

## **Empirical Estimates of the Long-Run Labor Market Adjustments to Immigration<sup>†</sup>**

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### **Abstract**

*Immigration's impact on native labor markets is the central issue in forming immigration policy. Traditional economic theory suggests that immigration puts downward pressure on wages and increases unemployment. However, most empirical studies of these relationships find little to no impact of immigration using cross-sectional data. We add to this literature by examining these same relationships in the long-run through use of a VAR model on both state and national level data. Our results indicate that while immigration has no impact on wages and unemployment at the national level, it can impact these variables at the state level, but not instantaneously.*

**Keywords:** Immigration, Unemployment Rate, Wage

**JEL Classification:** J21, J61, F22

### **1. Introduction**

According to the U.S. Census Bureau, there are currently 38 million foreign-born individuals residing in the United States, with an estimated 7 million immigrating to the U.S. between 2000 and 2007. With such a large inflow of immigrants into the United States, with similar immigration patterns in other countries, a need to understand the impact of such increases in the labor supply is critical to informing immigration policy. This importance has spawned a great deal of work investigating the impact of such immigration flows, with particular emphasis placed on the impact of immigration, both legal and illegal, on native workers.<sup>1</sup> Most of these studies focus on the impact of immigration on wages and unemployment, and have been largely cross-sectional in nature relying on micro-level data.<sup>2</sup> We add to this literature by using a time-series methodology to examine both the long- and short-run impact of immigration on the labor market. In particular, this time-series approach allows immigration to have, potentially, a longer-term impact on both wages and unemployment, accounting for possible lags between the time that immigrants arrive and the time that their impact is felt in the labor market, an impact unlikely to be empirically uncovered with cross-sectional data.

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<sup>1</sup> Card (2005), Friedberg and Hunt (1995), Borjas (1994) and Borjas (2003) provide an overview of the literature on legal immigration and its impact on native labor, while Hanson, Robertson and Spilimbergo (2002) provide a similar overview of the smaller literature on illegal immigration.

<sup>2</sup> Notable studies examining the labor market consequences of immigration using multiple cross sections of data over several years include: Card (2001), Friedberg (2001), Borjas (2003), Card (2005) and Orrenius and Zavodny (2007).

The history of immigration policy in the United States is virtually as long as the history of the country itself.<sup>3</sup> However, the current policies impacting the ability of an individual to immigrate into the U.S. have largely been enacted over the past 40 years.<sup>4</sup> These policies have both protected U.S. workers from the competition that allowing unlimited immigration would bring, and, at the same time, sought to encourage immigration from individuals with skills and knowledge that the U.S. economy could use. Not surprisingly, this dual goal of restricting certain immigrants while attracting others has led to a great deal of controversy over future immigration policy. This issue has also attracted a great deal of interest from the academic community as policy makers need clear results regarding the impact of immigration on native workers in order to determine the best course of action when developing these policies.

There have been two primary ways that researchers have used to analyze the impact of immigration on labor markets. The first of these strategies employs cross-sectional data to examine the impact of immigrants on wages in a given area. While these studies typically find that immigration has little impact on wages (e.g. Borjas (1987), Altonji and Card (1991), Butcher and Card (1991), LaLonde and Topel (1991), Pischke and Velling (1997), Schoeni (1997), and Hartog and Zorlu (2005)), it is also well recognized that the location choice of immigrants is likely to be endogenous (e.g. Borjas (2001)) which biases these results.<sup>5</sup> Other studies have used this same general methodology, but have looked at wages in particular skill groups and/or occupations (e.g. Card (2001) and Camarota (1997)), with these studies finding a negative impact of immigration on wages. Still other studies have used this skill/occupation group distinction while also including several years of data (e.g. Friedberg (2001), Borjas (2003) and Orrenius and Zavodny (2007)). Of these studies, Borjas (2003) and Orrenius and Zavodny (2007) find that immigrants negatively impact the wages of unskilled workers, while Friedberg (2001) finds no significant impact of immigration on wages.

A second type of analysis, which avoids the potential endogeneity problems associated with immigrants' location choices, is to use a factor-proportions model where one makes assumptions about the degree of substitutability between immigrants and native workers (e.g. Borjas, Freeman and Katz (1992); and Borjas, Freeman and Katz (1997)). These models tend to find a stronger negative relationship between immigration and native labor markets, particularly for unskilled workers. However, these models simulate, rather than estimate this relationship, and these simulations can be sensitive to the functional form used as evidenced by Ottaviano and Peri (2006) who find a positive impact of immigration on native wages.

