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Selected Issues

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MEXICO

Selected Issues

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Approved by Western Hemisphere Department

July 12, 2011

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I. Potential Growth and the Output Gap in Mexico[1]

Decomposing the growth process in trend and cyclical factors represents an important challenge, with implications for policy decisions. This paper applies several methodologies to the case of Mexico and tries to assess to what extent these methodologies adequately capture cyclical changes. The results suggest that care is needed when using these indicators in real time to assess the stage of the cycle, particularly in the presence of large shocks, and that a variety of macroeconomic indicators are needed to evaluate and validate the results.

A. The Output Gap

1. **Estimates of the output gap are important for the conduction of macroeconomic policies**. The central bank's inflation targeting framework entails assessing if the projected output implied by the monetary policy stance is consistent with the inflation target. A measure of the output gap is also helpful to assess the stance of fiscal policy and fiscal sustainability—even when the fiscal rule is not a structural one.

2. **However, estimating the output gap entails significant challenges.** Since potential output is not directly observable, it has to be inferred from the data. However, changes in actual output could reflect cyclical shocks or permanent impacts to potential output. Inferring whether a shock is cyclical or temporary can be a difficult task. As a result, an ample array of methodologies has been used in the literature to estimate the output gap, with filters frequently used to separate cyclical and structural components. It should be noted, however, that these estimates are subject to substantial uncertainty.

3. **The end-point problem is particularly important.** Some of the methodologies employed, including the HP filter, have been criticized on several grounds, including that the end-point has too much of an impact on the trend of the series. While this could be addressed, it is still hard to correctly identify a shock in real-time, with subsequent data providing relevant information, which can result in estimates that are not consistent across time. Several approaches have been used to reduce the weight of the last observation—including through the use of forecast—while multivariate filters use different variables in an attempt to identify the nature of the shock.

4. **The pre-crisis period entails an interesting test to these methodologies.** The unusually large cycle associated with the global crisis makes identifying cyclical and structural components a challenge. The availability of some post-crisis data allows us to compare real time and full sample results to assess their consistency.

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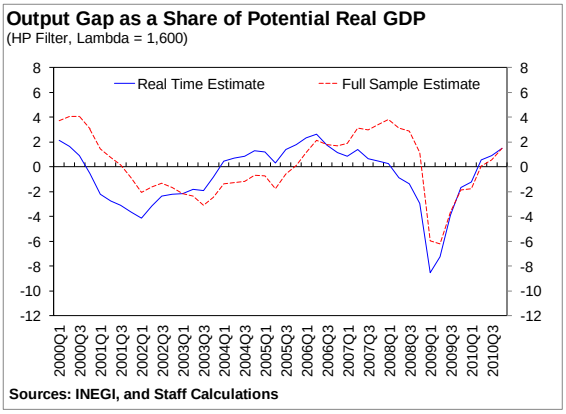
[1] Prepared by Enrique Flores and Francisco Vazquez-Ahued.

5. **We estimate the output gap applying different methods.** Using real GDP quarterly data from 1990 to 2010, we followed two different approaches: (i) a Kalman filter of unobserved components approach (with univariate and multivariate models) and (ii) a production function approach. The Kalman filter approach includes models used by Fuentes et al (2007), Marcet and Raven (2004), and Clark (1987), while the production function approach follows Krajnyak (2010).

Univariate filters

6. **A univariate HP filter is probably the most popular approach.** This method entails minimizing the square deviations from the trend (which basically penalizes the cyclical component) and the squared changes in the trend component (which penalizes variations in the growth rate of the structural component). When they proposed this method, Hodrick and Prescott (1997) set the smoothness of the trend (lambda=1600) such that the resulting cyclical patterns made sense using US post-war data. This smoothness parameter has become the standard when estimating the output gap, even though studies like Marcet and Ravn (2004) contest its validity outside the US.

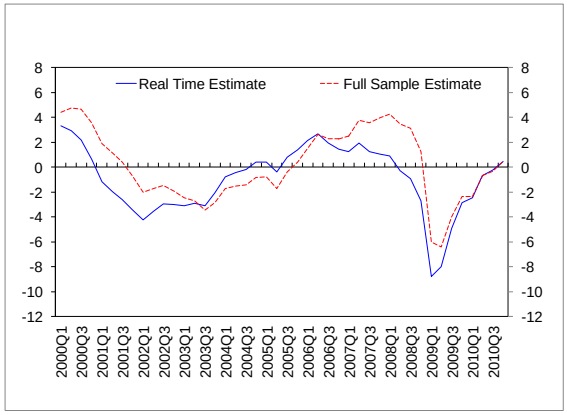


7. **This approach suggests a large pre-crisis positive output gap, using full sample data.** The real-time estimates, however, suggest the gap was nil in 2008. The large decline in output following the 2008 financial crisis is behind the difference between the two estimations. The estimated pre-crisis potential output in the full sample is lower than the one using just pre-crisis data, as the filter assigns some of the decline to the structural component. Therefore, and given that changes in the growth rate of potential are penalized, the decline in the estimated potential "anticipates" the crisis.

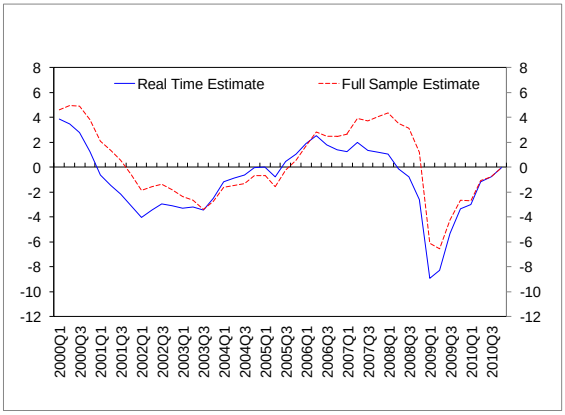
8. **Changing the smoothness of potential growth yielded similar results.** A higher penalty on changes in potential growth entails a smaller decline in the estimated potential following the crisis. The higher potential output entails smaller positive output gaps. Calculations using two arbitrary lambdas (5,600 and 10,000), and Marcet and Ravn "W" model entail smoother potential growth and yield lower (but still positive) output gaps; while Marcet and Ravn "V" model implies a less smooth potential and a somewhat higher gap. Real-time estimates remain inaccurate, particularly right before the global crisis.

Univariate Filter: Alternative Smoothness Parameters

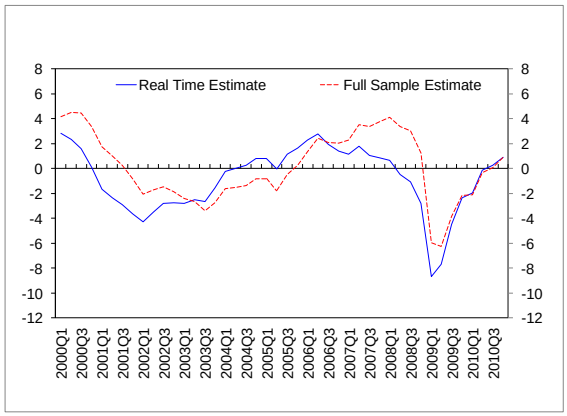
Lambda=5,600



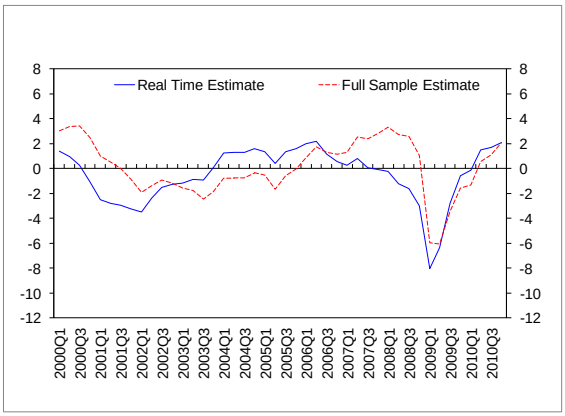
Lambda=10,000



"W Model"



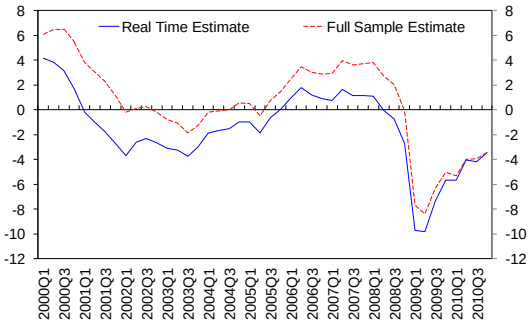
"V Model"



Sources: INEGI, and staff calculations.

9. **Increasing the persistence of the cyclical component improved the performance**. An alternative to the HP filter is an unobservable component model a la Clark (1987). This assumes that the cyclical component follows a second-order auto-regressive process.[2] The consistency between real time and full sample estimates improves for the pre-crisis period. This should not be

Output Gap as a Share of Potential Real GDP
(AR(2) Model, Lambda = 1,600)



Sources: INEGI, and staff calculations.

[2] This is different from the HP filter approach, which implicitly assumes a model with cyclical and structural shocks that follow a random walk.

surprising, as the model builds on persistence in the cyclical component.[3]

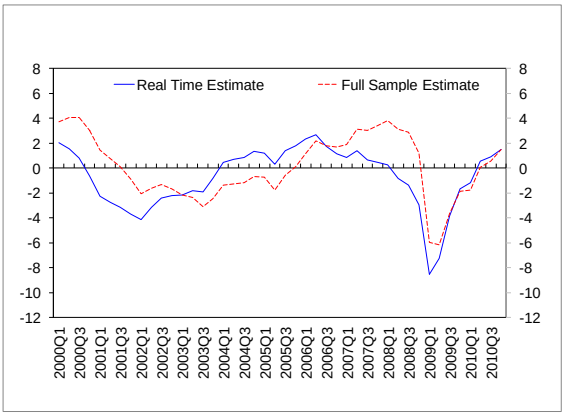
Multivariate filters

10. **Information from macroeconomic relations could help improve univariate filters.** We estimated the output gap using the Phillips Curve, the IS Curve,[4] and Okun's Law, as in Fuentes et al (2007). Core inflation, as defined by the Mexican authorities, is used in all three models. A backward looking Phillips curve is used as second signal equation in the first multivariate filter; the second one incorporates a standard backward looking IS curve; finally, while the third model builds on the first one by adding Okun's Law.

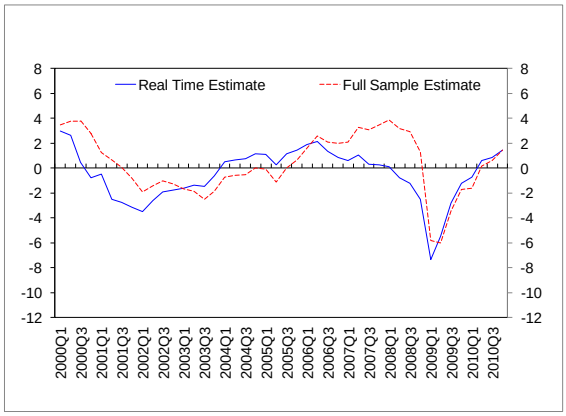
11. **Using a Phillips Curve and an IS curve in the multivariate filter did not yield significantly different results to the univariate filter**. Similar to the univariate HP filter, the real-time results suggest a 3 percent positive gap right before the crisis, while the full-sample results yielded larger gaps.[5] The lack of significant improvement from adding a Philips curve is not surprising, considering that Ramos-Francia and Torres (2006) found a small and non-significant coefficient for a backward-looking Phillips curve.

Multivariate filters: Phillips Curve and IS Curve

Phillips Curve



IS Curve



Sources: INEGI, Banxico, and staff calculations.

[3] Different values of lambda were tried, always obtaining a negative output gap.

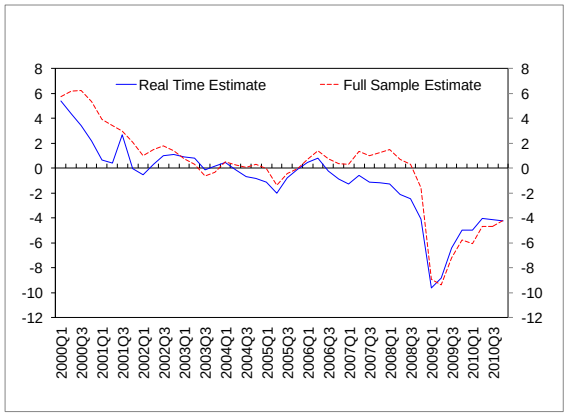
[4] Mexico officially adopted an inflation targeting regime in 2000. In order to estimate the inflation objective prior to that year, we used the inflation target estimates presented by Galindo and Ross (2005) from 1995 to 1999. For the period between 1990 and 1994, we assumed that the target was equal to 80 percent of the realized y/y inflation. We also assumed that the policy interest rate was equal to the 28 days CETES rate before the introduction of a policy rate by Banxico.

