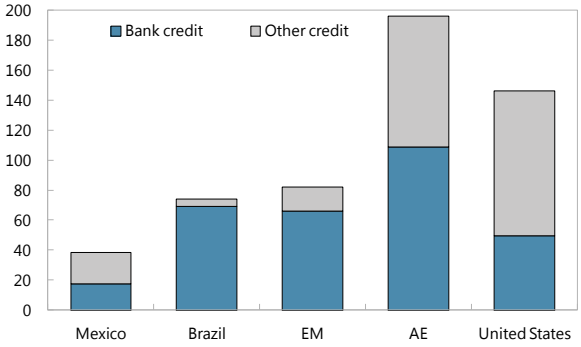
FINANCIAL DEEPENING IN MEXICO[1]

International comparisons reveal that, even controlling for a host of explanatory factors, credit depth is exceptionally low in Mexico, with a structural gap of about 40 percent of GDP. Possible explanations include the history of banking crises, the large informal sector and an inefficient legal system. Recent financial reforms address many of the supply constraints, but their success will depend on implementation. The main challenge going forward will be to support financial deepening, while limiting risks to financial stability. Current credit growth rates of around 10 percent allow gradual financial deepening, and boosting them much further would appear risky.

A. Motivation

1. The Mexican authorities are striving to boost growth structurally. Following the improvements in macroeconomic frameworks and the recent structural reforms, it is important to ensure that there are no other factors holding back the expected improvement in growth rates. One of the potentially important conditions for economic growth is the availability of financial intermediation, as recent studies (e.g., Sahay and others (2015) and papers quoted therein) have shown a positive growth impact from financial development.

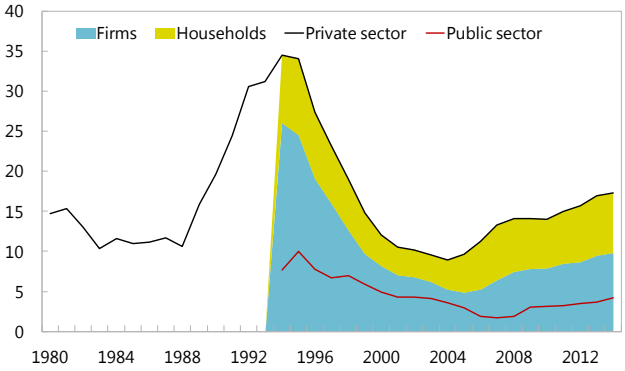
Credit to the Nonfinancial Private Sector, 2014
(In percent of GDP)



Sources: BIS; and Banxico.

2. Credit depth is very low in Mexico, not only in comparison to advanced economies, but also emerging markets. Bank credit is about a quarter of the level observed in other emerging markets, including Brazil, and it is just 1/6th of advanced economy average. While this paper focuses on bank credit, even total credit is comparatively low, so including other sources of credit would not change this broad finding.

Recipients of Banking System Credit
(Percent of GDP)



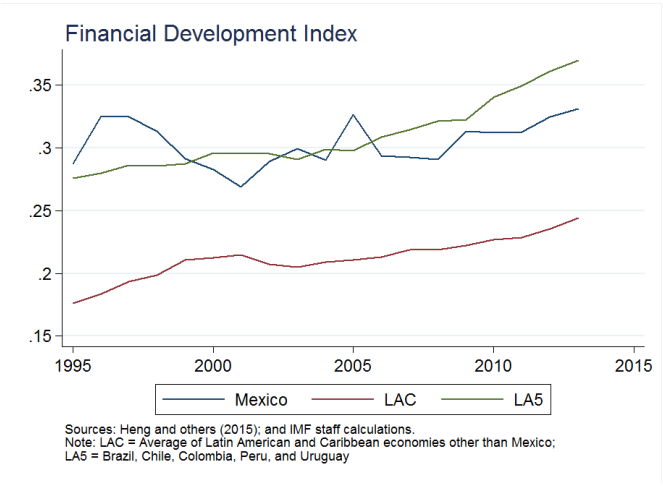
Sources: BIS; and Banco de Mexico.

