Do "Immigrants Increase the Unemployment of US Citizens?" An Empirical Examination of Trump's Campaign Rhetoric

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Abstract: I analyze the relationship between immigration and the US economy, specifically, the effects on levels of GDP and unemployment. Employing data that spans the time period 1870 to 2015, and using estimation results from a Vector Error Correction Model (VECM) Granger causality/Block exogeneity Wald test (Enders, 2003), I find a long run equilibrium relationship between GDP, unemployment, and immigration inflows that can be specifically described as a bidirectional causality between GDP and immigration, and a unidirectional causality running from immigration to unemployment. Examination of the response of changes in GDP and unemployment levels to a onetime Cholesky innovations (shocks) in immigration, I observe a rise in GDP and a fall in unemployment level. While these observations are relevant for policy making, especially given the current effort to limit legal immigration to the US, I have yet to validate these observations by accounting for the breakdown of the immigrant population into broad geographic regions of their countries of origins, and skill levels, my conclusions should be considered preliminary.

Key Words: Immigration, GDP, Unemployment, Granger Causality
JEL: F22, J64, E66

I. Introduction

Immigration has been the fabric and foundation of the US since the very beginnings of the country. The literature on the effects of immigrants on social values, culture, productivity, international trade flows, and innovation is extensive (See for example, White, 2010; Tadesse and White, 2010; Card, 2009). Despite the voluminous literature, the exact effect of immigrants on economic conditions, especially output and unemployment levels, however, is not clear cut. In recent years, immigration has received much interest from public policy makers and the public regarding those very effects on unemployment and GDP. Consequently, the socio-political debate about the importance of immigration in the US has reached at a cross roads where the heated debates surrounding immigration tends to ignore factual observations. Therefore, immigration and its effects on the economy have also piqued the interests of many economic researchers. Immigration has been on the forefront of discussion for more than just a few decades.

As globalization and the interconnectedness of countries rise, migration becomes a more feasible option for individuals. With the American context, it is necessary that we examine precisely how these increasingly migrating individuals can affect the lives of the natives, because immigration policy debates stem from this area. There has been raging debate on the immigration policies in the US based on morality, societal outcomes, and the potential effects on the economy. Similar discussions are prevalent throughout the world. Hence, a large immigration literature has focused on the effects of immigration on host countries' labor markets in regards to wages, unemployment, and welfare programs. All aspects of the immigration debate are worth research, but the focus of the paper at hand will be on the more salient side of the debate: the US economy. Recent US history has been colored by two more noticeable waves of immigration: the first of which began around the mid-1800s and petered off around the start of the 1900s with almost nine

million legal immigrants, and the second wave began in the 1950s and has not really ended yet (Chojnicki, et al, 2009).

To begin wading through the tangle of studies on this lively subject, one must understand that there exists a puzzling array of publications that permeate the literature surrounding the effects of immigration on different aspects of the economy. The corpus of scholarly research often begins with testing the common conceptions surrounding immigration, to examine their validity in the realm of reality. There are some who find the idea of loosening our borders to be an unpalatable option for a variety of reasons. The more basic of which include racism, fear of the unknown, or distaste for change. Certain groups believe that immigration could be the impetus to the downfall of our economy because of its effects on wages, unemployment, and output. Placing significant emphasis on rhetoric, opponents of immigration have recently started to incorporate their widely held views into policy actions. Amid such perturbation toward immigration, it is key to examine the reality behind these anxieties, to examine the valid economic risks which we may truly face so that we are able to make informed policy decisions.

A recent Washington Post (January 31, 2017) article, for example, points out two complementary plans under consideration by the current US administration.[1] According to the report, the first plan aims at curtailing would-be immigrants who are likely to require public assistance, and — when possible — deport immigrants already living in the United States who depend on taxpayer help. In addition to tightly controlling who enters the country and who can enter the workforce, with the goal of reducing "the social services burden of immigrants on U.S. taxpayers", the second plan under consideration calls for a substantial shake-up of the system through which the US administers immigrant and nonimmigrant visas. If enacted, these plans are

[1] See the ***Washington Post*** (Democracy Dies in Darkness), Jan. 31, 2017 Issue "Trump administration circulates more draft immigration restrictions, focusing on protecting U.S. jobs."

expected to significantly restrict all types of immigration and foreign travel into the United States. Noting that the plans under consideration tend to be a direct result of the widely held view, among current administration circles, that " … as recipients of U.S. social services immigrants end up eating significant amounts of federal resources, and more importantly, contribute to the unemployment of U.S. citizens …", the article describes the plans as an attempt to fulfil a campaign promise of protecting U.S. workers by restricting the inflow of immigrants and temporary laborers into the U.S. workforce.

The main objective of this research is therefore, to empirically examine if there is a causality that runs from increased flow of immigrants to the performances of US GDP and unemployment levels (i.e., whether increased immigration flow to the US contributes to the fall or the rise of the US GDP and the number of unemployed people). In addition to its relevance for providing a timely and relevant answer to the highly contested political, social, and economic implications of immigrants, the findings from this research would accord policy makers and individuals on either side of the debate the opportunity to make most informed decisions. Using data spanning the period 1870 to 2015 (146 years' worth of data), and employing a vector error correction based Granger causality/Block exogeneity Wald test, I find the following: (i) presence of long run equilibrium relationship between GDP, unemployment, and immigration inflows; (ii) a bidirectional causality between GDP and immigration, and (iii) a unidirectional causality running from immigration to unemployment. Examination of the response of changes in GDP and unemployment levels to onetime innovations (shocks) in immigration inflows, I observe a rise in GDP and a fall in the unemployment level. These results are, however, preliminary.

The remainder of the paper is structured as follows. Section II presents a brief review of the related literature. Section III presents some facts about data on GDP, unemployment, and immigration and provides descriptive statistics. It also introduces the econometric methodology and variables. Section IV presents the econometric results (tests for non-stationarity of the variables, VAR and VEC frameworks used in the analysis). Finally, in section V, I summarize the main conclusion of the paper and propose suggestions for future research.

II. A Review of Related Literature

One argument against immigration is the common complaint that immigrants coming into the United States are less educated than natives. This is causing fears regarding our 'limits to growth' and fears of allowing the flow of immigrants from less developed nations (Islam 2007). Following that, many believe that these immigrants, thus, pose a risk to low-skilled native workers in the way of wages and employment levels, and that these will then increase the level of inequality (Chojnicki, et al, 2009). Other claims include native behavioral changes due to immigration, including impacts on taxation, interest rates, and wages which alter the choices of natives regarding labor supply, human capital investment, and savings. Citing risks such as slow job growth, stagnant wages, and shrinking incomes of less-skilled native workers (Enchautegui, 1995), some critics also argue that the US economy cannot absorb immigrants as it used to be able to in the past. Others believe that immigrants steal jobs from native-born workers, and that they put pressure on government spending. Presenting these arguments as a rational, therefore, opponents of immigration stress that immigrants create higher unemployment (Islam, 2007).

Another concern from critics is that with the flood of workers in certain markets, the wages of natives will be driven down because there will be more supply than demand for work, and the price of the work will drop. If these workers are perfect substitutes, they may directly compete for

the same jobs, and increasing the labor supply will reduce the price of the labor (wages). It is incorrect to believe that there is a fixed number of jobs in the economy (Islam, 2007). Immigrants could very well be compliments to our own native work force and thus combining the two would create a more productive society with innovation and technology creation. Ortega and Peri (2013) show in their empirical findings that countries could benefit from having a diverse immigrant population because that raises the variety of abilities, skills, and ideas which are necessary to increase labor productivity in the long-run.