[5] The graphs shown in panel 2 correspond to a lambda equal to 1,600. We also estimated the models setting lambda equal to 5,600 and 10,000, with results similar to those using the univariate filter.

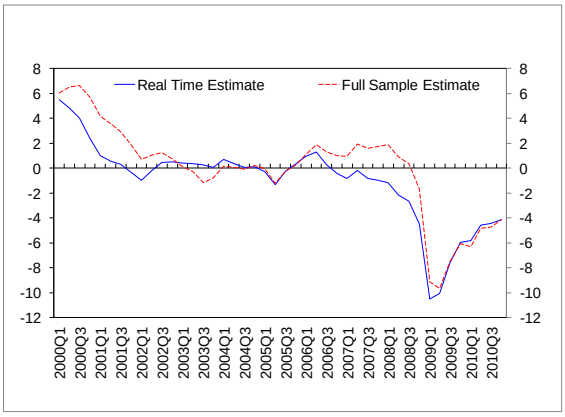
12. **The multivariate filter using Okun's Law shows less cyclical movements.** Given that the actual rate of unemployment increased following the crisis, and has remained above pre-crisis levels, we added an equation relating unemployment to the output gap. While the results were sensitive to the choice of potential output's smoothness, all of them showed a pre-crisis negative output gap using real-time estimates. Also, the time consistency of this model is superior to the univariate and the bivariate filters using the Phillips and IS curves, albeit not so for the pre-crisis period.

Multivariate Filter: Okun's Law Using Different Smoothness Parameters.

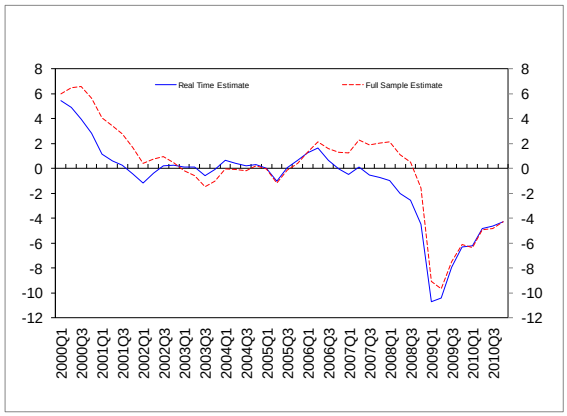
Lambda=1,600



Lambda=5,600



Lambda=10,000



Sources: INEGI, Banxico, and staff calculations.

Comparing models

13. **The substantial variation in results, particularly when considering real-time estimates, suggests caution should be used.** Most models yielded different results for the pre-crisis gaps using real-time and full sample estimates. We performed two tests based on

Fuentes et al (2007) to assess which models perform better in terms of both internal consistency (i.e., comparing real time vs. full sample estimates) and inflation forecasting.[6]

14. **Time consistency of the estimates.** We compared the results from real-time and ex-post estimation for the battery of models. We carried out the exercise for the period 2000–2009.[7] Some of the models had quite strong consistency, as suggested by high correlations and relative small squared errors—with persistence in potential growth helping as expected.

Table 1. Internal Consistency Check: Comparison Between Real-Time and Ex-Post Estimation

Methods	Correlation between real-time and ex-post estimation	Squared root of the MSE	Squared root of the MSE for period 2007Q2-2008Q2
Univariate model, lambda = 1,600	0.64	0.30%	0.63%
Univariate model, lambda = 5,600	0.78	0.25%	0.62%
Univariate model, lambda = 10,000	0.83	0.21%	0.64%
Bivariate model, Phillips Curve, lambda = 1,600	0.62	0.30%	0.62%
Bivariate model, Phillips Curve, lambda = 5,600	0.76	0.25%	0.62%
Bivariate model, Phillips Curve, lambda = 10,000	0.82	0.22%	0.64%
Bivariate Model, IS Curve, lambda = 1,600	0.53	0.24%	0.68%
Bivariate Model, IS Curve, lambda = 5,600	0.68	0.24%	0.68%
Bivariate Model, IS Curve, lambda = 10,000	0.76	0.20%	0.61%
Bivariate Model, Okun's Law, lambda = 1,600	0.60	0.16%	0.68%
Bivariate Model, Okun's Law, lambda = 5,600	0.66	0.16%	0.68%
Bivariate Model, Okun's Law, lambda = 10,000	0.80	0.20%	0.83%
Clark restricted model (Univariate AR(2)), lambda = 1,600	0.83	0.12%	0.12%
Clark restricted model (Univariate AR(2)), lambda = 5,600	0.90	0.13%	0.56%
Clark restricted model (Univariate AR(2)), lambda = 10,000	0.90	0.12%	0.48%
“V model”	0.56	0.30%	0.65%
“W model”	0.72	0.28%	0.62%

15. **Forecast performance of the estimates**. We compared the root mean squared error of two alternative forecasting models: a benchmark inflation autoregressive model and an extended model that added the real-time output gap estimates.

[6] A robustness test was performed for starting in 1997 in order to have two full economic cycles. The results did not change significantly.

[7] The sample was limited to 2009 in order to avoid the end-point problem mentioned above.

Table 2. Relative RMSE: Real-Time Output Gap Estimates/Inflation AR Models

Method	1 Q Ahead	2 Qs Ahead	4 Qs Ahead	6 Qs Ahead
Univariate model, lambda = 1,600	1.00	0.97	0.84	0.86
Univariate model, lambda = 5,600	0.98	0.93	0.81	0.83
Univariate model, lambda = 10,000	0.97	0.92	0.80	0.82
Bivariate model, Phillips Curve, lambda = 1,600	1.00	0.97	0.84	0.87
Bivariate model, Phillips Curve, lambda = 5,600	0.98	0.93	0.81	0.83
Bivariate model, Phillips Curve, lambda = 10,000	0.97	0.92	0.80	0.82
Bivariate Model, IS Curve, lambda = 1,600	1.01	0.98	0.85	0.87
Bivariate Model, IS Curve, lambda = 5,600	0.98	0.93	0.81	0.83
Bivariate Model, IS Curve, lambda = 10,000	0.98	0.92	0.80	0.82
Bivariate Model, Okun's Law, lambda = 1,600	1.01	0.94	0.81	0.83
Bivariate Model, Okun's Law, lambda = 5,600	0.98	0.91	0.79	0.81
Bivariate Model, Okun's Law, lambda = 10,000	1.00	0.92	0.80	0.82
Clark restricted model (Univariate AR(2)), lambda = 1,600	0.96	0.89	0.77	0.79
Clark restricted model (Univariate AR(2)), lambda = 5,600	0.96	0.89	0.78	0.80
Clark restricted model (Univariate AR(2)), lambda = 10,000	0.96	0.89	0.77	0.80
"V model"	1.01	0.94	0.81	0.84
"W model"	0.99	0.92	0.80	0.82

B. Trend Growth

16. **During the last three decades, growth has averaged 2.5–2.75 percent**. Even during the pre-crisis period, growth was below 3.5 percent on average. Recent papers have tried to explain these results pointing to a large list of factors.[8]

Table 3. Growth in Mexico, 1980–2010

	Maximum		Minimum		Mean	Median	Share of observations above 3.25%
	Quarter	Average	Quarter	Average			
I. Rolling averages	2000Q4	5.5	1987Q1	-0.5	2.5	2.5	31.7
5-Year moving average	1994Q4	3.7	1989Q2	0.5	2.6	2.7	22.0
7.5-Year moving average	2000Q3	3.7	1991Q4	1.5	2.7	2.7	30.0
10-Year moving average							
II. Selected periods							
1981–1990					1.9	2.7	
1991–2000					3.6	4.3	
2001–2010					1.7	2.7	
2001–2007					2.3	3.1	
2003–2007					3.4	3.4	

[8] See Chiquiar y Ramos Francia (2009), Hanson(2010), and Kehoe and Ruhl (2010).

17. **Potential growth was estimated using growth accounting.** Growth is decomposed in the contribution from capital and labor inputs, with TFP calculated as a residual. The distribution in cyclical and structural factors is made at the disaggregated level using a simple HP filter—subject to all the caveats mentioned earlier—albeit incorporating staff forecasts for these variables to limit end-point problems. The purpose is to assess how much can be explained by labor and capital accumulation, as opposed to TFP, which is harder to estimate, and for which an underlying historical growth rate is used. Similar to Krajnyak (2010) we build series for the capital stock and labor input. A share of 33 percent for capital and 67 percent for labor is used.[9]

- Capital stock was estimated applying the perpetual inventory methodology to the gross fixed capital formation (excluding residential investment) series presented by INEGI, assuming an annual depreciation of 7.5 percent.[10]

- Trend capacity utilization was assumed to stabilize around 80 percent from 2011, which is the historical average for this series.

- The historical data for working-age population and participation rate was taken from the World Bank's World Development Indicators, while the estimates for 2011–16 are based on CONAPO's projections.

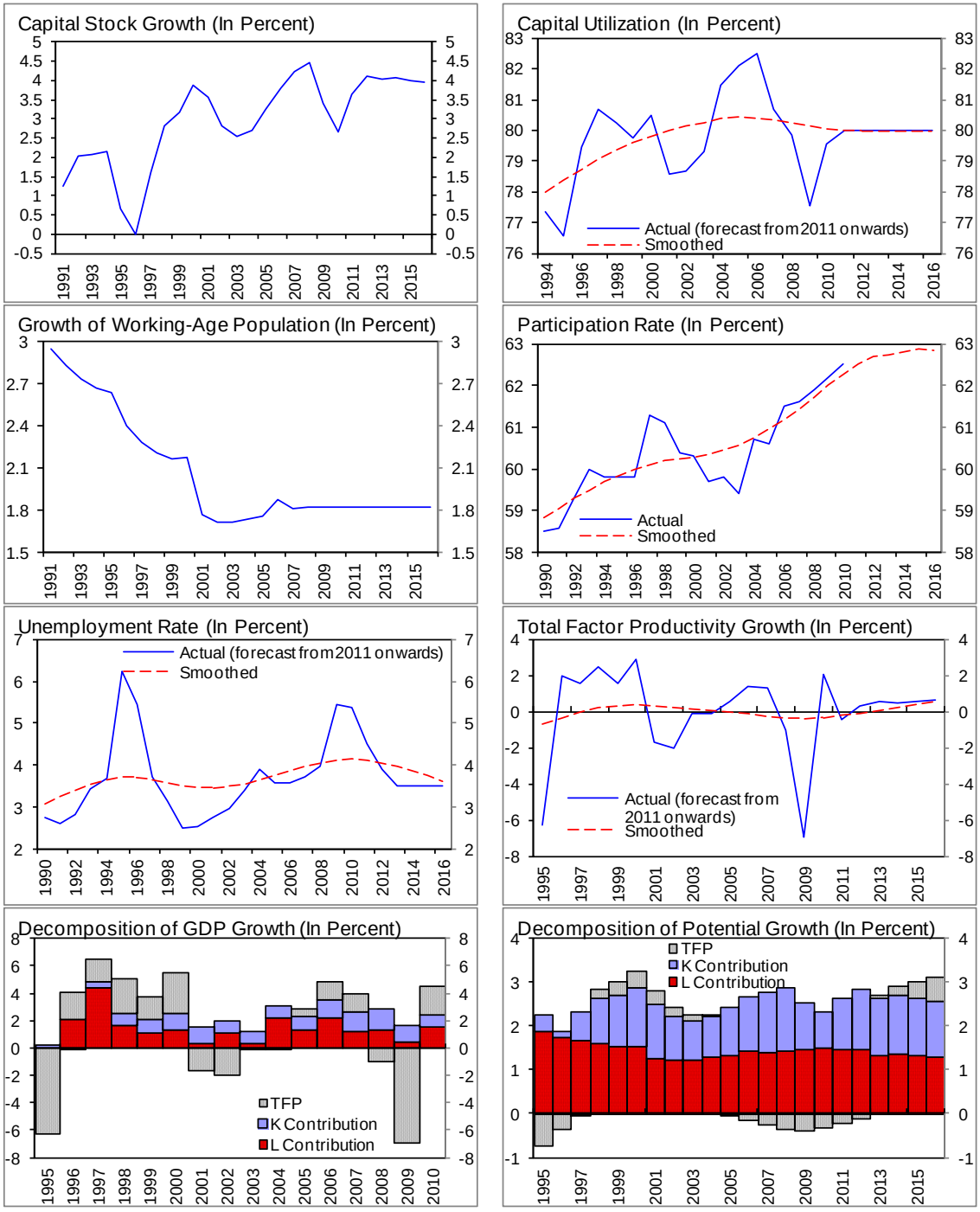
- The structural unemployment rate is assumed to stabilize at 3.5 percent starting in 2013. This figure is also in line with the results obtained in the Okun's Law filter exercise.

