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MEXICO

SELECTED ISSUES

November 8, 2013

Approved By
Western Hemisphere Department

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MEXICO—REFORMS TO THE FISCAL FRAMEWORK[1]

1. Mexico's resilient economic performance would be consolidated by increasing fiscal policy buffers and preparing for challenges associated with long-term budget pressures. In the short term, reducing public debt levels can create space to implement countercyclical fiscal policies and reduce exposure to high financing and hedging costs, which would protect Mexico's credit rating at times of distress.[2] Over the longer term, Mexico will benefit from revenue mobilization efforts to address any potential fall in oil revenues and the projected increase in health and pension expenditure due to population aging. These policy objectives should guide the assessment of the optimal policy framework for Mexico, as no framework shows absolute dominance over others—i.e., no fiscal rule is optimal for every country at any point in time, and there will be trade-offs among them that will depend on policy priorities.

2. The recent fiscal reform is designed with these policy objectives in mind, to build on the strengths of the previous fiscal framework. The previous fiscal framework had been instrumental to stabilize public debt, but some of its designing features were not conducive to addressing challenges ahead. Mexico's experience during the last decade suggests that the rapid increase in primary spending resulted in low savings from the oil price windfall.[3] Moreover, the framework—and in particular the balance target and the provisions defining the savings rule in the Fiscal Responsibility Law (FRL)—has not been instrumental to rebuild the policy buffers that Mexico had before the global crisis. The reforms—which can help contain public spending in periods of buoyant revenue and adopt a more transparent fiscal target in line with the public sector borrowing requirements—are steps in the right direction to increase fiscal policy buffers.

A. Background

3. Mexico's previous fiscal framework was defined in the FRL, which was approved in 2006 and modified in 2008. The FRL introduced a balanced budget rule that applied to the central government, financial and non-financial decentralized agencies, and public enterprises; i.e., to the "the traditional balance". Legislation also included an escape clause to be triggered during economic downturns.[4] The FRL was modified starting the 2009 fiscal year as PEMEX investment was excluded from the coverage of the balanced budget target—implying that the target became a deficit of around 2 percent of GDP.[5] Finally, the traditional balance usually excluded some expenditure and

[1] Prepared by Santiago Acosta-Ormaechea, Esteban Vesperoni, and Jeremy Zook.

[2] During the global crisis, Mexico was downgraded by the main rating agencies. Empirical evidence points to public debt as one key determinant of investment grade ratings in emerging markets. See Jaramillo (2010) and Jaramillo and Tejada (2011).

[3] For details, see Table in Appendix III.

[4] The escape clause in the FRL is described in Article 17.

[5] The exclusion of PEMEX has *de facto* switched the balanced budget rule into a variation of a Golden Rule.

included the drawing of financial resources outside the budget as revenue—i.e., one-off financing operations through the stabilization funds, asset revaluations, and above par issuance of sovereign bonds[6]—to finance spending. These 'adjustments' has generally reached about one percent of GDP per year on average.

4. The FRL helped Mexico anchor macroeconomic stability, and left space to run countercyclical fiscal policies during the global financial crisis. After bringing down the fiscal deficit to record-low levels during the first half of the 2000s, the approval of the FRL in 2006 helped consolidate the improvement in the public sector fiscal stance, introduced a credible macroeconomic anchor, and helped implement a countercyclical response amid the severe recession that took place during the global crisis. Fiscal policy was eased in 2009, leading to a significant fiscal impulse.

5. Primary spending, however, had been steadily increasing and procyclical during the 2000s, resulting in low savings of the oil price windfall during the last decade. Primary spending rose from about 17 percent of GDP in 2000 to about 23 percent of GDP in 2012. Moreover, the real growth in primary spending reached a peak of 13 percent a year in 2006–08—three years of high oil prices and with the economy operating above potential—and then plummeted to minus 5 percent in 2009 in the aftermath of the Lehman crisis.[7] As a result, while the government's potential savings from

Real Primary Spending Growth 1/
(In percent, y/y growth)

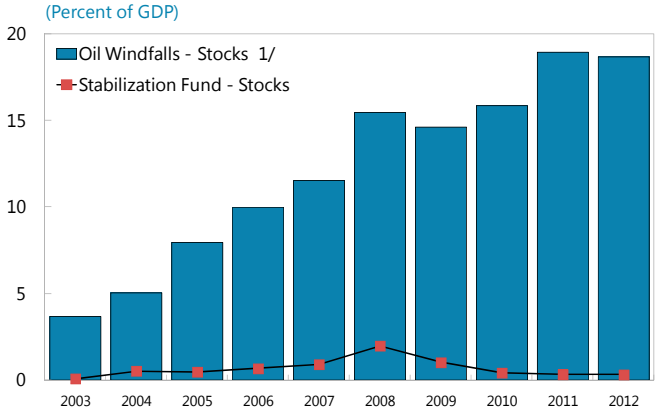
Sources: IMF staff calcuations
1/ Primary spending includes budgetary adjustments and oil subsidies.

[6] One-off financing operations and additional expenditures are usually included in the adjustment lines in Table 2 of Article IV consultations, where further information on these adjustments is described. The main one-off financing operations are captured in the adjustment lines entitled 'Non-recurrent Revenue' and 'Budgetary Adjustment' in the fiscal tables. These operations are accounted under *Aprovechamientos* by Mexican authorities, yet they are netted out in IMF fiscal tables since they reflect the use of financing items.

[7] This rapid increase in primary spending contrasts with potential GDP growth at around 3¼ percent. The figures on primary spending could also be adjusted by the resources sent to the stabilization funds, but this would not change the picture in terms of the trends in this expenditure during the period.

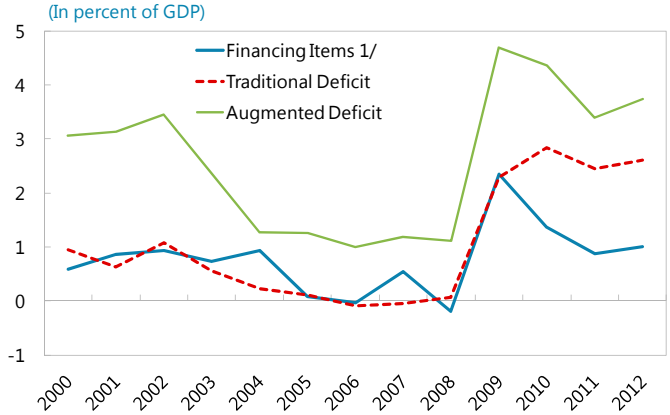
windfall receipts from oil production reached about 18 percent of GDP between 2000 and 2012, only trivial amounts remained in the balances of the oil stabilization funds.[8]

Mexico Oil Stabilization Fund
(Percent of GDP)



Sources: IMF staff calculations
1/ Defined as the difference between oil production at current and budget prices.

Traditional Balance and Financing Items
(In percent of GDP)



Sources: SHCP and IMF staff calculations
1/ Non-recurring revenue, oil stabilization funds, and budgetary adjustments.

6. Moreover, the fiscal framework did not contribute to a rapid rebuilding of policy buffers after the global crisis, as the 2009 stimulus was only partially unwound. In a context of sluggish revenues, the flexibility in the fiscal framework to use one-off financing operations resulted in public sector borrowing requirements above the 2 percentage points of GDP embedded in the fiscal rule. In fact, complying with the FRL required the use of one-off financing operations by about 1 percent of GDP during the last years.

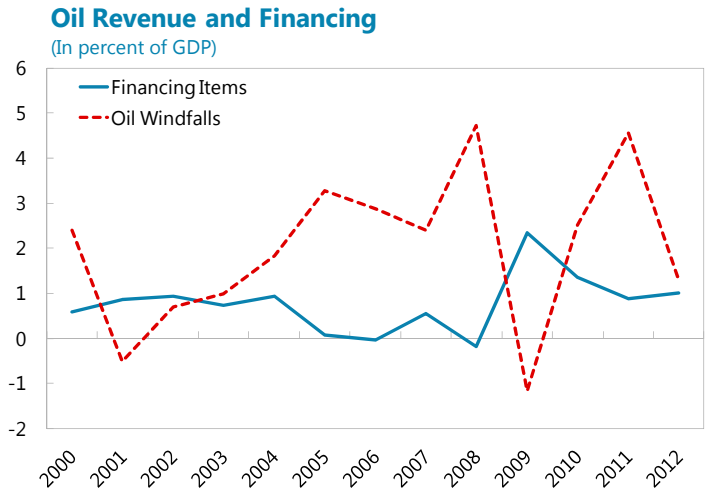
7. This note discusses how the recent reforms and potential further changes can strengthen the fiscal framework: (i) the adoption of a more transparent fiscal rule can strengthen its role as an anchor of macroeconomic policies; (ii) the modifications to the fiscal rule can reduce procyclicality in fiscal policy and help building fiscal buffers—savings—during favorable cyclical conditions; (iii) the discussions on the potential simplification of stabilization funds that could provide a better management of oil wealth; and (iv) the tax reform, which can help secure additional revenue to address longer term spending challenges, although more efforts are likely to be needed in this area.

[8] During this period, oil prices were high, increasing and higher than budgeted.

B. The Reforms

Adopting a more transparent fiscal target

8. The previous fiscal target—the traditional balance—did not reflect the public sector borrowing requirements, weakening its role as macroeconomic policy anchor. The use of one-off financing operations to help fund expenditures has been significant during the last few years. These operations have made the target in the fiscal rule an incomplete measure of the public sector borrowing requirements (PSBR)—which was reported for informational purposes only—and hence undermined its role as a policy anchor. Between 2000 and 2012, the data shows a negative correlation between the oil revenue windfall and the use of one-off financing operations, suggesting that the use of these operations have likely compensated for lower oil revenues to fund expenditures that have ratcheted up during the windfall years.[9] The persistent use of financing operations de facto worsened the PSBR, with the consequent negative impact on the balance sheet of the public sector.



Sources: SHCP and IMF staff calculations

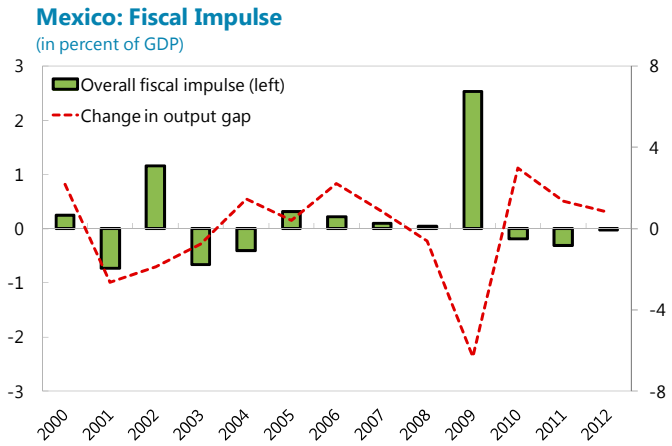
9. The reform introduces the PSBR as an additional target in the FRL, and this step will make the fiscal rule more transparent and enhance policy credibility. The PSBR will be an explicit fiscal target in addition to the traditional measure of the deficit. The 5-year projections for the PSBR included in the annual budget documents will have to be consistent with a sustainable debt path. This target and the efforts to curb under-budgeting practices in the budget law will bring the whole fiscal envelope to the forefront of the policy discussion, and the convergence to a lower PSBR will be made effective as the yields from the revenue reform kicks in fully in a context where primary spending growth will be capped.[10] The new fiscal target will be now the relevant indicator to track debt dynamics, strengthening its role as a macroeconomic anchor.

[9] The correlation between these two series is at almost -0.7 between 2000 and 2012. Starting in 2006, the correlation is even stronger, at about -0.8. Even excluding 2009, the correlation stands at -0.5.

[10] Details on the new cap on primary spending growth are presented in the next sub-section.

Modify the current fiscal rule

10. The low savings during the last decade reflects the fact that fiscal policy was oftentimes procyclical.[11] The evolution of the fiscal impulse suggests that fiscal policy has been procyclical in about half of the time since 2000. This has been particularly the case in years in which primary spending grew the fastest—between 2003 and 2008—at times of high oil prices. As for the years in which fiscal policy was countercyclical, a negative output gap was opening in more than half of them. All in all, out of 8 years in which a positive output gap was opening, fiscal policy delivered a negative fiscal impulse in only half of them.[12]



Sources: IMF staff calculations.

11. Procyclicality was embedded in the modified balanced budget rule, which had also introduced a deficit bias. When revenues decline during a recession, balanced budget rules force a cut in spending. At the same time, these rules typically lack the necessary provisions to encourage expenditure restraint during periods of above-trend growth. Escape clauses that allow for higher spending during downturns can introduce a deficit bias, as the countercyclical response in a recession may not be compensated by surpluses under favorable cyclical positions. International evidence suggests that balanced budget rules tend to be procyclical (see next section). The previous fiscal framework in Mexico—which included escape clauses for recessions but no provision for limiting expenditure growth in good times—was a case in which the fiscal rule incorporated a deficit bias.

12. One option was to move to a structural balance rule to prevent procyclical spending, but this would have likely opened a difficult debate. Concerns about procyclicality have led some other countries to specify targets that include adjustments for the cyclical position of the economy and the excess of market commodity prices with respect to structural prices. In fact, the experience in commodity rich countries suggests that these rules can help avoiding procyclical fiscal policies. Introducing a structural balance rule, though, would also raise implementation challenges from a technical and an institutional standpoint.[13] In any case, even if such a revision to the fiscal

[11] The discussion of procyclicality in this paragraph is base on the evolution of the structural primary balance, which is not only adjusted by the evolution of the domestic economic cycle, but also by the difference between market and structural oil prices, which gives place to a commodity gap.

[12] For other studies looking into cyclical features of Mexico's fiscal policies, see Burnside and Meshcheryakova (2005) and OECD (2009).

[13] For challenges associated to the implementation of structural rules, see Selected Issues Paper "Towards a Structural Fiscal Balance Measure for Mexico," and Rial (2012).

framework has proved too complex at this point, the definition of explicit measures for the structural balance in Mexico—at least for the monitoring of the fiscal stance—would be worth undertaken in coming years.

13. The authorities have opted for the introduction of a cap on expenditure growth to complement the new PSBR target. This will allow them to approximate the adjustment dynamics in structural balance rules (see next section). The government will set a cap on real expenditure growth, which will help contain spending, especially during periods of revenue windfalls. More specifically, the cap will apply to a new spending category—Structural Current Spending (SCS). This category covers all current primary expenditures including transfers to state and local governments for capital but excluding those expenditures governed by automatic rules (pensions, subsidies for electricity, and revenue sharing to state and local governments). The cap will be defined in the regulations to the revenue law, but it will never be higher than potential growth, as estimated by the secretary of finance. A cap on all primary spending would have secured a tighter management of revenue windfalls and reduced ambiguity associated with expenditure classification. In practice, once a fiscal policy objective is defined—either in terms of deficit targets or savings of revenue windfalls—a lower coverage in the expenditure rule will require a tighter cap on spending included in the rule.