Borjas (2005) claims their evidence indicates a sizable adverse effect of immigration on the wages of competing workers at the national level. Borjas also explains that analyzing wage differentials across regional labor markets actually hides much of that impact from immigration. Islam and Khan (2015) also found a long-run adverse effect on average weekly earnings caused by immigration. Further than those generalized findings, Borjas' (2003) data revealed in his study that given a 10 percent increase in supply (supply shock), will reduce people's weekly earnings by roughly 4 percent, while that same 10 percent supply shock has more damage in the long run: a reduction in annual earnings by 6.4 percent. While many arguments focus on the risks to low-skilled, or non-college educated individuals regarding employment and wages, there also exist risks for highly educated natives, otherwise called high skilled natives. Borjas (2014) studied these risks and found that a 10 percent increase in the supply of doctorates in a particular field due to immigration increases, lowers the earnings of that cohort of doctoral recipients by 3 percent. This is a significant adverse effect for competing native workers.

The counterarguments are just as plentiful, and the argued benefits balance, outweigh, and even counteract the costs of immigration. Ortega and Peri (2013) find that a 1 percent increase in the share of immigration in the US population actually increases income per person by roughly 6

percent. Similarly, Peri, et al., (2015) looked at Science, Technology, Engineering, and Mathematics (STEM) workers across US cities and found that foreign STEM workers increased total factor productivity growth in those cities. Additionally, a 1 percent rise in STEM as a share of employment created a 4 percent rise in native college-educated individuals' wages and about 2.4 percent increase in wages for natives without college education. In fact, one study by Ottaviano, et al., (2010) implies that immigrants are not directly competing with natives for employment, while Cortes 2008 draws the conclusion that low-skilled immigrants and low-skilled natives are imperfect substitutes, meaning they wouldn't compete directly for the same jobs. To further this line of thinking, Peri and Sparber (2009) show that immigrants tend to have a comparative advantage in manual-intensive tasks, whereas natives have an advantage in communication-intensive tasks. When immigrants come in, natives are forced to use their communication and language skills to get better jobs, because the immigrants take some of the available manual-intensive jobs. In this way, Peri and Sparber (2009) argue that immigrants actually increase the wages of the locals.

Looking beyond the immediate effects on the native individuals such as wage rates and unemployment levels, researchers have begun to analyze another relevant aspect of the economy: the potential effects of immigration on bilateral trade. One such study explains that immigration has positive effects on Spain's economy. The authors cite two possible effects that immigrants can have on host country economies, which the literature often suggests. First, that immigrants tend to have a preference for their home country's products, which could increase imports; and second, that immigrants could reduce the transaction costs that come with trade between countries. In their case study of Spanish exports and imports, the authors find that immigrants have positive effects on bilateral trade of consumer goods (Blanes-Cristobal and Vicente, 2008). To this end, using an

augmented gravity equation model, they find that a 10 percent increase in immigrant stock contributes to between 2.8 to 3.8 percent increase in Spanish exports and 1.8 to 2.6 percent increase in Spanish imports. Their research suggests that immigrants reduce trade transaction costs by way of increasing host country knowledge about their home countries. However, they find that it was immigrants with a medium level of education who have those positive effects because without that level, they cannot exploit their personal contacts or their greater knowledge of their home social institutions. This potentially means that a portion of the United States' immigrant inflow may not be beneficial for trade because they have lower levels of education. Girma and Yu (2002) using UK data, indicate that immigrants' knowledge of foreign markets and social institutions rather than their business or personal connections and contacts with their home country, influence bilateral trade flows positively.

Education clearly plays a role in how immigrants may impact their host economies. It is highly worth research, considering the United States can, in general, decide what types of people it will allow to immigrate. Common questions are: Could the low skilled, or low educated immigrants fill the jobs that the average US native will not take? Would highly educated and skilled immigrants be a threat to our individuals of similar caliber, or would they work in tandem to create a more productive society? Franzonie, et al., (2013) tackle some of those inquiries. Their study looked at migrant scientists as compared to native scientists in the US. They find that migrant scientists outperform domestic scientists, and their models show that migration enhances the performance of scientists. Part of their findings could have been due to mobility enhancing productivity because of specialization. Their results also match the idea from the knowledge recombination theory, which presents that when scientists are surrounded by likeminded individuals, they can be more effective and productive. The authors argue that their findings had

important implications for policy makers: facilitating the brain exchange across countries would be a worthwhile investment, and that making the immigration process easier for high-skilled human capital would be a good place to start.

There is one challenge of the modern era that some have not even considered: declining population growth rates, meaning that the native populace is not replacing itself at an increasing rate. Islam and Khan (2015) explain how many developed nations are facing new and unexpected challenges of low or even *negative* population growth. For these countries, they are suffering from labor shortages, but a viable potential remedy is managing their immigration policy. With native labor shortages, the obvious solution for the demand-supply gap is encouraging foreign individuals with high levels of experience and education to come into the host nation to live and work. In the American context, with the US population growth rate slowing down so much, we risk eventually hitting negative population growth which would be detrimental for the economy. Our solution could be immigrants; they could provide entrepreneurial skill and productivity to our economy.

Immigration could be a threat to individuals by altering wages and unemployment levels, but they also offer a benefit to businesses because they expand the size of the market and they increase demand for goods and services (Islam and Khan, 2015). If the competition that immigrants create in the labor market does end up lowering wages for individuals, they could make the cost of production lower for firms, which in turn would lower prices that consumers pay for the goods and services being produced. Thus, both firms and consumers could gain from immigration, in the way of lower wages. Analyzing the true benefits of immigration, and precisely who is affected and in how many different ways they are affected is clearly an important subject to study. Like trade, there will be those who gain and those who lose, but if the size of the pie becomes larger, than the overall gains are positive (Islam and Khan, 2015).

Chojnicki, et al. (2009) show that, according to their models, US immigration after WWII has been beneficial for all native cohorts and skill groups. Specifically, they compared the current organization and success levels with models that had zero immigration, and the US is better off with immigrants. However, they also argue that the US would have been even better off if it had a stronger selection of immigrants. Again, this leads back to education, experience, and skill level being an important characteristic to review when deciding which immigrants of the many can enter our borders. Chojnicki, et al. (2009) argue that despite the average education level of US immigrants deteriorating, they have significantly contributed to the American dream.

Other studies have come to results which are less straightforward. Cortes (2008) believes that immigrants' economic effects could be a redistribution of wealth. Whether or not that is socially or morally good can be left up to policy makers or other social scientists. Borjas (2005) found that a native response to immigration was a decline in the growth of the native workforce because native internal migration decisions are sensitive to increases in labor supply caused by immigration. Simply put, fewer people wanted to live in places of noticeable foreign immigration. Numerically, Borjas (2005) finds that for every ten immigrants who entered a particular state, two fewer natives chose to live there. The actual causes of people's aversion to living and working in those areas could be wages dropping because of a flooded labor market, too high of competition for jobs, or because some individuals have a tendency for xenophobia. Humans are not always rational creatures, so racism and aversions to other cultures cannot be ruled out here; further studies are needed in that subject area to determine the root causes of internal native migration.

