The Impact of International Trade on Electric Loads in Mexico

By Marc H. Vatter and Daniel F. Suurkask

INTRODUCTION

We estimate effects relevant to a possible shift in U.S. trade policy on electric loads in Mexico. We find exports to be a highly significant predictor of energy loads and a significant predictor of peak loads in models that do and do not include GDP and a trend toward greater efficiency in the use of electricity. These results are consistent with trade impacting load through high load factor, industrial customers. We conclude that, if a shift in trade policy toward Mexico is seen as a realistic possibility, it would be worthwhile to analyze its impact on loads, especially energy loads, in scenarios.

The North American Free Trade Agreement liberalized trade among Canada, Mexico, and the United States and went into force in January of 1994. From 1990 to 1994, Mexico ran trade deficits with the United States, but it ran trade surpluses with the United States every year from 1997 to 2014, and those surpluses grew at 8.6% p.a.[1] Trade across the Rio Grande was an issue in the 2016 U.S. presidential campaign, and a shift toward a more protectionist stance in U.S. trade policy appears to be a real possibility.

The wholesale electric market in Mexico is restructuring along lines established in other countries. The state-owned utility, Comisión Federal de Electridad (CFE), is in the process of creating transmission, distribution, supply, and six generation subsidiaries, each of which will be managed separately. The different generation subsidiaries will compete with one another and other entrants in spot and forward markets managed by the system operator, Centro Nacional de Control de Energía (CENACE). The restructuring has prompted a flourish of planning and analysis on the part of existing and new market participants, and the possible shift in U.S. trade policy adds an element of uncertainty to those efforts.

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See footnotes at end of text.

ECONOMIC DEVELOPMENT AND LOADS IN MEXICO

If one were to look back over the past 20 or 30 years, one might be tempted to conclude that Mexico is stuck in a "slow growth" trend, and that its aspirations to realize developed country status have in large part not been realized. But the same observer would likely acknowledge a fundamental economic transformation over the same time frame. Gone is the day of only low end manufacturing – clothing, textiles, and simple assembly. In its place is a diversified industrial base, led by high-end manufacturing. Mexico now ranks as the seventh largest producer of cars in the world, with many of the major car manufacturers having or soon to have major operations in the country.[2] Like the automotive industry, the aerospace, plastics, and medical device industries have seen tremendous growth.

In fact, Mexico has been able to establish itself as a manufacturing powerhouse, using to its advantage its proximity to the world's largest consumer market and its low wages relative to the U.S. Manufacturing now represents approximately 18 percent of GDP.[3]

Much of the export-oriented, high-end manufacturing is in the north of the country, along the U.S. border. Monterrey, in the Northeast region, has a very large manufacturing base, and is a major steel producing area. Electronics manufacturing is also important in the northern states of Chihuahua and Baja California.

Increasingly, however, owing to several factors, including the continuation of infrastructure development, high- and medium-end manufacturing in Mexico is now increasingly prevalent away from the U.S. border, in states such as Guanajuato, Aguascalientes, San Luis Potosi, and Queretaro, collectively called the "Bajio".[4] Stratfor elaborates:

> Unlike the border states, the central lowland region is a part of Mexico's economic and political heartland. It hosts a large, educated population, and its climate is the most temperate in the country. It is centrally located, with relatively easy access to ports on both coasts, the United States to the north, and Mexico City in the south.
>
> Geography has benefited the Bajio, as have improved transportation infrastructure, comparatively better security, and efforts to attract investment. More manufacturing investment and output will bring

Mexico's industrial core closer to Mexico City and populations in need of jobs. Bajio manufacturing will not replace manufacturing activity along the border, but it gives Mexico an opportunity to develop more evenly and sustainably.[5]

In the south of the country, in the Oriental and Yucatan Peninsula (hereinafter "Peninsular") regions, in addition to the petroleum industry, low-end manufacturing of goods like clothing and textiles continue to make an important – and growing – contribution to the economy. Low-end manufacturing in these regions of Mexico has benefited, in part, from strong wage and transportation inflation in China.

