Immigration and growth of GDP in the United States of America

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Abstract

This paper estimates the effect of immigration on real GDP in the United States of America using annual time series data from 1950 to 2013. For the estimation and analysis an aggregate production function model is developed in which total capital, labor, and immigration are variables to explain real GDP. Before estimating the model the time series properties of the data are diagnosed and an error correction model is developed and estimated. The estimated results suggest that labor and capital have a significant effect on output growth. Immigration, however, has neither positive nor negative statistical effect on real GDP.
I. INTRODUCTION

People move from one place to another in the hopes of finding better opportunities. Throughout history humans have moved in search of better hunting grounds, better sources of water, better security and safety. As time moved on and civilization advanced that movement continued as it always has under a different name: Immigration.

The United States of America has been the preferred destination for immigration since the discovery of the New World. The United States experienced major waves of immigration since it was a collection of colonies. In the 1600’s many immigrants came to America to escape religious persecution; or find their fortunes in the New World. From the 17th to 19th centuries, hundreds of thousands of African slaves were brought to America against their will. And in 1882 there were so many Chinese immigrating to America that the first significant federal legislation restricting immigration was passed called the Chinese Exclusion Act. Ellis Island was America’s first federal immigration station, opening it’s doors in 1892. Before the creation of Ellis Island each individual state had its own regulations regarding immigration. Laws were created in 1965 that ended the quota system designed to favor European immigrants. During the first 16 years of the 21st century America is experiencing another wave of immigrants, the majority of which are coming from Asia and Latin America. This level of diversity is unique to the United States. As the third most populous nation in the world, the US also boasts the highest population of immigrants in the world, totaling over 22 million in 2015.
Having an immigrant population that makes up about 14% of the nation’s total population does not come without its own distinct problems. Debates over public policy towards immigration reform, limits on how many immigrants are admitted, rules and timelines towards earning citizenship or a Green Card are all sensitive topics in politics. However, these problems are not unique to the US, nor are these problems new. Throughout human history whenever a group of people move to a new area, the native population receives them with mixed reactions. Some natives’ welcome immigrants warmly, others may be indifferent, and some may be hostile towards the new comers.

Today many believe immigrants to be an economic burden on the nation’s economy; making claims that immigrants drain social services and cause unemployment. There are claims that immigrants increase violent crime in areas they settle, lower property values, and take away from the host nation’s cultural identity. The most commonly voiced negative reaction to immigrants deals with job displacement. That is, natives are most concerned with immigrants taking their jobs away from them.

On the other side of the argument are those saying that without immigration the nation would not be able to maintain its economic standing. They claim immigrants boost the economy by creating markets for goods that were previously in low demand, increase new business and entrepreneurship, and add to the work force by taking low wage jobs that native workers do not desire. They also argue that this nation has its founding roots based on immigration and to turn away from it would be “un-American”. There are also claims that limiting immigration would lead to an increase in illegal
immigration, which would lower assimilation, decrease the amount of taxpaying citizens, and increase the animosity between the native population and the illegal immigrant population.

The purpose of this paper is to examine how much impact immigrants have on the nations GDP using the Cobb-Douglass production function model based on United States data during the period between 1951 and 2011. The paper is structured as follows. Next section reviews some of the existing studies on the topic of immigration effects on a host nation. Section III provides the data and methodology while sections IV and V provide the results and conclusion.

II. Literature Review

This topic has been a subject of study for many years. Joseph G. Altonji and David Card (1991) did a study on the effects of immigration on the labor market. They worked on finding out how hiring immigrants effected natives looking for the same job. The focus was on low skill labor. The study used variation in the fraction of immigrants across different cities in order to measure the effects of immigration on low skill labor markets. Census data from 1970 and 1980 were used on labor market outcomes of natives in 120 cities. Instead of doing a simple cross sectional analysis multiple Censuses were used in order to correlate changes in immigrant fractions along with the changes in native outcomes within cities in order to eliminate bias. The type of labor was separated by skill level required, demand for labor, population increase in immigrants and natives supplying labor, and location. Altonji and Card (1991) also address whether or not immigrants and natives in the same city compete in the same labor market. They focused on industry specific labor markets within cities and
developed an index that measured the effect of an inflow of immigrants on the labor market of natives.