3. The low degree of financial intermediation has been a feature of the Mexican economic for the last two decades and—apart from a short-lived boom in the early nineties—many years before. In particular, credit to firms has been low, which is worrying, as empirically this part of credit is particularly important for growth (Angeles,

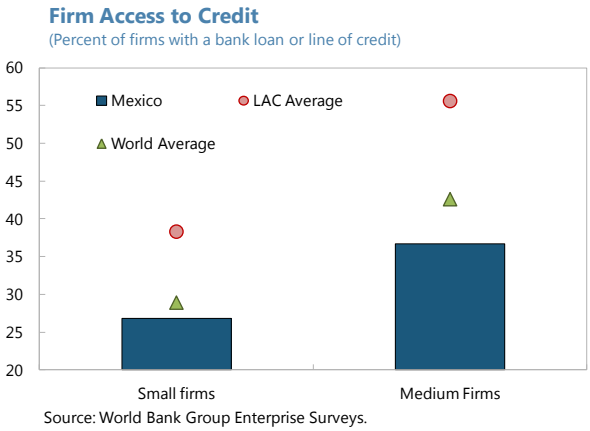
[1] Prepared by A. Klemm and A. Herman

2015). Given prudent macroeconomic policies, this is not caused by financial repression. Indeed, bank credit to the public sector is also quite low and while there may be some crowding out of other lending, it is unlikely to be a sufficient explanation.