14. The introduction of a cap will help curb the main source of procyclicality in the previous balanced budget rule by acting over its implicit deficit bias. A well-calibrated cap will also help the public sector build fiscal buffers when the economy is performing well. In fact, the use of balanced budget rules with escape clauses and expenditure caps has shown in other countries that the framework could broadly mimic the properties of fiscal policy under structural balance rules; they can be effective in letting fiscal policies adjust over the cycle (see next section).

International experience with fiscal rules

15. In order to assess the recent reform to the fiscal framework, we compare the international experience with alternative policy frameworks in terms of different policy objectives. To do so, the fiscal rules are compared in terms of their potential to: (i) secure debt sustainability; (ii) facilitate the implementation of countercyclical fiscal policies; (iii) minimize the fiscal effort—i.e. the required adjustment in expenditures at any given point in time, to make it politically feasible; (iv) minimize the volatility in expenditures; and (v) allow for the accumulation of fiscal buffers during favorable cyclical and commodity positions.[14]

16. The analysis of alternative fiscal frameworks—based on the experience of a number of emerging and developed economies (Table)[15]—can be summarized as follows:[16]

Table. Fiscal Rules: International Experience

	Sustainability 1/		Cyclicality 2/	Magnitude of Procyclicality 3/	Fiscal Effort 4/	Expenditure Volatility 5/	Expenditure Growth 6/	Fiscal Savings 7/
	Initial Debt (1999)	Ending Debt (2008)						
Structural Balance Rule								
Chile	13.3	4.9	-2.8	1.0	1.5	0.5	3.2	5.2
Norway	29.1	55.2	-2.4	0.7	2.4	0.3	2.1	15.6
Finland	45.7	33.9	-7.6	1.5	-1.8	0.7	-0.6	4.4
Balanced Budget Rule								
Austria	66.8	63.8	4.6	5.0	-5.3	3.0	-0.9	-1.1
Indonesia 8/	89.0	33.2	1.0	5.3	-15.8	1.0	8.2	-0.9
Mexico 9/	47.4	43.1	0.7	2.3	-3.3	0.8	6.6	-2.1
Poland 9/	39.6	47.1	4.0	6.0	-2.8	0.8	-1.4	-2.9
Balanced Budget Rule with Expenditure Cap								
Canada	91.4	71.3	-5.0	0.6	1.7	0.3	0.6	1.0
Peru	44.3	25.0	-2.4	1.2	-3.2	1.2	1.7	1.0
Luxembourg	6.4	14.4	-5.1	3.3	1.0	1.0	0.0	3.7

Sources: IMF and IMF staff calculations

1/ Measured by the evolution of debt over the period, from the initial level at end-1999 to end-2008.

2/ Cumulative fiscal Impulse (+) procyclical (-) countercyclical.

3/ Cumulative absolute values of procyclical fiscal impulses.

4/ Minimum change in primary expenditure in one year (real change).

5/ Coefficient of variation of real primary expenditures (real change).

6/ Average growth of real primary expenditure in excess of potential GDP growth in "good" years. (Note: "good" year: output gap > 0, commodity gap >0, if only one of the variables is greater than zero, then a "good" year is determined by whether the growth rate in real revenue is greater than the growth rate in potential GDP).

7/ Average overall balance in "good" years. (Note: see above for definition of a "good" year).

8/ Due to lack of data for structural balances, cyclical properties are analyzed by assessing changes in the primary balance.

9/ Mexico and Poland both adopted the balanced budget rule in 2006, but the results are similar when just looking at the period 2006-2008.

- *Structural balance rules.* The cumulative fiscal impulse in countries with structural rules suggests that they are instrumental in implementing countercyclical fiscal policies—the three countries in the sample, two of which benefitted from high commodity prices, managed to put in place

[14] We follow the approach in Rial (2010).

[15] For references on fiscal rules across countries, see Budina et. al. (2012) and Daban (2010).

[16] The period of analysis is 2000–2008. As we are interested in the ability to implement countercyclical and build buffers during favorable cyclical and commodity positions, the period of analysis looks relevant.

significant countercyclical responses. As a result, expenditures remained constrained—and not very volatile—and savings during years of favorable cyclical and commodity positions were significant. Public debt fell during the period in these countries.[17]

- *Balanced budget rules.* Countries with balanced budget rules tended to be procyclical during the period. Moreover, the indicator of cumulative fiscal impulses in years benefitting from favorable cyclical positions account for most of the procyclicality in these countries, as escape clauses are in general biased—i.e., they are called during periods of bad economic outcomes, but not during booms. As a consequence, expenditures grew very rapidly and these rules have generated no savings during 'good' years. Spending tends to be very volatile; hence the rule may impose harsh adjustments at certain times, as the indicator on fiscal effort shows for these rules.

- *Balanced budget rules with caps on expenditure growth.* These rules have been able to deliver countercyclical fiscal policies—cumulative fiscal impulses look similar to the ones under structural rules—in the context of low volatility in spending and restraint during period of favorable cyclical and commodity positions. As a consequence, expenditure has remained broadly subdued and these economies generated significant amounts of savings during good years, reducing public debt stocks.[18]

17. The international evidence suggests that a fiscal framework that combines deficit targets and caps on expenditure growth—as recently approved by congress in Mexico—can approximate structural rules. While these rules will not likely make a 'fine tuning' of fiscal policies under modest deviations from potential output like structural rules, they can actually mimic their most important features reasonably well, especially over the business cycle.

A simulation of alternative fiscal rules for Mexico

18. We also analyze potential deficit and debt trajectories for Mexico under different fiscal rules through stochastic simulations. In contrast with deterministic scenarios, stochastic simulations allow us to account for macroeconomic uncertainty, assessing alternative fiscal rules under a more realistic constellation of shocks that incorporates co-movements among the main determinants of debt dynamics. Fan charts summarize risks to debt dynamics by representing the frequency distribution of a large sample of debt paths. This allows us to make a probabilistic assessment of the debt trajectories under different fiscal rules, and in particular to identify the probability that a given rule can increase buffers in the economy—i.e. deliver a lower public debt within a 10-year horizon.

[17] Norway is an exception, since the concept of gross debt may be misleading given the significant accumulation of resources in its oil fund.

[18] For a survey on spending rules, see Ljungman (2008).

19. The simulations are built as follows.[19] First, we impose four fiscal rules as a predetermined fiscal policy in each year of the forecasting horizon. Second, we calibrate the distribution of shocks to fit the statistical properties of historical data for Mexico during the last 20 years. Third, we combine the fiscal policy embedded in every rule with the stochastic scenarios to produce annual paths for the main fiscal variables: debt, fiscal balance, revenues and expenditures. Fan charts depict confidence bands of varying degrees of uncertainty around the median projection for each fiscal variable.[20]

20. The results from the stochastic simulations can be summarized as follows:

- **The analysis suggests that the previous balanced budget rule could have put the public debt in a downward trajectory, but the target should have been set on the PSBR.** Should the PSBR had been set at 2 percent of GDP, the median debt path suggests that public debt would have fallen to 39 percent of GDP by 2022, and that debt would still be lower than in 2012 even in the 99 percent confidence interval. A PSBR target of about 2.6 percent of GDP would have stabilized debt in the median debt path (see Appendix II). Maintaining the 2 percent target together with the historical use of financing operations would have implied that the previous fiscal rule—an augmented public deficit of around 3 percent of GDP—would have not put public debt in a downward trajectory.

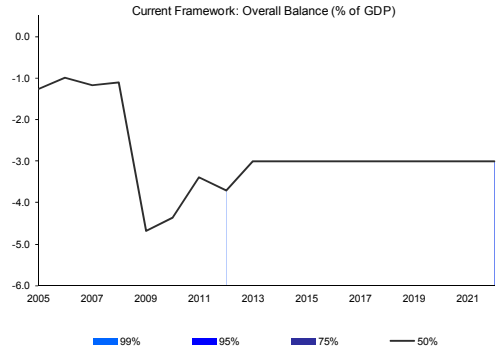
- **Structural rules could put the debt path in a downward trajectory, although with some uncertainty associated with its flexibility to smooth real shocks.** The implementation of a structural balance rule around a 2 percent target—i.e., in line with the previous fiscal rule under the assumption that one-off financing operations were eliminated—would have also reduced public debt in the median debt path to around 39 percent of GDP by 2022. However, this scenario still shows growing debt trajectories in the second decile of the distribution, as suggested by the broader fan charts compared to the previous rule. This higher uncertainty in the debt path is related to the fact that under structural balance rules fiscal policies can accommodate downward shocks to the cyclical position of the economy. Hence, there is a trade-off between uncertainty regarding the debt path and the room in structural rules to smooth economic growth.

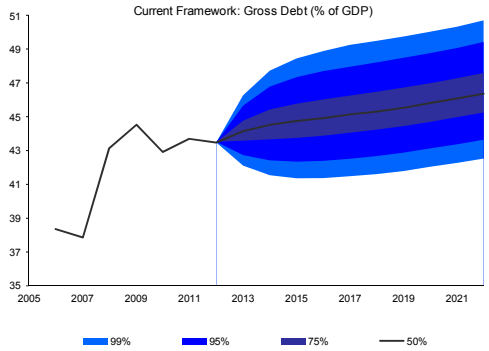
[19] We are grateful to Carlos Cáceres and Isabel Rial for sharing the MatLab codes for the stochastic simulations.

[20] Appendix I explains in more detail the methodology for stochastic simulations. Also see Celasun et. al. (2006) and IMF (2003).

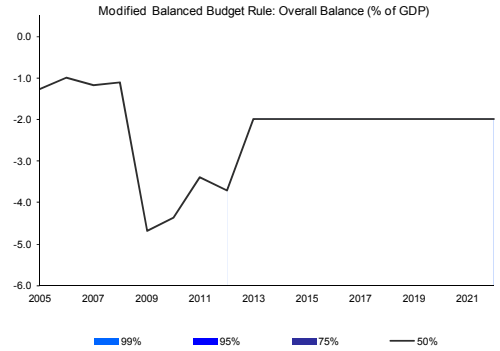
Figure 1. Alternate Fiscal Rule Simulations

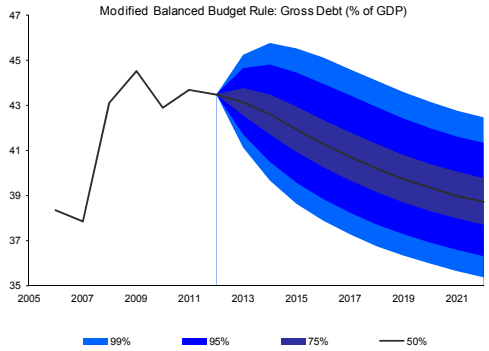
Current Path (Modified Balanced Budget; 3% PSBR Target):



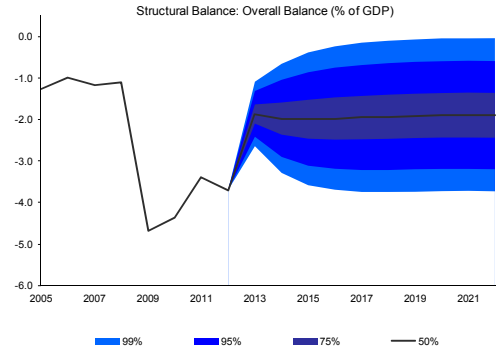


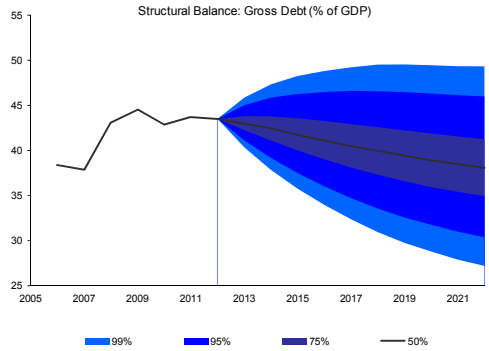
Current Fiscal Rule (Modified Balanced Budget; 2% PSBR Target):



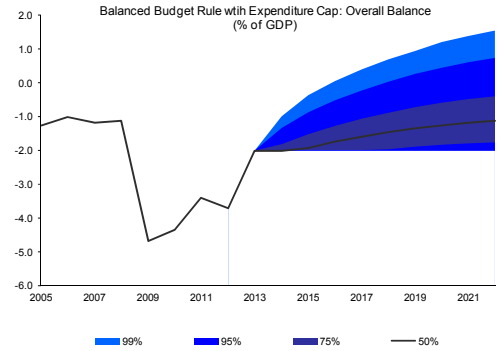


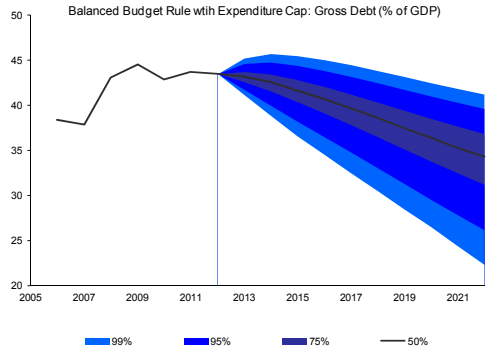
Structural Balance Rule(2% Target):





Balanced Budget Rule (2% target); with Expenditure Cap (3% growth cap):





Sources: SHCP and IMF staff calculations

- **Deficit targets with spending caps put public debt in a reliable downward path, with a greater downside risk than other rules.** The simulation imposes a modified balanced budget rule with a ceiling to the augmented deficit at 2 percent of GDP and an additional restriction on primary spending growth, which is capped at 3 percent in real terms, slightly below Mexico potential growth.[21] Under the median scenario, public debt falls to 35 percent of GDP. This is slightly lower than the median under the previous framework because the spending cap is binding starting in 2015, reducing the deficit to less than 2 percent of GDP.[22] However, the most important effect of the spending cap—which actually fix the deficit bias in the fiscal rule—is best illustrated by the upper bound of the fan charts. In contrast to other rules, the upside risks to the fiscal balance are most significant under this rule—reaching a surplus of more than 1 percent of GDP in the 99 percent confidence interval—as spending would be capped in a context of a revenue windfall. As a consequence, public debt reaches less than 25 percent of GDP for the same confidence interval, in contrast with the 35 percent of GDP in the previous rule.[23]

Modifications to the oil stabilization funds

21. The stabilization funds have several design flaws. The design of these funds are complicated, and include three important limitations: (i) resources in the funds are subject to accumulation caps; (ii) some items are deducted from the pool of resources before they are transferred to the funds—i.e., shortfalls in revenues with respect to the budget, changes in energy costs not reflected in domestic electricity tariffs, and costs of natural disasters and outlays resulting from changes in interest or exchange rates; and (iii) there are complicated rules to distribute resources in the funds. These adjustments and rules operate as de facto earmarking over oil revenue windfalls.