Summing up, theoretical studies (Johnson, 1980; Grossman, 1982) on the impact of immigration on labor market in host countries show that the effects of immigrants on the employment of residents depend on whether immigrants and natives are substitutes or

complements in production. Generally, the empirical studies on the impact of immigration on labor markets in host countries conclude that migration flows do not reduce the labor market prospects of natives (Simon et al., 1993; Pischke and Velling, 1997; Dustmann et al., 2005). It is also clear that results from the body of literature on the topic are not clear cut. The take away is that there is no simple answer to the question of the effects of immigrants on the economy as a whole. Several authors of the aforementioned studies caution in their concluding remarks to interpret their results carefully and within context. For example, a study of the US may not find results that are applicable to the European scene. The answers are complex, as are the questions, whether policy makers acknowledge it or not. There are numerous factors that influence immigration, its effects, and the economy separately. To complicate matters, immigrants are not all the same, they are human and as such, their many individual traits will change how they influence the area they migrate to, including their education, job experience, the languages they speak, and more. Further, the economy is not just a massive bundle. Each piece of the economy could suffer or gain in different ways from immigration. Research on this subject must be very pointed to answer the specific question at hand.

III. Econometric Methodology, Data, and Variables

3.1. Variables and Data

Answering the research question requires historical data on immigration, and measures of economic performances, specifically corresponding historical figures on Gross Domestic Product (GDP) and unemployment. As indicated at the outset, there exist extensive literature examining effects of immigration on native wages, employment, labor demand and supply, productivity, native education levels, and values of cultural diversity. I use annual data on immigration inflow (IMM), Gross domestic product (GDP), and number of unemployed persons (UNEP) in the USA,

over the period 1870-2015, which provides me with 146 years of data to analyze. My data on immigration is from the US department of homeland security. Data on unemployed persons is from the US Bureau of labor and statistics (BLS). I use unemployed persons, instead of unemployment rate, because the latter accounts for changes in unemployment at individual levels.[2] My data on the US GDP is from the World Bank (2016). The GDP data is in 2011 purchasing power parity prices.

Table-1 present's average annual values of the corresponding variables for every decade starting in 1870. The figures in the table indicate that the US GDP, which was on average around $186 Billion in the 1870s has steadily increased every decade reaching $15.9 trillion after 2010. To provide a better perspective of the size, using corresponding population figures, I find that these figures amount to an increase in per capita income from $4,154 in the 1870s to $50, 323 for a typical year in the latest decade. Examining the annual values of the number of unemployed persons during the corresponding decades, I also observe a steady rise, with the exception of a sudden rise in the1930s compared to the 1920s, from a little over 800,000 persons per year in the years during 1870s to 11,741,430 unemployed persons in years after 2010. With the exception of the years during the 1930s and 1940s, where I find a significant dip, I also find a steady increase in the number of legal immigrant inflows to the US, up from an average of 247,213 during the 1870s, to reaching just over a million people during the typical year in the most recent decade.

Taking into account the anomaly (the dip in the inflow of immigrants, a rise in the number of unemployed persons, and the fall in GDP levels) in the data from 1930 to 1949, most likely associated with the aftermath of the great depression, in order to obtain a better understanding of the behavior of economic conditions and the inflows of immigrants, a preliminary descriptive

[2] Also, opponents of current US immigration practices, including the presidential campaign rhetoric, often address the issue down at individual US citizen level, instead of rates of unemployed people.

Table-1: Average Annual Values of Immigration and Economic Conditions in USA by Decades (1870-2015)

Decades	GDP (PPP, 2011 Prices, Millions)	Per capita Income (PPP, 2011 Prices)	Unemployed Persons (in 000)	Number of Immigrants
1870-1879	186,332.60	4,154.06	818.40	274,213.70
	(21101.11)	(200.2832)	(320.7468)	(118461.5)
1880-1889	297,666.80	5,288.49	823.50	524,856.80
	(25051.27)	(110.2639)	(154.888)	(134461.3)
1890-1899	401,269.00	5,785.75	1,598.60	369,429.40
	(44820.4)	(357.3703)	(503.1567)	(131290.2)
1900-1909	620,421.70	7,443.32	1,412.10	820,238.80
	(75120.06)	(525.6234)	(598.6749)	(263106.3)
1910-1919	835,348.80	8,413.28	1,956.80	634,738.00
	(80064.85)	(526.6664)	(935.1992)	(442904.3)
1920-1929	1,141,003.00	9,926.19	2,045.30	429,551.00
	(147269.7)	(856.5833)	(1171.941)	(188981.2)
1930-1939	1,175,056.00	9,251.66	9,580.00	69,937.50
	(147308.7)	(1049.926)	(2478.028)	(65126.52)
1940-1949	2,170,233.00	15,206.10	2,951.40	85,660.80
	(384690.7)	(2611.187)	(2315.862)	(63281.98)
1950-1959	2,790,100.00	16,404.27	2,939.50	249,926.80
	(262989)	(781.3746)	(884.9309)	(48984.11)
1960-1969	4,042,300.00	20,376.35	3,519.80	321,374.90
	(592782.8)	(2263.105)	(646.8999)	(57232.94)
1970-1979	5,774,867.00	26,418.49	5,817.70	424,820.30
	(604697)	(2052.298)	(1318.568)	(70901.07)
1980-1989	7,755,235.00	32,283.07	8,304.70	624,437.90
	(861580.6)	(2661.033)	(1432.189)	(167684.6)
1990-1999	10,500,000.00	39,574.87	7,569.30	977,539.80
	(1117066)	(2833.991)	(1209.246)	(392494.7)
2000-2009	14,200,000.00	48,216.21	8,265.30	1,029,943.00
	(882013.5)	(1837.183)	(2332.003)	(159887.6)
2010-2015	15,900,000.00	50,303.37	11,741.83	1,032,400.00
	(613787.3)	(1239.032)	(2473.001)	(25823.23)
1870-2015	4,211,688.00	19,104.39	4,427.91	510,692.40
	(4814165)	(14762.54)	(3592.335)	(358499.5)
No. of Observations	146	146	146	146

Standard Deviations in parentheses

analysis of the data is first carried out. Table-2 presents the corresponding descriptive statistics of the three variables and their pairwise correlation. Results presented in the upper portion of the table indicates that, during the time period covered in my study (1870-2015), the average annual inflows of immigrants stand at 510, 692. The corresponding average annual values of GDP and unemployed persons are found to be $4.2. Trillion and 4.4 million. Comparing the pre-1930 and the post-1950 average annual values of the respective variables against the averages during for the entire period covered, I find that the GDP and unemployment figures before 1930 are significantly lower, while the corresponding annual averages values of GDP and unemployment levels are significantly higher.

However, only minor differences exist in the average annual immigration inflows before 1930 and after 1950 when compared to the averages for the entire time period. Further examination of the distributions of the corresponding variables using the Jarque-Bera test, indicates that, with the exception of unemployment after 1950, all variables are not normally distributed, typically with longer tails on the right.

