AN ESTIMATE OF THE MEXICAN ECONOMY'S POTENCIAL GROWTH RATE BY 2016 BASED ON THE DYNAMIC INPUT-OUTPUT MODEL

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Abstract

In this paper we estimate the Mexican economy potential growth for the year 2016 by using the dynamic input-output model proposed by Leontief and extended by ten Raa. Actually, we asset the capital coefficient matrix base on the life spans vector of the economic sectors in Mexico. Then, using this information, we calculate the Leontief's dynamic inverse matrix. Finally, we calculate the dominant Eigen value of the dynamic system whose magnitude represents the maximum potential growth rate of the economy.

Our results show that, taking the Mexican economic structure of production and trade as given; the potential growth would not be bigger enough to bring a economic develop that can better affront the needs of the country than the way we face today. Similarly, we obtain a lower rate of growth than the one estimated by economic international and national institutions that we compare to. In addition, this analysis let us to identify the sectors that allow us to propose economic policies in order to obtain bigger growth rates.

Key words: Dynamic input-output model, potential growth rate, Structural Change.

1. Introduction

One of the most important issues in an economy is its growth, which can be measure by its rate of growth and its growth expectations. A lot of works analyzing economic growth are made every year, their finality is the estimation and forecasting of potential rates of growth by using increasingly sophisticated tools. The International Monetary Fund (IMF) publishes its World Economic Outlook, where he presents his worldwide growth's perspectives; some other international –as the OECD- and national institutions around world, made similar work.

In Mexico, the principal public institutions who publish their growth rates forecast are the Secretary of Finance and Public Credit (SHCP, by his acronym in Spanish) and the Mexican Central Bank. In the Table 1, we present the estimated rates of growth for the Mexican economy for the 2015 and 2016.

Table 1 Mexican growth rates perspectives

Institution	Estimated growth rate
SHCP	3.2%
Mexican Bank	2.5%
IMF	3.0%
OECD	3.9%

Data from SHCP, Mexican Central Bank, IMF, and OECD

Although the sophisticated and high technology tools used by the researchers in this works, mostly of the models employs to do that –as it is known- do not take in account the structural composition of the economy but only the tendencies, patterns, and contingent changes in the national and international markers, which make less realistic the computation and bank to make adjusts and changes in their forecasting.

In this sense, the objective of this paper is to estimate the Mexican's economy potential growth for 2016, using an alternative form that take advantage of the structural information of the economy and is based on the dynamic input-output model. Our results show that, given Mexico's economic structure of production and trade, its growth potential is insufficient to absorb a labor supply proportionate to its develop needs. That is, we obtain a lower rate of growth than the one obtained via comparable international and national economic studies. In addition, this analysis enabled the identification of sectors toward which economic policies might be targeted to facilitate faster growth.

The present work is structured as follows; section II presents a brew review of the concept of potential output as well as the techniques commonly used to estimate potential growth; section III, focuses on the estimation of potential growth, elaborating on the dynamic input -output methodology and results; finally section IV concludes.

1. Potential Output

An alternative common form to obtain the estimation of the economic growth of an economy is by calculate its potential output, which is generally defined as the highest level of output that can be achieved with balanced inflation (Okun, 1962; IMF, 2015; Blagrave, et al., 2015 and Mitra, et al., 2015). It is also considered that, in the short term, the actual levels of output can deviate from their potential growth, if there is an internal or external shock that affects its economic behavior. This short term divergence is called the output gap; a positive output gap implies that there is idle capacity, whereas a negative output gap means that there are underemployment inputs.