18. **Potential growth is estimated at 3–3¼ percent, driven by labor and capital accumulation.** Our calculations show rather unchanged contributions of labor and capital to potential growth, as well as marginal improvements in TFP. Stable labor and capital contribution and low TFP growth is consistent with potential growth around 3–3¼ percent, in line with Mexico's previous economic performance, and OECD (2009) and Krajnyak (2010) estimates. This also suggests that enhancing TFP is required to achieve higher long term growth, with recent reforms moving in that direction.

[9] Our results would not change significantly if we assume a 60 percent share of labor, as found by Garcia-Verdu (2005).

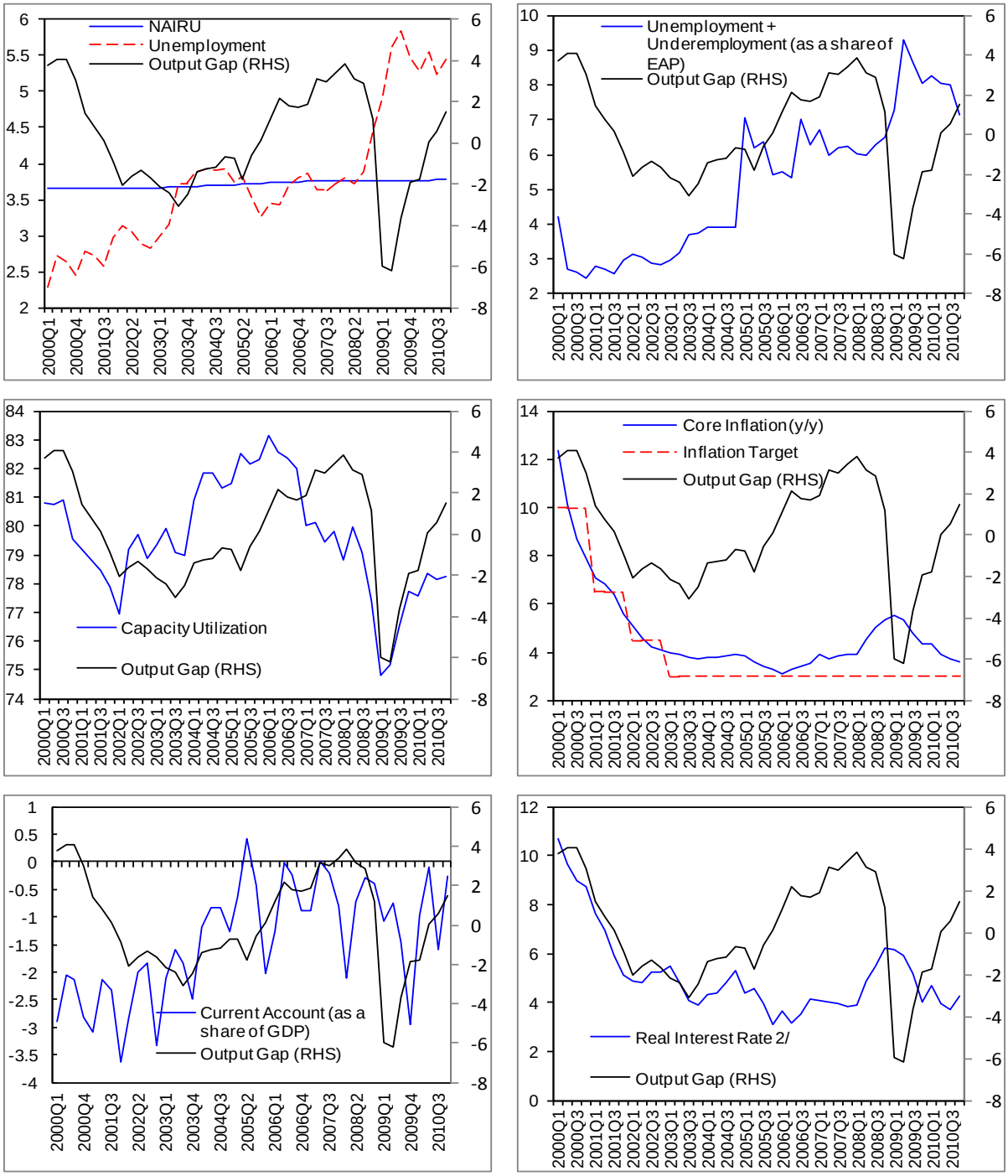
[10] The results presented by Garcia-Verdu (2005) use a depreciation rate of 5 percent. As a robustness test, we used such depreciation rate and the results for TFP growth did not change significantly.

Figure 1. Mexico: Growth Accounting, 1991–2016



Sources: INEGI, Banxico, WEO, Haver Analytics, CONAP, and staff estimates.

Figure 2. Mexico: Output Gap and Other Macroeconomic Indicators, 2000–2010 1/



Source: Banxico, Haver Analytics, INEGI, and IMF staff calculations
1/ Calculated using HP filter, lambda = 1,600
2/ Defined as the difference between CETES to 28 days and Y/Y changes in CPI

REFERENCES

Chiquiar, Daniel, and Manuel Ramos-Francia. "Competitiveness and Growth of the Mexican Economy." *Banco de Mexico: Documentos de Investigacion No. 2009–11*. Mexico City: Banxico, 2009.80.

Clark, Peter K. "The Cyclical Component of U.S. Economic Activity." *Quarterly Journal of Economics* 102 (1987): 797–814.

Faal, Ebrima. "GDP Growth, Potential Output, and Output Gaps in Mexico." *IMF Working Paper No. 05/93*, 2005: 30.

Fuentes, Rodrigo, Fabian Gredig, and Mauricio Larrain. "Estimating the Output Gap for Chile." *Central Bank of Chile Working Paper No. 455*, December 2007: 29.

Galindo, Luis Miguel, and Jaime Ros. "Inflation tergeting in Mexico: An empirical appraisal." *Amherst/CEDES Conference on Inflation Targeting.* Buenos Aires, 2005.30.

Garcia-Verdu, Rodrigo. "Factor Shares From Household Survey Data." *Banco de Mexico: Documento de Investigacion, No. 2005–05*. Mexico City: Banco de Mexico, 2005.42.

Hanson, Gordon H. "Why Isn't Mexico Rich?" *NBER Working Paper 16470.* Cambridge: National Bureau of Economic Research, 2010.34.

Hodrick, Robert J., and Edward C. Prescott. "Postwar U.S. Business Cycles: An Empirical Investigation." *Journal of Money, Credit and Banking* 29, No. 1 (February 1997): 1–16.

Kehoe, Timothy J., and Kim J. Ruhl. "Why Have Economic Reforms in Mexico Not Generated Growth?" *NBER Working Paper 16580.* Cambridge: National Bureau of Economic Research, 2010.34.

Krajnyak, Kornelia. "The Global Crisis and Potential Growth in Mexico." In *Mexico: Staff Report for the 2010 Article IV Consultation Selected Issues, IMF Country Report No. 10/70*, 3–12. Washington, DC: International Monetary Fund, 2010.

Marcet, Albert, and Morten Ravn. "The HP-Filter in Cross-Country Comparisons." *Discussion Paper Series No. 4244* (Centre for Economic Policy Research), 2004:28.

Medina, Leandro. "Potential Growth and Output Gap in Peru." In *Peru: Staff Report for the 2010 Article IV Consultation Selected Issues, IMF Country Report No. 10/99*, 57–67. Washington, DC: International Monetary Fund, 2010.

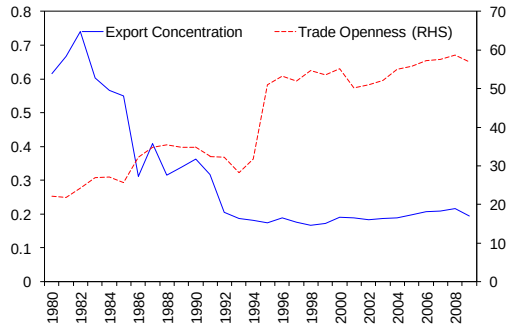
Ramos-Francia, Manuel, and Alberto Torres. "Inflation dynamics in Mexico: a characterization using the new Phillips curve." *Documento de Investigacion 2006–15* (Direccion General de Investigacion Economica, Banco de Mexico), 2006:24.

II. Understanding Mexico's Recent Export Performance[1]

Mexico's trade integration has been important for growth. But the high export growth experienced after joining the GATT, and particularly NAFTA, has been followed by a more muted performance since 2000. Direct competition from China may have, in part, played a role, but the estimated magnitude appears moderate with Mexico's flexible exchange rate helping to mitigate the impact. An indirect channel may have also been at play, with a shift of production from North America to Asia linked to productivity growth differentials during this period. More recently, there have been signs of renewed export growth which could be associated with a significant rebound in U.S. manufacturing and Mexico's regained advantage in certain manufacturing segments. Over the medium term, reforms to improve productivity would be important to sustain export dynamism in Mexico.

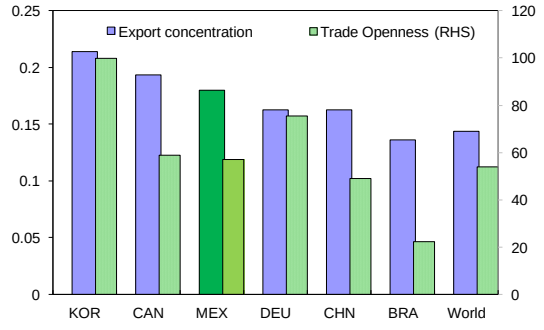
1. **Since trade liberalization three decades ago, Mexico has been transformed from a predominantly oil exporter to an open economy with a diversified export basket.** Export concentration, as measured by the Herfindahl index using 4-digit SITC data, shows a clear pattern of continued decline in concentration since early 1980's. This is the period that Mexico transformed from a predominantly oil exporter into a major exporter of manufacturing goods. During the same period, Mexico also became more open to trade. The enactment of NAFTA in 1994 significantly boosted Mexico's openness, particularly to the U.S. market. Total exports and imports as a share of GDP, a standard measure of trade openness, grew from less than 30 percent of GDP in 1980 to about 60 percent in 2009. By 2009, Mexico was an open economy with an export basket as diversified as many peer countries and leading export power houses.

Mexico: Export Concentration and Openness



Sources: World Economic Outlook, UN COMTRADE and staff calculations.

Export concentration and openness
(2009)

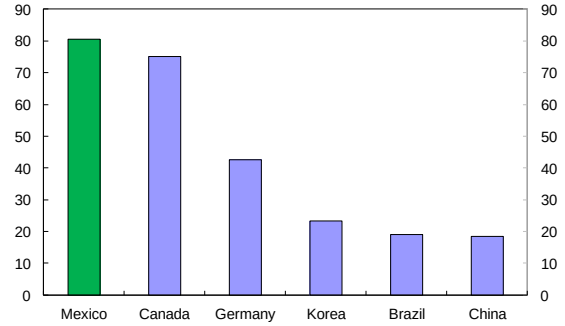


Sources: UN COMTRADE and staff calculations.

[1] Prepared by Kai Guo (SPR).

2. **However, Mexico's exports are very concentrated in the U.S. market, which absorbs 80 percent of Mexico's exports.** Other countries typically have a much smaller exposure to their largest trading partners, at a range of 20–40 percent for Korea, China, Germany and Brazil. While this is a natural result of "gravity" and good access to the world largest economy is beneficial, the high concentration to the U.S. market also makes Mexico's exports sensitive to demand conditions in and competition for the U.S. market.

Share of exports to the largest trading partner
(In percent, 2009)



Sources: DOTS and staff calculations.

3. **The export basket of Mexico has been evolving over time.** Among the top 10 products that have the highest revealed comparative advantage (RCA) scores, there are only 4 overlapping products between 1996 and 2009. Notably, petroleum dropped out the top 10 list during that period while motor vehicles became one of the top products that Mexico appears to have comparative advantage on.

