Energy Economics 55 (2016) 253–265

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

Made in Mexico: Energy reform and manufacturing growth☆

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ARTICLE INFO

Article history:
Received 6 August 2015
Received in revised form 19 January 2016
Accepted 29 January 2016
Available online 26 February 2016

JEL Classification:
C14
C31
C33
E30
E65

Keywords:
Growth
Energy reform
Manufacturing output
Electricity
Gas
Mexico
Panel VAR

ABSTRACT

We assess the real effects of a recent opening of the energy sector in Mexico to private investment. We look at one particular channel, which operates through the change in the structure of electricity generation in favor of cheaper sources of energy, such as natural gas. We look at the potential impact of this structural change on electricity prices and ultimately on manufacturing output using subsector and state-level manufacturing output data. We first document that electricity prices—relative to oil and gas—are more important to the manufacturing sector, with a one-standard deviation reduction in those prices leading to a 2.8% increase in manufacturing output. This elasticity, together with estimated decreases in electricity prices on the back of the reform, could increase manufacturing output by up to 3.6%, and overall real GDP by 0.6%. Larger effects are possible in the long run if increased efficiency in the electricity sector leads to further decreases in electricity prices. There can also be larger effects stemming from output in the services sector which we find to also respond statistically significantly to electricity prices; and from the endogenous response of unit labor costs, which decrease with lower electricity prices.

1. Introduction

In December of 2013, Mexico began the process of a controversial energy reform by passing a constitutional reform which eliminated barriers to private investment in the sector. The reform is expected to deeply transform oil, gas, and electricity markets in Mexico. It aims at expanding oil and gas production by eliminating PEMEX's, the state-owned oil company, monopoly on exploration, production, and transportation of hydrocarbons, and at increasing private participation in the electricity sector.

We assess real effects of this energy reform through its impact on energy prices. We look in particular at the manufacturing sector because of its energy intensity and because this sector, despite exhibiting strong performance post-NAFTA, was stricken by high costs of energy before the reform. We first study the composition and inter-linkages between the manufacturing and energy sectors in Mexico, and identify the potential impacts of the reform on energy prices. We then exploit past price variation to study the potential effects of energy cost reductions on manufacturing output. We also contrast the response of manufacturing output to changes in energy costs to those from the services industry.

We use subsector and state-level GDP data along with past variation in energy prices to estimate, in panel regressions and a panel vector autoregression (VAR) model, the effects of energy cost reductions on manufacturing output. Our VAR approach is similar to models used in macroeconomic studies on the effect of oil prices on economic growth (Lee and Ni, 2002; Blanchard and Gali, 2007; Kilian, 2009; among others).

Using these empirical approaches, we find electricity prices, relative to oil derivatives and natural gas, to have the largest quantitative impact

☆ The authors are grateful to Dora Iakova, Herman Kamil, Robert Rennhack, Ernesto Revilla, Richard Tol (the editor), Alberto Torres, Alejandro Werner, two anonymous referees, and seminar participants at the Central Bank of Mexico, at the Mexican Treasury, and at the IMF for comments and discussions. The views expressed in this paper are those of the authors and do not necessarily represent those of the IMF or IMF policy.

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http://dx.doi.org/10.1016/j.eneco.2016.01.016
0140-9883/

on manufacturing output. We find that a one-standard deviation reduction in electricity prices is associated with a 2.8% increase in manufacturing output. Moreover, we estimate that, by relaxing constraints to private investment, the reform could facilitate a substitution of natural gas for fuel oil in electricity generation. With natural gas being cheaper than fuel oil, this substitution could lead electricity prices to decline by 13%. Our estimated elasticities imply that this reduction in electricity prices would boost manufacturing output by up to 3.9%, and increase overall GDP by up to 0.6%. Larger effects are possible if increased efficiency in the sector leads electricity prices to converge to U.S. levels. We also find that output in the services sector responds statistically significantly to changes in electricity prices, but less so than manufacturing output. However, because services account for a larger fraction of GDP (about 60%), the combined response of manufacturing and services output to a decrease in electricity prices could be about four times larger than the response of manufacturing output alone. Among manufacturing subsectors, we find larger effects for metals, machinery and equipment, which includes the export-oriented automotive industry. Finally, we extend our analysis to consider the endogenous response of unit labor costs in a panel VAR framework. We find a statistically significant response of unit labor costs to changes in electricity prices. This result is analogous to what has been documented in the literature on the macroeconomic effects of oil prices (for instance, Blanchard and Gali, 2007). This endogenous response of unit labor costs amplifies the impact of lower electricity prices on manufacturing output.