Finally, a cursory review of the pair-wise correlation among the respective variables show that there exists strong positive correlation among all variables, implying not only a rise in GDP and unemployment levels as the inflow of immigrants rises, but also a positive association between levels of GDP and unemployment levels. With immigration and GDP being correlated, this probably contradicts what President Trump is saying. However, high unemployment is also positively correlated with unemployment, which could be what he is referring to. Also, GDP and unemployment being positively correlated is quite unusual. Given that correlation doesn't imply causation, I now turn to discussion of the econometric methodology that enables me to examine the nature of the relationships among the variables.

Table-2: Descriptive Statistics of the Variables

	1870 - 2015			1870 - 1929			1951 - 2015		
	GDP (Millions, In 2011 PPP Prices)	UNEP (in 1000)	IMMG	GDP (Millions, In 2011 PPP Prices)	UNEP (in 1000)	IMMG	GDP (Millions, In 2011 PPP Prices)	UNEP (in 1000)	IMMG
Mean	4,211,688	4,427.91	510,692.40	590,997	1,489.95	504,458.60	8,282,321	6,585.06	643,558
Median	2,074,701	2,925	401,660.50	500,447	1,205	439,730	7,003,324	6,770	559,100.50
Maximum	16,784,705	14,825	1,826,595	1,350,544	4,918	1,285,349	16,784,705	14,825	1,826,595
Minimum	157,539.40	437	23,068	157,539.40	437	110,618	2,331,553	1,834	170,434
Std. Dev.	4,814,165	3,592.34	358,499.50	347,106.50	907.33	293,335.60	4,529,382	3,031.62	362,775.90
Skewness	1.23	0.85	0.87	0.58	1.59	0.97	0.41	0.59	0.84
Kurtosis	3.25	2.76	3.38	2.16	6.07	3.16	1.81	3.13	3.26
Jarque-Bera	37.35	17.91	19.4	5.15	49.59	9.66	5.73	3.93	7.91
Probability	0	0	0	0.08	0	0.01	0.06	0.14	0.02
Pairwise Correlation (Pearson)									
GDP	1			1			1		
UNEP	0.711**	1		0.481**	1		0.762***	1	
IMMG	0.588***	0.285**	1	0.105*	0.129**	1	0.827***	0.681**	1
No. of Years	146	146	146	61	61	61	66	66	66

***, **, and * indicate statistical significance at *p< 0.01, p<0.05* and *p<0.10*, respectively.

3.2.Econometric Model

The standard Granger causality test (Granger, 1988) seeks to determine whether past values of a variable help predict future changes in the values of another variable. In the context of my study, examining the relationship between GDP, Unemployment and inflows of immigration in the US, the Granger method involves estimation of the following system of equations:

$$GDP_t = \beta_0 + \sum_{i=1}^{i=p} \beta_{1i}\, GDP_{t-i} \; + \sum_{i=1}^{i=p} \beta_{2i}\, UNE_{t-i} \; + \sum_{i=1}^{i=p} \beta_{3i}\, IMM_{t-i} \; + \; \epsilon_{1t} \qquad (1)$$

$$UNE_t = \varphi_0 + \sum_{i=1}^{i=q} \varphi_{1i}\, UNE_{t-i} + \sum_{i=1}^{i=q} \varphi_{2i}\, GDP_{t-i} + \sum_{i=1}^{i=q} \varphi_{3i}\, IMM_{t-i} \; + \epsilon_{2t} \qquad (2)$$

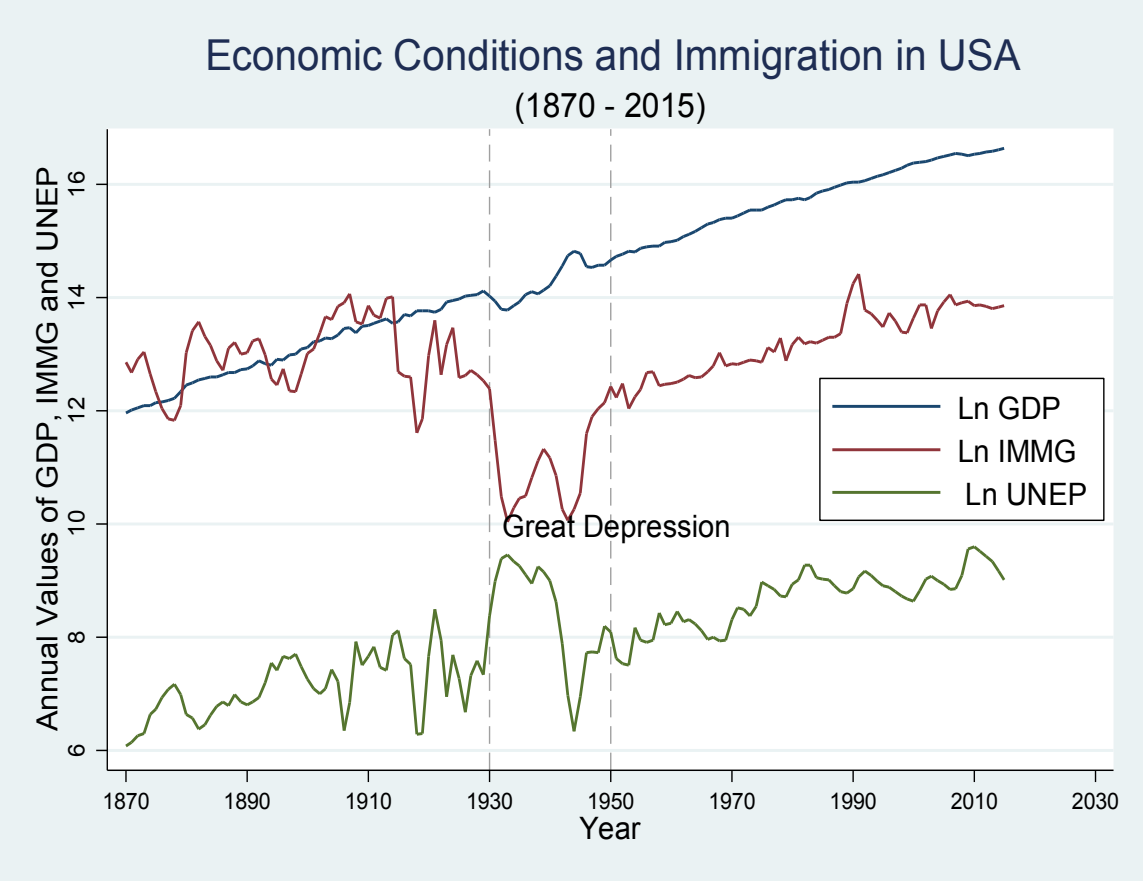
$$IMM_t = \gamma_0 + \sum_{i=1}^{i=r} \gamma_{1i}\, IMM_{t-i} \; + \sum_{i=1}^{i=r} \gamma_{2i}\, GDP_{t-i} \; + \sum_{i=1}^{i=r} \gamma_{3i}\, UNE_{t-i} \; + \epsilon_{3t} \qquad (3)$$

where, GDP_t, UNE_t and IMM_t represent log values of gross domestic product, the number of unemployed persons, and immigrant inflows, respectively during a given year, *t*, with i=0, 1, 2, … p, or q, or r, denoting the number of lags of the respective variables included in each equation, and ϵ_{1t}, ϵ_{1t} and ϵ_{1t} are uncorrelated stationary random processes. Failing to reject *H*0: $\beta_{31} = \beta_{32} = ... = \beta_{3p} = 0$ or *H*0: $\varphi_{31} = \varphi_{32} = ... = \varphi_{3q} = 0$ implies that immigration do not Granger cause either GDP levels or unemployment.