22. The design of stabilization funds would benefit from simplifications to their transfer rules and operations. A fiscal framework that precludes procyclicality in policies would define the savings that are consistent with the economy's cyclical position and the difference between current and structural commodity prices. In such a framework, there would be no need for special financial arrangements to channel savings. Fiscal surpluses should be allocated to the single treasury account

[21] The authorities have set the target for 2017–2018 at 2 percent of GDP in real terms, although it does not imply that this would be the medium term target, which according to the new framework should be consistent with debt sustainability. Simulations are run with the target at 2 percent to facilitate comparison with the potential application of the previous rule replacing the traditional balance with the PSBR.

[22] The simulation assumes that escape clauses for economic downturns—which could overturn the spending caps—are not triggered during the projection period. If triggered, the lower bound of the fan chart will shift downwards.

[23] An alternative rule would be to implement spending caps without a balanced budget rule. Appendix II shows that such rules would not stabilize public debt, basically because the initial point in the simulations show a non-debt stabilizing primary balance, and the rule—without a balanced budget provision—does not force an adjustment to a lower deficit path.

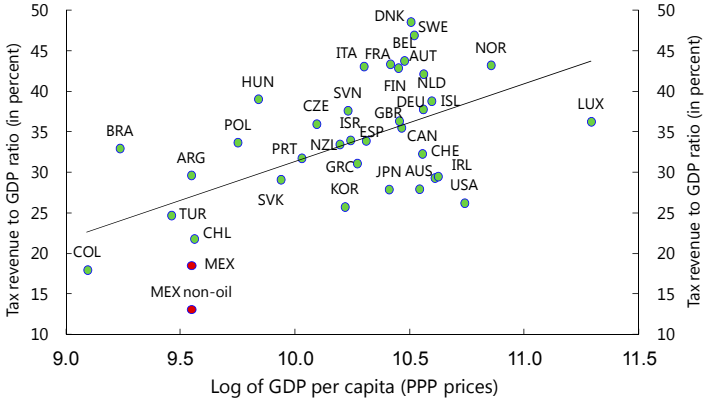
(STA) in good years, and resources from the STA should be withdrawn during downturns. In this context, some of the provisions that could be revisited include:

- *The unification of the different funds.* A single fund would avoid coordination problems and reduce administrative costs.
- *The elimination of accumulation ceilings*, implemented annually through articles in the revenue law during the last years, should be turned into a permanent provision.
- *Simplification of the transfer rules* of revenue to the funds, which should consider the simplification of the rules to determine the amount of resources that can be saved into the funds, including the elimination of excessive compensations, including to electricity price support. Moreover, the rules for the use of resources in the funds should not be subject to earmarking.
- *A revision of the budget oil price.* Mexico could also consider creating an independent commission for the assessment of the budget oil price.

Revenue mobilization

23. Tax collection in Mexico is low by regional and OECD standards. Mexico's tax revenue appears as an outlier taking into account income levels and collection ratios of comparator countries. According to the OECD, Mexico's total tax revenue at the general government level including social security contributions was not much more than half of the OECD average in 2010 (18 percent of GDP compared with 34 percent).[24] It was also significantly lower than in other Latin American economies. With the prospect of declining oil production over the next decade, the federal

Total Tax Revenue and Income Levels
(2006-10 unweighted average)



Note: Data refer to the general government level.
Source: IMF staff calculations based on OECD revenue database and WEO.

[24] Differences with tax revenue figures presented in standard IMF fiscal tables are due to the fact that the OECD includes oil revenue excluding fuel subsidies as tax revenue, in addition to differences in the coverage level of the government—the OECD figures presented here also include sub-national tax revenue. More generally, the OECD Revenue Statistics Database used to construct the chart on total tax revenue and income levels provides a standardized classification system of tax revenue at the general government level, which significantly facilitates cross-country comparisons.

government needs to beef up its collection on non-oil revenues.

24. The reform just approved by congress introduces changes in the main taxes, in particular to the Value Added Tax and excise taxation:

- *VAT:* the main measures of the reform extend the 16 percent value added tax to the border—previously it was set at 11 percent—and imposes stricter requirements for entities seeking access to full *Maquila* regime benefits, which will now be applicable for sales backed by an export request.

- *Income Tax:* the reform broadens the tax base by eliminating some special deductions and exemptions (including the *Maquila* regime), increases tax rates for high income earners, and impose an additional corporate income tax of 10 percent on capital gains and dividends. It also eliminated the *Impuesto Empresarial de Tasa Unica*—a single rate minimum income tax for corporations—and the *IDE,* a tax on cash deposits.

- *Fuel subsidies:* the gasoline subsidy is to be phased out by end-2014, and the domestic gasoline price will rise with domestic inflation starting in 2015. The government will raise the domestic price further if international gasoline prices increase to avoid the reemergence of the subsidy.

- *Excises and special taxes:* the reform imposes new taxes on (i) flavored drinks, concentrates, powders, syrups, essences or flavor extracts, containing any type of added sugars; (ii) the import and sale of fossil fuels; and (iii) pesticides. There will be also a special tax of 8 percent on 'junk food', as defined in the revenue initiative.

25. Reforms to the tax regime constitute a step in the right direction to reduce public finances dependence on oil revenues, but further efforts are likely to be needed in the future. The projected revenue yield of the tax reform, while realistic, is subject to risks—especially given its reliance on phasing out the fuel subsidies—which will make it critical to maintain a link between domestic and international gasoline prices to avoid the resurgence of gasoline subsidies. All in all, aside from the increase in excise collection on gasoline, the tax reform will lead to a modest increase in other non-oil tax revenues.

C. Concluding Remarks

26. This note analyzed the recent fiscal reforms, which can make the fiscal framework more instrumental in addressing challenges that Mexico will likely face in coming years. Mexico would benefit from building of fiscal policy buffers to reduce the exposure to high financing and hedging costs during periods of global uncertainty, improving flexibility to implement countercyclical fiscal policies, and addressing long term fiscal challenges associated with a reduction in oil revenue and an increase in health and pension spending. Introducing an additional target on the public sector borrowing requirement in the Fiscal Responsibility Law will make the fiscal rule more transparent and enhance its credibility, and the new structural current expenditure growth cap will help reducing procyclicality in its fiscal framework by restraining expenditure in periods of unusually high revenues. The reforms to mobilize tax revenue are also encouraging initial steps to improve the management of oil wealth and reduce the public sector dependence on oil revenue over the medium term. Looking forward, Mexico could consider a modification in the design of the oil stabilization funds that would allow for simpler revenue transfer rules and operations.

References

Budina, N., T. Kinda, A. Schaechter, and A. Weber, 2012, "Fiscal Rules at a Glance: Country Details from a New Dataset," IMF Working Paper No. 12/273 (Washington: International Monetary Fund).

Burnside, C., and Y. Meshcheryakova, 2005, "Mexico: A Case Study in Procyclical Fiscal Policy," Chapter 6 in *Fiscal Sustainability in Theory and Practice: A Handbook*, ed. by C. Burnside, (Washington, DC: World Bank).

Celasun, O., X. Debrun, and J.D. Ostry, 2006, "Primary Surplus Behavior and Risks to Fiscal Sustainability in Emerging Market Countries: A 'Fan-Chart' Approach," IMF Working Paper 06/67.

Daban, T., 2010, "Strengthening Chile's Rule-based Fiscal Framework," IMF Selected Issues Paper, Chile: Staff Report for the 2010 Article IV Consultation.

Debrun, X., N. Epstein, and S. Symansky, 2008, "A New Fiscal Rule: Should Israel 'Go Swiss'?" IMF Working Paper No. 08/87 (Washington: International Monetary Fund)..

International Monetary Fund, 2003, "Public Debt in Emerging Markets: Is it too High?" Chapter III in *World Economic Outlook*, September (Washington, International Monetary Fund)

Jaramillo, L., 2010, "Determinants of Investment Grade Status in Emerging Markets," IMF Working Paper No. 10/117 (Washington: International Monetary Fund).

Jaramillo, L. and C. Tejada, 2011, "Sovereign Credit Ratings and Spreads in Emerging Markets: Does Investment Grade Matter," IMF Working Paper No. 11/44 (Washington: International Monetary Fund).

Ljungman, D., 2008, "Expenditure Ceilings—A Survey" IMF Working Paper No. 08/282 (Washington: International Monetary Fund).

OECD, 2009, "Managing the oil economy—Can Mexico do it Better?" Chapter 2 in *Economic Survey of Mexico 2009*, (Paris: OECD).

Rial, I., 2010, "Performance of Alternative Fiscal Rules: An Application to Peru," IMF Selected Issues Paper, Peru: Staff Report for the 2010 Article IV Consultation.

Rial, I., 2012, "Towards a Structural Fiscal Framework," IMF Selected Issues Paper, Peru: Staff Report for the 2012 Article IV Consultation.

Appendix I. Stochastic Simulation Methodology

1. To assess the sustainability of the fiscal rules discussed in the paper, stochastic simulations were performed to develop probabilistic paths for fiscal variables; in particular the fiscal deficit and the public debt. Following Celasun et. al. (2006), we estimate an unrestricted VAR to assess the impact of shocks in non-fiscal determinants of public debt dynamics—output gap, real exchange rate, domestic real interest rate, commodity gap, and U.S. real interest rate. Formally,

$$Y_t = \gamma_0 + \gamma Y_{t-1} + \propto X_{t-1} + \varepsilon_t$$

where Y is a vector of endogenous variables—the output gap, the log of the real effective exchange rate, and the domestic real interest rate—X is a vector of exogenous variables—the commodity gap and U.S. real interest rate—and ε is a vector of well-behaved error terms. The output gap is calculated using a Hodrick-Prescott filter over the period 1980–2013. The commodity gap is expressed in percent of the structural price, defined as the 7-year moving-average of the price of the Mexican oil mix. For the real domestic interest rate, the one-year CETES rate was used, adjusted by CPI. The real foreign interest rate is the 10-year Treasury bond, adjusted by CPI.

2. The VAR uses quarterly data for 1990–2012 to calibrate the distribution of shocks. The variance-covariance matrix of the residuals characterizes the joint statistical properties of the contemporaneous disturbances. Then, a sequence of random shocks is used to generate conditional forecasts. Annualized quarterly projections from the VAR are used as a basis for projections using the alternative fiscal rules. We estimate paths for revenue, expenditure, the fiscal balance and public debt. These paths are presented using fan charts, which illustrate the confidence bands of the probability of each scenario around the median path.

3. For robustness, we estimate the VAR using the 2000–2012 period, which offers similar results to the ones presented in this note.

Appendix II. Additional Fiscal Rules

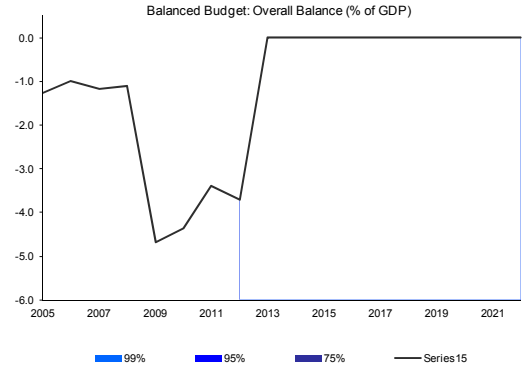
1. We examine three additional rules in this appendix: a balanced budget rule with a 0-deficit target, an expenditure rule, and a debt-stabilizing modified balanced-budget rule.

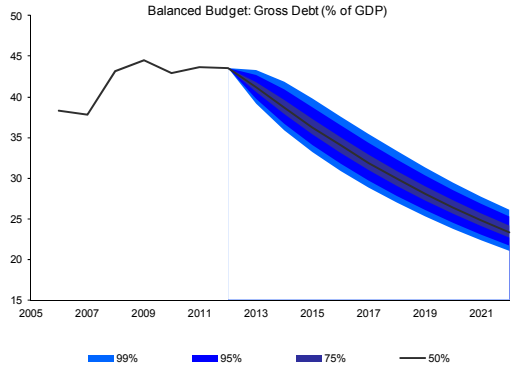
2. Under a balanced budget rule with a 0-deficit target, public debt falls to 25 percent of GDP over the next 10 years. In the case Mexico, shifting to this rule would require a sharp adjustment in expenditure. Notice that confidence intervals around the median are much narrower, as lower levels of debt reduce uncertainty associated with the different shocks on debt.

3. By itself, expenditure rules do not necessarily put public debt on a downward trajectory. This is the case for a rule that sets a cap on real spending at 3.25 percent. Under this rule debt trends upwards, to over 53 percent by 2022. This is explained by the primary deficit in the year before the initial forecast, which is significantly higher than the debt stabilizing balance. A downward trajectory for public debt would require either reducing the initial fiscal deficit or the cap on expenditure growth (to about 2½ percent in the case of Mexico).