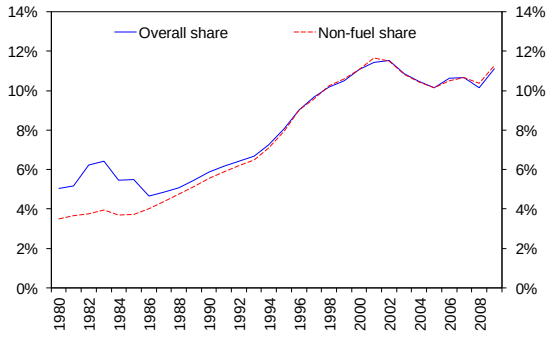
Products with highest revealed comparative advantage scores 1/

1996			2009		
Code	Product Description	RCA	Code	Product Description	RCA
723	EQUIPMENT FOR DISTRIBUTING ELECTRIC	7.6	724	TELECOMMUNICATIONS APPARATUS	4.9
961	COIN	6.3	54	VEGETABLES, ROOTS & TUBERS	3.9
54	VEGETABLES, ROOTS & TUBERS	4.2	723	EQUIPMENT FOR DISTRIBUTING ELECTRIC	3.7
71	COFFEE	3.3	62	SUGAR CONFECTIONERY	3.3
331	PETROLEUM	3.0	685	LEAD	3.2
681	SILVER	2.8	725	DOMESTIC ELECTRICAL EQUIPMENT	2.8
267	WASTE MATERIALS FROM TEXTILE FABRICS	2.7	686	ZINC	2.6
724	TELECOMMUNICATIONS APPARATUS	2.6	112	ALCOHOLIC BEVERAGES	2.3
697	HOUSEHOLD EQUIPMENT OF BASE METAL	2.1	732	ROAD MOTOR VEHICLES	2.2
722	TRACTORS	2.1	681	SILVER	2.1

Source: UN COMTRADE and staff calculations.
1/ Calculations are based on 3-digit SITC (rev.1) data from UN COMTRADE. The exact RCA scores and rankings will be different if different revisions of SITC codes are used.

4. **Mexico has made significant progress in increasing its presence in the U.S. market.** Mexico's market share in the U.S. market grew steadily between 1980 and 2000, from less than 4 percent of U.S. non-fuel imports in 1980 to about 12 percent in 2000. Along the way, there were two noticeable accelerations in gaining market share following Mexico's

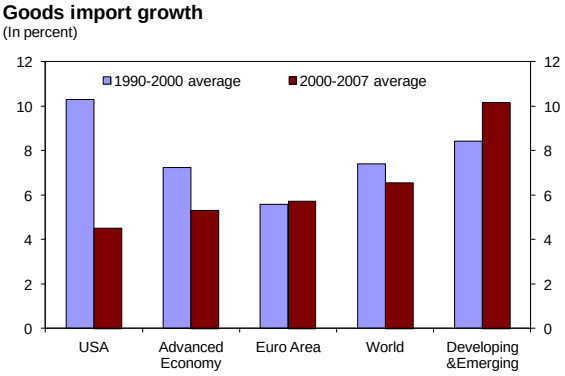
Mexico: Export market share in the U.S.
(share of total imports)



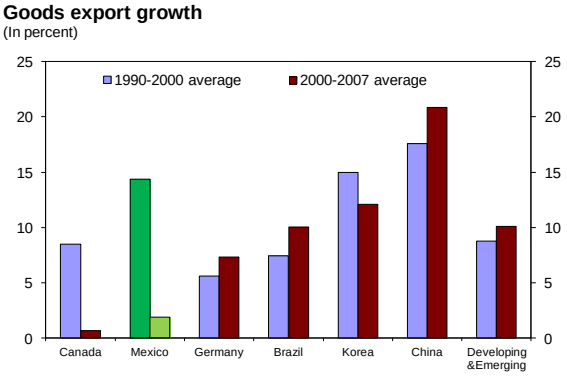
Sources: UN COMTRADE and staff calculations.

entry into GATT in 1986 and NAFTA in 1994. However, Mexico's market share stopped growing and even declined somewhat after 2001. Recent data show that Mexico's market share recovered after the crisis and stabilized at a historically high level.

5. **Relatively moderate import growth in the U.S. in the 2000s has in part contributed to Mexico's relatively low export growth in this period.** Average goods import growth in the U.S. during 2000–07 is about 4½ percent per annum, slower than both the average growth rate in the U.S. during the 1990s and other comparator groups during the same period, most notably developing and emerging economies. Given Mexico's large exposures to the U.S. market, like Canada, these two countries saw their exports growth decelerate considerably during the 2000s. This is in contrast to countries that have greater trade with more dynamic developing and emerging economies.

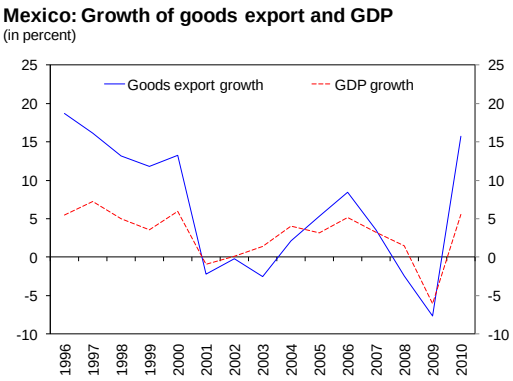


Sources: World economic outlook and staff calculations.



Sources: World economic outlook and staff calculations.

6. **Mexico's economic growth has been significantly correlated with its export performance.** After the Tequila crisis and joining NAFTA, Mexico's economic growth tended to move in tandem with its export growth, particularly goods export. The simple correlation between the two growth rates is high at 0.86 during 1996–2010. While there were many domestic factors at play,[2] the lackluster export performance since 2001 could help explain Mexico's overall growth in the 2000s.



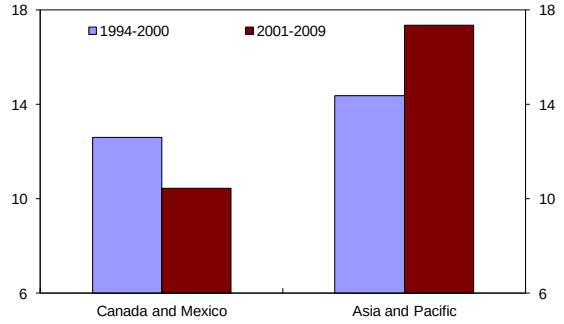
Source: World Economic Outlook.

7. **A structural shift in manufacturing production from North America to Asia can help explain the relatively low export growth.** A significant fraction of Mexico's exports

[2] See Hanson (2010) for more discussions on potential factors behind Mexico's growth performance.

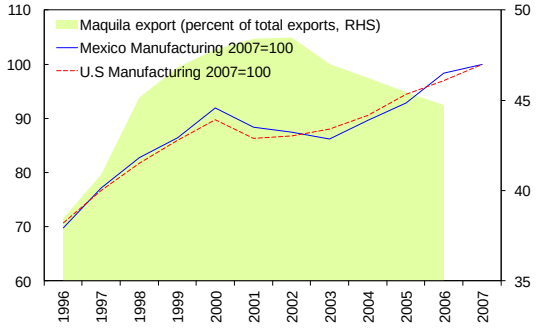
are by the Maquila industry, which is an integral part of the North America supply chain. The result of moving production to Asia by U.S. companies, as suggested by an increasing share of U.S. FDI in Asia and a substantial moderation of manufacturing growth in the US, meant that the exports associated with the North America supply chain from Mexico were also shipped to Asia. As a result, the export performance of the Maquila industry was particularly weak after 2000.

Share of US Outward Investment
(in percent)



Sources: CEIC, Haver and staff calculations.

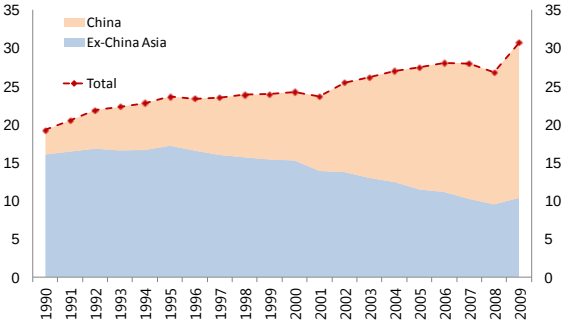
Manufacturing Index and Maquila Export



Sources: CEIC and staff calculations.

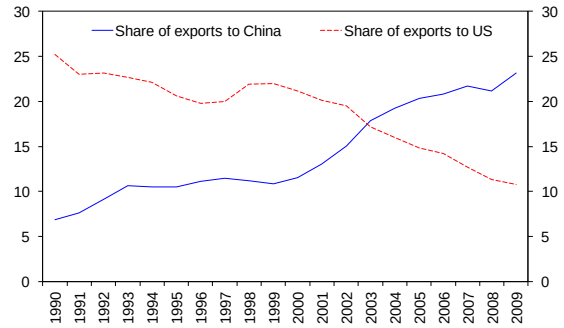
8. **The evolution of the Asia supply chain is dominated by the ascendance of China.**[3] The U.S. market share of the Asia supply chain has been growing steadily over time, from less than 20 percent in 1990 to more than 30 percent in 2009. The increase was entirely driven by exports from China, while market share by ex-China Asia actually declined. This reflects the fact that China is the end point of the Asia supply chain, importing raw materials, capital goods and intermediary goods from Asia and exporting final products to the U.S. and other markets.

US market share of Asia supply chain
(in percent)



Sources: UN COMTRADE and staff calculations.

The shifting exports of ex-China asia
(in percent)

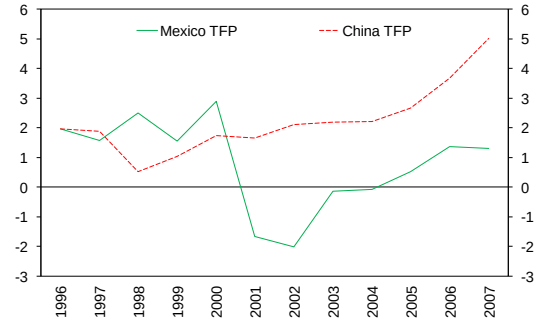


Sources: UN COMTRADE and staff calculations.

[3] The Asia supply chain is comprised of China, Hong Kong SAR, Korea, Singapore, Taiwan Province of China, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam.

9. **Mexico's relatively lower productivity growth may have influenced outsourcing decision to Asia, particularly China.** Average total factor productivity growth in Mexico was markedly lower during 2001–07, before the global crisis, compared to the period of 1996–2000. The lack of productivity gains in the 2000s became more striking when compared with China. During the same period, China experienced an acceleration of productivity growth as well as an export boom, following significant structural reforms it undertook during the late 1990s and the early 2000s, including restructuring state-owned enterprises and reforming the banking sector.[4]

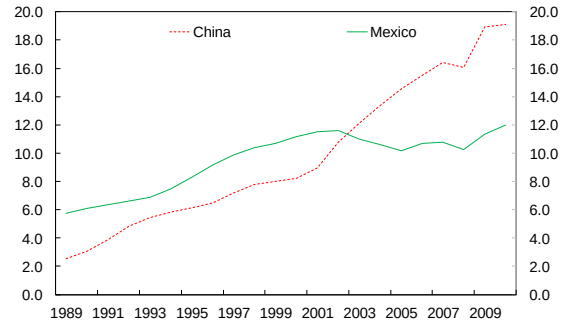
Total factor productivity growth
(in percent)



Source: Staff calculations.

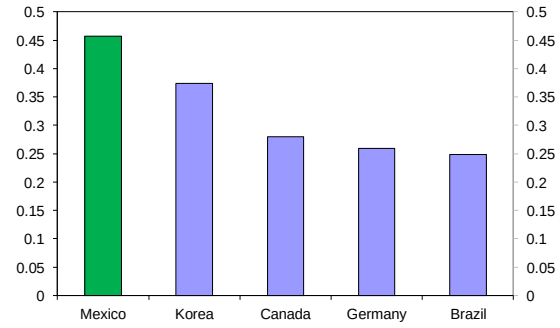
10. **Remaining export industries in Mexico have faced increased direct competition from China.** In 2001, China joined the WTO and gained greater access to the U.S. market. China's exports to the U.S. soon took off while the gains of market share by Mexico stopped. In terms of similarity, both China and Mexico export large quantity of manufacturing goods and the similarity between exports from the countries is high and more so than many other countries that are also important players in the U.S. market.