We add to this literature by allowing immigrants to have both an immediate, contemporaneous, effect on native labor and a prolonged effect which could impact native labor over a longer period of time. To accomplish this goal, we use a vector autoregressive model (VAR) to capture the short and long run effects of immigration on both wages, and also on unemployment. This analysis is conducted both on a national level between 1964 and 2004, and also for the five states which receive the largest number of immigrants from 1976 to 2005.<sup>6</sup> Using these data, we find no evidence of immigration impacting either wages or unemployment at the national level in either the short-, or long-run. However, we do find evidence that immigration impacts future immigration. In addition, we find that immigration can increase unemployment shortly after the arrival of the immigrants at the state level.

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<sup>3</sup> For a detailed description of the history of immigration policy in the U.S., see Congressional Budget Office (2006).

<sup>4</sup> Two major immigration policies enacted over this period of time are: the Immigration and Nationality Acts Amendments of 1965 which abolished quotas based on nationality, but created a category based preference system for immigrants, including preferences for immigrants with occupational skills needed in the U.S.; and the Immigration Act of November 29, 1990, which increased the total number of immigrants allowed in a given year, and revised temporary worker categories.

<sup>5</sup> Several studies, including Card (1990), Kugler and Yuksel (2006) and McIntosh (2008), are able to overcome this problem by examining the labor market impact of migration to a particular area due to a specific event such as a hurricane.

<sup>6</sup> The five states which receive the largest number of immigrants yearly are: California, New York, Florida, Texas and Illinois. Combined these five states receive almost 90% of the nation's immigrants.

We also find evidence that an increase in unemployment, such as that caused by immigration, causes a decrease in real wages, but that this impact isn't realized until approximately 2 years after the jump in unemployment. These results imply that, at the state level, immigration increases unemployment in the short run, which then causes a delayed decrease in real wages.

The remainder of this paper is divided into four sections. Section 2 provides an overview of current theoretical alternatives regarding the impact of immigration on labor markets. Section 3 outlines the empirical methodology and data used for this study, while the results of this analysis are presented in Section 4, with concluding comments given in Section 5.

## **2. Immigration, Wages, and Unemployment Rates**

There are numerous theoretical models which have been developed to examine the impact of immigration on labor.<sup>7</sup> Most of these models focus on the impact of an increase in labor supply, caused by immigration, on native workers. However, this impact is anything but clear in the literature and is highly dependant upon a variety of factors which determine labor supply.

Primary to this debate is the degree of substitutability of immigrants for native workers, which varies by industry. In particular, immigrants into a country have certain levels of skills. In markets demanding these particular skills, the immigrants are substitutes for native labor and are expected to put downward pressure on wages and upward pressure on unemployment in that particular industry. However, these same immigrants may well be complements for native labor in other industries, putting upward pressure on wages and downward pressure on unemployment in these industries. While this impact is dependent upon the exact skills of immigrants, most studies find that immigrants are substitutes for unskilled labor (e.g. Borjas, Freeman and Katz (1997) and Orrenius and Zavodny (2007)). In addition to the human capital that immigrants possess, they may also be complements for native labor if they are able to add to the capital stock, and if capital and labor are complements (e.g. Chiswick, Chiswick and Karras (1992)).

Besides the substitutability of immigrants for native labor, immigration also impacts the decisions made by native workers. Specifically, native workers may choose to relocate if either their wages have decreased due to immigration of substitute workers in their location, or if the wages they could receive in a different location have increased due to immigration of complementary workers. In either case, native workers may respond to immigration by moving, which will alter the labor supply impact of immigration in both the origin labor market and the destination labor market. On this issue, the literature is ambiguous with Card (1990); Butcher and Card (1991); Wright, Ellis and Reibel (1997); and Card and DiNardo (2000) finding no evidence of immigration impacting native migration patterns, while Frey (1996) and Borjas (2005) find that immigration increases out-migration by native workers.<sup>8</sup>