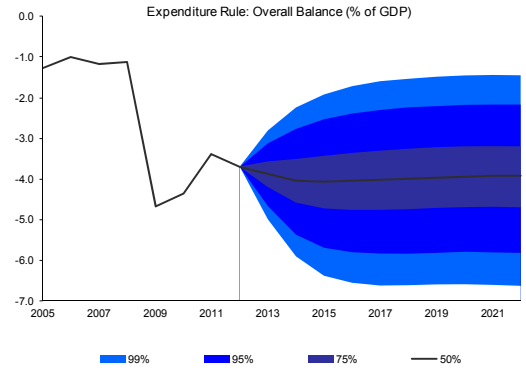
Appendix Figure. Alternate Fiscal Rule Simulations

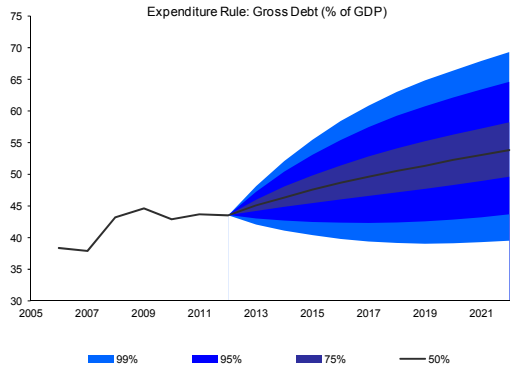
Balanced Budget Rule (0% PSBR Target):



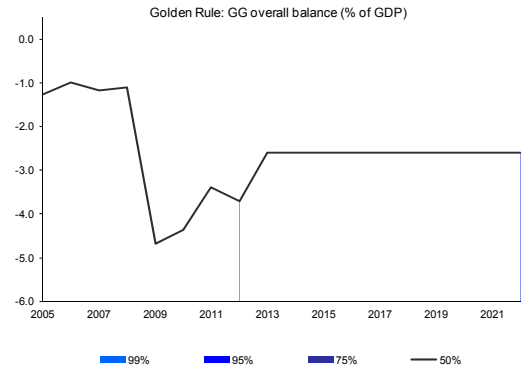


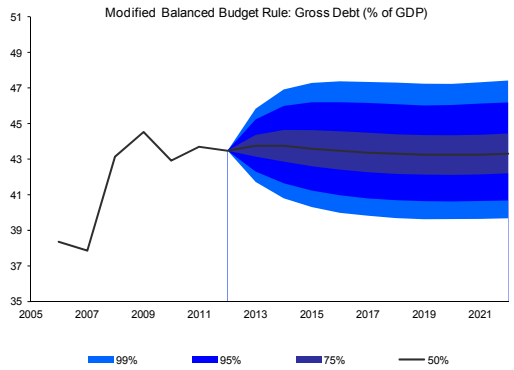
Expenditure Rule (3.25% Real Growth Cap):





Modified Balanced Budget Rule (2.6% PSBR Target):





Sources: SHCP and IMF staff calculations

Appendix III: Statement of Operations of Non-Financial Public Sector

Appendix Table. Mexico: Statement of Operations of Non-financial Public Sector, 1990-2012 1/

	Avg 1990-94	Avg 1995-00	Avg 2001-04	Avg 2005-09	Avg 2010-12
	(in percent of GDP)				
Revenue 2/ 3/	21.9	18.8	20.2	23.0	23.7
Taxes	9.7	8.5	9.9	9.3	10.1
Other revenue	12.2	10.3	10.4	13.6	13.6
Expenditure 2/ 3/	21.0	19.4	20.9	23.4	26.4
Expense	18.2	16.9	18.6	20.4	21.8
Net acquisition of nonfinancial assets	2.8	2.5	2.3	3.1	4.6
Traditional Balance 4/ 5/	0.9	-0.5	-0.6	-0.5	-2.6
Augmented balance 6/	n/a	n/a	-2.5	-1.9	-3.7
Public Sector Borrowing Requirements 7/	n/a	n/a	-1.9	-1.6	-3.1
Memorandum items:					
Traditional primary balance	5.0	2.8	2.0	1.7	-0.7
Augmented primary balance 7/	n/a	n/a	0.8	0.8	-1.2
Oil revenue 2/	4.9	6.0	6.6	8.5	8.6
Nonoil tax revenue	9.7	7.6	8.7	9.2	9.9
Nonoil nontax revenue	7.3	5.2	5.0	5.2	5.2
Oil spending 2/	1.8	2.1	2.4	3.3	4.1

Sources: Mexican authorities and IMF estimates.

1/ Data exclude state and local governments.

2/ May differ from official figures due to treatment of negative excise on gasoline, computed here as an expense under subsidies and transfers.

3/ Due to lack of disaggregated data financing items are included in revenue and expenditure.

4/ Includes transactions in financial capital assets.

5/ Public Sector Borrowing Requirements as defined by Mexican authorities, excl. nonrecurring revenue and net transfers to stabilization funds.

6/ Public Sector Borrowing Requirements as defined by Mexican authorities excl. nonrecurring revenues.

7/ Treats transfers to IPAB as interest payments.

TOWARDS A STRUCTURAL FISCAL BALANCE MEASURE FOR MEXICO[1]

1. The objective of this note is to provide an operational guideline to compute a structural fiscal balance in Mexico, to then discuss its associated policy implications. Having this alternative measure of the fiscal position has various benefits. It helps define more accurately what would be the level of revenue that can be saved during favorable cyclical conditions, to have enough resources to act counter-cyclically during downturns. A structural balance target adequately defined, moreover, can also help provide the basis to guarantee the sustainability of public finances over the long term. From a surveillance point of view, the stance of fiscal policy relative to the economic and commodity cycles can be better assessed considering a structural balance measure. However, obtaining this measure requires the use of different key inputs, being some of them unobservable and subject to judgment. Caution is therefore needed when evaluating the implications that follow from the analysis of the structural balance, as stressed in this note.

A. Computing the Structural Balance

2. A number of steps are required to compute the structural fiscal balance. First, the government level subject to the analysis needs to be properly defined. Second, the particular revenue and expenditure items that can be directly affected by either the economic or the commodity cycles should be identified. Given that budget figures are mixed with financing items, and that oil-related revenue and spending components are significant in the budget, this step is particularly challenging in the case of Mexico. Third, potential output and the structural price of oil should be determined in order to compute the associated output and commodity gaps. A proper estimation of these two key unobservable variables is difficult and, moreover, results are sensitive to the methodology used to calculate them. Fourth, the elasticities of relevant revenue and spending categories with respect to the output and commodity gaps should be estimated. The combination of these elasticities with the estimated output and commodity gaps will determine the overall size of the structural adjustments.

Government level subject to the analysis

3. The government level considered in the analysis is the federal public sector as defined by Mexican authorities. This includes the federal government, and public enterprises and entities under direct and indirect control of the budget. This broad definition of the public sector includes the social security system and development banks. However, sub-national governments are excluded due to data availability. As more information becomes available, local and state

[1] Prepared By Santiago Acosta-Ormaechea, Esteban Vesperoni, and Jeremy Zook.

governments can also be included in the analysis. This will help assess from a broader perspective and thereby more accurately the state of public finances in Mexico.

Revenue and spending categories subject to adjustments

4. Revenue and spending figures in the budget need to be adjusted to obtain Mexico's borrowing requirements. Accordingly, revenue and spending categories are defined as follows:

- Total revenue: includes total revenue as defined in the budget stripping out non-recurrent revenue, as defined by Mexican authorities, and fuel subsidies.[2] Total revenue is then divided into oil revenue (subject to oil price adjustments) and non-oil revenue (subject to business cycles adjustments).

- Oil revenue: includes oil fees levied by the federal government, net income of the national oil company (PEMEX), positive fuel excises, and tax on oil profits.[3]

- Total spending: includes total spending as defined in the budget, adding the following additional items: (i) fuel subsidies; (ii) financing needs of long-term infrastructure projects (PIDIREGAS); (iii) borrowing requirements of the Institute for Protection of Bank Savings (IPAB); (iv) budgetary adjustments; (v) net inflows to stabilization funds;[4] (vi) borrowing requirements of the National Infrastructure Fund (FARAC/FONADIN); (vii) borrowing requirements of the debtor support program; and (viii) expected profits of credit guaranteed by development banks. Total spending is then divided into oil spending (subject to oil price adjustments) and non-oil spending (subject to business cycles adjustments).

- Oil spending: includes fuel subsidies, and current and capital spending undertaken by PEMEX.

5. The underlying overall balance derived from these adjustments is consistent with the IMF's augmented balance. The augmented balance is equivalent to Mexico's Public Sector Borrowing Requirements, with the only difference that the latter does not include the adjustment for stabilization funds. Either of them can assess how fiscal policy affects aggregate demand and gross debt dynamics more comprehensively than the traditional balance defined in Mexico's Fiscal Responsibility Law (FRL).

[2] As more disaggregated information becomes available, further refinements would be needed to define more accurately which fraction of non-recurrent revenue effectively refers to one-off measures mixed in the budget. This step is important to better identify the total revenue that is subject to business cycles adjustments.

[3] Oil revenue may differ from those figures reported by Mexican authorities due to the different treatment of fuel subsidies. Whereas they consider the latter as a negative excise on fuels, this subsidy is registered as an expense in this note.

[4] Corrections are included in the adjustment for stabilization funds to avoid any potential double-counting of withdrawals from these funds, relative to those already included under non-recurrent revenue by Mexican authorities.

Output and commodity gaps

6. Mexico's potential output is estimated using the univariate Hodrick-Prescott (HP) statistical filter. Different approaches have been suggested in the literature to estimate potential output, being the HP filter a statistical approach which provides a reasonably good proxy for it. To reduce the so-called end-of-period bias, output projections through 2018 are included in the estimations. If *Y* and *Y** denote actual and potential output, respectively, the output gap is then defined as $g = \frac{Y-Y^*}{Y^*}$.

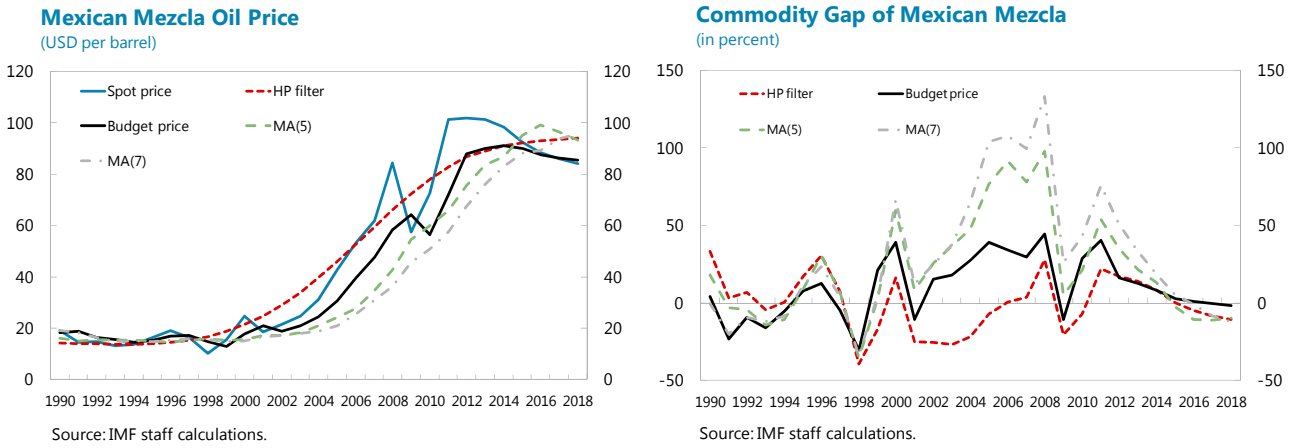
7. The structural oil price can be calculated using different methodologies. A first approach uses 5- and 7-year backward looking moving averages—i.e., MA(5) and MA(7), respectively. Although challenging given the uncertainties involved in the estimation of structural oil prices, this approach provides a good benchmark to estimate the underlying commodity gap and thereby the size of the commodity price adjustment. For completeness, the structural balance will also be computed considering the oil price budget formula considered in Mexico's FRL as the structural price, which combines both backward- and forward-looking components, as well as the commodity gap obtained by applying a simple HP filter to the observed oil price. If *P* and *P** denote the current and structural price for the oil Mexican *Mezcla*, respectively, the commodity gap is then defined as $p = \frac{P-P^*}{P^*}$.

8. Over 2003–12, the MA(7) approach provided the largest commodity gap, followed by the MA(5), the budget price and the HP filter.[5] In fact, backward-looking approaches provided the largest commodity gaps over such period, owing to the particular behavior of oil prices, which have been characterized by a steep upward trend. For this reason, the budget price formula incorporated in Mexico's FRL, which gives a larger weight to current and future oil prices, yielded a smaller commodity gap. Going forward, if oil prices were to follow a declining path as projected by the IMF over the medium term, the commodity gap estimated by the MA(7) would decrease significantly. It may also turn out to be negative earlier than other approaches that give some weight to future prices, depending on the pace at which oil prices decrease over time.[6]

[5] To reduce the end-of-period bias associated with the HP filter, projections of the Mexican *Mezcla* oil price through 2018 are also included in the estimations using IMF oil price forecasts.

[6] Although for the purposes of this study the MA(7) approach to calculate the structural oil price is considered, this decision is subject to some degree of arbitrariness. Given the uncertainties involved in the determination of the structural price of oil, a fruitful topic for further research would be to analyze more thoroughly the advantages and disadvantages of using the different criteria to estimate structural oil prices.

Mexico: Oil Price and Commodity Gap



Source: IMF staff calculations.

Source: IMF staff calculations.

Revenue and spending elasticities

9. Aggregate revenue and spending elasticities can be estimated following a number of steps. This analysis assumes that only non-oil revenue (spending) is affected by the economic cycle. Likewise, oil revenue (spending) will only be affected by the oil price cycle by assumption.

- Denoting with a star the structural or potential level for a particular variable, it follows that non-oil and oil revenue are related to their structural levels as follows (time subscripts are avoided for simplicity):

$$R^{NO} = R^{NO*}(\mathrm{Y}/\mathrm{Y}^*)^{\gamma_{RY}}; \text{and } R^{O} = R^{O*}(\mathrm{P}/\mathrm{P}^*)^{\gamma_{RO}}$$

- Similar expressions relate actual and structural spending:

$$S^{NO} = S^{NO*}(\mathrm{Y}/\mathrm{Y}^*)^{\gamma_{SY}}; \text{and } S^{O} = S^{O*}(\mathrm{P}/\mathrm{P}^*)^{\gamma_{SO}}$$

- From these expressions it is possible to estimate the various elasticities γ_{RY}, γ_{RO}, γ_{SY} and γ_{SO} by running a simple regression of the form:[7]

$$\log\left(R^{NO}/R^{NO*}\right) = \alpha + \gamma_{\mathrm{RY}}\log(\mathrm{Y}/\mathrm{Y}^*)$$

where α is a constant. The sample period for the estimations is 1990–2012, and the CPI index is used to convert figures into real terms. Structural values for the relevant revenue and spending items are obtained using an HP filter. Table 1 summarizes the minimum and maximum values for the different elasticities, considering recursive regressions starting with the period 1990–2005. Subsequent

[7] Similar linear expressions can be obtained to estimate the elasticities of the other revenue and spending categories.

estimations add one observation each time, with the period 1990–2012 being the sample with the largest number of observations:[8]

Table 1. Mexico: Estimation of Revenue and Spending Elasticities (sample 1990–2012)

	Output gap	Commodity gap
Revenue		
Non-oil revenue	1.05-1.35	n/a
Oil revenue	n/a	0.46-0.52
Expenditure		
Non-oil spending	0	n/a
Oil spending	n/a	0.04-0.19
Semi-elasticity of budget balance (percent of actual GDP)		
Current estimation	0.14-0.16	n/a
Previous estimations 1/	0.14	n/a
OECD average 2/	0.44	n/a
Memorandum item:		
Elasticity of tax revenue	1.95-2.34	n/a

Source: IMF staff calculations.
1/ From Daude et al (2011).
2/ From Girourard and André (2005).