Based on this definition of the potential growth, there are many different methods to that are used to estimate it; some of the most common ones are described next:

a) Statistical Filters Invariant methods, which decompose the GDP data into cyclical, and trend components. One of the most used is the Hodrick-Prescott (HP) filter, (1997); and tehe band-pass filters as the Christiano and Fitzgerald (CF) (2003) and Baxter and King (BK) (1999). However, as it is showed in Mitra, et al., (2015) these techniques have some limitations, main of these is that since these filters do not incorporate any economic structure, theirs estimates are the reflect of the trend rather than the potential growth of the economy, furthermore theirs results are broadly depended of the selection of the smoothing parameter.

b) Production Function Approach methods, which decomposes the production into contributions from labor, physical capital and total factor productivity (TFP) by following a framework proposed by Solow (1957). This model assumes that the economy's production is govern by a Cobb-Douglas production function which parameters most by estimated. The TFP is calculated as the residual from the production-function equation. Finally, the potential output for the economy is calculated, by combining the trend of each of the production function components with the estimate of the capital stock.

c) Multivariate filters approach, which estimate potential output by adding some economic theoretical relationships to the use of multivariate filters (Kuttner, 1994; Banes, et al., 2010).

d) Finally, we have some models which use Dynamic Stochastic General Equilibrium (DSGE) models, to estimate the potential output of an economy, however its theoretical rigorousness and model specification, make it difficult to implement.

Although these models consider unrealistic simplifications for their modeling -as the estimation of the parameters by a filtering process (as the HP, CF and BK filters), linear relations and normal distributions of their parameters, production functions with poor analysis capacity (Acemoglu, 2009)- and there are some limitations relating to the accuracy and scope of the forecast made by this models, about, they are the most used methods in economic growth research.

Despite restrictions, there are important findings related with the estimation of the potential output in an economy. Mitra, et al., (2015), estimate potential growth considering the statistical univariate filters and the production function approaches, the analysis shows that the Middle East and Central Asia region´s potential growth is 0.75% lower than in other the emerging and development countries. Furceri and Mourougane, (2009) uses a model whit production function and statistical filter invariant and measures the impact of financial crisis on potential output for the OECD countries from 1960 to 2007; then by applying the production approach the long term effects on potential output are 1.5%, while using the filters method they estimate a rate of 2.1 for the long term effect.

A study by Acevedo (2008), that uses these approaches, estimate a potential growth between 3.7 y 4.3 per cent potential growth for the Mexican Economy, in the 2006-2007 period.

2. The Dynamic Input – Output Model

Our maximum potential growth rate calculation is based on the Leontief's Dynamic Model whose basis is the fundamental matrix identity (Lenotief (1953))

(1) $$(I - A)X = F$$

where I is the identity matrix, A is the technic coefficients matrix, X is the gross value of production vector, and F is the final demand vector.

Our alternative takes the economic and technology structure of the economy as an input for the estimation and do not require restrictive assumptions as stochastic or equilibrium conditions, although we most suppose that there is a linear relation of production and our model have a steady state nature. Then, in order to consider a dynamic model based on our assumptions, Leontief's first approach of the model assumes that all inputs used on annual production processes are all consumed in a year, besides many of this goods (as machinery and real state) last over a period.

2.1. The Dynamic Model

In order to make a more realistic modelling, our model incorporates gradual spending of inputs. To do this, it is necessarily to know the quantity of the inputs that are incorporated during the production of outputs (Miller and Blair, 2011). Formally, let k_{ij} be the amount of input j which is incorporated into the output i as a stock, then we calculate the amount of production of sector i kept as capital stock to produce a unit of output j, which is denoted as $b_{ij} = k_{ij}/x_i$.

We assume an economy that is growing up from one period to another, and the capital stock employed in production is been different every year. Then, the new capital stock demanded due to a change in the future production, is equal to:

(2) $$b_{ij}\left(x_j^{t+1} - x_j^t\right),$$

where x_j^t and $\mathrm{x}_\mathrm{j}^{\mathrm{t}+1}$ are the amounts of good j produced in period t and $(\mathrm{t}+1)$ respectably. Then, the total production of sector j in time t is given by:

(3) $$x_i^t = \sum_{j=1}^{n} a_{ij} x_j^t + \sum_{j=1}^{n} b_{ij}\left(x_j^{t+1} - x_j^t\right) + f_i^t.$$

The first sum of the right side of equation (3) is the intermediate demand required by industrial sectors to produce total output, the second one is the input that will be occupied the next period into production process, and the last sum is the final demand in t.