We also mention the importance of the tourism and hospitality industry in the economic development – and load growth – of different areas of the country, but especially around Cancun, a popular tourist destination, in the Peninsular region.

Figure 1 shows the regions on a map of Mexico. (The Bajio is situated in the Occidental region.)

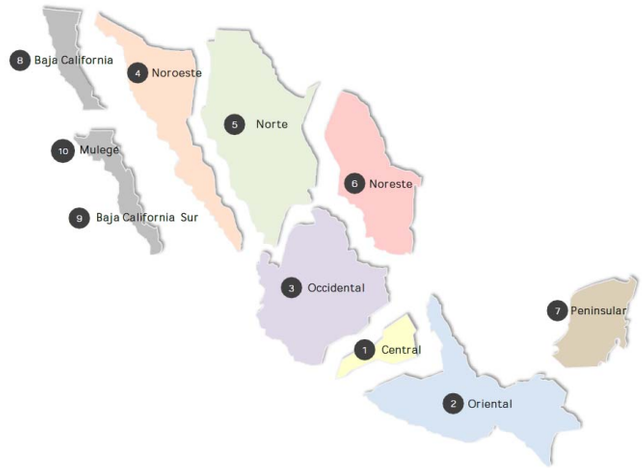

Figure 1: Mexican Regions[6]

Electric load growth and load shapes, as one might expect, reflect this economic transformation. Over the 1997-2015 period, load growth has averaged 3.0 percent. Over the same period, GDP growth has averaged 2.4 percent. As with growth in GDP, load growth has been quite variable over this period. GDP growth and load growth, for the period 1997-2015, are shown in Figure 2.

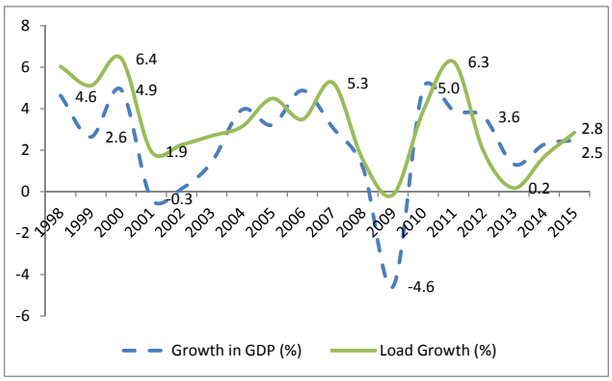

Figure 2: GDP & Load Growth, 1997-2015[7]

On the whole, Mexico has high load factors, with the electric grid covering most of Mexico maintaining an average 78% load factor between 2010 and 2015.[8] This, of course, reflects the large manufacturing base, as well as the relatively low penetration of air conditioners and a large body of population in the relatively temperate Mexico City and surrounding areas. In the North of the country, where temperatures are more extreme, load factors are lower than elsewhere, notwithstanding the manufacturing base. The primary driver of peak loads in the North of the country, then, is the use of air conditioning. In contrast, in the Central region, including Mexico City, the annual peak is typically in the winter around the Christmas festivities, owing to decorative lighting on homes and businesses, electric space heating, and additional lighting requirements owing to the shorter days.

Figure 3 shows the distribution of load across the regions, and over the months. Estimated 2016 loads are shown in average hourly megawatts, by region and by month.

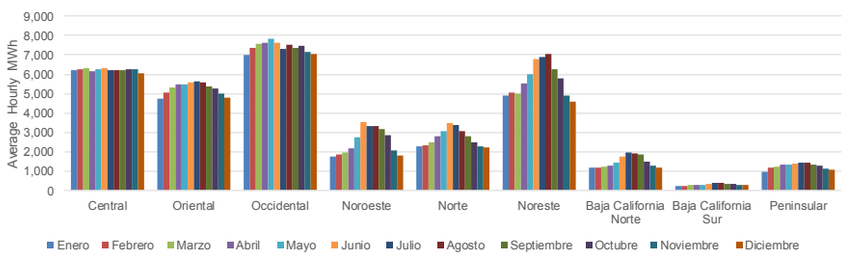

Figure 3: Monthly Load by Region[9]

As can be observed from the chart, the two regions with the most load, Central and Occidental, have a relatively flat monthly load profile, owing largely to temperate weather year-round. The Noreste, Norte, Noroeste, and Baja California Norte loads exhibit more seasonal variation because of more extreme summer temperatures.