- Revenue side: point estimates for the elasticity of non-oil revenue with respect to the output gap in the range of 1.05–1.35 appear to be broadly in line with estimations for other countries. The elasticity of oil revenue to the commodity gap at around 0.46–0.52 is somewhat on the low side, probably reflecting that other components and not just oil determine the behavior of the so-called oil revenue, as defined in Mexican fiscal accounts. For the elasticity of tax revenue to the output gap, the estimated coefficients are larger (at about 1.95–2.34), a finding consistent with the long-run elasticities estimated by CEFP (2009) for the VAT and income taxes.[9]

- Spending side: given the relatively low relevance of automatic stabilizers such as unemployment benefits in Mexico, this elasticity will be assumed equal to zero. The estimated elasticity for oil spending relative to the commodity gap has significantly increased over time, reaching values of around 0.19 by the end of the sample period, reflecting to a large extent the relevance of oil

[8] The elasticity of tax revenue as defined by Mexican authorities, but excluding the oil subsidy within gasoline excises, is also included in Table 1 for completeness.

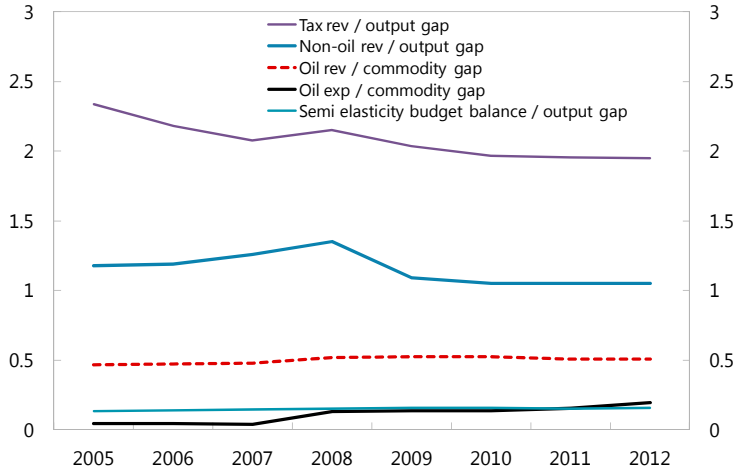
[9] VAT and income taxes represent about 90 percent of total tax collection in Mexico.

subsidies. Overall, the particular sample under consideration provides a relatively low sensitivity of oil spending to the oil price gap.[10]

- The implicit semi-elasticity of the budget balance as a share of *actual* GDP with respect to the output gap can easily be computed and given by: $r^{NO}\gamma_{RY}$, where r^{NO} is the non-oil revenue to GDP ratio and γ_{RY} is its associated elasticity with respect to the output gap. The average estimation of 0.15 appears to be in line with results from Daude et al (2011) for the case of Mexico. Other things equal, this suggests that a 1 percentage point increase in the output gap improves the overall balance to GDP ratio by 0.15 percentage points of GDP.

10. The estimated elasticites appear to be fairly stable over time. To check this, a number of recursive regressions, as indicated above, were considered starting with the sample 1990–2005 and adding one year to each regression, until the complete sample 1990–2012 is covered. The chart below shows that in all cases the estimated coefficients are not significantly different over time.[11]

Recursive Estimation of Elasticities
(recursive regressions; adds one observation each time)



Source: IMF staff calculations.

[10] Although operational spending by PEMEX associated with wages and pensions may not react to the commodity cycle, both oil investment and oil subsidies—which represent more than 75 percent of total oil-related spending in 2012—do show a significant association with oil prices. In fact, the contemporaneous correlation between the cyclical components of oil investment, the oil subsidy and the oil Mexican *Mezcla* derived from an HP filter during the period 2000-12 are 0.21 and 0.94, respectively. This association is also apparent when comparing the trends in these series measured in current US dollars during the period.

[11] To further test for the stability of the estimated elasticities, confidence intervals considering the associated standard errors for each estimated coefficient presented in the chart above over the sample period of the recursive estimations where constructed (not shown). In all cases, it was not possible to reject the null that the coefficients were statistically equal within a 95 percent confidence interval.

Computing the structural balance

11. The structural balance can be computed considering all inputs previously derived. This is given by:[12]

$$OB^* = R^{NO*} + R^{0*} - S^{NO*} - S^{O*}$$

As before, a star denotes the structural level of a particular variable. Although *OB* (or *OB**) defines the overall balance, a similar analysis follows if instead these variables refer only to the primary balance component. In such a case, spending should be appropriately re-defined to capture only the primary spending part. Using the previous expressions that link actual and structural revenue and spending items, and expressing all variables as a share of *actual* GDP gives:[13]

$$ob^* = r^{NO}(\mathrm{Y}/\mathrm{Y}^*)^{-\gamma_{RY}} + r^{O}(\mathrm{P}/\mathrm{P}^*)^{-\gamma_{RO}} - s^{NO}(\mathrm{Y}/\mathrm{Y}^*)^{-\gamma_{SY}} - s^{O}(\mathrm{P}/\mathrm{P}^*)^{-\gamma_{SO}} \quad (1)$$

Eq. (1) implies, after some rearrangement, that the structural balance is given by the difference between the observed balance and the combination of two adjustments, one due to the business cycles and one due to the commodity cycles as follows:

$$ob^* = ob - \Delta(adj.economic\ cycle) - \Delta(adj.oil\ cycle) \quad (2)$$

where:

$$\Delta(adj.economic\ cycle) \equiv r^{NO}[1 - (\mathrm{Y}/\mathrm{Y}^*)^{-\gamma_{RY}}] - s^{NO}[1 - (\mathrm{Y}/\mathrm{Y}^*)^{-\gamma_{SY}}]$$

and

$$\Delta(adj.oil\ cycle) \equiv r^{O}[1 - (\mathrm{P}/\mathrm{P}^*)^{-\gamma_{RO}}] - s^{O}[1 - (\mathrm{P}/\mathrm{P}^*)^{-\gamma_{SO}}].$$

Thus, if the economy is in a positive business or commodity cycles, the structural balance will tend to be below its observed level. This can be seen more clearly by assuming that *Y/Y** and *P/P** are close to 1—i.e., for small values of the output and commodity gaps—as indicated below:

$$ob^* = ob - (r^{NO}\gamma_{RY} - s^{NO}\gamma_{SY})g - (r^{O}\gamma_{RO} - s^{O}\gamma_{SO})p \quad (3)$$

[12] A similar expression for the structural balance in commodity-rich countries is defined in Vladkova-Hollar and Zettelmeyer (2008).

[13] The structural balance is often expressed as a share of *potential* GDP (see, for instance, Fedelino et al, 2009). For simplicity, everything is scaled here in terms of *actual* GDP. Main results are not affected by this scaling assumption.

When the output gap is positive, the structural fiscal balance will tend to be below the headline balance.[14] The total impact will depend on the shares of non-oil revenue and non-oil spending in GDP and their associated elasticities. A similar interpretation holds for the case of the commodity gap.[15]

B. Results

Baseline results

12. From Eq. (2) structural adjustments to the headline fiscal balance can be decomposed into: (i) adjustments due to the business cycles; and (ii) adjustments due to the oil price cycle. Table 2 summarizes the main results for the period 2003–12. Mid-point values for the elasticities indicated in Table 1 are considered in the analysis.

Table 2. Mexico: Estimation of the Structural Fiscal Balance (in percent of GDP)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
A. Headline overall balance	**-2.3**	**-1.2**	**-1.2**	**-1.0**	**-1.2**	**-1.0**	**-5.1**	**-4.3**	**-3.4**	**-3.7**
B. Structural Adjustments	**0.4**	**1.4**	**2.0**	**2.7**	**2.6**	**3.6**	**-0.3**	**0.6**	**1.7**	**1.4**
Business cycles	-0.5	0.0	-0.1	0.4	0.4	0.5	-1.0	-0.6	-0.2	-0.1
Oil price cycle	0.9	1.4	2.1	2.3	2.1	3.1	0.7	1.1	1.9	1.4
C. Structural Balance (=A-B)	**-2.7**	**-2.6**	**-3.2**	**-3.7**	**-3.7**	**-4.5**	**-4.8**	**-4.8**	**-5.0**	**-5.1**
Fiscal impulse (adj. by business cycles) 1/	-1.2	-0.4	0.0	0.3	0.4	0.0	2.5	-0.2	-0.4	0.3
Fiscal impulse (adj. by business and oil price cycles) 1/	-0.8	0.1	0.6	0.5	0.2	0.9	0.1	0.2	0.3	-0.1
Memorandum items:										
Output gap (nominal; in percent of *potential* GDP) 2/	-3.1	-0.3	-0.4	2.3	2.8	2.9	-5.2	-3.1	-1.1	-0.3
Output gap (real; in percent of *potential* GDP) 2/	-2.3	-0.8	0.0	2.6	3.4	2.2	-4.6	-2.2	-0.8	0.1
Commodity gap (baseline; in percent of *structural* price)	37.6	64.8	104.1	107.4	99.3	133.1	25.9	42.9	75.8	50.7
Headline primary balance	0.7	1.6	1.6	1.8	1.5	1.5	-2.4	-1.7	-1.0	-1.2
Structural primary balance (adj. by business cycle)	1.2	1.7	1.7	1.4	1.0	1.1	-1.4	-1.2	-0.8	-1.1
Structural primary balance (adj. by business and oil price cycles)	0.3	0.2	-0.4	-0.9	-1.1	-2.0	-2.1	-2.3	-2.6	-2.5

1/ Negative of the change in the relevant structural primary balance. May differ from other IMF estimations, since figures depend on the particular inputs and methodology used in the calculations.
2/ Estimations of potential output and the associated output gap may differ depending on the methodology used in the analysis. As indicated in the main text, a Hodrick-Prescott filter (λ=100) was used in this case.
Source: IMF staff calculations.

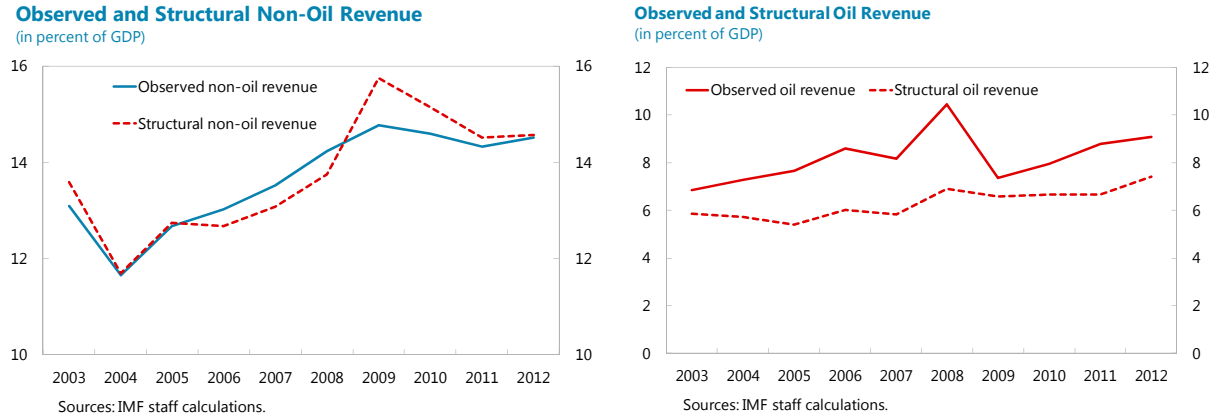
[14] Recall that the elasticity of non-oil spending relative to the output gap, γ_{SY}, is assumed to be equal to zero (Table 1). Therefore, the first bracket in Eq. (3) will always be positive during the sample period.

[15] Since the elasticity of oil spending relative to the output gap, γ_{SO}, is significantly lower than that of oil revenue relative to the output gap, γ_{SO}, and so is oil spending as a share to GDP relative to oil revenue as share to GDP, the second bracket in Eq. (3) is also positive during the sample period.

13. Except for 2009–10, adjustments due to the business cycles have been relatively modest. During the 2009 crisis, for instance, the output gap was largely negative and thereby the observed non-oil revenue level was significantly below its associated structural level. This gave rise to a larger structural balance relative to headline balance observed in that year. Conversely, during 2006–08 the output gap was positive, and thus observed non-oil revenue was above what its structural level would indicate. With a closing output gap during 2011–12 the adjustment for the cycle has tended to fade away.

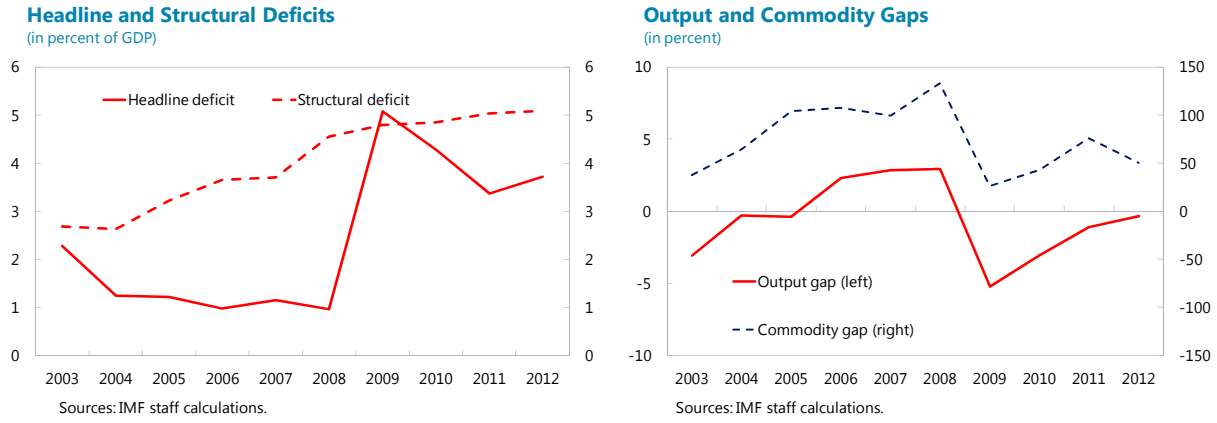
14. Due to high oil prices, oil revenue has persistently exceeded its structural level over the period 2003–12. The largest difference was observed in 2008, coinciding with the sharp increase in oil prices during that year. In fact, during the whole period, observed oil revenue has been on average above its structural level by about 2 percent of GDP. This gives rise to the large structural adjustment observed in Table 2 originated in the oil price cycle. In line with the reduction in the commodity price gap, the difference between observed and structural oil revenues has decreased accordingly over time.

Mexico: Adjustments to Revenue



15. On average, the structural deficit was more than 1.5 percent of GDP higher than the observed headline deficit during 2003–12. The largest difference took place in 2008 (3.6 percent of GDP), shrinking significantly during the 2009 crisis. Since then it has increased again to a considerable size, a situation that has remained through 2012.