U.S. Market Share: Mexico and China
(in percent)



Sources: DOTS and staff calculations.

Export Similarity with China
(in the U.S. market, 2009)

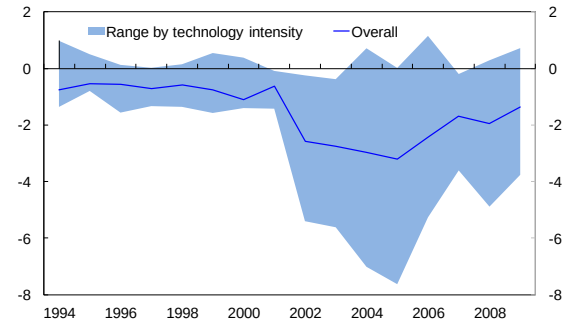


Sources: UN COMTRADE and staff calculations.

11. **A constant market share (CMS) analysis indicates that Mexico's exports have lost competitiveness, particularly to China, but the overall magnitude of the direct China effect appears moderate.** After gaining competitiveness for 15 straight years in the US, Mexico started to see its competitiveness eroding at around 2001. The loss of

[4] One important caveat is that TFP may be endogenouswhereby the derived low TFP growth in Mexico could be a result of competition from China.

competitiveness is more pronounced when China is included than when China is excluded, suggesting a direct China role. The reverse is, however, not true. China has been gaining competitiveness regardless of whether Mexico is considered or not. The direct impact from China on Mexico's exports, as measured by the difference between Mexico's competitiveness gain with and without China, increased substantially after 2001 and peaked at around 3 percent of Mexico's exports in 2005, a moderate overall effect.[5] This calculation however does not necessarily capture all potential channels of impact from China, including terms of trade effects and shift of production to Asia.[6] On the other hand, the identified China effect may not be limited to China, but reflect the impact of the entire Asia supply chain.

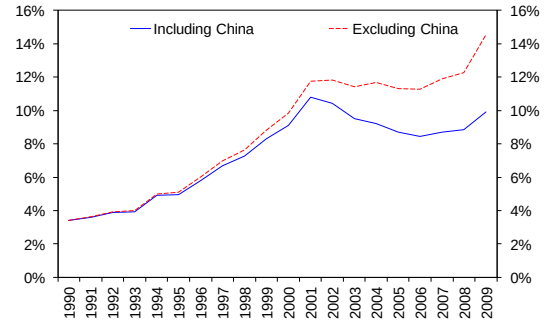


12. **However, there is considerable heterogeneity across products, with some sectors experiencing stronger effects.** This can be seen from the wide range of China effects on products that are grouped by their technology intensities (see appendix for the definition of technology intensity). While the China effect on Mexico's high-tech exports was nearly 8 percent of its high-tech exports to the U.S. in 2005, the China effect on resource-based low technology exports was on average negligible. Even for products of the same technology intensity, some were affected more than others. For example, while Mexico's auto exports to the U.S. so far experienced little competition from China, the direct competition from China on machinery exports has been very fierce.

[5] Hanson and Robertson (2010) also tried to derive the impact from China's competition by estimating a gravity equation. Despite the different methodology, the magnitude of the China effect on Mexico's manufacturing exports is estimated to be between 0.2 to 3.4 percent during 1995–2005, similar to this paper's finding.

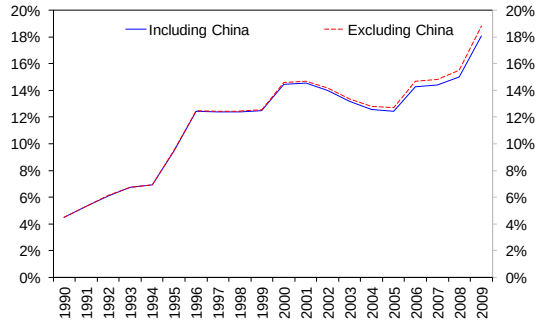
[6] For example, the income effect due to terms of trade changes, which could be a result of competition from China, is not captured by the analysis. Such effect could be quite important.

Mexico: machinery market share in US



Sources: UN COMTRADE and staff calculations.

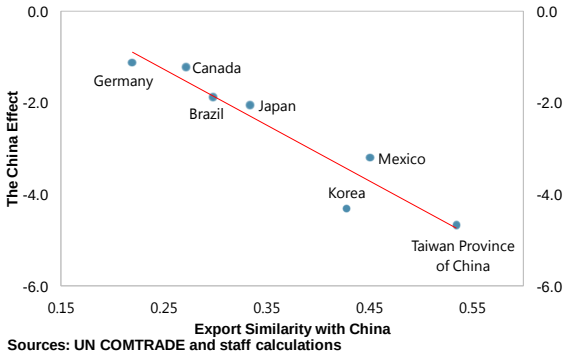
Mexico: automobile market share in US



Sources: UN COMTRADE and staff calculations.

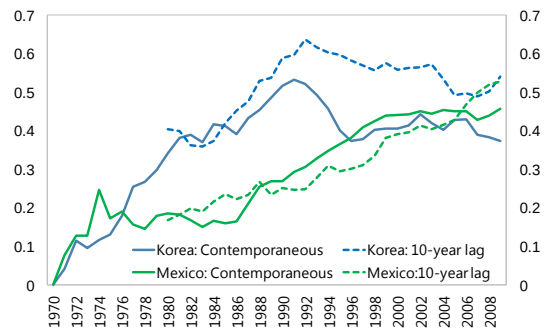
13. **More generally, countries with greater export similarity to China have shown a larger effect from China's growing presence in global trade.** A cross section correlation between export similarity with China and the China effect in 2005, when the China effects peaked for most countries, depict a clear pattern that more similarity with China is associated with more negative impact from China. In fact, some countries, e.g., Korea, responded by moving to industries that there is less competition from China. The similarity of exports between Korea and China has been declining in recent years. Moreover, China's exports are closer to what Korea was exporting 10 years ago than what Korea is exporting today. While similar response may have also happened in Mexico,[7] it appears to be less strong compared to Korea's, at least initially.

Export Similarity and the China Effect
(2005)



Sources: UN COMTRADE and staff calculations

Export Similarity with China in the US



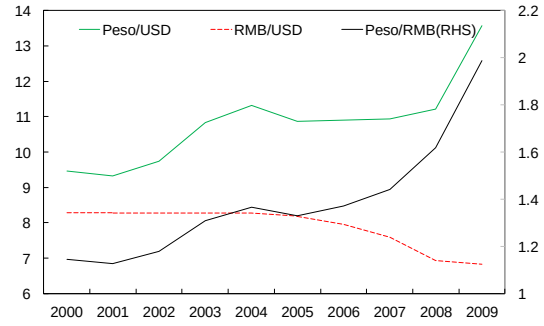
Sources: UN COMTRADE and staff calculations.

14. **Bilateral exchange rate flexibility may have helped mitigate the impact.** The bilateral exchange rate between the peso and RMB has moved considerably over the years, as a result of Mexico's flexible exchange rate. Inflation and particularly wage growth

[7] Chiquiar, Fragoso and Ramos-Francia (2007) documented such response in Mexico through 2005.

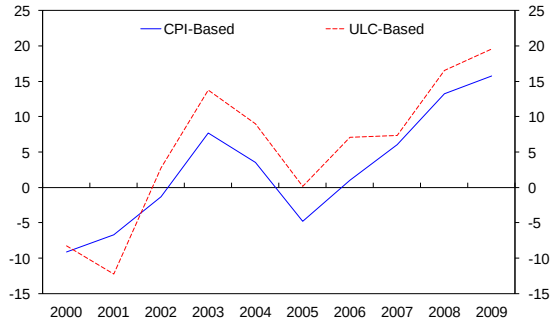
differentials also lead to considerable movements in the bilateral real exchange rate.[8] Between 2005 and 2009, RMB appreciated about 33 percent in nominal terms and 29(38) percent in CPI-based (ULC-based) real terms against the peso. Some regression analyses suggest that the China effect on Mexico's export would decline by ½ percentage points for every 10 percent real appreciation of RMB against the peso. Moreover, low-tech and medium-tech products maybe more sensitive to bilateral exchange rate movements than either high-tech products or resource-based low-tech products.

Nominal Exchange Rate



Sources: CEIC and staff calculations.

Annual Real Appreciation of RMB
(vis-a-vis peso, in percent)



Sources: EMED, CEIC and staff calculations.

Exchange Rate and the China Effect (2002-2009) 1/

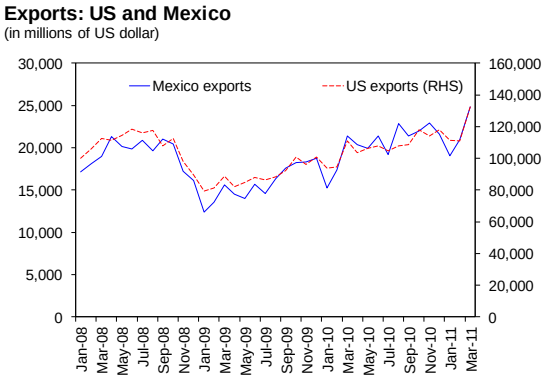
	All Products	Resource-based low tech	Low-tech	Medium-tech	High-tech
CPI-Based REER	0.050 ***	-0.023	0.048**	0.060**	0.032
	(0.017)	(0.052)	(0.024)	(0.027)	(0.061)
Constant	-0.184*	0.087	-0.209	-4.715	-0.312
	(0.097)	(0.198)	(0.153)	(3.856)	(0.326)
Fixed Effect	Y	Y	Y	Y	Y
OBS	3543	164	1338	1762	266
R-Sq	0.08	0.13	0.16	0.05	0.05

Source: UN COMTRADE, Staff estimate and calculations.
1/ Robust standard error reported in prentices. ***, **, *, represent 1 percent, 5 percent and 10 percent siginificance level, respectively.

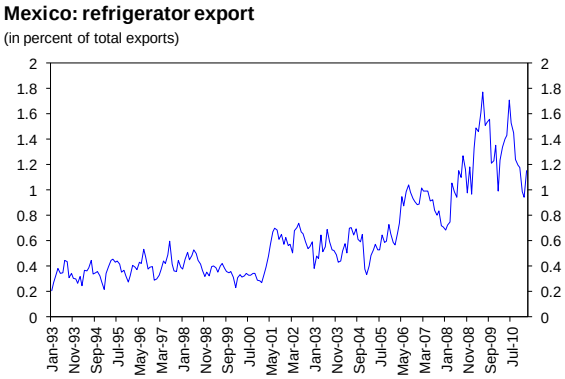
15. **More recently, the recovery in U.S. manufacturing, the depreciation of the peso and increase in relative costs in China may have contributed to the rebound in Mexico's exports.** The recovery in manufacturing activity in the U.S. has been strong, particularly driven by robust exports, which have also benefited Mexico's exports. Meanwhile, RMB is currently appreciating at an annualized rate of about 6 percent against USD. Wage growth is

[8] It should be noted that the quality of wage data in China is known to be of low quality. Therefore, this paper refrains from using wage data and ULC-based real exchange rate to conduct regression analysis.

also brisk in China, at about 20 percent annually, although unit labor cost is growing at a slower pace due to productivity gains. This has allowed Mexico to regain some competitiveness edge against China, especially in sectors that are sensitive to transportation cost. There are in fact some nascent signs that exports of bulky household goods, such as refrigerators, are getting stronger.



Sources: Banco de México and CEIC.



Sources: Banco de México and staff calculations.

16. **However, efforts to boost productivity would be important to sustain export growth over the medium term.** Several sectors including telecom, consumer staples, and cement remain dominated by a few private market participants and efficiency is low in the energy sector that is dominated by state monopolies. The quality of education is poor and long-standing contractual rigidities in the labor market remain. Violence from organized crime has hindered investment. Therefore, measures to foster competition and labor flexibility, improve education and reinforce domestic security are all crucial to unleash the potential of Mexico untapped productivity growth, which will ultimately be required to sustain continued strong export growth. In this regard**,** the recent anti-trust reform is a welcome right step to increase competition.

APPENDIX 1

Data

All trade data are taken from UNCOMTRADE database, which reports bilateral trade flows at detailed product level. The observations are annual and in U.S. dollar terms. 4-digit SITC product data are used for all calculations that require product-level details.