While the majority of work done on immigration has focused on the labor supply impact of immigrants, there are also theoretical reasons to believe that immigration will impact the demand for labor. Specifically, Lach (2007) notes that immigrants not only supply their labor, but also the demand for domestic output, which increases the demand for labor producing these goods and services. As shown by Hanson and Slaughter (2002), immigrants could also impact demand for labor regionally, as businesses will respond to the increase in labor by shifting production of goods that use higher levels of immigrant labor into the areas where immigrants settle, increasing the labor demand for all workers, native or immigrant, with these skills. Combining the aforementioned literatures on the impact of immigration on labor supply and labor demand, it is clear that immigrants have a theoretically ambiguous impact on native labor markets. That being said, very few of these studies have considered the adjustment time necessary for these immigration impacts on labor supply and labor demand to work themselves into the market. Therefore we add to this literature by empirically examining the long-run and short-run impact of labor on immigration and unemployment at both the national- and state-level as described in the next section.

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<sup>7</sup> Examples of such models are numerous, but include: Johnson (1980), Borjas (1995), Greenwood and Hunt (1995), Pischke and Velling (1997) and Borjas (2003).

<sup>8</sup> In addition to changing their location, native workers may also change their human capital to be less of a substitute for immigrant labor (Chiswick (1989)).

### 3. Data & Empirical Model

The data used for this analysis consist of yearly observations on immigration, unemployment rates and real wages at the national level from 1964 to 2004. The immigration variable is obtained from the Yearbook of Immigration Statistics and contains the number of immigrants into the U.S., while the unemployment rate and real average hourly earnings, measured in 1984 dollars, over this period of time are obtained from the Bureau of Labor Statistics.<sup>9</sup>

In addition to examining the impact of immigration on wages and unemployment at the national level, we also explore these same relationships at the state level. In particular, we use annual state data from 1976 to 2005 for five U.S. states: California, New York, Texas, Illinois, and Florida, as these five states absorb 90 percent of new immigrants each year according to the Yearbook of Immigration Statistics. To these state level immigration data, we add data on unemployment rates and per capita wages obtained from the Bureau of Economic Analysis (BEA). Mean values of these three variables, at both the national and state level, are provided in Table 1.

Because immigrants both strategically choose their destination based on the expected wages and employment opportunities, and impact the wages and unemployment rate in their chosen destination, all three variables are endogenous. To account for this endogeneity, we use a vector autoregressive model (VAR) to estimate the relationships between these variables. In particular, this model allows us to investigate the long-run effects of immigration on the labor market at both the national and state level. The specific specification of our VAR model follows the previously described existing theories regarding the labor market impact of immigration. Specifically, we assume that immigrants increase labor supply, which causes a short-run excess supply of labor, increasing the unemployment rate. However, in the long-run, the wage rate falls because of this increase in the labor supply. Because of this relationship between immigration, unemployment and wages, we treat immigration as the most exogenous variable and wages as the most endogenous variable in the VAR model.

In general, this VAR model is written as:

$$Y_t = m + Y_{t-1} + e_t \quad (1)$$

where  $Y'_t = [I_t, U_t, W_t]$ , and  $Y'_{t-1} = [I_{t-1}, U_{t-1}, W_{t-1}]$ , with  $I_t$  representing the number of immigrants in period  $t$ ,  $U_t$  representing the unemployment rate in period  $t$ , and  $W_t$  representing the real wage in period  $t$ . The number of lags included in this model is selected based on Akaike information criterion (AIC), and the multiplier matrix is lower triangular, with the Choleski decomposition used to identify restrictions. Notice that equation (1) implies that the current values of immigration, the unemployment rate and real wages are a function of the previous value of each variable. This model then allows for a shock in one of these variables to impact the future values of each variable. For example, a shock in the immigrant variable will be allowed to impact future immigration, unemployment rates and real wages.

To account for the possibility that one or more of these time series variables may be non-stationary, we use an Augmented Dickey-Fuller (ADF) test for a unit root, the results of which are presented in Table 2 at the national level and in Table 3 at the state level. At either level, the test indicates that the data are indeed non-stationary, leading us to estimate equation (1) using first differenced variables as these differenced variables are shown to be stationary in both Tables 2 and 3.