Empirical works based on time series data assume that the underlying time series is stationary. However, many studies have shown that the majority of time series variables are nonstationary or integrated of order 1 (Engle and Granger, 1987). Fig.1 presents a scatter diagram of the log values of the respective variables. I used log values to minimize heteroskedasticity. Corroborating my observations both from the pair wise correlation coefficients, and the decennial annual averages (Table-1), the patterns in the movements of the variables show that not only have the variables been steadily rising from 1870 to 2015, with a break between 1930 and 1950, but that

they also appear to have a stochastic trend. Simply, this means that all the variables rising at roughly the same times could give us a spurious impression, because two variables could appear to be related, but actually due to the trend and not because they are truly related. As trending series are usually nonstationary, the use of these variables in examination of their effects on another variable, or their relationships with one another, as in my study, requires stabilizing and/or transforming them. [3]

Fig. 1.1: Economic Conditions and Immigration Patters in the U.S.A. (1870-2015)



[3] Empirical works based on time series data assume that the underlying time series is stationary. A process is said to be stationary, if its mean, variance, and covariance do not change over time (Stadnitski, 2010). If that is not the case, I deal with a nonstationary process. If the goal of analysis consists of measuring the effects of an intervention, as in an interrupted time-series experiment, or in forecasting future values of the series, stationarity (i.e., stability) of the data under consideration is required.

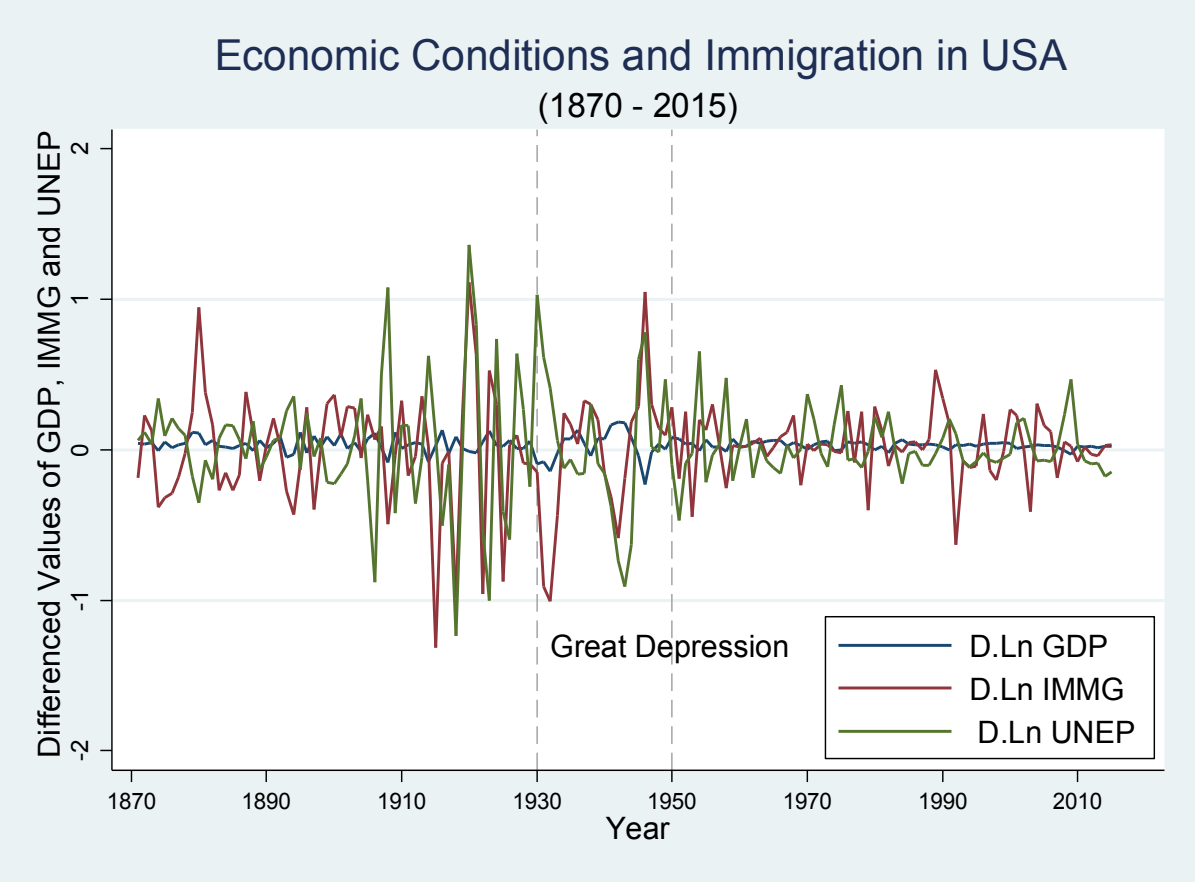
Thus, I examine the time series properties of the data using three different approaches: the traditional augmented Dickey–Fuller (ADF) test; the Dickey-Fuller generalized least squares (ADF-GLS) test, and the Phillips and Perron (PP) tests. While the PP tests are more efficient in the presence of a one–time structural break in the data (as in my case), the ADF-GLS approach has a substantially improved power than the traditional ADF tests, when an unknown mean or trend is present (Elliott et al., 1996). Table 3 presents results from the corresponding tests. For all variables, the null hypothesis of a unit root (non-stationarity) in the log transformed values are examined under two conditions: with intercept only, and with intercept and trend. In the instance where I fail to reject the null hypothesis from the intercept only estimation, I proceed to assessing whether there is a deterministic trend. Finally, by differencing the respective variables and conducting the same battery of tests, I assess if the transformed values of the variables are stationary and hence, their respective order integration. With a few exceptions, specifically when using the traditional ADF test and examining the hypothesis under the assumption of intercepts and a deterministic time trend, in seven of the nine cases presented in the upper portion of the table, when using the ADF-GLS and PP tests overwhelmingly fail to reject the null hypothesis of a unit root in the variables (the absolute values of the test-statistics are less than their critical values). These results clearly suggest that each of the variables is integrated of first order, I (1).

Given that my battery of tests indicates the variables are non-stationary, taking the first difference of the respective variables, I again assess if the differenced values of the variables are stationary. The bottom part of Table-3 presets results from the application of the tests on the differenced series, and figure 2 depicts the patterns of the differenced series. While results from all tests reject the presence of a unit root in the differenced series, the scatter plot of the respective series (Fig. 3) clearly depict that the differenced series are stationary, with a mean of zero.