RESULTS

Table 1 shows results from estimation. The constant terms in Model I represent the annual rate of growth in Baja California (Norte), and the coefficients on the indicator variables represent adjustments by region. Energy loads in Baja California grew at 3.7% during the sample period, and peak loads there grew at 3.5%. Loads in Peninsular grew considerably faster, and loads in Central grew considerably more slowly.

Model II introduces exports. In the absence of GDP and a trend toward energy efficiency, exports are highly statistically significant in the energy equation, and significant in the equation predicting peak load. These results are consistent with exports driving loads disproportionately through their impact on high load-factor, manufacturing customers. However, the domestic economy is certainly an important driver of electric loads.

Model III introduces a GDP variable from which variation dependent on exports has been removed. Variation in exports may still cause variation in GDP, but variation in GDP that is independent of exports is now included in the model. The GDP variable is statistically significant in both the energy and peak load equations. Exports continue to be highly significant in the energy equation and significant in the equation predicting peak load. Results are still consistent with international trade substantially involving manufactured goods produced by industrial customers with high load factors. Domestic economic activity also appears to be a stronger driver of energy than of peak load.

		Model							
Variable		I		II		III		IV	
Percent Change	**GWH**	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
	Exports			0.107	0.026	0.107	0.024	0.111	0.023
	GDPd					0.531	0.114	0.524	0.110
	Year							-0.001	0.000
Indicator	Baja Sur	0.013	0.009	0.017	0.009	0.017	0.008	0.017	0.008
	Central	-0.016	0.009	-0.016	0.009	-0.016	0.008	-0.016	0.008
	Noreste	-0.001	0.009	-0.002	0.009	-0.002	0.008	-0.002	0.008
	Noroeste	-0.004	0.009	0.001	0.009	0.001	0.008	0.001	0.008
	Norte	0.001	0.009	0.001	0.009	0.001	0.008	0.001	0.008
	Occidental	-0.001	0.009	0.000	0.009	0.000	0.008	0.000	0.008
	Oriental	-0.006	0.009	-0.004	0.009	-0.004	0.008	-0.004	0.008
	Peninsular	0.015	0.009	0.017	0.009	0.017	0.008	0.017	0.008
	Constant[a]	0.037	0.006	0.027	0.006	0.014	0.007	2.697	0.818
Percent Change	**MW**	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
	Exports			0.071	0.033	0.071	0.032	0.077	0.031
	GDPd					0.397	0.152	0.387	0.147
	Year							-0.002	0.001
Indicator	Baja Sur	0.020	0.011	0.024	0.011	0.024	0.011	0.024	0.011
	Central	-0.022	0.011	-0.024	0.011	-0.024	0.011	-0.024	0.011
	Noreste	0.001	0.011	0.003	0.011	0.003	0.011	0.003	0.011
	Noroeste	0.001	0.011	0.007	0.011	0.007	0.011	0.007	0.011
	Norte	0.005	0.011	0.004	0.011	0.004	0.011	0.004	0.011
	Occidental	-0.002	0.011	-0.001	0.011	-0.001	0.011	-0.001	0.011
	Oriental	-0.011	0.011	-0.011	0.011	-0.011	0.011	-0.011	0.011
	Peninsular	0.015	0.011	0.016	0.011	0.016	0.011	0.016	0.011
	Constant[a]	0.035	0.008	0.027	0.008	0.018	0.009	3.520	1.092

[a] Applies to Baja California (Norte).