Mexico: Observed and Structural Balance



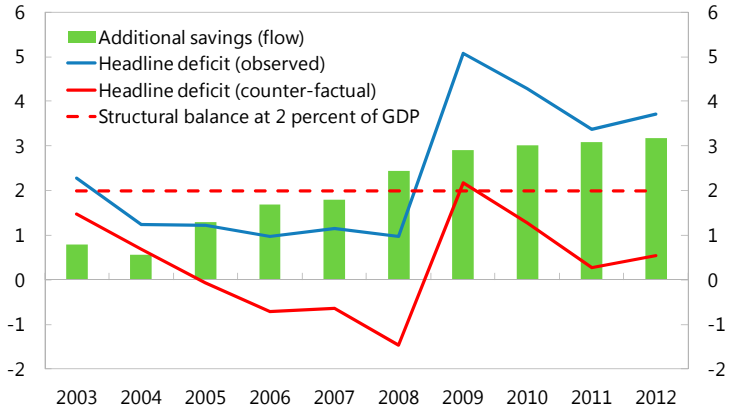
Sources: IMF staff calculations.

Sources: IMF staff calculations.

A counterfactual exercise: behavior under a structural balance budget rule

16. Mexico could have accumulated more significant savings during 2003–12 with a structural balance rule. Under a structural balance budget deficit rule at 2 percent of GDP—as indicated in Mexico's FRL for the headline traditional balance—cumulative savings could have been about 20 percent of GDP during 2003–12.[16] A looser structural target say at 3 percent of GDP could have still yielded substantial savings, at more than 10 percent of GDP.

Mexico: Counterfactual Exercise of Structural Deficit at 2 (in percent of GDP)



Sources: IMF staff calculations.

[16] Cumulative savings are measured as the difference between the overall balance underlying such counter-factual rule and that actually observed.

Sensitivity analysis

17. Estimates for the structural balance are sensitive to alternative assumptions about the structural oil price. Considering the baseline elasticities values but instead the budget price formula established in Mexico's FRL to determine the structural price of oil, the underlying structural balance could have been slightly lower than that using the MA(7) approach. This feature is even more noticeable when using the HP filter to determine the structural price of oil. The reason behind this is the lower commodity gaps estimated under either of these two methods relative to the MA(7) approach. In any case, the fact that the structural deficit in Mexico has been significantly above that actually observed during the commodity-boom years, stands regardless of the particular method used to estimate the structural price for oil.[17]

Table 3. Mexico: Sensitivity Analysis of Structural Balance Calculations (in percent of GDP)

Year	Headline overall balance	Structural balance		
		Baseline (MA(7))	Budget price	HP filter
2003	-2.3	-2.7	-2.3	-0.7
2004	-1.2	-2.6	-1.9	-0.4
2005	-1.2	-3.2	-2.2	-0.9
2006	-1.0	-3.7	-2.4	-1.4
2007	-1.2	-3.7	-2.5	-1.7
2008	-1.0	-4.5	-3.0	-2.5
2009	-5.1	-4.8	-3.7	-3.3
2010	-4.3	-4.8	-4.5	-3.5
2011	-3.4	-5.0	-4.4	-3.9
2012	-3.7	-5.1	-4.2	-4.3

Sources: IMF staff calculations.

C. Concluding Remarks

18. This note provides a methodology to estimate a structural fiscal balance for Mexico, which also helps disentangle more precisely the role of the business and commodity cycles in explaining Mexico's overall fiscal stance. According to the estimations presented here, Mexico's fiscal position has been more significantly affected by the recent oil price boom rather than the non-oil business cycles. While further refinements are necessary, the estimations suggest that had

[17] Although final results are also sensitive to the elasticities used in the calculations, there are no significant differences in terms of the main conclusions of the paper when considering the range of point estimates for these elasticities indicated in Table 2.

Mexico followed a structural balance rule set at a level similar to that indicated in the FRL for the headline traditional balance, the accumulation of savings could have been substantial during 2003–12, reaching eventually two-digits figures by the end of the period. Although results are sensitive to the main underlying assumptions used in the analysis, the assessment of the significant role of the recent commodity price boom in explaining Mexico's fiscal position remains, even when considering different methodologies to estimate the structural oil price for the Mexican oil *Mezcla*.

References

Centro de Estudios de las Finanzas Públicas (CEFP), 2009, "La elasticidad del ISR e IVA respecto al Producto Interno Bruto," Nota Informativa No 055/2009.

Daude, Christian, Melguizo Ángel, and Alejandro Neut, 2011, "Fiscal Policy in Latin America: Countercyclical and Sustainable?," Economics: The Open-Access, Open-Assessment E-Journal, Vol. 5, 2011–14. http://dx.doi.org/10.5018/economics-ejournal.ja.2011–14.

Fedelino, Annalisa, Anna Ivanova, and Mark Horton, 2009, "Computing Cyclically Adjusted Balances and Automatic Stabilizers," IMF Technical Notes and Manuals 09/05.

Girouard, Nathalie, and Christophe André, 2005, "Measuring Cyclically adjusted Budget Balances for OECD Countries," OECD Economics Department Working Papers, No. 434, OECD publishing.

Vladkova-Hollar, Ivanna, and Jeromin Zettelmeyer, 2008, "Fiscal Positions in Latin America: Have They Really Improved?," IMF Working Paper No. 08/137 (Washington: International Monetary Fund).

CREDIT RISK MODELING—THE ROLE OF MACROECONOMIC FACTORS IN THE MEXICAN BANKING SYSTEM[1]

A. Introduction

1. The Mexican banking system is relatively small compared with its Latin American peers. It consists of 42 commercial banks with assets comprising about 40 percent of GDP, with credit to the non-financial private sector accounting for a small share of GDP. Concentration in the sector is high, with a large presence of foreign banks: the three largest banks (subsidiaries of large Global systemically important financial institutions, G-SIFIs) account for nearly half of lending to the non-financial private sector, and the six largest about 75 percent. As part of a strategy to promote competition in the banking sector, in the past decade, 10 new banks began operating in Mexico, but the market share of the new banks has remained small. The government has a negligible direct presence in the commercial banking segment, but as in other countries has been more active in development banks (about 11 percent of loans) and the residential mortgage market, which is dominated by housing lending companies—*Infonavit and Fovissste*.[2]

2. In recent years, the supervision of Mexican banks has been considerably strengthened, including through regular application of stress tests. Since 2009 the Financial Stability Council (*Consejo de Estabilidad del Sistema Financiero*, or FSC for short) has conducted comprehensive stress testing exercises of the banking system, covering the largest financial institutions.[3, 4] The results of the 2012 exercise were presented in the FSC's 2013 Annual Report. It covers the 25 largest financial institutions and consists of two scenarios (baseline and adverse). The IMF's WEO projections are used in the baseline scenario and the adverse scenario is designed in-house. While the latest FSC's stress testing exercise finds that the banking sector can withstand credit risk shocks, the modeling of credit risk does not take into account the feedback effect from the rise in NPLs and LLPs to credit and economic activity.

3. The main objective of this paper is to model credit risk in the banking system with a focus on the feedback loops generated by macroeconomic shocks. Credit risk is the main source

[1] Prepared by Roberto Guimaraes-Filho.

[2] They account for about two-thirds of mortgages, with commercial banks accounting for nearly one-third.

[3] The FSC comprises of the Ministry of Finance, Central Bank, Banking supervisor (CNBV), National Insurance Council, National Pension Fund supervisor (CONSAR), and the National Deposit Insurance Institute (IPAB). The CNBV regulates and supervises the banking system, with on- and off-site surveillance and a risk-based supervisory approach. Basel III capital adequacy norms have been in effect since January 2013.

[4] The 2011 FSAP update discusses in detail progress on banking supervision as well as areas for further improvements, notably concentration risk. One of the main areas of progress has been on stress testing.

of risk facing commercial banks in Mexico, and asset quality has recently deteriorated in some areas (e.g., consumer lending, although they represent a small share of total assets), highlighting the importance of better understanding the dynamics of credit risk and the effects of the latter on activity and other macroeconomic variables. The recent slowdown in the economy also underscores the importance of furthering credit risk model to shed light on the implications for financial stability.

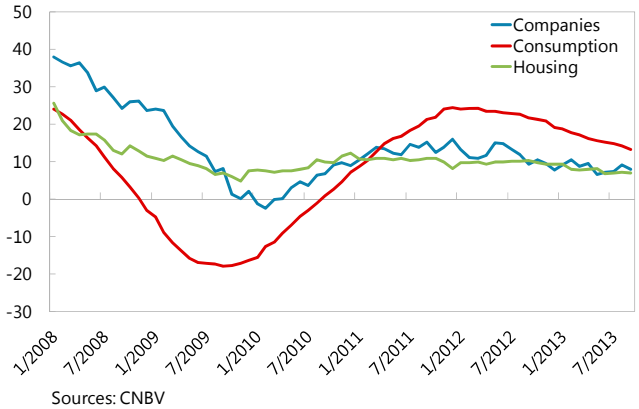
4. The results suggest that bank credit risk variables are strongly affected by macroeconomic factors such as GDP, unemployment, and the interest rate. Given Mexico's strong linkages with the U.S., the direct effect of U.S. shocks on domestic NPL and LLP ratios are also significant; positive shocks to U.S. GDP growth lowers NPLs by nearly the same magnitude as domestic GDP shocks in the case of corporate loans. Positive inflation and nominal interest rate shocks increase NPLs and LLPs. Moreover, a positive shock to the NPL/LLP ratio leads to a decline in GDP growth and an increase in unemployment rate. In this vein, the VAR estimations confirm the presence of significant macro-financial linkages.

5. The remainder of the paper is structured as follows. Section II presents some stylized facts covering the Mexican banking system. Section III present some modeling issues, including choice of variables as well as how the VAR methodology is applied in the context of modeling NPL and LLP ratios. Section IV contains the main estimation results on the effects of the macroeconomic shocks on NPLs and LLPs. It also presents a quantitative analysis of the role of activity (external and domestic) in explaining credit risk volatility and the role of credit risk variables in explaining domestic activity, including how they account for the volatility in GDP growth (compared with monetary policy determinants).

B. The Mexican Banking Sector: Some Stylized Facts

6. Following a period of rapid credit expansion before the global financial crisis (GFC), credit growth has moderated, averaging 12 percent so far in 2013. The overall rate of credit growth masks significant differences among main segments. Credit to sub-national government rose sharply in 2009–2010 and after declining rapidly in 2011; it rose again in 2012, and remains relatively high. While credit to companies and housing has grown between 7 and 15 percent y/y since 2011, consumption credit growth has seen a sharp deceleration in recent months to 15 percent y/y (by mid-2013) from about 25 percent y/y in early 2012. The growth in consumer credit (about a fifth of total credit) has been fueled primarily by payroll and other consumer loans, with the latter reaching nearly 50 percent y/y in early 2012 (though it has been moderating since). While overall credit remains low as a share of GDP, it is difficult to discern whether the expansion in consumer loans reflects a healthy deepening

Credit Granted by Commercial Banks to the Non-Financial Private Sector (Outstanding loans; in percent)

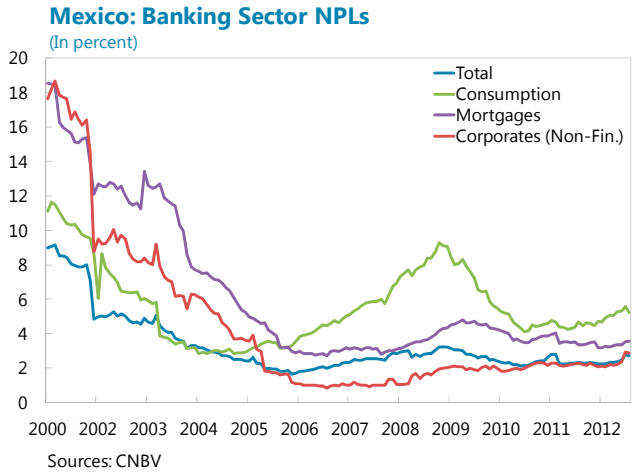


Sources: CNBV

of the financial system or a potential risk to financial stability, even if the latter appears unlikely given the share of consumer lending in total assets. But with the recent moderation in economic activity, monitoring the risks stemming from consumer credit growth is at a premium.

7. The banking sector has low levels of leverage. Mexican banks fund themselves primarily through customer demand and time deposits, which account for about 85 percent of total funding. Interbank loans have been generally less than 10 percent of funding, while bonds have increased in importance, reaching 5 percent of total funding in 2013. In terms of customer deposits to interbank loans, the Mexican banking system compares with its Latin American peers. Smaller banks lacking a more solid deposit franchise rely more on deposits from domestic corporations and development banks.

8. The NPL ratio of the banking system has risen with the moderation in economic activity and the slowdown in the consumer lending segment. In regional terms, the system-wide NPL ratio is comparable to that of other Latin America countries. After declining from a peak of 4.5 percent in early 2009 to 3 percent at end-2012, the NPL ratio has risen to 3.7 percent by mid-2013. The recent rise also masks significant differences in behavior among main loan segments. For instance, the sharp uptick in May 2013 has been driven by industrial sector, whose ratio has been steadily rising since late 2010. In the case of consumer loans, the rise in NPLs has been concentrated on payroll and other consumption, with credit cards (which had experience a sharp rise during the GFC) and consumer durables relatively stable. But more importantly, the steady increase in the NPL ratio for consumer lending has broadly coincided with the deceleration in economic activity. Given that NPL ratios tend to lag activity, a relevant question is whether the upward trend in the consumption NPL ratio is expected to continue. Moreover, with the prospect of higher (external and domestic) interest rates, could the rise in NPLs persist even if growth in economic picks up in the near term? Loan loss provisioning rules were also backward looking (and tended to lag the cycle) until recently when expected losses were introduced.[5]



[5] NPLs would pick up if the transmission to policy interest rates to consumer lending rates is significant (though most payroll and personal loans have a fixed rate scheme). Another possibility is if interest rates go up as the domestic economy benefits from a stronger than expected expansion in the U.S., which could lower NPLs. Loan loss provisioning rules for consumer loans, mortgages, and loans to sub-national governments, and corporate loans are now based on expected losses. See Box on Macro-prudential regulations in the 2013 Staff Report.

9. The Mexican banks sector is well capitalized and profitable. The system-wide capital adequacy ratio (CAR) reached 15.7 percent at end-May 2013, a small increase vis-à-vis end-2012. The CAR of the six largest banks ranges from 15.2 to 16.8 percent, slightly higher than that of the smaller banks among the 25 largest banks in the system (comprising 95 percent of banking sector assets). The average CAR of the largest institutions has been improved slightly so far in 2013, with the performance of smaller banks has been more mixed. The higher provisioning for loan losses in the consumption and sub-national government segments account for most of the difference. Profitability indicators have remained broadly stable. Return on assets has approached 1.7 percent and return on equity has been rising moderately, reaching 15 percent in 2012.