We write last equation for the whole economy by using matrices as

(4) $$(I - A)x^t - B(x^{t+1} - x^t) = f^t$$

where A is the technic coefficients matrix, B is a matrix that transform capital stocks into flows, x and f are the vectors of total output and final demand respectively. This equation represents a dynamic model that give us a response to the question about the total output that most be produce in order to find the total demand in the economy.

To solve this model, we regroup total demands of factors as:

(5) $$(I - A + B)x^t - B(x^{t+1}) = f^t$$

Then, we solve this last equation by using forward or backward iterations. To use backward iterations, we need to know the total production coefficients of the last period that we want to analyse, and also all final demands until this period.

For instance, doing this for a three period model we obtain

$$Gx^3 - Bx^4 = f^3,$$

(6) $$Gx^2 - Bx^3 = f^2,$$

$$Gx^1 - Bx^1 = f^1,$$

$$Gx^0 - Bx^1 = f^0,$$

where the G matrix is defined by $G = (I - A + B)$. Then, we solve these equations jointly by using the known values of x^4 and the final demands, as well as the coefficients for A and B as follows:

$$\mathrm{x}^3 = \mathrm{G}^{-1}\mathrm{f}^3$$

$$\text{(7)} \qquad \mathrm{x}^2 = \mathrm{R}\mathrm{G}^{-1}\mathrm{f}^3 + \mathrm{G}^{-1}\mathrm{f}^2, \text{ con } \mathrm{R} = \mathrm{G}^{-1}\mathrm{B}$$

$$\mathrm{x}^1 = \mathrm{R}^2\mathrm{G}^{-1}\mathrm{f}^3 + \mathrm{R}\mathrm{G}^{-1}\mathrm{f}^2 + \mathrm{G}^{-1}\mathrm{f}^3$$

Note that we almost all needed information needed for the model are available from official data, but due to coefficients of matrix B are theoretical built, we need to obtain from somewhere else.

Calibration for the Time Life Coefficient Matrix

In order to obtain matrix B in our model, we use the methodology proposed by Brody (1966), who suggests that the stock coefficients b_{ij} can be expressed as a multiple the of technical coefficients a_{ij} by multiplying them with appropriate time life coefficient t_{ij} as follows

$$\text{(8)} \qquad b_{ij} = t_{ij}a_{ij}.$$

Next, we need to obtain such time life coefficients.

In order to guarantee positive results in the calculation of the inverse dynamic production, the routine includes a computational routine that makes an looking for values in the $(t_i - \frac{t_i}{2}, t_i + \frac{t_i}{2})$ neighbors, which better adjust to our economy by minimizing the distance between the observed vector and the resulting production of inverse dynamics.

2.3. The Potential Growth Rate

The growth of an economy can be given in terms of its previous production. An explanation to this is given by Koopmans[1], which claims that there is a relationship between in production from one period to another; so there may be a value λ such that production in period 2 is proportional to production in period 1 as follows:

$$x^2 = \lambda x^1 \tag{9}$$

Moreover, this λ ratio can be maintained for all subsequent production periods, that is to say

$$x^{t+1} = \lambda x^t \tag{10}$$

In this sense, for an economy with n sectors, we can take the closed model between two periods of production[2] given by:

$$\mathrm{A}\mathrm{x}^{\mathrm{t}} + \mathrm{B}(\mathrm{x}^{\mathrm{t}+1} - \mathrm{x}^{\mathrm{t}}) = \mathrm{x}^{\mathrm{t}} \tag{11}$$