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



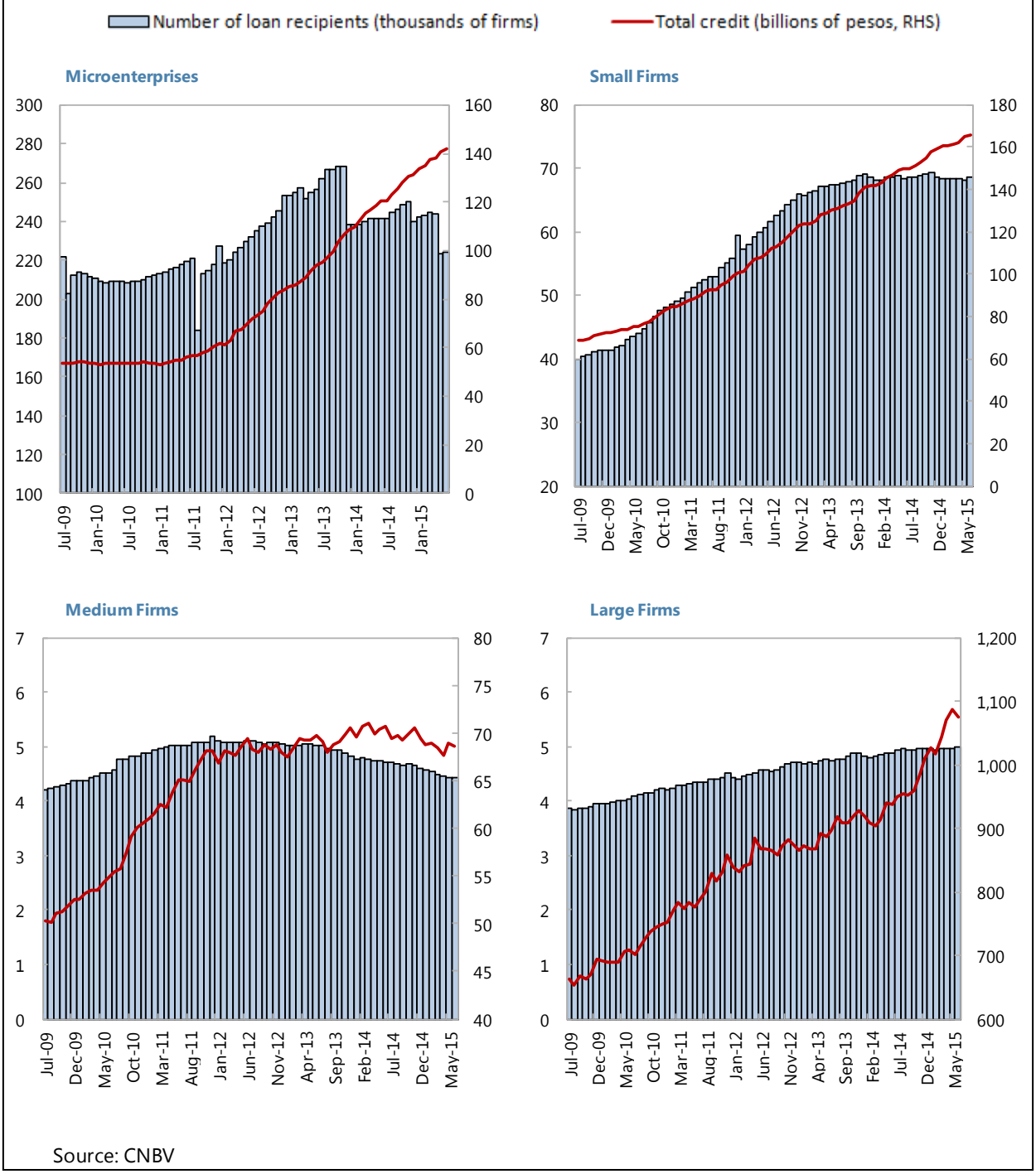
5. Access to credit remains difficult for some individuals and businesses. According to the World Bank Financial Inclusion Database, in 2014 51 percent of adults borrowed some money, but only 10 percent (up from 8 percent in 2011) used a formal financial institution. According to the 2010 World Bank enterprise survey, access to credit by small and medium-sized firms is low by international standards (text figure). CNBV data show that the amount of credit has been growing for most categories. However, the number of businesses obtaining loans has stagnated in the case of medium firms and recently even fallen in the case of microenterprises (Figure 1). According to the World Bank's Doing Business Indicators, however, Mexico fares relatively well in terms of ease of getting credit, with a rank of 12, and a distance to frontier of 20 percentage points (down



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

from 25 percentage points in 2014) in 2015. The subcomponent of the strength of legal rights was however a weak point (at 8 out of 12 points).

Figure 1. Mexico: Bank Loans to Enterprises



Source: CNBV

6. The economic benefits of deepening financial integration need to be weighed against the risks to financial stability. Excessive credit growth can lead to financial risks and has been shown to be one of the most robust predictors of banking and currency crises (the other predictor being real appreciation, see Gourinchas and Obstfeld (2012)). This is particularly important in an environment of rising interest rates. This would immediately affect the affordability of variable interest rate loans, but ultimately also the cost of rolling over fixed-term debt, and it could entail risks for financial institutions with maturity mismatches.

7. Credit growth can be both cyclical and structural, but empirically it can be difficult to disentangle both. The recent financial reforms could boost credit structurally, but the improvement in the economy can also be expected to lead to a cyclical rise in credit, given that credit cycles tend to lag growth cycles in Mexico.

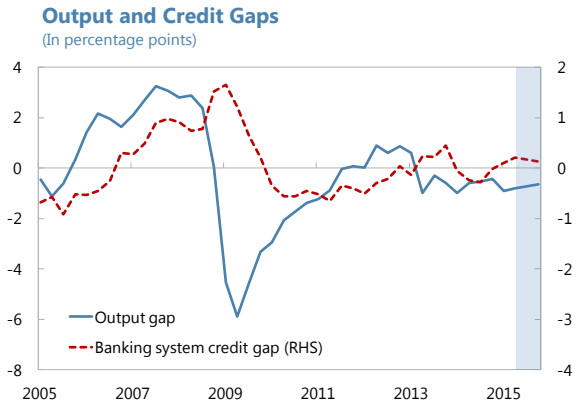
8. This paper aims to address a few policy-relevant questions related to financial intermediation in Mexico:

- How large is the gap between credit depth in Mexico and other economies, controlling for macroeconomic and structural fundamentals?
- What are the potential reasons for the low level of financial intermediation?
- Are current trends and policies adequate or is there a need for fundamental change?