C. Modeling Credit Risk and Macro-Financial Linkages

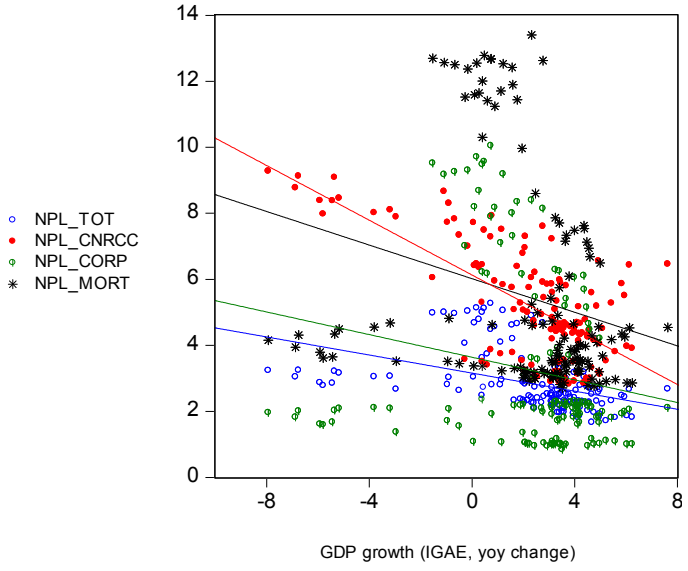
10. This paper contributes by modeling credit risk faced by the Mexican banking system. It does so by estimating the sensitivity of non-performing loan ratios (and loan loss provisions) to changes in key macroeconomic factors. The focus on credit risk is obvious: credit risk is generally the most important risk of universal banks and has been a key part of stress testing exercises. In the case of Mexican banks, capital charges related to credit risk account for more than half of risk weighted assets and the Mexican banking system is highly liquid, funded mostly through core liabilities (deposits). Moreover, credit risk indicators tend to commove more strongly with business cycle indicators, whereas liquidity risk, for example, is more linked to movements in asset prices.

Correlation with GDP Growth

Total loans	
NPLs	-0.39
LLPs	-0.35
Consumer loans	
NPLs	**-0.64**
LLPs	-0.36
Corporate loans	
NPLs	-0.28
LLPs	-0.24

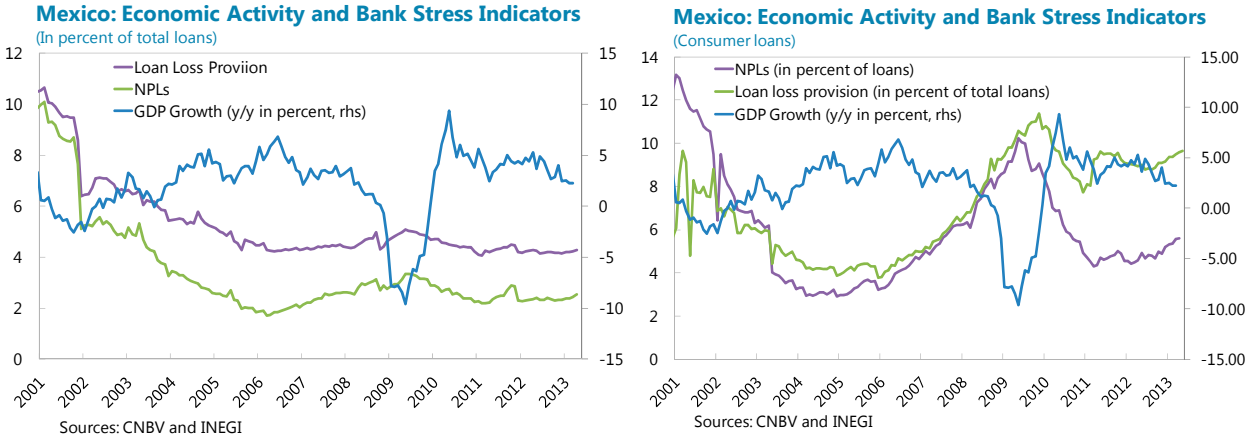
11. The indicators of credit risk used here are NPL ratios and LLP ratios for the banking system, but disaggregated by loan segment. In addition system-wide ratios, five loan segments are covered: corporates, household consumption excluding credit cards, credit cards, mortgages, and sub-national governments. Since system-wide ratios are used, there is no need to control for bank specific variables. The Financial Stability Council models the relationship between macroeconomic factors and probabilities of default (PDs, system-wide PDs are shown in the FSC's Annual Report), but relatively long series of PDs clean of structural breaks (changes in methodology) are not available, hence the

NPLs and GDP Growth



Source: IMF staff calculations

focus here on NPL and LLP ratios. The LLPs are also potentially subject to structural breaks as provisioning rules for some types shifted from historical losses to expected losses. As shown in Section III of the FSC's annual Report, LLPs and NPLs are highly correlated. In fact, both measures are significantly correlated with GDP growth. The contemporaneous correlation is statistically significant, and particularly large for consumer loans. The correlation is also economically significant for all subsamples analyzed here, including consumer loans (revolving and non-revolving), corporates, and mortgages, as well as for different sub-periods, including the pre-GFC period.

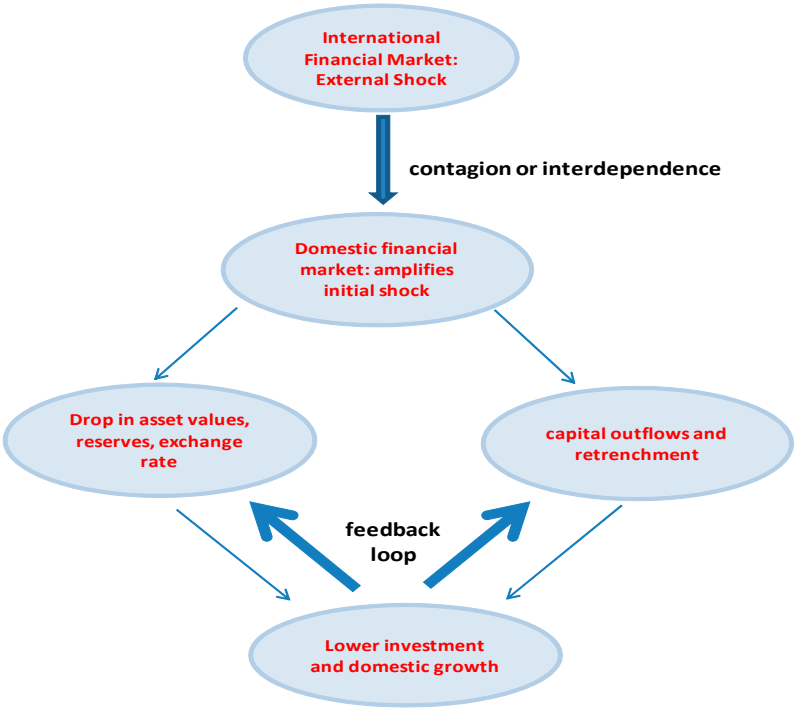


12. This paper estimates the joint interdependences between financial (credit-risk) stress variable and macroeconomic factors. This is done by applying vector autoregressions and stands in contrast to many works in macrofinancial credit risk models which are based on "satellite models" (linear or nonlinear) regressions linking NPLs (or LLPs) to macroeconomic variables. The advantage of using VARs in the context of credit risk modeling is to capture the feedback effect from deteriorating credit quality and the macroeconomic environment, as bank lending and financial conditions are generally pro-cyclical. That is, once a negative shock to GDP raises NPLs (for example), banks generally start cutting down on credit, which further depresses economic activity.[6]

13. This feedback loop between credit risk and macroeconomic variables can be easily captured through impulse response functions. This is the reason why the VAR framework potentially yields a better understanding of the *dynamics* of credit risk — in contrast to the generally *static* nature of satellite models and credit risk stress tests. In addition, the effect of external variables can be easily incorporated, and their effect on credit risk variables is direct as well as through domestic activity and other channels (domestic interest rates, exchange rate, and so on). The following diagram illustrates the aforementioned feedback effect:

[6] Klein (2013) finds that for Emerging European countries, NPLs respond strongly to macroeconomic conditions, particularly GDP growth unemployment, and inflation. Interestingly, bank-specific factors have relatively low explanatory power. As in many papers in this area, Klein (2013) finds that feedback effects from the banking system to the real economy are quantitatively important. See also Espinoza and Prasad (2010), Nkuzu (2011), and Quagliarello (2007).

Links Between External and Domestic Factors



Data

14. All series used are monthly and taken from Haver, the Mexican central bank (Banxico), the Mexican banking regulator (CNBV), and the IMF's International Financial Statistics (IFS). The series are sampled monthly and average values are used in the case of financial market data (interest rates, exchange rate and VIX), which have a higher frequency. In the case of estimations with GDP series, a linear interpolation to monthly data is used. In some cases, such estimations are also redone with industrial production data, which are available at the monthly frequency. Most of the models are estimated over the sample December 2000–May 2013, with a total of 149 observations. Cases where the sample size differs significantly are noted below. The variables used in the baseline estimations are: U.S. real growth, U.S. VIX, domestic GDP growth (proxied by the monthly index of economic activity, IGAE), domestic real credit growth, short-term interest rate (TIE_28_day), exchange rate change (first difference of log-MXN/USD), and the credit risk variable (NPL or LLP). For robustness, trivariate VARs with the domestic interest rate and GDP growth or unemployment rate are also run, as well as VARs without the VIX.[7] In all the estimations, the activity

[7] According to the analysis presented in Section VII of the FSC's 2013 Annual Report (see pages 71–72), these are some of the most significant variables in a regression model explaining default probabilities for different segments of the banking sector.

(GDP, industrial production, and unemployment rate) and price variables are seasonally adjusted by X-12 and annualized log-growth rates are then calculated.

Estimated Model and Assumptions

The VAR model utilized in this paper assumes that the model economy can be represented by:

$$B_0 y_t = k + B_1 y_{t-1} + \ldots + B_p y_{t-p} + u_t$$

where y_t is the n x 1 data vector containing U.S. real growth, U.S. VIX, U.S. federal funds rate, domestic inflation, domestic GDP growth, short-term interest rate (TIE_28_day), exchange rate change (first difference of log-MXN/USD), and the credit risk variable (NPL or LLP); k is a vector of constants, B_i is an n x n matrix of coefficients (i = 1, ..., p), and u_t is a white-noise vector of structural shocks, with diagonal variance-covariance matrix D.

As standard in the VAR literature, the model can be rewritten as:

$$y_t = c + C_1 y_{t-1} + \ldots + C_p y_{t-p} + e_t$$

where $e_t = B_0^{-1} u_t$ is also white-noise vector process, with variance-covariance matrix given by $\Omega = B_0^{-1} D (B_0^{-1})'$. The identification of structural shocks amounts to imposing restrictions on the matrix B_0 that eliminates the contemporaneous correlation of the reduced-form residuals.[8] For example, the recursive ordering (Cholesky) proposed by Sims (1980) assumes that B_0 has a lower triangular structure. This is equivalent to saying that the ordering of the variables follows a hierarchical structure, with the most exogenous variable ordered first.

The reduced form model is estimated by least-squares (MLE) and the lag structure is determined according to the Bayesian information criteria. The standard errors for the impulse response functions are calculated according to Sims and Zha (1999).[9] According to the lag selection criteria (multivariate BIC), generally one or two lags are sufficient to accommodate the dynamics

[8] The matrix Ω can be rewritten as Ω = ADA' where D is diagonal. In this case, since $u_t = A^{-1} e_t$, with A = B_0^{-1}, then E($u_t u_t'$) = $E(A^{-1} e_t e_t' (A^{-1})')$ = $A^{-1}(ADA')(A^{-1})'$ = D, i.e. the vector u_t is orthogonal and can be interpreted as structural (or orthogonalized) shocks, since they are contemporaneously uncorrelated.

[9] More specifically, the probability bands are calculated from 10,000 draws using a Bayesian-Gaussian approximation to the posterior of the matrix B_0^{-1}.

present in the data.[10] In the case of the non-recursive model, to identify the structural shocks, the following contemporaneous restrictions are imposed:[11]

- U.S. real GDP growth is exogenous with respect to all the variables in the system;
- Risk aversion shocks responds contemporaneously only to U.S. real GDP growth shocks;
- Domestic activity responds only to U.S. activity (through exports); in the robustness exercises domestic activity growth also responds to global risk aversion (through investment), although the last channel is more tenuous given the monthly sampling of the data and the normal delays in spending (including investment) decisions, justifying a zero restriction in the baseline estimations.
- Domestic (real) credit growth reacts to external variables and to domestic activity. Given the monthly sampling of the data, the contemporaneous effects are likely to be small, but no restrictions are imposed a priori.
- Domestic interest rate reacts to the external variables (zero effect imposed in the robustness exercises) and domestic activity (through a Taylor rule).
- The credit risk variable (NPL or LLP ratio) only reacts contemporaneously to external activity since the latter can affect contemporaneously expectations of future domestic activity and real credit growth.
- The nominal exchange rate change reacts contemporaneously to all variables in the system, including the credit risk variable.

The above restrictions imply that the non-recursive structural model can be represented as:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & \mathbf{0} & 1 & 0 & 0 & 0 & 0 \\ a_{41} & \mathbf{0} & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & \mathbf{0} & \mathbf{0} & \mathbf{0} & 1 & 0 & 0 \\ a_{61} & a_{62} & \mathbf{0} & \mathbf{0} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} \Delta y_t^* \\ \sigma_t \\ \Delta x_t \\ \Delta cr_t \\ \Delta y_t \\ \Delta i_t \\ \Delta e_t \end{bmatrix} = B(L) \begin{bmatrix} \Delta y_t^* \\ \sigma_t \\ \Delta x_t \\ \Delta cr_t \\ \Delta y_t \\ \Delta i_t \\ \Delta e_t \end{bmatrix} + \begin{bmatrix} u_{y*,t} \\ u_{\sigma,t} \\ u_{x,t} \\ u_{cr,t} \\ u_{y,t} \\ u_{i,t} \\ u_{e,t} \end{bmatrix}$$

[10] Residual tests reveal mild forms of autocorrelation (but not of heteroskedasticity) that can be reduced by adding more lags (or dummies) to the baseline model. To preserve degrees of freedom, the 1-lag structure with one crisis dummy was preserved for the baseline results presented in this note.

[11] No coefficient restrictions are imposed on the lagged structural parameters of the model.