Table-3: Non-Stationarity Test Results (Null Hypothesis: the given variable is non-stationary (i.e., has a unit root))

Variables	ADF Test			ADF-GLS Test			Philips -Perron Test	
	SIC Lag	t-Stat	Critical Value (5%)	SIC Lag	t-Stat	Critical Value (5%)	t-Stat	Critical Value (5%)
Log Levels								
ln(GDP)								
a) Intercept only	1	-0.937	-2.882	1	2.775	-1.943	-1.173	-2.881
b) Intercept and trend	1	-4.084***	-3.441	1	-2.493	-2.986	-3.281	-3.441
ln(UEP)								
a) Intercept only	2	-0.604	-1.943	2	-0.604	-1.943	-2.503	-2.881
b) Intercept and trend	3	-4.776***	-3.442	3	-2.114	-2.988	-3.511	-3.441
ln(IMG)								
a) Intercept only	0	-2.037	-2.881	0	-2.058	-2.581	-2.249	-2.881
b) Intercept and trend	0	-2.231	-3.441	0	-2.169	-2.985	-2.439	-3.441
First Difference								
D.ln(GDP)								
a) Intercept only	0	-9.178***	-2.882	0	-9.013***	-1.943	-9.028***	-2.882
b) Intercept and trend	0	-9.182***	-3.441	0	-9.234***	-2.986	-9.185***	-3.441
D.ln(UEP)								
a) Intercept only	1	-10.908***	-2.882	1	-10.857***	-1.943	-10.707***	-2.882
b) Intercept and trend	1	-10.879***	-3.442	1	-10.903	-2.987	-10.666***	-3.441
D.ln(IMG)								
a) Intercept only	1	-7.661***	-2.882	0	-8.865***	-1.943	-9.928***	-2.882
b) Intercept and trend	4	-7.648***	-3.442	0	-9.744***	-2.986	-9.899***	-3.441

Fig. 2: Economic Conditions and Immigration Patterns in the U.S.A. (1870-2015)



Once I established that the variables are *I (1),* my next step is to test for the existence of any co-integrating relationship among the variables. I employ the Johansen co-integration test, which uses the likelihood ratio tests involving the *Trace test* and the *Maximum Eigenvalue tes*t to evaluate the number of co-integration vectors (r). Equations (4) and (5) below, describe the specifications.

$$\lambda_{Max} = -\mathrm{T}(1 - \lambda_{r+1}) \quad \text{.....(4)}$$

$$\lambda_{Trace} = -\mathrm{T}\sum_{i=r+1}^{p} \ln(1 - \lambda_i) \quad \text{.....(5)}$$

Where ln is the logarithm; *T* is the sample size (number of years) and *i* is the eigenvalue. The trace statistics tests the null hypothesis of $r = 0$ (i.e. no co-integration) against the alternative that $r > 0$

(i.e. there is one or more co-integration vector). The maximum eigenvalue statistics test the null hypothesis that the number of co-integrating vectors is r against the specific alternative of *r* + 1 co-integrating vectors.[4] Subject to establishing a co-integration vector(s) among the variables, I estimate the vector error correction model (VECM) as follows:

$$\Delta GDP_t = \beta_0 + \sum_{i=1}^{i=p} \beta_{1i} \Delta GDP_{t-i} + \sum_{i=1}^{i=p} \beta_{2i} \Delta UNE_{t-i} + \sum_{i=1}^{i=p} \beta_{3i} \Delta IMM_{t-i} + \alpha_1 Z_{t-1} + \epsilon_{1t} \quad (6)$$

$$\Delta UNE_t = \varphi_0 + \sum_{i=1}^{i=q} \varphi_{1i} \Delta UNE_{t-i} + \sum_{i=1}^{i=q} \varphi_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{i=q} \varphi_{3i} \Delta IMM_{t-i} + \lambda_1 Z_{t-1} + \epsilon_{2t} \quad (7)$$

$$\Delta IMM_t = \gamma_0 + \sum_{i=1}^{i=r} \gamma_{1i} \Delta IMM_{t-i} + \sum_{i=1}^{i=r} \gamma_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{i=r} \gamma_{3i} \Delta UNE_{t-i} + \phi_1 Z_{t-1} + \epsilon_{3t} \quad (8)$$

Where, Z_{t-1} is the Error Correction term obtained from the long run co-integrating relationship among the three variables included in the system. The above VECM specifications imply two possible sources of causality among the variables: lagged dynamic repressors and lagged co-integrating vector. Given the estimates of the respective parameters, I can say that immigration Granger causes GDP if the joint test of the null hypothesis $\sum_{i=1}^{i=p} \beta_{3i} = 0$ or $\alpha_1 = 0$ (Eq. (6)) is rejected. Similarly, I conclude that immigration Granger causes unemployment if I reject the null hypothesis of $\sum_{i=1}^{i=p} \varphi_{3i} = 0$ or $\lambda_1 = 0$ (Eq. (7)). Rejection of $\sum_{i=1}^{i=r} \gamma_{2i} = 0$ or $\sum_{i=1}^{i=r} \gamma_{3i}$ and/or $\phi_1 = 0$ (Eq. (8)), similarly presents evidence for Granger causality running from GDP and/or employment to immigration.

[4] The null hypothesis, in the tests for co-integration, is that the log likelihood of the unconstrained model including the co-integrating equations is not significantly different from the log likelihood of the constrained model that does not include the co-integrating equations. It the two models are significantly different then I reject the null hypothesis and conclude that there is statistical evidence of co-integration amongst the variables. In other words, beginning with *r=0* (implying the null of no co-integration amongst the variables, vs r=1 (at least one), the test stops when it encounters the first null that is not rejected against the alterative.

IV. Empirical Results

Table 4 presents Trace and Maximum Eigenvalues based Johansen co-integration test results derived by setting a lag length 7 years that was selected based on information from a battery of tests including the LR (Sequential modified LR test statistic), AIC (Akaike Information Criteria), FPE (Final prediction error), SC (Schwarz Information Criterion) and HQIC (Hannan-Quinn Information Criterion).

Table-4: Johansen Co-Integration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized

No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (5%)	Prob.**
None *	0.185739	36.3345	29.79707	0.0077
At most 1*	0.035882	17.979052	15.49471	0.04677
At most 2	0.021053	2.936266	3.841466	0.0866

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized

No. of CE(s)	Eigenvalue	Max- Eigen Statistic	Critical Value (5%)	Prob.**
None *	0.185739	28.35544	21.13162	0.004
At most 1*	0.035882	18.042786	14.2646	0.0364
At most 2	0.021053	2.936266	3.841466	0.0866

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values

With calculated Trace test statistic value of 36.33, and a 95% critical value of 29.79, results presented in the first part of the Table-6 indicate the rejection of the null hypothesis of r = 0 against the alternative hypothesis of r =1, which states that there is one co-integrating relation. Similarly, for r = 1 vs r =2, as the trace test statistic of 17.97 is greater than its 95% critical value of 15.49, I reject the null hypothesis of only one versus at least two co-integrating vectors. However, with the

Table-5: Vector Error Correction Estimates (VECM) --Differenced Values)