B. Credit Depth in Mexico

Credit cycles

9. Estimates suggest that the cyclical credit gap is small in Mexico. This means that credit is currently growing close to its trend rate. However, if there is a structural change in trend credit growth, then estimates based on an HP-filter are hard to interpret. Credit cycles also appear to lag output cycles, a finding which has also been confirmed in a dedicated empirical study (Banco de Mexico (2010), Box 3).



Sources: National authorities; and IMF staff calculations.

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

Table 1. Mexico: Synchronization of Credit and Real Cycles				
	Number of cycles (1980-2014)	Average cycle duration (in years)	Amplitude	Synchronization Ratio with GDP
GDP	8	4.4	0.3	1.00
Total credit	12	2.9	0.8	0.54
Commercial bank credit	10	3.5	1.0	0.56
Other credit	13	2.7	0.9	0.49

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

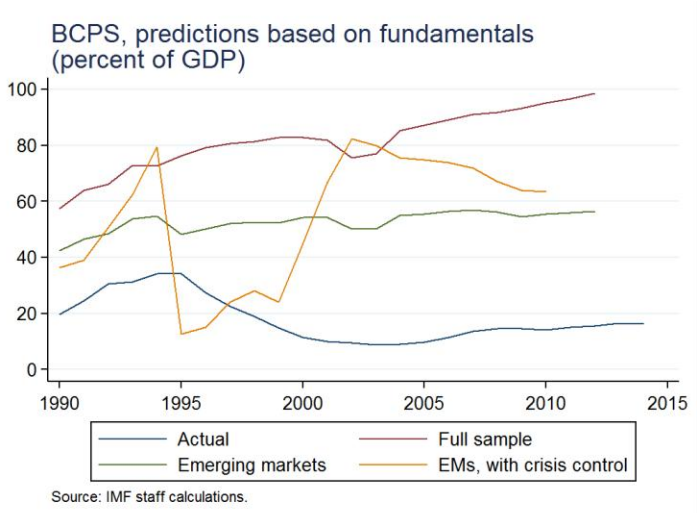
11. Cyclical analysis cannot reveal structural credit gaps. While there does not appear to be a short-term credit gap in Mexico, international comparative data are needed to assess the structural level of financial intermediation. Moreover, if Mexico is in a process of increasing credit depth, then estimated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

Credit depth in international comparison

12. Regressions linking credit growth and fundamentals using international panel data allow the estimation of expected credit levels in Mexico. Specifically, a random-effects regression linking credit depth to fundamentals was estimated using data from advanced and emerging markets. The specification follows closely Cottarelli and others (2004):

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

where BCPS stands for bank credit to the private sector, u_i is a random effect and ε_{it} an error term. X contains explanatory variables, which are: public debt, logged per capita GDP, inflation, capital account openness, bank regulation indicators, legal origin and a time trend. This is estimated on all other countries. Then, using Mexico's fundamentals, the expected level for Mexico is calculated.