Export Concentration

Export concentration is measured by the Herfindahl index, which is defined as

$$H = \left(\sum_{i=1}^{N} s_i^2 \right)^{1/2}$$

where s_i is the share of good *i* in a country's overall export basket. *H* is an index between 0 and 1 and a higher *H* corresponds to more concentration.

Revealed Comparative Advantage

Reveal comparative advantage (*RCA*), which was proposed by Balassa (1965), is defined as

$$RCA = \frac{s_i}{s_i^{world}}$$

where s_i is the share of good *i* in a country's overall export basket and s_i^{world} is the share of good *i* in the world trade. A *RCA* score greater than 1 suggests that a country has revealed comparative advantage in exporting that particular good.

Export Similarity

Export similarity between country m and n, which was originally proposed by Finger and Kreinin(1979), is defined as

$$ESI_{m,n} = \sum_{i=1}^{N} \min(s_{m,i}, s_{n,i})$$

where $s_{m,i}$ ($s_{m,i}$) is the share of good i in country *m*'s (*n*'s) export basket. *ESI* is an index between 0 and 1, where 1 corresponds to identical export structures and 0 corresponds to completely different export structures.

Technology Intensity

This paper uses the Hatzichronoglou (1997) methodology to group products into different technology intensities. The technological intensity reflects to some degree "technology-producer" aspect, which is measured by the ratio of R&D expenditure to value added. It also reflects "technology-user" aspect, which is measured by purchases of intermediate and capital goods.

There are two main steps involved. Step 1: mapping each of the OECD ISIC code into a technology intensity category. Step 2: mapping SITC code in UN COMTRADE to the OECD ISIC code.

The paper classifies manufacturing industries in four categories of technological intensity: resource-based low tech, low-tech, medium-tech and high tech.

One caveat is that products which belong to a high-technology industry do not necessarily have only high-technology content. Likewise, some products in industries of lower technological intensity may incorporate a high degree of technological sophistication.

Deriving Mexico's Competitiveness and the China Effect

Constant market shares analysis

The main analytical tool in deriving Mexico's competitiveness is the constant market shares (CMS) analysis, which was first applied to studying international trade by Tyszynski (1951). The CMS analysis is similar to a growth accounting exercise, which decomposes the growth of a country's exports into components that correspond to holding its market shares constant at certain disaggregated product level and a residual term, which will be treated as "competitiveness."

More specifically, let *i* denote a commodity exported by a country *j* to a given destination, which, in the context of this paper, is the US. The change in the value of export of commodity *i* between period *t* and *t-1* can be written as

$$(1) \qquad V^i_{j,t} - V^i_{j,t-1} = g_{i,t} \times V^i_{j,t-1} + C^i_{j,t}$$

Where $V^i_{j,t}$ is the value of export of commodity *i* by country *j* in period t, $g_{i,t}$ is the growth rate of import of commodity *i* by the destination country and $C^i_{j,t}$ is a residual. If country *j* maintains its market share for commodity *j* in the destination country between *t-1* and *t*, then its exports of commodity *j* to the destination country should also grow at the rate $g_{i,t}$ and $C^i_{j,t}$ will be equal to 0. If $C^i_{j,t}$ is greater than 0, it indicates that country *j* is gaining market share for commodity *i* in the destination and vice versa. $C^i_{j,t}$ will be interpreted as "competiveness",

under the assumption that a country's export market share for a particular product would remain constant without competitiveness gains or losses.

We can normalize the decomposition by dividing both sides of the equation by $V^i_{j,t-1}$, which yields,

$$(2) \qquad g^i_{j,t} = g_{i,t} + c^i_{j,t}$$

In essence, export growth of product *i* by country *j* can be decomposed into two parts: the overall import growth of product *i* $g_{i,t}$ and competitiveness gains/losses $c^i_{j,t}$.

If we sum over all products that country *j* exports to the destination country, it becomes

$$(3) \qquad V_{j,t} - V_{j,t-1} = \sum_i (g_{i,t} \times V^i_{j,t-1}) + \sum_i (C^i_{j,t})$$

where $V_{j,t}$ is the total exports from country *j* to the destination in period *t*, namely, $V_{j,t} = \sum_i V^i_{j,t}$.

The above equation can be similarly normalized by $V_{j,t-1}$, which yields

$$(4) \qquad g_{j,t} = \sum_i (g_{i,t} \times s^i_{j,t-1}) + c_{j,t}$$

where $s^i_{j,t-1} = \frac{v^i_{j,t-1}}{v_{j,t-1}}$ is the share of product *i* in country *j*'s export basket in *t-1* and $c_{j,t} = \frac{\sum_i (c^i_{j,t})}{v_{j,t-1}}$. This equation simply states that the growth of country *j*'s exports to the destination is equal to the weighted average of growth rates of imports by the destination plus an unexplained residual $c_{j,t}$, which again would be interpreted as competitiveness gains or losses in this paper.

Equations (2) and (4) are the basis for calculating a country's competitiveness at individual product level and at the aggregate level.

The China effect

To single out the China effect, it is important to know the counterfactual-what would have happened if there were no China. Without controlling for the counterfactual, the China effect could be either overstated or understated. While there are potentially many different ways of constructing the counterfactual, this paper takes a very straightforward and simple approach-doing the CMS analysis by excluding imports from China.

By excluding imports from China, equations (2) and (4) become

$$(5) \qquad g^{i}_{j,t} = g^{excn}_{i,t} + c^{i,excn}_{j,t}$$

and

$$(6) \qquad g_{j,t} = \sum_i (g^{excn}_{i,t} \times s^{i}_{j,t-1}) + c^{excn}_{j,t}$$

$c^{i,excn}_{j,t}$ and $c^{excn}_{j,t}$ effectively measure country *j*'s competitiveness in the residual market that excludes imports from China, at the product level and aggregate level, respectively. The difference between $c^{excn}_{j,t}$ and $c_{j,t}$ (or $c^{i,excn}_{j,t}$ and $c^{i}_{j,t}$) is treated as the China effect.

Similar approach is also used to derive the Mexico's effect.

REFERENCES

Benelli, Roberto and Kai Guo, 2011, "Impact of China's Competition: Brazil and Mexico:, *Selected Issues Paper in China Spillover Report, IMF*.

Chiquiar, Daniel, Edna Fragoso and Manuel Ramos-Francia, 2007, "Comparative Advantage and the Performance of Mexican Manufacturing Exports during 1996–2005," *Banco de Mexico Working Papers*, No. 2007–12.

_____, and Manuel Ramos-Francia, 2009, "Competitiveness and Growth of the Mexican Economy," *Banco de Mexico Working Papers*, No. 2009–11.

Balassa, Bela, 1965, "Trade Liberalisation and 'Revealed' Comparative Advantage," *The Manchester School of Economics and Social Science*, 33, 99–123.

_____, 1979, "The Changing Pattern of Comparative Advantage in Manufactured Goods," *The Review of Economics and Statistics*, 61(2), 259–266.

Garnaut, Ross, Ligang Song, Stoyan Tenev, and Yang Yao, 2005, "China's Ownership Transformation: Process, Outcomes, Prospects," (Washington: The World Bank).

Finger, J. M. and M. E. Kreinin, 1979, "A Measure of `Export Similarity' and Its Possible Uses," *The Economic Journal*, 89(356), 905–912.

Hanson, Gordon, 2010, "Why Isn't Mexico Rich?" *Journal of Economic Literature, December* 48(4), 987–1004.

_____, and Raymond Robertson, 2010, "China and the Manufacturing Exports of Other Developing Countries," In *China's Growing Role in World Trade*, eds. Robert Feenstra and Shang-Jin Wei, 137–59. Chicago and London: University of Chicago Press.

Hatzichronoglou, Thomas, 1997, "Revision of the High-Technology Sector and Product Classification," *OECD Science, Technology and Industry Working Papers* 1997/2.

Tyszynski, H., 1951, "World trade in manufactured commodities, 1899–1950," *The Manchester School of Economics and Social Science*, 19, 272–304.

III. LONG-TERM FISCAL CHALLENGES IN MEXICO[1]

Mexico's fiscal position is solid. Fiscal credibility, underpinned by prudent fiscal management and a strong fiscal framework, permitted a countercyclical fiscal response during the 2009 global crisis. The envisaged fiscal consolidation during 2010–12 will return the structural fiscal stance to pre-crisis levels. Mexico is expected to return to the budget balance specified under the fiscal rule in 2012 and maintain it thereafter, ensuring a stable public debt path. However, Mexico faces significant long-term fiscal challenges that are not easily appreciated in a standard medium-term fiscal analysis. Oil revenues may decline by 4 percent of GDP over the next two decades due to stagnation in production, while age-related spending could increase over 3 percent of GDP in response to demographic and other factors. The combination of age-related spending pressures and declining oil revenues implies that sustaining prudent levels of public debt would require a large (non-oil) revenue mobilization effort and an expenditure reform strategy. Addressing effectively such fiscal challenge would require early action since corrective measures may have long implementation lags.

A. Medium-Term Fiscal Outlook

1. **To assess Mexico's medium-term fiscal outlook this section lays out a fiscal forecast for the period 2012–16 anchored in the balance-budget rule and under the following macroeconomic assumptions:**

Table 1. Mexico: Macroeconomic Assumptions 2012-16

	2012	2013	2014	2015	2016
Real GDP growth (percent)	4.1	3.3	3.3	3.3	3.2
GDP deflator growth (percent)	2.9	3.2	3.3	3.4	2.9
Nominal exchange rate (average)	12.3	12.5	12.6	12.8	12.9
Interest rate (public debt; percent)	6.1	6.5	6.5	6.5	6.5
Oil price world markets (US dollars per barrel)	105	102	100	99	99
Oil production (thousand barrels per day)	2,550	2,550	2,550	2,550	2,550
Oil exports (thousand barrels per day)	1,347	1,347	1,347	1,347	1,347
Oil derivatives consumption growth (percent)	4.1	3.3	3.3	3.3	3.2
Oil derivatives domestic price growth (percent)	12.0	12.0	0.0	0.0	0.0

Source: IMF Staff estimates.

2. **The projected real GDP growth path is consistent with potential output growth estimates discussed in Chapter 1**. Oil prices projections are obtained from the WEO

[1] Prepared by Pablo Lopez-Murphy (FAD)

forecast,[2] oil production projections come from SHCP (2010), and oil exports are projected assuming that the ratio between oil exports and oil production observed in 2010 is maintained during 2012–16. Oil derivatives consumption growth is assumed to be equal to real GDP growth and the domestic price of oil derivatives is projected to increase 12 percent during 2012–13 to reach at least international prices. In addition, we assume that 5 percent of projected duties on hydrocarbons are saved and transferred to oil stabilization funds.[3]

3. **Fiscal projections under these assumptions are as follows:**

Table 2. Mexico: Financial Operations of the Public Sector 2012-16
(in percent of GDP)

	2012	2013	2014	2015	2016
Revenue	22.5	21.9	21.3	21.0	20.7
Oil revenue	7.9	7.5	7.2	6.8	6.6
Non-oil revenue	14.6	14.4	14.1	14.2	14.1
Expenditure	24.5	23.8	23.1	22.7	22.3
Primary	21.8	21.0	20.3	19.9	19.5
Pensions	2.8	2.9	3.1	3.2	3.3
Health	2.3	2.3	2.4	2.4	2.5
Other	16.8	15.8	14.9	14.3	13.7
of whick revenue sharing	3.5	3.6	3.4	3.3	3.3
Interest	2.6	2.8	2.8	2.8	2.8
Traditional Balance 1/	-2.0	-1.9	-1.8	-1.7	-1.6
Traditional Balance for fiscal rule 2/	0.0	0.0	0.0	0.0	0.0
Public Sector Borrowing Requirements 3/	2.8	2.6	2.5	2.4	2.3

Source: IMF Staff and "Criterios 2011".
1/ This is the same path as in "Criterios 2011", p.101.
2/ This is the Traditional Balance excluding investment by PEMEX.
3/ These include the Traditional Balance deficit plus some adjustments (i.e., PIDIREGAS, IPAB, Budgetary Adjustments, FARAC, Debtor support,and net lending by development banks) minus transfers to oil stabilization funds.