## 4. Empirical Results

### 4.1 National Labor Market

The results from estimating equation (1) using first differenced variables at the national level are presented in Figure 1. This figure shows the response of immigration, the unemployment rate, and real wages to shocks in each variable. In particular, a shock in each variable is allowed to impact all three variables, with the effect of the shock having both short and long run impacts. The effect of a shock in immigration is shown in the left-hand column of graphs in Figure 1, while the middle column shows the impact of a shock in unemployment and the right-hand column shows the impact of a shock in real wages.

<sup>9</sup> We do not consider illegal immigrants because of the measurement problems associated with these data.

Likewise, the first row of graphs shows the impact of each shock on immigration, while the second row shows the impact of each shock on the unemployment rate and the last row shows the impact of each shock on real wages.

In Figure 1, it is shown that a shock in the change in immigration positively impacts future changes in immigration in the short run, but that this effect dies off and has no impact on long run changes in immigration. However, Figure 1 also shows that the impact of a shock in the change in immigration has no statistically significant impact on the change in real wages or the change in unemployment in either the short run or the long run. This result supports many of the previous studies discussed early, and is not surprising given that the variables used in Figure 1 represent national changes to real wages and the unemployment rate. Changes which are not likely to be dramatically impacted by a shock in immigration, as new immigrants in any given year are likely to represent a small portion of the labor supply.

As with a shock in the change in immigration, a shock in the change in the unemployment rate positively impacts future changes in the unemployment rate in the short run, but again, this effect dies off shortly and has no long run effect. Figure 1 also shows that a shock in the change in the unemployment rate positively impacts future changes in the real wage, but notice that this effect is not present in either the very short run or the long run. One explanation of this effect is that, at the national level, wages tend to be stagnant during economic downturns characterized by higher unemployment, but eventually workers demand higher wages to compensate them for accepting these stagnant wages in the past.

Also shown in Figure 1 is the effect of a shock in real wages, which are shown to positively impact future changes in real wages, and also negatively impact changes in the unemployment rate, with both of these effects being felt only in the short run. Notice that the latter of these results, the negative impact of a shock in real wages on the future unemployment rate, has potential implications for the impact of immigration on labor markets. Specifically, to the extent that immigrants put downward pressure on the wage rate, which we do not find evidence of here, but which may be present in particular industries or in particular locations, we should expect the unemployment rate to decrease as employers find it profitable to hire more workers at these lower real wages.

#### **4.2 State Labor Markets**

The results of estimating equation (1) using first differenced variables for the five states which receive the largest number of immigrants are presented in Figures 2 through 6. For all five of these states, the results presented in these figures indicate the same pattern between each variable and changes in their future values, namely that a shock in each variable positively impacts changes in its future value.

However, unlike the results of estimating equation (1) nationally, the state level estimates presented in figures 2 through 6 do indicate that immigration does have an impact on labor markets on the state level. Specifically, the estimates indicate that a shock in immigration leads to an increase in the unemployment rate in the short run, although this effect is only significant for New York, while being barely insignificant for California and Florida.<sup>10</sup> Also shown in Figures 2 through 6 is that a shock in the unemployment rate leads to a short run decrease in real wages, which this impact being statistically significant for California, New York and Florida. Combining these results, we do find evidence that immigration puts upward pressure on the unemployment rate at the state level in the short run, with increases in the unemployment rate leading to decreases in the real wage in these states in the following years.

Not only do these estimates indicate that immigration can have an impact on labor at the state level, but they also indicate that our time series approach is warranted. Specifically, the results indicate that the impact of immigration is not necessarily instantaneous, implying that previous studies looking for wages and unemployment to respond to changes in immigration in the same year are unlikely to find any impact.

#### **5. Conclusions**

In this paper we use a time series vector autoregressive model on both national and state level data to examine the impact of immigration on labor markets.

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<sup>10</sup> Note that according to Table 1, New York and California are the two states which receive the largest numbers of immigrants.

Our findings indicate that immigration has virtually no short or long run impact on the unemployment rate or real wages at the national level. However, we do find that immigration has an impact on future immigration at both the national and state level. In addition, our findings at the state level suggest that immigration can impact unemployment and real wages. Specifically, our estimates indicate a short run increase in the unemployment rate of New York following a shock in immigration. Our estimates also indicate that an increase in the unemployment rate, such as that caused by an increase in immigrants, leads to a decrease in real wages approximately 2 years later.