13. Given Mexico's fundamentals bank credit in Mexico appears to be between 40 and 80 percent of GPD below of what would be expected. Instead of around 20 percent of GDP, based on estimates from the full sample, including advanced economies, credit would be expected to reach almost 100 percent of GDP. Based on estimates from other emerging markets and Mexican

fundamentals, bank credit would be expected to reach 60 percent of GDP. Finally, to allow for the impact of bank crises, a variable containing the number of years the banking system was in crisis (using data from Laeven and Valencia (2012)) in each country was added. With this approach, Mexican credit depth appears to be in line with expectations during the crisis years. After the year 2000, however, when macroeconomic policy stabilized, credit would have been expected to be much higher. In recent years, the resulting gap is the virtually the same as in the specification without a crisis variable.[3]

C. Reasons for the Low Level of Financial Intermediation

14. The Mexican banking sector has had a tumultuous history, with two major banking crises since 1980. During the debt crisis of 1982 Mexican banks were nationalized and reduced in numbers through mergers. They faced tight regulations, such as interest rate caps and credit allocation regulations, which limited possibilities for credit growth. In the early 1990s the sector was liberalized, banks were privatized again, and new banks also entered the market. Credit supply boomed, but lending standards were low, possibly because of lack of experience after the years of state-owned banking. There were also weaknesses in financial supervision, for example banks circumvented the not open foreign currency exposure limit of 15 percent of capital by using derivatives. The currency crisis of 1994 then had a greater than expected impact on banks, both through international funding difficulties, and because of rising NPLs, resulting from the economic crisis, and specifically from the widespread use of variable rate mortgages, which were affected by the interest rate rises. A major rescue program, partly financed by the IMF and the U.S., was put in place addressing (i) the short-term funding needs of banks that lost access to international markets and (ii) recapitalization needs, both through capital injections via convertible debt and the purchase of NPLs above market value. For some banks these programs were insufficient and the government needed to intervene and take them over. Additionally, various programs were set up to support debtors, especially for mortgages.[4] Overall, estimates of the cost of financial sector support are about 15 percent of GDP (see, for example, McQuerry (1999)).

15. The history of banking crisis is likely to have had lasting effects. Trust in financial institutions was eroded, both for savers who lost deposits in the crisis of the 1980s and for borrowers, who faced difficulties due to rising interest rates in the 1990s. Moreover, banking know-

[3] In addition to the regression based on fundamentals, a regressions relating bank credit to deposits reveal the long-run relationship between both. Similar to Hansen and Sulla (2013) a long-run relationship between bank credit and deposits was estimated using pooled mean regression: $\frac{\text{BCPS}}{\text{GDP}} = \alpha + \beta \frac{\text{Deposits}}{\text{GDP}} + u_i + \varepsilon_{it}$. As in equation (1), the coefficient was estimated using international panel data on countries other than Mexico. Then, predicted bank credit ratios were estimated using Mexico's deposit ratio. Credit and deposits are both low, but the long-run relationship between them is in line with other emerging markets. Given the level of deposits, credit provision is very close to what would be expected based on coefficients from other emerging markets. With coefficients estimated on the full sample, however, credit is below expectations, although to a much smaller extent than in the regressions based on fundamentals.

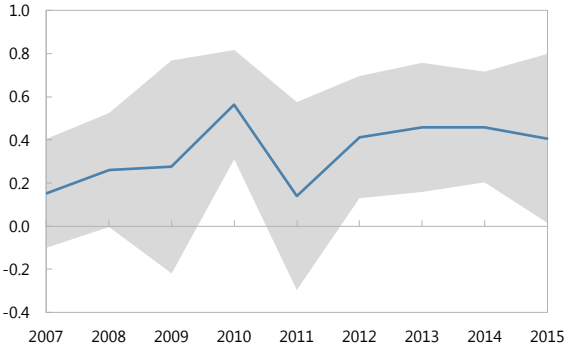
[4] This paragraph draws heavily on Graf (1999), which contains further details on the post 1994 banking crisis.

how was lost, because following the nationalization of banks, a tightly regulated system required very different skills from commercial banking and offered lower rewards. While these effects are likely to have largely faded, the legacy of a years of slow credit and deposit growth still affects today's stocks, even though growth is now at a healthy pace.