Error Correction:	D(LOG(IMMG))	D(LOG(GDP))	D(LOG(UNEP))
CointEq1	-0.020769	0.004635	-0.0265
	-0.00749	-0.00119	-0.00728
	[-2.77285]	**[3.89484]**	**[-3.64241]**
D(LOG(IMMG(-1)))	0.146638	-0.009665	0.117032
	-0.08718	-0.01385	-0.08468
	[1.68204]	[-0.69772]	[1.48203]
D(LOG(IMMG(-2)))	-0.093665	0.005462	-0.190555
	-0.08517	-0.01353	-0.08273
	[-1.09978]	[0.40363]	**[-2.4815]**
D(LOG(IMMG(-3)))	-0.007881	0.009561	0.069045
	-0.08537	-0.01357	-0.08293
	[-0.09231]	[0.70480]	[0.83258]
D(LOG(IMMG(-4)))	-0.058431	0.011666	-0.05374
	-0.08616	-0.01369	-0.02369
	[-0.67820]	[0.85220]	**[-2.26421]**
D(LOG(IMMG(-5)))	-0.280847	0.002543	-0.142724
	-0.08704	-0.01383	-0.06454
	[-3.22676]	[0.18385]	**[-2.0818]**
D(LOG(IMMG(-6)))	-0.138716	0.018452	-0.115325
	-0.08882	-0.01411	-0.08628
	[-1.56173]	[1.30743]	[-1.33667]
D(LOG(GDP(-1)))	1.268786	0.175146	-0.09592
	-0.77931	-0.12383	-0.75698
	[1.62810]	[1.41446]	[-0.12671]
D(LOG(GDP(-2)))	-1.183836	0.224184	-2.427153
	-0.78691	-0.12503	-0.76437
	[-1.50441]	[1.79299]	[-3.17536]
D(LOG(GDP(-3)))	-0.969347	-0.006232	-1.120457
	-0.83035	-0.13193	-0.80656
	[-1.16740]	[-0.04724]	[-1.38918]
D(LOG(GDP(-4)))	0.657139	-0.269627	1.732497
	-0.82424	-0.13097	-0.80063
	[0.79726]	[-2.05877]	[2.16391]
D(LOG(GDP(-5)))	0.966822	-0.063423	-0.389925
	-0.81427	-0.12938	-0.79095
	[1.18734]	[-0.49020]	[-0.49299]

Table-5: Continued

Error Correction:	D(LOG(IMMG))	D(LOG(GDP))	D(LOG(UNEP))
CointEq1	-0.020769	0.004635	-0.0265
	-0.00749	-0.00119	-0.00728
	[-2.77285]	**[3.89484]**	**[-3.64241]**
D(LOG(GDP(-6)))	-1.237803	0.250066	-0.193581
	-0.82119	-0.13048	-0.79767
	[-1.50732]	[1.91651]	[-0.24268]
D(LOG(UNEP(-1)))	-0.060789	-0.035713	0.360375
	-0.14129	-0.02245	-0.13724
	[-0.43024]	[-1.59080]	[2.62581]
D(LOG(UNEP(-2)))	0.071905	0.000368	-0.375552
	-0.14326	-0.02276	-0.13916
	[0.50191]	[0.01616]	[-2.69873]
D(LOG(UNEP(-3)))	-0.116633	-0.007637	-0.019794
	-0.14847	-0.02359	-0.14421
	[-0.78558]	[-0.32372]	[-0.13725]
D(LOG(UNEP(-4)))	0.032886	-0.034831	0.198817
	-0.14439	-0.02294	-0.14025
	[0.22776]	[-1.51821]	[1.41755]
D(LOG(UNEP(-5)))	0.081758	-0.009429	0.007064
	-0.12743	-0.02025	-0.12378
	[0.64160]	[-0.46570]	[0.05707]
D(LOG(UNEP(-6)))	0.035685	0.008753	0.069939
	-0.12709	-0.02019	-0.12345
	[0.28079]	[0.43348]	[0.56655]
C	0.034702	0.024544	0.085089
	-0.07873	-0.01251	-0.07647
	[0.44078]	[1.96210]	[1.11267]
DD	-0.485427	-0.137996	0.943356
	-0.32129	-0.05105	-0.31208
	[-1.51089]	[-2.70317]	[3.02279]
Adj. R-squared	0.288337	0.252178	0.398334
S.E. equation	0.290629	0.046178	0.282303
F-statistic	3.795596	3.326791	5.568155
Log likelihood	-14.08569	241.6097	-10.04567
Akaike AIC	0.50483	-3.174241	0.4467
Schwarz SC	0.948168	-2.730903	0.890038

Standard errors in ( ) & t-Statistics in [ ] Sample (adjusted): 1876 -2015

trace test statistic of 2.93, which is lower than the 95% critical value of 3.84, I fail to reject the null hypothesis of two versus at least three co-integrating vectors. These observations suggest that there are two co-integrating relations. Results from the Maximum Eigenvalue test statistic also support the finding that there are two co-integrating equations among the variables.

Having established the presence of a long run relationship, I turn to addressing my empirical question: how are US economic conditions (GDP and unemployment levels) and the inflow of immigrants related? How do, for example, changes in the past values of immigration affect the present and future values of GDP and/or unemployment? To answer these questions, I estimate a system of equations described by my specifications 6-8 using the vector error correction model. Using results from the estimation, I employ the block exogeneity Wald test (Enders, 2003) and examine the presence and direction of causality among the variables.

Table-6: VEC Granger Causality/Block Exogeneity Wald Tests

Dependent variable: D(LOG(UNEP))			
Excluded	Chi-sq	df	Prob.
D(LOG(IMMG))	12.62538	5	**0.0272**
D(LOG(GDP))	19.57614	5	**0.0015**
All	38.89005	10	**0.000**

Dependent variable: D(LOG(GDP))			
Excluded			
D(LOG(IMMG))	11.231554	5	**0.0016**
D(LOG(UNEP))	7.495345	5	0.1863
All	13.41479	10	**0.0424**

Dependent variable: D(LOG(IMMG))			
Excluded	Chi-sq	df	Prob.
D(LOG(GDP))	7.486527	5	**0.0467**
D(LOG(UNEP))	1.194086	5	0.9454
All	12.76189	10	0.2373

Focusing the results of the block exogeneity Wald test results, presented in Table 6, which allow me to examine the Granger causality, starting with figures reported in the upper part of the table where unemployment is the dependent variable, the *F* statistic on linear restriction of the lagged values of immigration and GDP suggests the rejection of the null hypothesis that changes in unemployment levels are exogenous to changes in past values of immigration and GDP levels. The implication is that both immigration and GDP values, separately and jointly, Granger cause changes in unemployment levels. Similarly, using the specification where the changes in GDP levels are the dependent variable, I fail to reject the null hypothesis of exogeneity of changes in GDP levels with respect to changes in unemployment levels; however, the same is not true with regards to changes in the inflow of immigrants. Based on these results, I can infer that changes in immigration levels Granger causes changes in GDP levels. In the bottom portion of the table, I find evidence indicating that changes in GDP levels do Granger cause immigration levels. Summing up, based on my results, I can infer that while there is a feedback (bidirectional) causality between immigration and GDP levels, only a unidirectional causality running from immigration to unemployment levels exist.

Finally, although I observe a bidirectional causality between GDP and immigration, and a unidirectional causality running from immigration to unemployment levels, the results presented thus far do not inform us whether, for example, the impact of immigration on GDP and unemployment levels, or that of GDP on immigration levels is positive or negative. It is also unclear as to whether the impact of immigration on GDP is stronger when compared to its impact on unemployment levels. To answer these questions, I analyze the Orthogonalized impulse-response functions.