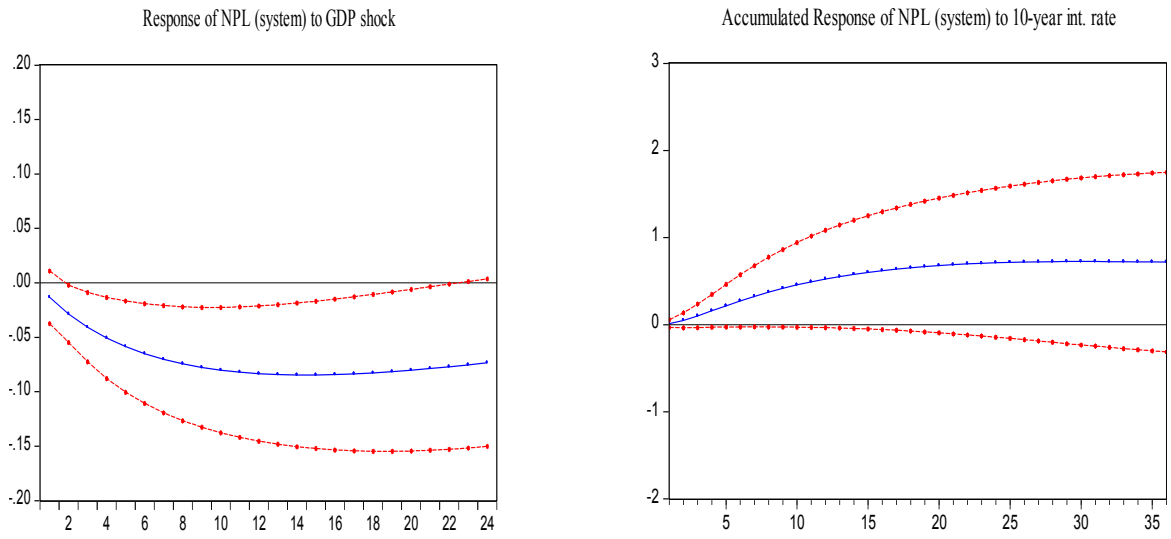
where $B(L) = \sum_{i=1}^{p} B_i(L^i)$, and consistent to the notation above, $u_{i,t}$ is the vector of structural shocks. In the case above the likelihood-ratio test statistic for overidentifying restrictions is distributed as Chi-square (7), compared to the just-identified model usually used in the case of a simple recursive ordering. The variance decomposition calculations are also based on the same identification assumptions outlined above (more details below). For robustness, the generalized impulse response functions (which are invariant to the ordering of the variables in the VAR) were also computed.

D. Baseline Results

The Effects of Macroeconomic Factors on Credit Risk Variables

- **GDP/unemployment shocks:** The effect of domestic real GDP growth shocks on NPLs is relatively large and significant. A one percentage point decline in GDP growth leads to a cumulative increase of 0.3 percentage points in the system-wide NPL ratio (after 12 months). In the case of the LLPs, the effect of the GDP shock is smaller at 0.14 pps. In the case of the non-financial corporates, the effect of a negative GDP shock is not statistically significant and wrongly signed. For consumer loans (which include credit cards and other types of loans) the model is also estimated with the unemployment rate. In the case of activity, a one percentage point increase in the GDP leads to a cumulative drop in the NPL ratio for consumer loans of about 0.6 percentage points. In the case of unemployment, a one pp increase in the unemployment rate leads to a 0.5 pps increase in the NPL ratio. The one percentage point increase in the unemployment rate is similar to the adverse scenario presented in the 2013 Annual report of the FSC. Nonetheless, it is small when compared with the 2.4 pps increase in unemployment between May 2008 and September 2009. For mortgages, the effects of unemployment shocks are also significant: a one pp rise in the unemployment rate lowers the NPL ratio by 0.4 percentage points.

Response of NPLs to GDP and Interest Rate Shocks



Source: IMF staff calculations.

- **Interest rate shocks:** the effect of nominal interest rate increases is to increase NPL and LLP ratios, consistent with simple correlation analysis. This effect is borne out in the baseline estimations. The relevance of this effect is non-trivial since with the exit form accommodative monetary policies in the U.S. and other advanced economies, interest rates in Mexico are likely to rise, and quite possibly suddenly, akin to movements typically simulated in adverse stress test scenarios. In the case of system-wide NPL ratios, the effect of a 400 basis point increase in the nominal rate is to increase NPL ratios by 2.8 percentage points. The 400 bps increase corresponds to the movement in the adverse scenario in the FSC's 2013 Annual Report. In the case of consumer loans the effect of an interest rate shock is nearly twice as large. For corporates, the effect is much smaller (0.2 pps) and statistically insignificant when based on the 95 percent probability coverage of the impulse response function. The smaller effect on corporates' NPLs could reflect the relatively comfortable liquidity of the sector and the sharp reduction in delinquency at the beginning of the sample. Interest rate shocks also have large and significant effects on credit risk indicators for mortgage lending. A decline in interest rates of 100 basis points lowers the NPL ratio by about 2.5 pps. The effect on LLPs is estimated at 0.7 pps in a VAR without the external variables (since the baseline VAR the effect is not statistically significant). Several caveats are in order. First, interest rates for corporates are linked to market interest rates (TIIE), while mortgages typically have fixed rates and consumer lending rates tend to be sticky. Second, the significant rise in the NPL ratios in some cases reflects the fact that interest rate shocks lead to a decline in credit growth, which in turn affects the denominator of the NPL ratio.

The table below summarizes the effects for GDP and interest rate shocks. As noted above, In the case of mortgage and corporate loans the effect of activity on NPLs and LLPs is estimated in VAR with and without external variables, since in the augmented VAR the effect has the wrong sign (although they are not statistically significant).

Effects of Shocks on NPLs and LLPs

(one-year horizon) 1/

	Total	Consumer	Corporate	Corporate 2/	Mortgage	Mortgage 2/
dnpl/dy	-0.25*	-0.57*	0.50	0.10	-1.02*	-
dnpl/di	0.71*	1.14*	0.17*	0.57*	2.57*	-
dllp/dy	-0.14	n.a.	0.29	-0.43*	0.63	-0.67
dllp/di	0.29	n.a.	0.43*	0.86*	1.86*	2.09*

Source: IMF staff calculation

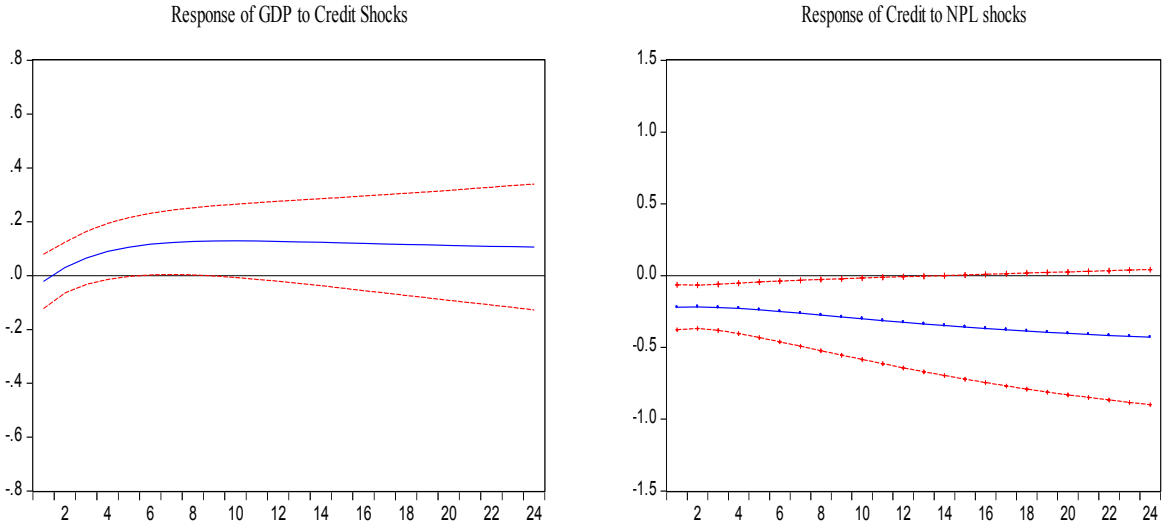
1/ Six-month horizon for impact of activity on system-wide LLP.

2/ Model excluding external variables.

* Statistically significant using 68 percent probability bands from VAR.

- ***Credit shocks:*** An increase of one percentage point in real credit growth leads to a decline in the system-wide NPL (LLP) ratio of about 0.4 (0.3) pps after 12 months. The effect increases until 18 months, and then after then, it starts to revert. Credit also responds to a deterioration in asset quality, declining persistently with the rise in NPLs. Credit shocks are also important for activity, consistent with a strong credit channel.

Impulse Responses



Source: IMF staff calculations.

- ***External variables and exchange rate shocks:*** The effects of external variables, particularly shocks to U.S. GDP growth are generally large and significant. For instance, in the case of system-wide NPL and LLP ratios, a one standard deviation decline to U.S. real GDP growth rate,

equivalent to about 0.4 pps, raises the NLP ratio by about 0.15 pps (about two-thirds of the effect of domestic shocks). While the effect is large, it should be kept in mind that a drop in U.S. activity growth triggers an endogenous response in domestic activity, so the cumulative rise in the NPL ratio reflects both effects after the initial impact. The initial impact of the U.S. VIX on the system-wide NPL and LLP ratio is also relatively small, but the cumulative effect after 12 months is significant as it is associated with declines in U.S. activity and domestic activity. The effect of exchange rate shocks is in line with correlations over the total sample: depreciation shocks lead to a rise in NPLs and LLPs (ratios). The estimated effects are quantitatively small (and statistically insignificant), reflecting declining in foreign exchange indebtedness in the economy since currency and banking crisis of the mid-1990s.

Variance decomposition of credit risk indicators

15. The variance decomposition from VAR can also be used to gauge the importance of the different shocks affecting credit risk indicators. More specifically, the variance decomposition (VD) shows the contributions of the different shocks to the variance of the forecast error of a given variable. In a stationary VAR the variance of the forecast error converges to unconditional variance of the variable of interest, so loosely speaking one can simply refer to the "variance". In the case of system-wide NPLs, at the 12 month horizon its variance is explained mostly by its own shocks, which is typically the case in these exercises. As the horizon increases the effects of other variables on the variance of the forecast error of the NPL ratio accumulates. For instance, domestic real GDP growth shocks account for about 10 percent of the variance of the NPL ratio at the 36 month horizon. The contribution of real credit growth shocks to the variance of NPL is also significant at 15 percent. External variables and interest rates account for less than 10 percent each. In the case of the LLP for the system, the magnitudes are broadly similar. For consumer and mortgage NPL ratios, the contribution of shocks to the unemployment rate is smaller at about 7 percent, partly reflecting the relative stability of unemployment during our sample period.

The Feedback Effect arising from Macro-Financial Linkages

16. The macro-financial linkages are sizable and significant according to the model results. The feedback mechanism between credit risk and macroeconomic variables can be captured by examining the effects of credit risk shocks on activity, unemployment, and credit growth. For the system as a whole, a one percentage point increase in the NPL ratio leads to a drop in real GDP of about 0.8 percent after 12 months (measured from the cumulative impact on real GDP growth). The effect persists even after 24 months and the cumulative impulse responses are broadly unchanged at both horizons. In the case of different loan segments, the effect of credit risk on activity seems to be stronger for the corporate NPL ratio, suggesting that rises in corporate non-performing loans might be associated with lower liquidity and cash-flows and lower corporate investment. The impact of credit risk shocks on credit growth is also significant (0.7 pp after 12 months), consistent with a strong credit cycle, also contributing to the overall effect on economic activity as the latter is influenced by credit conditions more generally. For consumer loans, a one pp increase in the NPL ratio lowers credit in that sector by about 0.3 pps (similar in magnitude to that of mortgages). In the

case of mortgage lending, the effect is about 0.15 percent, possibly reflecting the role played by collateral in attenuating the credit cycle in that segment (in the absence of severe conditions).

Variance Decomposition of domestic activity and credit growth

17. The VD exercise is also used to analyze the contribution of credit risk and credit shocks to the variability of domestic real GDP growth. Domestic real GDP growth shocks explain about 40 percent of its own variability after 12 months. A non-trivial fraction is accounted for by external variables (15 percent combined). The contribution of the nominal exchange rate depreciation is relatively small at 5 percent, as is that of the interest rate at 7 percent. The contribution from credit growth and credit risk shocks (measured using the NPL ratio) to the variance of domestic activity growth is almost 30 percent, suggesting a significant feedback effect from credit to activity. The effects asset quality and credit cycle in explaining activity are important. In this connection, it is also important to consider the contribution of credit risk shocks on credit growth. For the system as a whole, the share is large at almost 20 percent after 12 months. For corporates the effect is even larger at 25 percent, while for consumer and mortgage lending the share of credit risk shocks is smaller than the system average (based on the NPL ratio and the baseline estimations).

E. Concluding Remarks

18. While the Mexican banking system has experienced robust growth in credit intermediation in recent years and remains well capitalized, non-performing loans have been on the rise. While the overall levels of non-performing loans remain manageable, the rise in the NPL ratio has been significant and concentrated in some loan segments, especially consumer lending. With the moderation in activity expected in the near term, NPLs are likely to rise further, which could have implications for credit growth and financial stability.

19. This paper finds significant macro-financial linkages between credit risk and economic activity in Mexico. First, macroeconomic factors play an important quantitative role in explaining credit risk dynamics. Moreover, the latter has important implications for economic activity in the near and medium terms. In particular, the recent rise in NPLs, while not necessarily posing threats to financial stability, is likely contribute to a further moderation in activity.

20. The findings reported here have uncontroversial policy implications. As in the past, banking supervision should continue to put a premium on preventing a significant buildup of non-performing loans in the system. Careful monitoring of credit growth in specific segments is warranted, as well as developing early warning systems to identify incipient buildup of systemic risks that could lead to prospective loan losses.[12]

[12] The behavior of NPL ratios for sub-national governments (which declined rapidly in 2012 following a tightening of lending standards), while not representing a systemic risk, is a case in point.

References

Espinoza, R., and Prasad, A. (2010). "Nonperforming Loans in the GCC Banking Systems and their Macroeconomic Effects," IMF Working Paper No. 10/224 (Washington: International Monetary Fund).

Klein, N. (2013). "Non-Performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance," IMF Working Paper No. 13/72 (Washington: International Monetary Fund).

Nkuzu, M. (2011). "Nonperforming Loans and Macrofinancial Vulnerabilities in Advanced Economies," IMF Working Paper No. 11/161 (Washington: International Monetary Fund).

Quagliarello, M. (2007). "Banks' Riskiness over the Business Cycle: A Panel Analysis on Italian Intermediaries," Applied Financial Economics, Vol. 17, pp. 119–38.