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

17. Lack of competition in the banking sector may play a role, but does not seem to be a major impediment. Claessens and Laeven (2004) show that already between 1994 and 2001, banking competition as measured by the H-statistic[5] was relatively high in Mexico compared to other economies. IMF staff estimates of an H-statistic also show a slow, improvement in competition over time. The Herfindahl concentration index[6] stands at 0.13, indicating that the commercial banking sector is moderately concentrated. Recent developments in lending and deposit rates also suggest that competition may be intensifying as spreads are coming down (Figure 2).

Competition in the Commercial Banking Sector
(H-statistic, ranging from -∞ to 1 (monopoly to perfect competition))

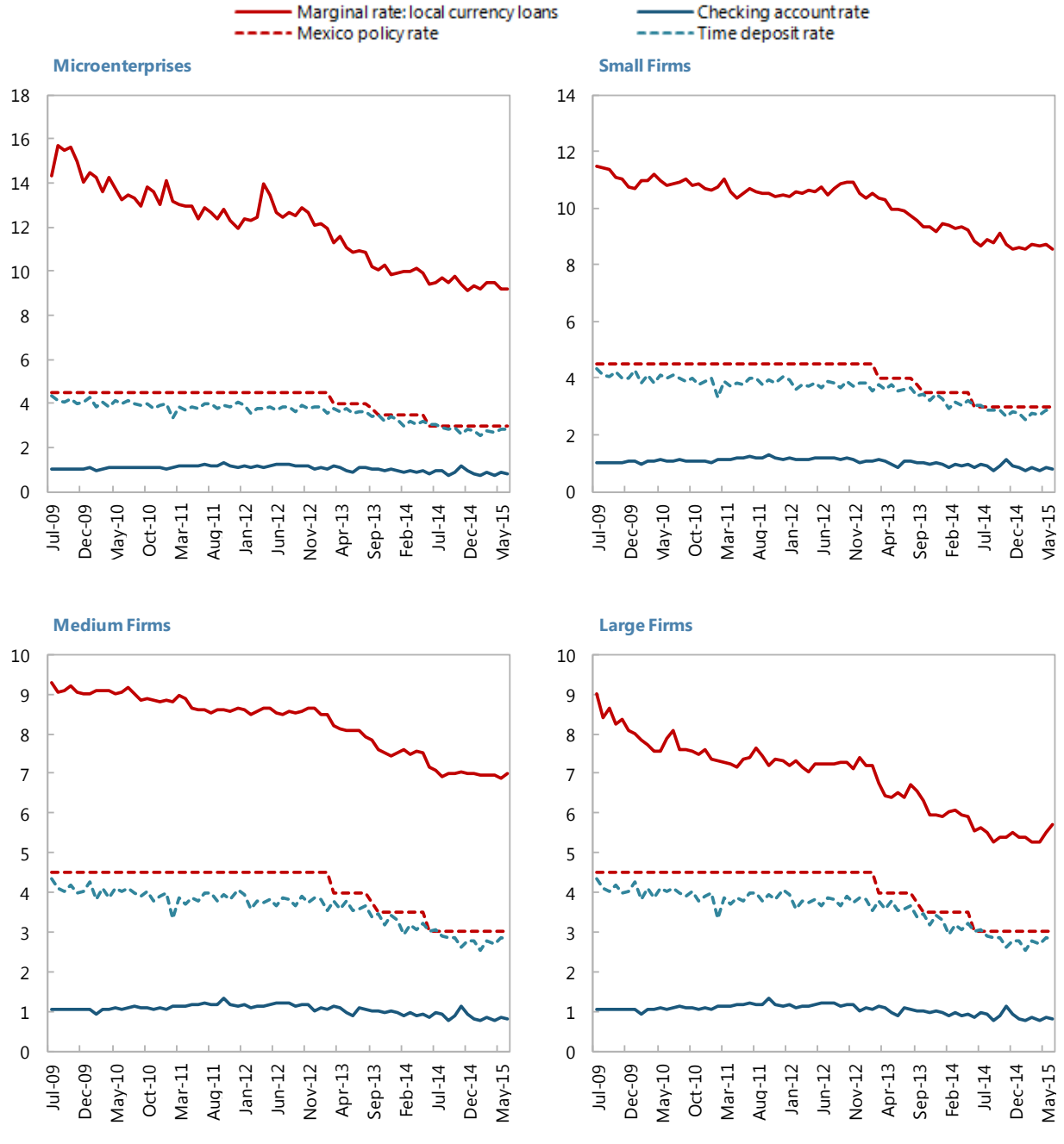


Source: IMF staff calculations.

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

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

Figure 2. Mexico: Marginal Interest Rates



Source: CNBV.

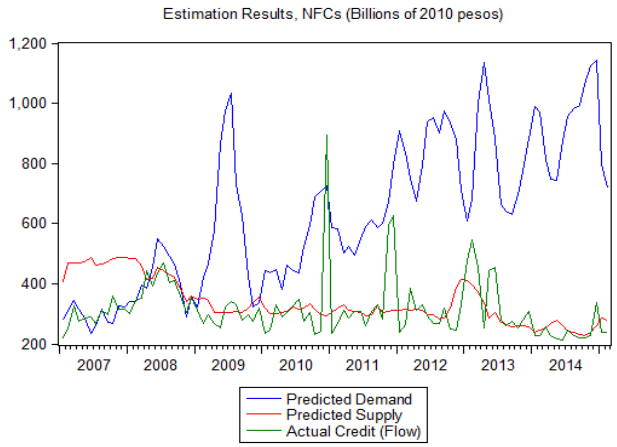
18. Financial education may still be lacking in some sectors of the economy and some regions of the country. More generally, Campero and Kaiser (2013) have shown that households with greater levels of schooling are more likely to be aware of credit sources (formal and informal) and that regions with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

19. The large informal sector may impede access to financial services. Participants in the informal sector find it harder to document their financial situation, given the absence of tax returns. They may also prefer to deal in cash to avoid leaving traces in the financial system.[7] Campero and Kaiser (2013) show empirically for Mexico that households employed in the formal sector are 5.7 times more likely to use bank credit than those in the informal sector.