Table 1: Effects of National Exports on Electric Loads in Mexican Regions

Model IV adds a deterministic trend ("Year") to reflect improving efficiency in the use of electricity. Consistent with expectations, its coefficients are negative and significant in both the energy and peak load equations. Exports continue to be highly significant in the energy equation and significant in the equation predicting peak load. The GDP variable is highly significant in the energy equation and significant in the equation predicting peak load. The trend toward efficiency appears to have explanatory power.

Across all four models, the largest difference in regional effects between the energy and peak load equations are in Central and Oriental. The differences in Central can be attributed to a program designed to shave peak load during the sample period, and to a temperate climate and relatively flat load, as shown in Figure 3. The differences in Oriental, which is near Central America and west of Peninsular, are attributable to industrial growth. At the turn of the century, low wages in China made it difficult for Mexico to compete in markets for light manufactured goods, but rising wages in China have since changed that, and we forecast that load factors will rise in the Oriental region and hold steady in Peninsular, despite falling somewhat nationwide. According to Stratfor, the low-end manufacturing is set to grow rapidly in the Oriental region.

> …the area in central-southern Mexico is large, populous and still relatively underdeveloped. It is in this area, which includes the states of Campeche, Veracruz, Chiapas and Yucatan, where we see the type of low-end development that fits our criteria. Mexico's ability to develop its low-wage regions does not face the multitude of challenges China faces in doing the same with its interior.
>
> …rising wages in China have once again shifted the equation in global manufacturing. Average manufacturing labor costs in Mexico are now almost 20 percent lower than in China, whereas in 2000, Mexico's labor costs were 58 percent more expensive than China's.
>
> …low-end manufacturing of goods like clothing and textiles is continuing to expand in southern Mexico, in cities like Campeche and Veracruz…[10]

For this reason, we forecast a rise in load-factors in that part of the country.

CONCLUSION

Exports are a highly significant driver of energy loads and a significant driver of peak loads in Mexico, with or without accounting separately for GDP and a trend toward efficiency in the use of electricity. If a change in U.S. or other countries' trade policies toward Mexico is seen as real possibility, it would be

worthwhile to examine scenarios in which the effects of trade on electric loads, especially energy loads, are taken into account. A, possibly extreme, benchmark could be established in a load-forecasting model that did not explicitly include international trade, but did include GDP. If exports no longer led economic growth in Mexico, so that exports and GDP grew at the same rate, forecast GDP growth could be lowered by 2.38% - 1.23% = 1.15% from what one would assume with no change in trade policy, where 2.38% is the rate of growth in Mexican GDP during the sample period, 1997 2015, which included the Great Recession, and 1.23% is the rate at which GDP would have grown had GDP and exports grown at the same rate during those years.

Footnotes

[1] Source: World Bank; http://data.worldbank.org/data-catalog/wits, accessed December 30, 2016.

[2] "Despite fears, Mexico's manufacturing boom is lifting U.S. workers," Aug 21, 2016. Available at http://www.latimes.com/projects/la-fi-manufacturing-boom-mexico/, accessed Jan 19, 2017.

[3] "Mexico's Manufacturing Sector Continues to Grow", Apr 6, 2015. Available at https://www.stratfor.com/analysis/mexicos-manufacturing-sector-continues-grow, accessed Jan 19, 2017.

[4] The corresponding electric region is Occidental.

[5] "Mexico's Manufacturing Sector Continues to Grow", Apr 6, 2015. Available at https://www.stratfor.com/analysis/mexicos-manufacturing-sector-continues-grow, accessed Jan 19, 2017.

[6] Source: PRODESEN 2016.

[7] Sources: Secretaría de Energía (SENER) and Organization for Economic Cooperation and Development (OECD).

[8] Load factor is a measure of the load shape, namely average load divided by peak load. The higher the load factor, the less capacity is required to meet the energy requirements.

[9] Source: SENER, with modifications by authors.

[10] "Mexico's Manufacturing Sector Continues to Grow," April 6, 2015. Available at http://www.forbes.com/sites/stratfor/2015/04/08/mexicos-manufacturing-sector-continues-to-grow/#71e061373c9e, accessed May 2, 2016.