Sari Pellala Kerr and William R. Kerr (2011) performed a survey on the economic impacts of immigration. Their work surveys recent empirical studies on the economic impacts of immigration. They first examine the magnitude of immigration as an economic phenomenon in different host countries. The second part of the survey deals with the assimilation of immigrant workers into host-country labor markets and the naturally occurring effects for natives. The paper then turns to immigration's impact for the public finances of host countries. The final section talks about emerging topics in the study of immigration. The survey primarily focuses on fairly recent events in Northern Europe and Scandinavia and compares them to traditional destination countries like the US.

A study from Francesco D’Amuri and Giovanni Peri (2011) focused on immigration, jobs and employment protection in Europe. They analyzed the effect of immigrants on native jobs in fourteen European countries. They looked for the inflow of immigrants from 1996 to 2007 to see if immigrants decreased employment rates and/or if they altered the occupational distribution of natives with similar education and age. No evidence was found of the first but there was evidence of the second. Immigrants took basic manual labor types of jobs and natives moved into more technical jobs requiring more education. The results are very clear based on the study of past settlement of different nationalities of immigrants across European countries. D’Amuri and Peri (2011) also documented the labor market flows through which such a positive reallocation took place. According to them immigration created jobs, and the jobs
offered to new native hires was higher due to the increase in education required relative to the more basic jobs that were taken. They also found evidence that the job reallocation of natives was significantly larger in countries with more flexible labor laws. This seemed to be the case more for less educated workers.

Francine D. Blau and Lawrence M. Kahn (2012) did work on Immigration and the Distribution of Incomes. In this study Blau and Khan (2012) reviewed research on the impact of immigration on income distribution. They talk about ways immigration can affect income distribution in the host and origin countries, and effects on native incomes. Immigration may affect the composition of skills among the residents of a country, like how many construction workers there are vs. software engineers. Likewise, immigrants can, by changing relative factor supplies, affect native wage and employment rates and the return to capital. They provided evidence on the level and recent increases in immigration to OECD countries and on the distribution of native and immigrant educational attainment. They also showed a breakdown of 1979-2009 changes in US wage inequality, highlighting the effects of immigration on the workforce. Blau and Lawrence (2012) also considered the impact of immigration on income distribution, emphasizing labor market substitution and complementarity between natives and immigrants. Further, by changing job opportunities or child care availability, they found that immigrants can affect family, as well as individual, income distribution. They looked at research methodologies used to estimate the impact of immigration on the native income distribution. These include the structural approach, by estimating substitution and complementarity among factors of production, including
capital and labor force groups, as well as the natural experiment approach, by seeking exogenous sources of variation in immigration, to studying the labor market.

Mete Feridun (2005) wrote a journal article titled *Investigating the Economic Impact of Immigration on the Host Country: The Case Of Norway*. The journal entry discusses many of the same topics discussed in this paper, such as the native population showing concerns about immigration due to fears of rising unemployment and the rising costs of social services. To effectively measure the effect immigrants have on a host nation, Feridun (2005) assesses the impact of foreign workers on GDP per capita and unemployment. This is done by taking a closer look at the causal relationship between immigration and the two macroeconomic indicators GDP per capita and unemployment using Granger causality tests. The data collected for the tests are from the time period between 1983 and 2003. What was found using the Granger causality tests was that when the level of immigration increased, GDP per capital also increased. It was also found that immigration had no impact on unemployment, nor did unemployment have an impact on immigration. A Johansen cointegration tests was done to find out of any of the data sets were related in any way, however the test results showed no cointegration among the data sets.