Our work contributes to a literature that is partially inconclusive about the effects of energy reforms on both energy production and prices. Williams and Ghanadan (2006) argue that energy reforms have yielded mixed results in many non-OECD countries. Steiner (2000) uses data from 19 OECD countries and concludes that privatized competitive generation lowers prices and increases efficiency. In the context of lower income countries, Zhang et al. (2008) use panel data including 36 developing and transitional economies that conducted reforms from 1985 to 2003. They conclude that introducing competition in the generation and transmission sectors can increase productivity and improve efficiency. A theoretical consequence of this, which they do not test, is a fall in energy prices. Similarly, Cubbin and Stern (2006) study 28 developing countries over from 1980 to 2001 and find that the regulatory framework is critical to achieve superior electricity efficiency and increased generation. Bortolotti et al. (1998) reaches comparable conclusions by surveying the experience with privatization of electricity generation in 38 countries between 1977 and 1997.

This paper is also related to a strand of the literature exploring the effect of electricity consumption on economic growth. Payne (2010) surveys the literature and concludes that 22.95% of studies support the notion of electricity consumption causing growth, while the others support the reverse or do not find a causal relationship at all. In a similar survey, Ozturk (2010) argues that the lack of consensus in the literature is due to the use of different data, alternative econometric techniques, and country heterogeneity. Apergis and Payne (2010) find Granger causality that runs from energy consumption to growth in Latin America. Nonetheless, country studies on Mexico using aggregate output in a time series context (Cheng, 1997; Murray and Nan, 1996) conclude the opposite. All of these studies, however, have not explored effects through prices, nor have they focused on disaggregated sectoral and regional GDP data as we do in this paper. One related study that does conduct this type of disaggregated analysis is Ellison and Glaeser (1999) who explore subsector and state variation in U.S. electricity prices. Finally, the paper also adds to related to studies on the determinants of manufacturing productivity growth in Mexico (Chavez and Foseca, 2012; Bernal and Salgado, 2007; Chiquiar and Ramos Francia, 2009a, 2009b; among others).

The rest of the paper is organized as follows. Section 2 presents stylized facts about the Mexican manufacturing sector and its evolution since NAFTA, the structure of the energy sector, and the potential impact of the energy reform on prices. Section 3 conducts difference in difference panel regressions to estimate elasticities of manufacturing output with respect to different energy prices. Section 4 estimates price effects on manufacturing output in a panel VAR framework. Section 5 concludes.

2. The Mexican manufacturing and energy sectors, and the energy reform

2.1. The components of manufacturing growth

Manufacturing activity in Mexico surged after the signing of the North America Free Trade Agreement (NAFTA) in 1994, particularly in the production of transportation equipment. The period 1994–2000 saw an explosive average annual growth of 5.6% in manufacturing output, and exports rose from 15% of GDP before NAFTA to over 30% in 2012. However, the manufacturing surge did not translate into spectacular growth rates in overall GDP, which grew at an annualized rate of 2.6% from 1994 to 2012, partially because growth was unevenly distributed across sectors and regions (Fig. 1A and B).

In the last two decades, the north outperformed the south, a trend that was particularly present in the 1990s and in the recent recovery. This is consistent with the general view that the north was the region that benefited most from its greatest proximity to the U.S. market, and attracted the largest export-oriented investment projects. As a direct consequence, the north gained greater susceptibility to the booms and busts of the U.S., explaining the pattern observed since 2008 in Fig. 1A. The differential trend of the north relative to the south appears to be connected to the differential growth observed in export-oriented manufacturing production relative to other sectors. Furthermore, differential gains are even clearer when decomposing manufacturing into its subsectors (Fig. 1C).

It is evident from the graph that the metals, machinery, and equipment sectors are outliers relative to the others. In fact, there is a remarkable similarity between the pattern of this subsector's output and that of the northeast region in Fig. 1A because both grew in the 1990s, slowed in the early 2000s, and recovered with renewed strength after the 2008 crisis. Altogether, heterogeneity in performance across sectors probably translated into geographical disparities in performance, as regional manufacturing clusters implied much stronger performance in the north than in the south.

The automotive industry—included in metals, machinery, and equipment—is a key part of the story. Mexico's car production tripled since NAFTA, and it was the only subsector with meaningful contributions from total factor productivity to growth (Fig. 1D). After slowing in the early 2000s, this subsector regained strength after the 2008 crisis. In fact, Mexico has now surpassed Japan and Canada to become the largest car exporter to the United States. Mexico also currently supplies one third of all U.S. imports of auto parts.

It is important to highlight that energy prices have a dual effect on overall manufacturing output in Mexico. On the one hand, energy is a direct input in manufactured goods production, and thus changes in relative prices lead to different input compositions. On the other hand, energy prices change the comparative advantage of Mexico in the U.S. market relative to other, more distant countries. This is a central issue when analyzing the role of international oil prices in export-oriented manufacturing industries in Mexico, both because of the importance of U.S. demand and because of the geographical proximity of Mexico to the U.S. The post-NAFTA rise of Mexico's manufacturing sector was hard hit by China's rise to the global stage when it joined the WTO in 2001 (Fig. 2). Kamil and Zook (2012) argue that China was able to crowd out Mexican exports in the U.S. market because Mexico had lost its advantage in several