4. **Over the medium term, government revenues are expected to fall about 1.8 percent of GDP driven by lower oil revenues.** The combination of broadly stable world oil prices with constant oil production/exports implies that oil revenues decline in percent of

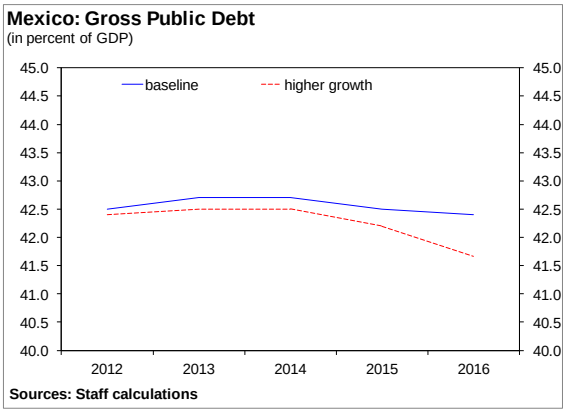
[2] The price of oil exports is obtained by assuming that the ratio between WEO prices and the price of Mexican oil exports in 2010 is maintained during 2012–16.

[3] Transfers to oil stabilization funds are, by Law, a fraction of duties on hydrocarbons and excess tax revenues. Excess tax revenues are tax revenues higher than those projected in the budget. Medium-term projections assume no excess tax revenues.

GDP. Non-oil revenues decrease slightly in 2012–13 as a result of the envisaged cut in income tax rates.[4]

5. **Age-related spending, over the medium term, is expected to increase about 0.7 percent of GDP, mainly in response to demographic factors**. Interest payments are also expected to increase in a context of a gradual increase in interest rates. Under the balance-budget rule, the combination of lower revenues and higher age-related spending would require a reduction in non age-related spending of about 3 percent of GDP during 2012–16.[5] But since a significant fraction of non-age related spending are earmarked transfers to subnational governments, the spending compression would fall on other expenditures.[6]

6. **Under the balanced-budget rule, the path for public debt would remain stable**. This would be driven by an increasing primary balance that compensates for a declining growth-interest rate differential.[7] In terms of sensitivity analysis, if GDP growth were 4 percent (as assumed in "Criterios 2011") instead of 3.2 percent, then a slightly declining path for public debt would result. If the real effective exchange rate were to appreciate rather than remain constant, then a declining path for public debt would also result.



[4] Income tax rates were temporarily increased from 28 to 30 percent in 2010 as part of a fiscal package reverting the 2009 fiscal stimulus. The rates will be reduced to 29 percent in 2013 and to 28 percent in 2014.

[5] Around 0.5 percent of the fall would result from lower investment by PEMEX given the expected increase in private investment as a result of recent changes to the fiscal regime of the oil sector.

[6] Non age-related spending includes, spending in education and infrastructure. Schwellnus (2009) documents that education spending (and quality) in Mexico is low compared to other OECD countries.

[7] Debt dynamics would be driven by: $D_t - D_{t-1} = PSBR_t + \varepsilon_t D_{t-1}^*$ where D_t denotes public debt at the end of period t, ε_t is the rate of depreciation of the exchange rate during period t, and D* is foreign currency debt (measured in domestic currency).

B. Oil Revenue Outlook in the Long Term

7. **This section extends oil revenue projections to 2030 and assesses its implications for the long-term sustainability of fiscal policy**. Projecting over such a long horizon is subject to significant uncertainty, related *inter alia* to the path for the oil price, oil production, GDP growth, and the real exchange rate.

8. **Production has fallen from peak levels but has stabilized in recent years.**

- **In recent years oil production and reserves have fallen significantly**. Proven reserves fell during 2004–07 and were broadly stabilized since then, with proven reserves 28 percent lower in 2010 than in 2003. Oil production reached a peak of 3,383 thousand barrels per day in 2004 and declined significantly in following years, but has stabilized more recently. The cumulative fall in production during 2004–10 has been 24 percent. The level of proven reserves in 2010 would last 10 years at the current production level.

- **Oil derivatives production has also been on a downward trend in recent years while imports have soared**. The cumulative fall in oil derivatives production during 2004–10 has been 10 percent, explained by the fall in crude oil production.[8] Oil derivatives imports in 2010 more than doubled those in 2004, led by imports of fuels.

- **Natural gas production has expanded significantly but remains a small share of oil revenues**. The cumulative increase in natural gas production during 2004–10 has been more than 50 percent, but has stabilized since 2008. Imports of natural gas declined substantially during 2004–06 and recovered gradually thereafter. Natural gas accounted for 6 percent of total oil revenues in 2010.

9. **The oil sector has been reformed in recent years, but further measures may be needed to realize the sector's full potential**. In 2008 there was an important reform of the state-owned oil sector (PEMEX). The main goals of the reform were to improve the governance of PEMEX and to attract private investment by allowing PEMEX to sign service contracts with private companies, which provide performance-based incentives.[9] More recently some additional reforms were introduced giving PEMEX more financial flexibility to explore new fields in deep waters and in the field of Chincotepec. However, further

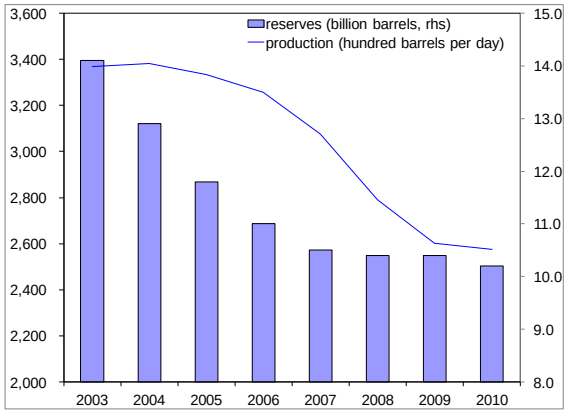
[8] The decline in the production of oil derivatives is also explained by the fact that PEMEX has been reconfiguring some of the refineries to produce cleaner gasoline.

[9] Payments should only be made in cash, and should never be a percentage of production, sales, or profits.

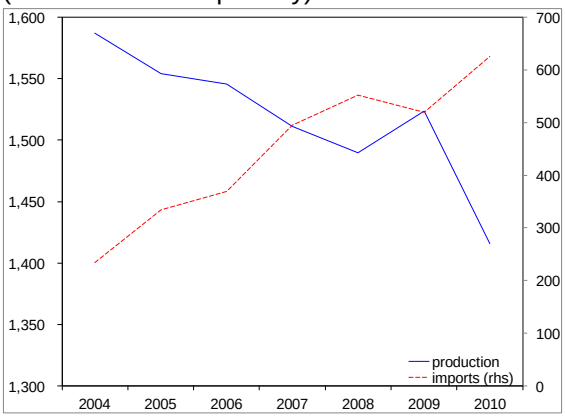
reforms may be needed to foster the development of the sector, including fields in deep waters.[10]

Oil Sector

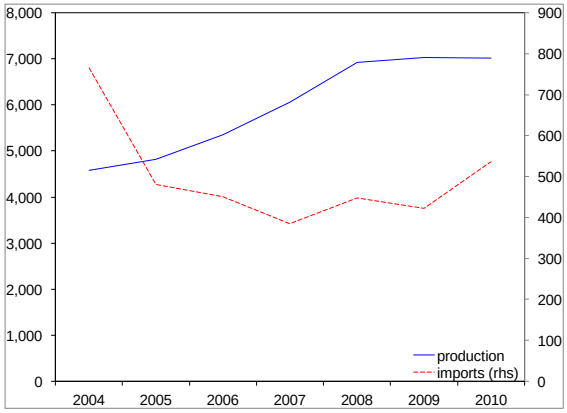
Oil Production



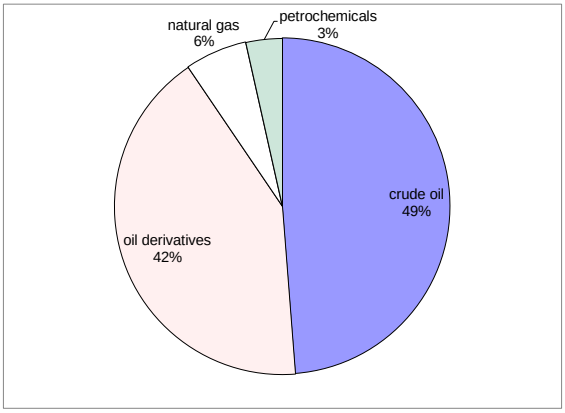
Oil Derivatives Production and Imports
(thousand barrels per day)



Natural Gas Production and Imports
(million cubic feet per day)



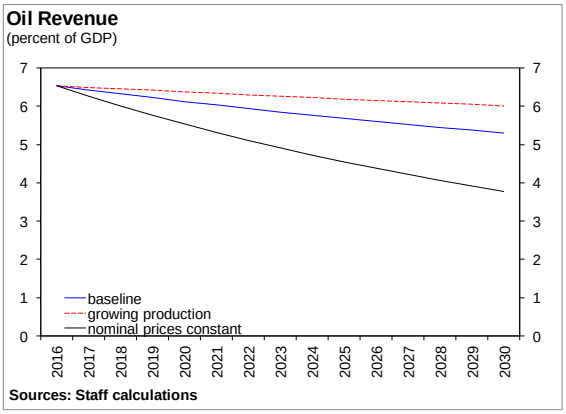
Oil Revenue Composition
(percent)



Sources: PEMEX, and staff calculations

[10] Joint ventures (i.e., production sharing deals) with other oil companies, which are common in the global industry, are constitutionally prohibited.

10. **Oil revenues could fall substantially in the long term**. In our baseline scenario, in which the real price of oil is assumed to remain constant, revenues could fall by 2.5 percent of GDP during 2011–30.[11] This result is explained by the fact that in a growing economy, a stagnant oil sector becomes less important as a source of revenue. In terms of sensitivity analysis, if oil prices (international and domestic) remain constant in nominal terms, then revenues would fall by around 4 percent of GDP. If crude oil production was gradually increased to its 2004 peak, then revenues would fall by 1.8 percent of GDP.

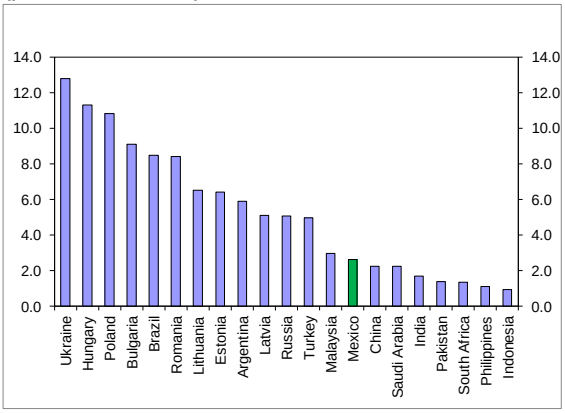


C. Pension Spending Outlook

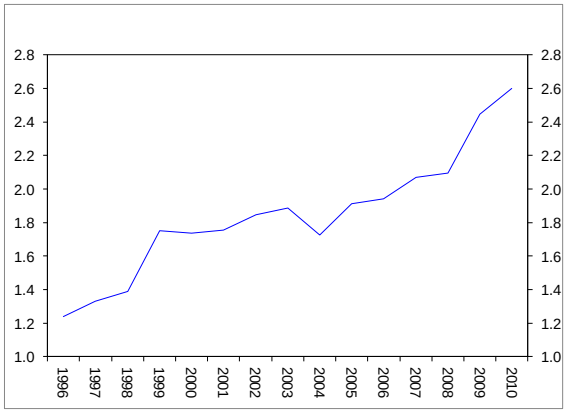
11. **Public pensions in Mexico do not appear relatively high compared with other emerging countries**. In a sample of emerging countries, pensions in Mexico (2.6 percent of GDP) are well below the average (5.4 percent of GDP) in 2010. However, pensions have more than doubled in the last 15 years, increasing particularly rapidly since 2008.

Spending in Pensions

Selected Economies: Public Expenditure in Pensions, 2010
(percent of GDP)



Mexico: Public Expenditure in Pensions
(percent of GDP)



Sources: SHCP, IMF 2010a, and staff calculations.

[11] We assume that the macroeconomic parameters (i.e., growth, inflation, exchange rate, real oil price, oil production, oil exports) remain stationary. We also assume that the consumption of oil derivatives grows in line with the economy.

12. **Fiscal risks from pensions have been addressed by a series of important pension reforms**. The pension system covering private sector employees (IMSS) was changed from a defined benefit system to a defined contribution system in 1997 and the pension system covering most public sector employees (ISSSTE) had a similar reform in 2007. IMSS' own employees' regime was reformed in 2004 and the regime of the public electricity company (CFE) was reformed in 2008.[12]

13. **However, important fiscal risks and challenges from pensions remain**. There are significant pension regimes that have not been reformed (i.e., PEMEX and subnational governments).[13] Moreover, there is a high transition cost in shifting from a defined benefit to a defined contribution scheme There is also the risk that, for a fraction of workers, accumulated contributions in a defined contribution system may result in inadequate pensions, with the attendant fiscal risk.[14] Finally, there is a relatively narrow fraction of the population participating in pensions systems,[15] and pressures may emerge to expand non-contributory pensions which would create a substantial fiscal liability.