### III. Theoretical Background, Data and Methodology

The amount of GDP produced by a nation’s economy is defined by the accessibility of factors of production which are land, labor, and capital. For this study we are mainly concerned with labor and capital. The Cobb-Douglass production function explains this as:
Where $y$ represents real GDP, $K$ represents domestic capital, and $L$ represents labor. $\alpha$ and $\beta$ signify the impact of labor and capital respectively in the total output and $A$ is the efficiency factor. It is also assumed that both $\alpha$ and $\beta$ are less than one and the law of diminishing returns operates with both labor and capital inputs. For the purposes of this study, we add immigration in equation (1) as $M$ and we obtain:

$$y = AL^\alpha K^\beta M^\tau$$

(2)

After the log transformation of equation (2) we get:

$$\log y = A + \alpha \log L + \beta \log K + \tau \log M + V$$

(3)

If we take the first difference of equation (3) it will change to growth form, which would follow this model with added error correction variable EC and $V$ representing the random error term:

$$\Delta \log y = c_0 + c_1 \Delta \log L + c_2 \Delta \log K + c_3 \Delta \log M + EC + V$$

(4)

Since the effect of current economic growth appears in the future instead of the present we use one year lag of the GDP output in our regression. In equation (4) the coefficients of $\log K$ and $\log L$ are expected to be positive since an increase in capital and/or labor will increase the level of output. The coefficient of $M$ may be positive or negative depending on the level of immigration.

Before carrying out the estimation of equation (4) it is important to test the stationarity of the data series to avoid spurious results. Following Nelson and Plosser (1982), an augmented Dickey-Fuller test is conducted on the data series to ensure the
stationarity of the data. This involves estimating the following regression and carrying out unit root tests:

\[ \Delta X_t = \alpha + \rho t + \beta X_{t-1} + \sum_{i=1}^{n} \lambda_i \Delta X_{t-i} + \epsilon_t \]  

(5)

In equation (5) \( X \) is the variable under consideration, \( \Delta \) is the first difference operator, \( t \) is a time trend and \( \epsilon \) is a stationary random error term. If the null hypothesis, that \( \beta = 0 \), is not rejected the variable series contains a unit root and is non-stationary. The optimal lag length in the above equation is identified by ensuring that the error term is white noise. In addition to the augmented Dickey-Fuller (1979) test, a Phillips-Perron test (Phillips 1987, Phillips-Perron 1988) is also conducted to ensure the stationarity of the data series. The Phillips-Perron test uses non-parametric corrections to deal with any correlation in the error terms. The test results are reported in Table 1. As the results in Table 1 point out, both the Dickey-Fuller test and the Phillips-Perron test indicate that all the data series are non-stationary in level form. Therefore the same tests are performed for first-differences. The test results (see Table 1) indicate that all the series are stationary in first-difference form.

Having established the stationarity of the data, the Johansen (1988) and Johansen and Juselius (1990) approaches are explored to test for a long-run equilibrium relationship among the variables. This involves testing the cointegrating vectors. Consider a \( p \) dimensional vector autoregression,

\[ X_t = \sum_{i=1}^{k} \pi_i X_{t-i} + c + \epsilon_t \] 

(6)

which can be written as,
\[ \Delta X_t = \sum_{i=1}^{k} \Gamma_i X_{t-i} - \pi X_{t-k} + c + \varepsilon_t \]  

(7)

where,

\[ \Gamma_i = -1 + \pi_1 + \pi_2 + \ldots + \pi_t \]  

(8)

\[ \pi = I - \pi_1 - \pi_2 - \ldots - \pi_k \]  

(9)

and where \( p \) is the number of variables under consideration. The matrix \( \pi \) captures the long run relationship between \( p \) variables, and this can be decomposed into two matrices, \( A \) and \( B \), such that \( \pi = AB' \). \( A \) is interpreted as the vector error correction parameter and \( B \) as cointegrating vectors. This procedure is used to test the existence of a long run relationship between the variables in equation (3). The cointegration test results are reported in Table 2. The test results in Table 2 shows that the null hypothesis of no cointegration is rejected, following Engle and Granger (1987) in the final model (equation 4) is estimated as an error correction model.