20. Regressions using a disequilibrium approach allow distinguishing between supply and demand factors in determining credit growth. Following Everaert and others (2015)[8] a disequilibrium approach was used to estimate credit demand and supply separately, so that actual credit is the minimum of both:

$$\begin{aligned} C^D &= \beta_1' X_1 + \varepsilon^D \\ C^S &= \beta_2' X_2 + \varepsilon^S \\ C &= min(C^D, C^S) \end{aligned} \tag{2}$$

where C is new credit to firms measured in real monthly terms, superscripts S and D indicate supply and demand, and X_1 and X_2 are two sets of explanatory variables. Both include the real lending rate as the price of credit. Moreover, demand equation contains the NPL ratio as a measure of debt overhang, consumer confidence as a measure of economic conditions, and the growth of the stock market as a measure of alternative funding sources. The supply equation includes also the NPL ratio as measure of debt overhang, the deposit rate as a measure of funding costs, and banking system capital as a share of the minimum capital requirement as a measure of capacity to lend. This set of related equations is estimated using a maximum likelihood method developed by Maddala and Nelson (1974).



Source: IMF staff calculations.

[7] Nevertheless, indicators of informality came out insignificant in the regressions estimating expected credit depth.

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

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

D. Current Trends and Policies

22. Measures taken in response to the 1994 foreign currency crisis, as well as more recent reforms can be expected to increase trust in the banking system.

- The Bank of Mexico tightened the regulation on net open foreign currency positions following the 1994 crisis to close the loophole that allowed banks circumventing it by using derivatives or off-balance sheet positions.