And substituting (10) into (11):

$$\begin{aligned} \mathrm{A}\mathrm{x}^{\mathrm{t}} + \mathrm{B}(\lambda\mathrm{x}^{\mathrm{t}} - \mathrm{x}^{\mathrm{t}}) &= \mathrm{x}^{\mathrm{t}} \\ \mathrm{B}\lambda\mathrm{x}^{\mathrm{t}} &= (\mathrm{I} - \mathrm{A} + \mathrm{B})\mathrm{x}^{\mathrm{t}} \\ \mathrm{B}^{-1}(\mathrm{I} - \mathrm{A} + \mathrm{B})\mathrm{x}^{\mathrm{t}} &= \lambda\mathrm{x}^{\mathrm{t}} \end{aligned} \tag{12}$$

and take $Q = B^{-1}(I - A + B)$, $Q\mathrm{x}^{\mathrm{t}} = \lambda\mathrm{x}^{\mathrm{t}}$. Then, we must to solve the characteristic polynomial

$$(\mathrm{Q} - \lambda\mathrm{I})\mathrm{x} = 0 \tag{13}$$

The potential economic growth rate coincides with by the principal eigenvalue of the equation (13) and is known as the turnpike growth rate, where all sectors of the economy grow at the same rate.

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[1] Koompans, 1954.

[2] See this equation in Miller anb Blair, 2009, section 13.4.

3. Results and discussion

Starting from the dynamic input-output matrix methodology described above, we obtain the optimal life spans values for each sector of the Mexican Economy.

Table 2 Sectorial life spans

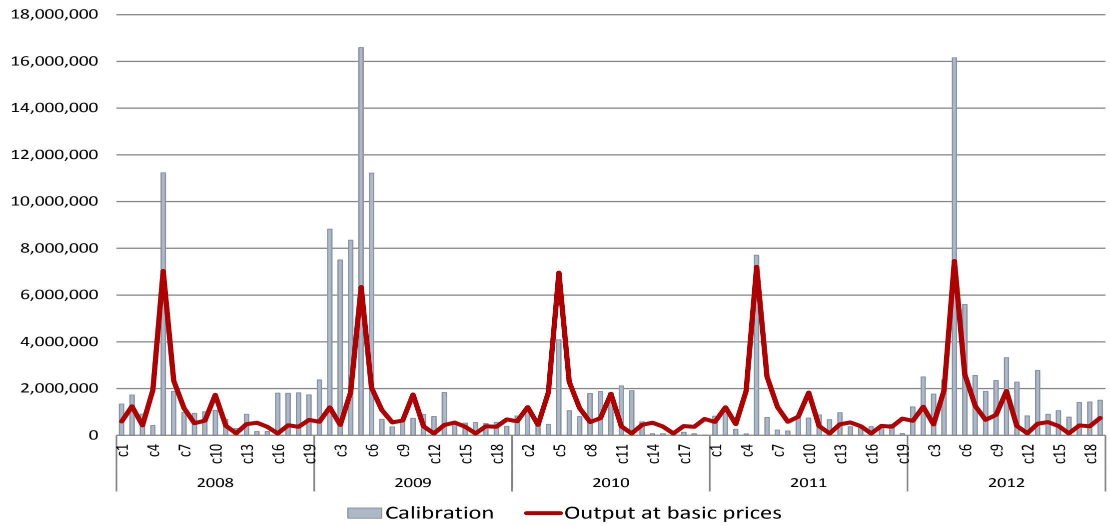
Sector	Life span
Agriculture	1.48
Minery	1.93
Electricity	0.00
Construction	48.90
Manufacture	1.88
Transport, mailing and storage	0.00
Masive media information	0.00
Finantial services	0.00
Property and rent of realtive	0.00
Professional, cientific and tecnical services.	0.00
Bussnes support	0.00
Education	0.00
Health and social assistence	0.00
Leassure and cultural and deportive services	0.00
hotels and restaurants	0.00
Other services	0.00
Government	0.00

Calibrated data

As is showed in the Table 2, services sectors have a null life span, which means that they are totally consumed at the moment in the production process (a life span of 1 indicates that the good is used in the same productive process, defined as one year). The sector with the bigger life span is the construction, with 48.9, followed by Minery, manufacture, and agriculture with significantly positive values of their life span.