This study is based on the United States of America. All the variables are in real terms. Time series data from 1951-2011 are used. Population, capital stock, and real GDP data originated from FRED. Immigration data originated from the Bureau of Labor Statistics and the Department of Homeland Security.
### Table 1

**ADF Unit Root Test**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>First Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Y</td>
<td>-0.8156</td>
<td>-7.277763*</td>
</tr>
<tr>
<td>log K</td>
<td>-0.3094</td>
<td>-3.377569*</td>
</tr>
<tr>
<td>log L</td>
<td>-0.9306</td>
<td>-5.762065*</td>
</tr>
<tr>
<td>log M</td>
<td>-1.2952</td>
<td>-6.980451*</td>
</tr>
</tbody>
</table>

*denotes statistically significant at 5% critical level

### Table 2

**Johansen Cointegration Test**

<table>
<thead>
<tr>
<th>r</th>
<th>Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>r = 0</td>
<td>0.476201*</td>
<td>69.83674*</td>
</tr>
<tr>
<td>r &lt; 1</td>
<td>0.309454*</td>
<td>31.68455*</td>
</tr>
<tr>
<td>r &lt; 2</td>
<td>0.151906</td>
<td>9.838499</td>
</tr>
<tr>
<td>r &lt; 3</td>
<td>0.001988</td>
<td>0.117421</td>
</tr>
</tbody>
</table>

*denotes rejection of the hypothesis at the 5% level

### Table 3

**Error Correction Model**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.004112</td>
<td>-0.476351</td>
<td>0.6357</td>
</tr>
<tr>
<td>D(LEMP)</td>
<td>0.280528</td>
<td>1.837836</td>
<td>0.0714</td>
</tr>
<tr>
<td>D(LK)</td>
<td>1.001126</td>
<td>3.08576</td>
<td>0.0032</td>
</tr>
<tr>
<td>D(LM)</td>
<td>-0.002701</td>
<td>-0.235592</td>
<td>0.8146</td>
</tr>
<tr>
<td>ER(-1)</td>
<td>-0.18259</td>
<td>-2.372816</td>
<td>0.0211</td>
</tr>
</tbody>
</table>
IV. Results

As shown above, since the null hypothesis of no cointegration is rejected equation 4 is changed into an error correction model and estimated. The estimated result of this error correction model is as follows:

\[
\Delta \log Y = -0.04c + 0.28\Delta \log L + 1.001\Delta \log K - 0.003\Delta \log M - 0.18EC \\
(10)
\]

\[
\begin{align*}
  -0.48 & \quad (1.84) * \\
  3.09 & \quad ** \\
  -0.24 & \quad (-2.37) **
\end{align*}
\]

*, ** denotes significant at 5% and 10% respectively

In equation (10) E is the error correction term which is nothing but the lagged values of the estimated error term from equation (3). The F-statistics is significant suggesting that overall estimation of the model is statistically significant. The D.W. value suggests that it is not suffering from any problem of autocorrelations. The coefficients of both labor (L) and capital (K) have appropriate signs as expected. The sign of L is statistically significant and suggests that a one percent change in employment of labor (L) will lead to a 0.28 percent growth in total output in the country. Similarly the coefficient of capital (K) is also statistically significant. The coefficient suggests that there is a one to one relationship between the capital growth and output growth in the U.S. Our variable of interest in this model is immigration (M). The coefficient of immigration carries a negative sign, but it is statistically not significant from zero. This suggests that immigration has neither positive nor negative effect on output growth in the US at least for this sample period.
V. Conclusions

This paper estimates the effect of immigration on real GDP in the United States of America. An aggregate production function model is developed in which total capital, labor, and immigration are variables to explain real GDP which is the dependent variable. Annual time series data from 1950 to 2013 is used. Before estimating the model the time series properties of the data are diagnosed and an error correction model is developed and estimated. The findings suggest that labor and capital have a significant effect on output growth. Immigration has neither positive nor negative effect on growth of real GDP.
References


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