Fig-3: Impulse Response Function based on VECM

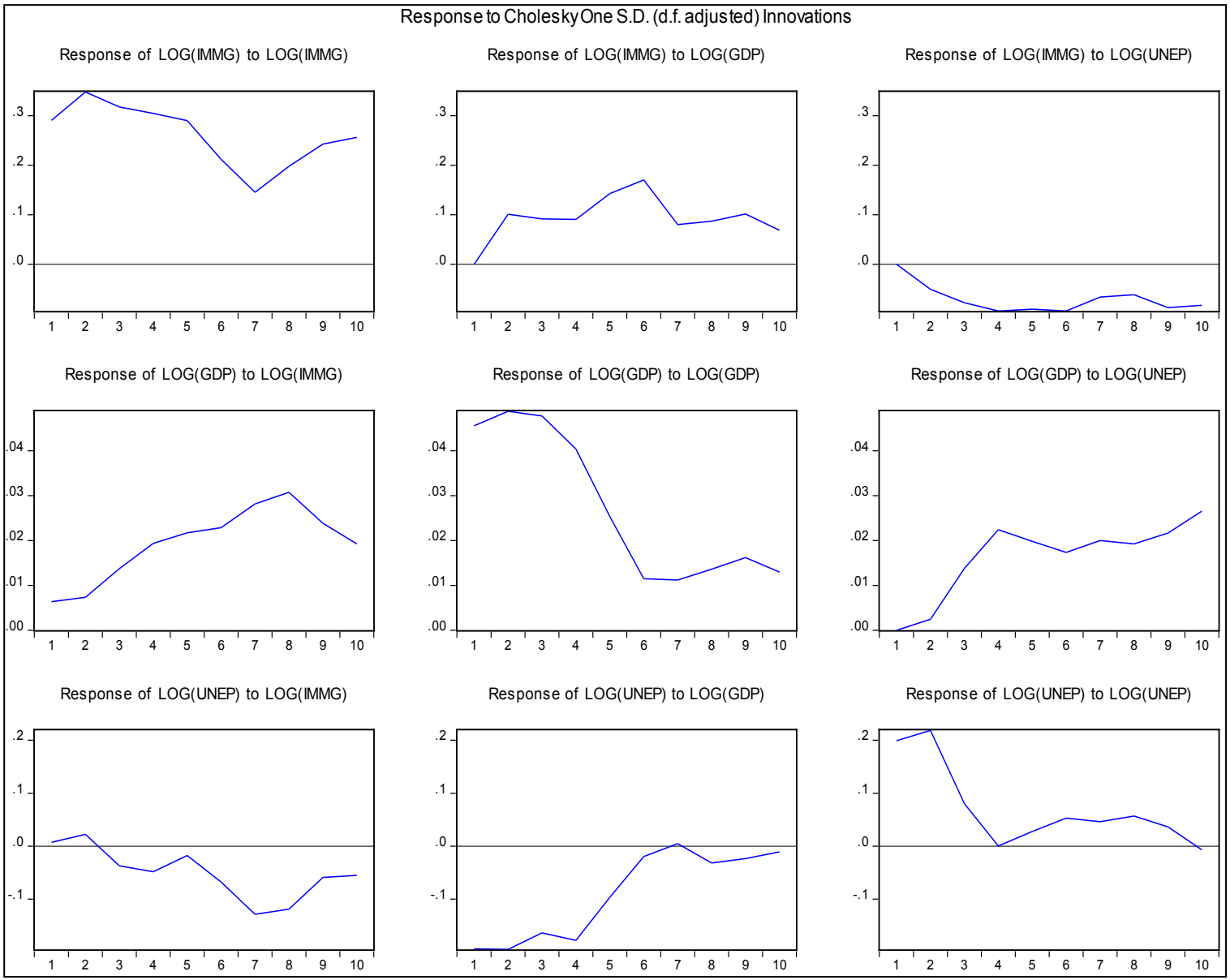


Fig. 3 exhibits a summary of the corresponding response functions. The graph includes 9 figures depicting the dynamic response of each of the target variables (immigration, GDP and unemployment levels (as I move from top left to right), respectively, to a Cholesky one-standard-deviation shock induced by itself, and the other two variables (in the order presented). In each case, the horizontal axis presents the 10 years over which the effect of a one-time shock (innovation) in the respective variable is examined, while the vertical axis measures the yearly response of each of the endogenous variables to a shock from the given variables. Given my observation from the block exogeneity/Granger causality test, in which I observed that changes in GDP and unemployment levels are not exogenous to changes in immigration levels, I focus on the figures presented in the second (Response of GDP to IMMG) and third (Response of UNEP to IMMG) rows of the first column representing a onetime shock in immigration levels.

For brevity, focusing only on the graph which exhibits the response of GDP to a Cholesky one standard deviation shock in IMMG, I observe that a onetime shock in immigration has a statistically significant long-run positive effect on GDP, which continuous to rise for seven years. Although the effect tempers after 7 years, it still remains above the pre-shock level further out. Similarly, referring to the graph (third row of the first column) which depicts the response of UNEP to a corresponding shock in immigration levels, I find that starting from an effect that is very negligible during the first two years (and not statistically significant), a onetime shock in immigration results in continuously declining level of unemployment eight years into the forecast horizon.

V. Concluding Remarks

Immigration has been the core of the foundation and functioning of the US and its economy. Despite the voluminous literature on the role of immigrants in our societies, the exact

effect of immigrants on economic conditions, especially output and unemployment levels, is not clear cut. As a result, in recent years, the debate on the implications of immigration to the US economy has become a central issue. Placing significant emphasis on the 2016 campaign rhetoric of president Trump, for example, opponents of immigration have started working on incorporating their widely held views into policy actions.

In this paper, I empirically examine a long run relationship between immigration and the US economy (as reflected by levels of GDP and unemployment). Employing data that spans the time period 1870 to 2015 and using estimation results from a vector error correction granger causality/Block exogeneity Wald test (Enders, 2003), I find two important observations: First, that there exists a long run equilibrium relationship between US GDP, unemployment, and immigration inflows. Second, while relationship between GDP and immigration can be described in the form bidirectional causality between GDP and immigration, the relationship between immigration and unemployment is only in the form of a unidirectional causality running from immigration to unemployment. Accordingly, examination of the response of US GDP and unemployment levels to a onetime shock in immigration, reveals a rise in GDP levels and a fall in unemployment levels. These observations are contradictory to the campaign rhetoric of the president, and that of the position of policy makers who often focus on the negative effects of immigration. Given the long time span I cover (146 years) and my observations from a rigorous econometric approach, this conclusion is of significant policy implication, in and off itself. However, as I have not yet broken down the immigrants by their broad geographic region of origin, immigrants' specific countries of origin, and their skill levels, my observation should be taken cautiously and considered preliminary.

It should be of note the reason I used data on unemployed persons, rather than the unemployment rate was that specific rhetoric often targeted immigrants for stealing US natives' jobs. This target focuses on individual people's employment, rather than employment rates, thus, using the number of unemployed persons each year better captured the data that the rhetoric discussed. Another important point to note, is the broadness of my results. It could be argued that it is of great importance to look at different sectors of the US economy or break down the data of effects of immigration per state, and those would certainly be worthwhile areas to study in the future. However, with the purpose of this paper being to specifically examine the campaign rhetoric of the President, broad results are sufficient. In fact, they are needed, because the rhetoric I was analyzing were broad and sweeping remarks, thus to test them properly, it is completely necessary to test only the broad data to examine the effects of immigrants on the whole of the US (with all natives pooled together in one data set). Additionally, effects on wages and underemployment were not addressed in this research because that would constitute another paper, as these are such complex issues. Further, future research on my specific topic should be done to compare case studies to see if my results hold at a more micro level; if so, the results from this paper would be proven even more robust.

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