Using this information, we estimate the output at basic prices from 2008 to 2012 in order to prove that the adjustment between observed and real data is good enough, as we observe in the next figure.

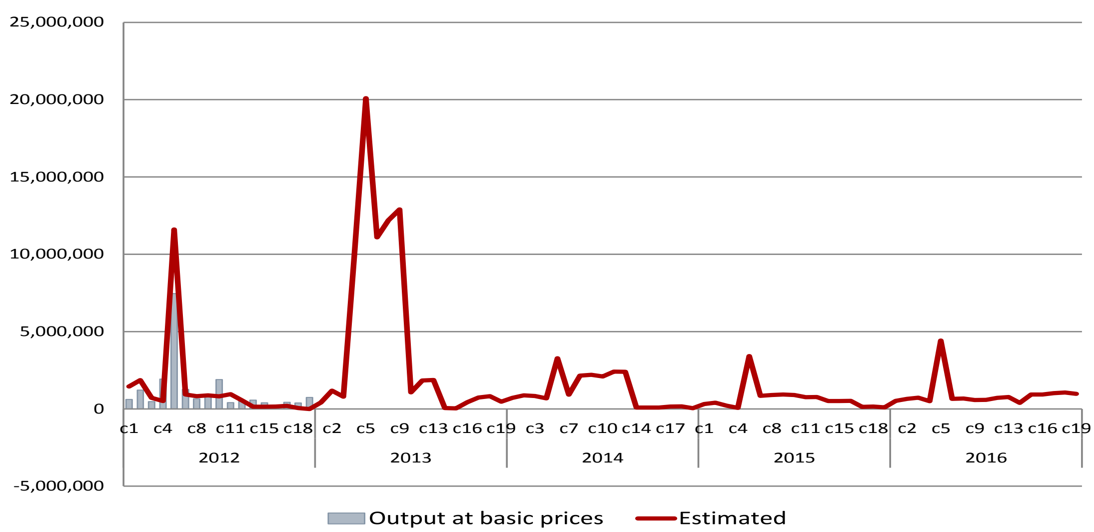
Figure 1 Calibrated data for the output at basic prices



Data from INEGI

We find that agriculture; construction; manufacture; hotels and restaurants; and other services sectors have the best adjustment in our model, while transport; mailing and storage; financial services; leisure, sporting and cultural services; and professional, scientific, and technical services are the sectors whit the poorest adjustment.

Figure 2 Estimated data for the output at basic prices, 2012 - 2016



Data from INEGI

Table 2, shows the estimations for the output at basic prices that we obtain by applying the dynamic input–output model using projections of the sectorial final demand levels for 2015 and 2016 in order to obtain the Mexican potential rate of growth. Finally, we obtain a potential rate of growth of 1.015% as a result.

This last results became so far away to forecasting of national and international economic institutions for the Mexican growth rate for 2016, who obtained values around 3%. This difference can be explained because our model is strongly dependent with the Mexican economic structure, which affects the estimation of the national production and trade capacities and it is not considered in the other estimations.

4. Conclution remarks

Our procedure was made in two steps: First, we calibrate our model by comparing the results of the estimation using different vectors of capital stock's life spans over a range of their coefficient's values. Then, using the estimate capital stock's life spans vector and using the final demand's estimations from 2014 to 2016, we estimate the potential rate of growth of the global economy in 1.015.

The principal difference between these two rates is that, the first one only takes account the tendency of the data and the contingent situations that affects the economy, but ignore its the structural composition; while the second one mostly consider this structure and the input requirements for the production in the economy. Although the characteristics of the dynamic input-output model are related with a strong relationship with the economic structure of the nation that is studied, which is an advantage of the model with respect to the models that do not take it into account, the liner relation assumed constitutes a weakness of the model because we tend to underestimate the effects of internal or external shocks that modifies economic growth.

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