14. **Pension spending is projected to increase to 4.6 percent of GDP by 2030**.[16] The projected pension spending increase of 2 percent of GDP during 2010–30 is relatively high compared to a sample of emerging countries (IMF (2010a)).[17] The projected increase in pensions may be a conservative estimate given the current narrow coverage of the pension system. It should be underscored that pension spending is projected to peak in 2035 and then go down as the effects of the pension reforms kick in.[18]

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[12] The reform of CFE's pension system had a parametric component for current workers, and new workers participate in a defined contribution scheme based on individual accounts.

[13] World Bank (2007) documents that pension schemes sponsored by subnational governments are predominantly defined benefit schemes with short contribution periods and relatively young retirement ages.

[14] OECD (2011) estimates that projected replacements rates (i.e., pensions as a fraction of pre-retirement income) in Mexico are around 30 percent while the OECD average is 57 percent.

[15] Levy (2009) documents that less than half of the labor force is covered by social security.

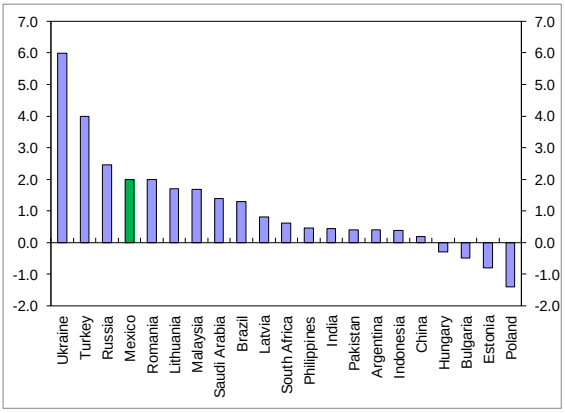
[16] The appendix lays out the framework used to project pension spending. We assume that the dependency ratio increases from 9.9 percent in 2010 to 17.5 percent in 2030 in line with demographic projections, and that the employment ratio increases from 63.4 percent in 2010 to 66.8 percent in 2030 in line with recent trends. We also assume that coverage and generosity remain unchanged. The increase in pension spending might generate some small increase in income tax revenues but not much because no income tax is paid on pensions that are below 9 times the minimum wage.

[17] IMSS (2010) shows cash flow projections in which pension spending grows from $144,688 million in 2010 to $487,333 million (at constant prices) in 2030. This cumulative growth during 2010-30 is in line with our projections.

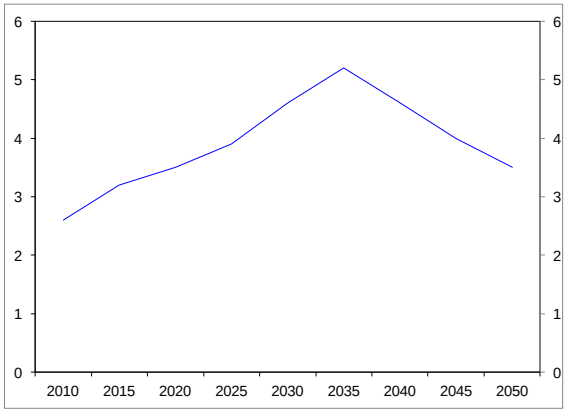
[18] Sales et al. (1999) estimate that the transition cost will peak in 2035. People who started working in 1997 will normally retire in 2037.

Pension Spending Projections

Projected Increase in Public Spending in Pensions During 2010-30
(percent of GDP)



Projected Pension Spending During 2010-50
(percent of GDP)



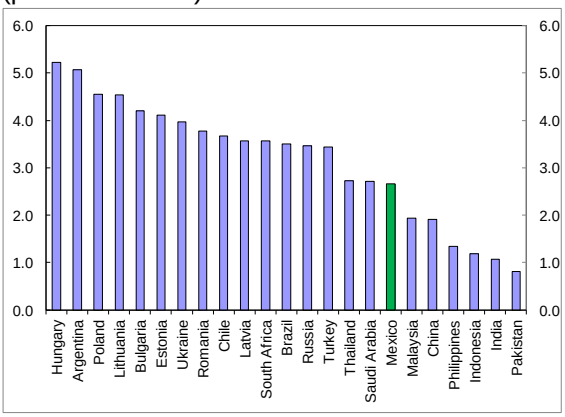
Sources: SHCP, IMF 2010a, and staff calculations

D. Health Spending Outlook

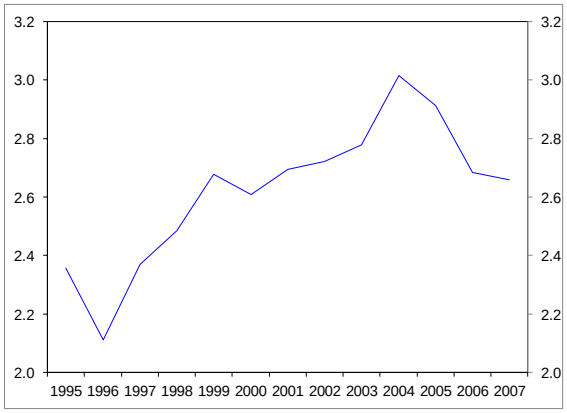
15. **Public spending in health in Mexico is below other emerging countries**. Public spending in health has grown less than the spending in pensions, while it has been more volatile. Health indicators in Mexican have shown significant improvements over the past decades, but remain behind most OECD countries.[19]

Spending in Health

Selected Economies: Public Spending in Health, 2007
(percent of GDP)



Mexico: Public Spending In Health
(percent of GDP)



Sources: SHCP, IMF 2010a, and staff calculations

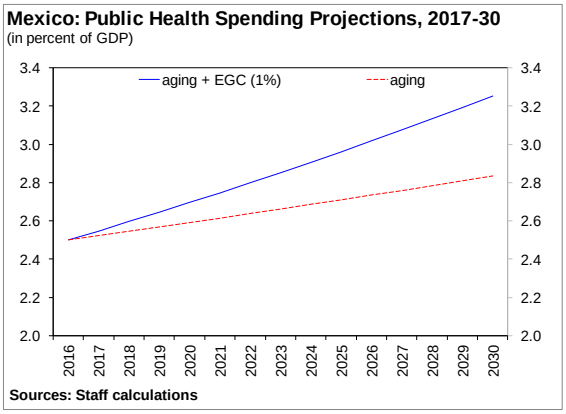
[19] In 2007, life expectancy at birth in Mexico was 75 years, higher than in the Slovak Republic (74.3), Hungary (73.3), and Turkey (73.2).

16. **Mexico's health care system has lagged in efficiency among OECD countries**. Schwellnus (2009) compared health outcomes (e.g., life expectancy) with health inputs (e.g., health spending) and found that Mexico is among the least efficient health care systems in OECD countries and average among emerging countries. One key explanation behind these findings is that Mexico has a highly segmented public health system in which different health providers (supply side) have no access to each others' services. In addition, there is lack of competition because patient choice is limited.

17. **Mexico is close to achieving universal insurance of basic health services**. The most important recent reform in the sector was the Health System of Social Protection (SPSS) that started in 2004. It introduced a system of family insurance, Seguro Popular (SP), to facilitate access to affordable health insurance for those without social security. Family contributions to SP are based on a sliding fee scale and are waived for families meeting the low income criteria. The relatively narrow health package provided by SP entails fiscal risks as pressures might emerge to expand the package in line with standard social security packages.

18. **Mexico has yet to complete an epidemiological transition**. Communicable and infectious diseases (e.g., influenza, pneumonia) are decreasing while chronic diseases (e.g., cancer, diabetes) are rising. This transition comes hand in hand with economic development and would imply higher health care costs in the future.

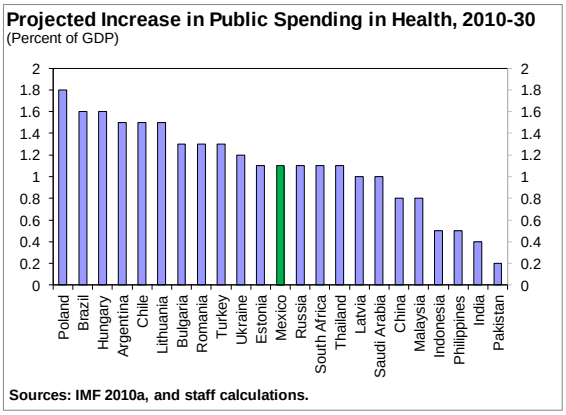
19. **The main determinants of public health spending are demographics and excess growing costs (EGC)**. IMF (2010b) documents an average EGC of 1 percent for a sample of 27 advanced countries during 1980–2007.[20] To project public health spending in Mexico for 2011–30 we follow IMF (2010b) and assume that the EGC is 1 percent each year and that spending increases proportionally with the share of the population aged 60 or more.[21]



[20] Public health spending-to-GDP ratio in advanced countries has increased on average by almost 2 percent of GDP since 1980. IMF (2010b) presents evidence showing that spending increases do not appear to be correlated with initial levels of income per capita or rates of economic growth suggesting that non-income factors (e.g., aging of the population, medical technology) are the key drivers explaining cross-country and time series variations.

[21] The assumption of 1 percent EGC means that the health spending-to-GDP ratio increases 1 percent each year (e.g., from 3percent of GDP in one year to 3.03 percent of GDP the following year). This assumption may be conservative for a country that is yet to complete epidemiological transition.

20. **Public health spending would increase about 1.1 percent of GDP during 2010–30**. The projected health spending increase is average among emerging countries. The increase in public health spending is a permanent factor, unlike the projected increase in public spending in pensions which would eventually fade away after 2035 (when the transition costs of pension reforms go down).



REFERENCES

IMF , 2011, "Mexico: Staff Report for the Article IV Consultation" (Washington: International Monetary Fund).

IMF, 2010a, "From Stimulus to Consolidation: Revenue and Expenditure Policies in Advanced and Emerging Economies", *IMF Staff Paper* 10/64 (Washington: International Monetary Fund).

IMF, 2010b, "Macro-Fiscal Implications of Health Care Reforms in Advanced and Emerging Economies", *IMF Policy Paper* (Washington: International Monetary Fund).

IMSS, 2010, "Informe Al Ejecutivo Federal y al Congreso de la Union sobre la situación financiera y los riesgos del Instituto Mexicano de Seguridad Social 2009-10" (Mexico: IMSS).

Levy, Santiago, 2009, "Social Security Reform in Mexico: For Whom?", in Levy, Santiago and Michael Walton (eds), *No Growth Without Equity,* World Bank, (Washington: World Bank).

OECD, 2011, "Pensions at a Glance 2011", OECD, Paris.

Sales Sarrapy, Carlos, Fernando Solís Soberón y A. Villagómez, 1999, "Pension system reform: The mexican Case", in Feldstein, Martin (ed), *Privatizing social security,* The University of Chicago Press

Secretaria de Hacienda y Credito Público (SHCP), 2010, "Criterios 2011", SHCP policy paper (Mexico: Secretaria de Hacienda y Credito Publico).

Schwellnus, C., 2009, "Achieving Higher Performance: Enhancing Spending Efficiency in Health and Education in Mexico," *Economics Department Working Paper # 732* (Paris: Organization for Economic Cooperation and Development).

World Bank, 2007, "Mexico State Pension Survey", World Bank, (Washington: World Bank).

APPENDIX 1

Pension spending can be broken down in the following way:

- PE / GDP = (Pensioners * Average Pension)/GDP
- PE / GDP = Pensioners * (Average Pension / Average Wage) * (Average Wage / GDP)
- PE / GDP = (Pensioners / Pop65+) * (Average Pension / Average Wage) * [(Average Wage * Workers) / GDP] * (Pop65+/Workers)
- PE / GDP = (Pensioners / Pop65+) * (Average Pension/Average Wage)* (Wages / GDP) * (Pop65+ / Pop15-64) * (Pop15-64 / Workers)

(Pensioners / Pop65+) measures the coverage of the pension system.
(Average Pension/Average Wage) measures the generosity of the pension system.
(Pop65+ / Pop15-64) measures the old dependency ratio of the population.
(Pop15-64 / Workers) measures labor force participation.