- Financial regulation has been strengthened over the years, and Mexico has been fast in adopting Basel III accord standards, with both the risk-based capital and the liquidity rules assessed as compliant (Basel Committee on Banking Supervision, 2015). The Liquidity Coverage Ratio applies from 2015 and is phased in according to the Basel implementation schedule reaching the final value of 100 percent in 2019.

- A new deposit insurance institution (IPAB) was set up in 1999. This now insures deposits of up to MXN 2.1 million,[9] which is clearer and more credible than the previous system, which did not have an explicit limit.

23. Difficulties in monitoring credit quality and obtaining access to collateral are being addressed.

- The 2014 financial reform created a new legal instrument to allow for quicker execution of client collateral in case of default. As a result of this and other changes, in the World Bank's (2014) Doing Business data, Mexico's distance to frontier indicator for resolving bankruptcy improved by 6.5 percentage points.

- More mercantile matters, such as loans involving physical collateral, will be shifted to federal courts, but this is not implemented yet.

- Information sharing between the private credit bureaus is improved and will contain information from the public mortgage lenders (Infonavit and FOVISSSTE) in addition to information from private banks.

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

24. Financial education is being strengthened.

- CONDUSEF, the financial consumer protection agency provides various online tools. A new Financial Entities Bureau will facilitate product comparisons across financial entities. It already allows a broad comparison of banks and lists abusive clauses and bad practices.
- The move toward cashless salaries and benefits[10] familiarizes recipients with financial services.
- A more general education reform aims at improving the quality of education.

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

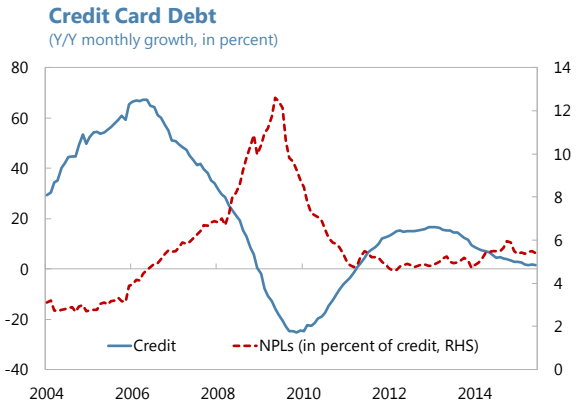
26. The Secretary of Finance has been given the mandate to assess compliance of banks with their objective to support and promote productive sectors and domestic economic growth in accordance to best practices and banking guidelines. The first report will be prepared during 2016 and contain recommendations.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

27. At current credit growth rates, credit depth is increasing gradually and this pace seems appropriate.

- The current growth rate of around 10 percent exceeds the rate of nominal GDP growth. While rising credit to GDP shares are sometimes considered a warning sign, in the case of Mexico this is welcome after years of weak credit. According to estimates by Arcand and others (2015), increasing the share of bank credit by 1 percentage point of GDP to 18 percent of GDP (as forecast for 2016), would boost growth by 0.03 percentage points. Increasing the ratio of bank credit to GDP to 60 percent, would boost growth rates by 0.8 percentage points.
- At the current credit growth rate of around 10 percent, and assuming nominal growth of 6.4 percent over the medium term (potential growth of 3.3 percent and 3 percent inflation), the predicted bank credit ratio of 60 percent of GDP would be reached in 37 years. Boosting the credit growth rate to 15 percent would reduce this time frame to 16 years. An even faster growth rate would be risky. Sahay and others (2015) shows that financial deepening at a fast pace leads to increased growth volatility and financial instability.

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

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



Sources: National authorities; and IMF staff calculations.

E. Conclusions

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

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

31. Empirical evidence supports the idea that structural aspects of the banking sector are behind the low degree of financial intermediation. This is suggested both by results showing that credit growth has been supply-driven in recent years, and by the apparent lagging of credit cycles with respect to real cycles.

32. The financial reforms over the last few years address the weaknesses, but must be strongly implemented and further evolutionary changes will be needed.

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

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