While these results point to immigration having an impact on real wages and unemployment at the state level, these effects are relatively short run in nature, and we find no impact of immigration on real wages and unemployment in the long run. Nevertheless, because our findings indicate that immigration can have an impact on labor markets at the state level, but that this impact is neither long run, nor instantaneous, the incorporation of time series models in examining the dynamic impact of immigration is warranted.

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**Table 1: Mean Values of Immigration, the Unemployment Rate and Real Wages**

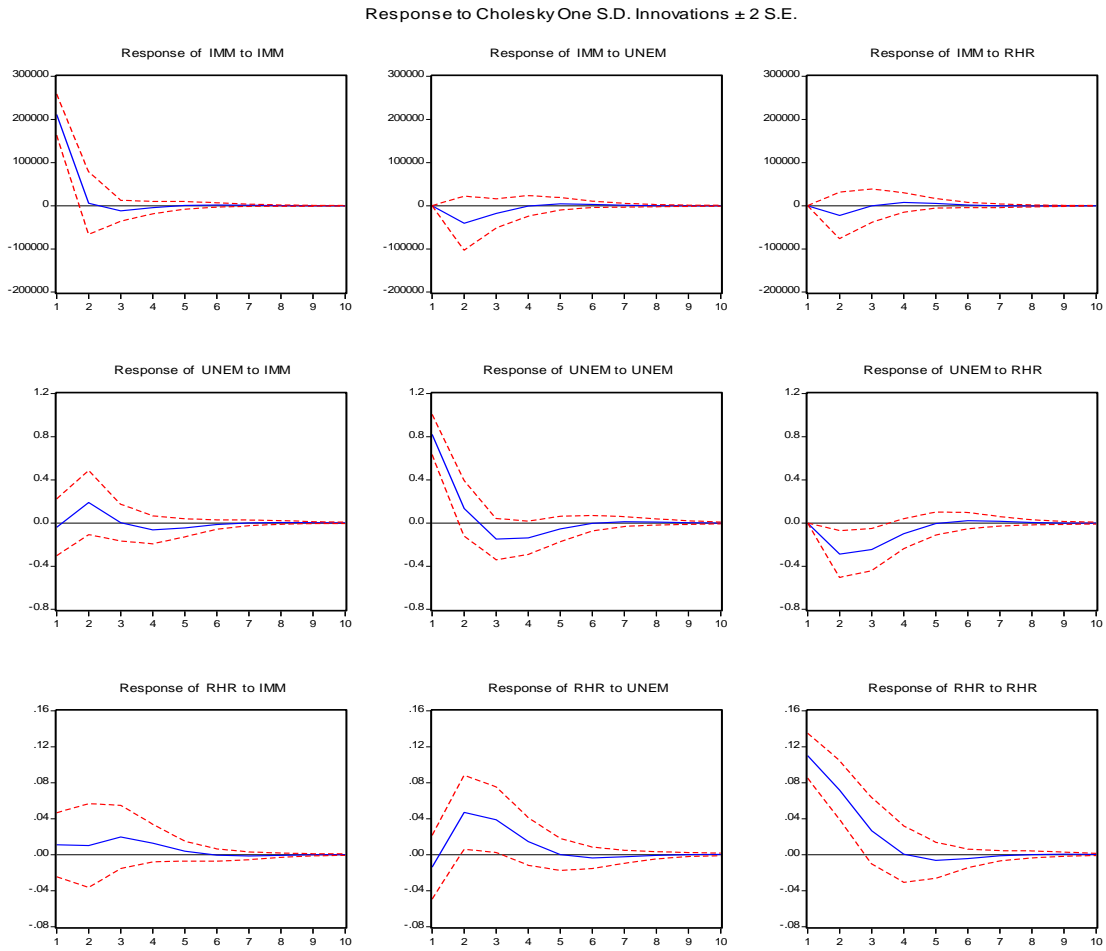
Variable	National	California	Texas	New York	Florida	Illinois
Immigration	662,612.7	229,139.9	65,653.6	117,069.2	61,129.1	38,273.2
Unemployment Rate	6.920	7.083	6.191	6.656	6.124	6.819
Real Wage	\$8.31	\$11,068.84	\$9,652.45	\$12,062.41	\$8,605.65	\$11,153.85

Note: Immigration data is collected from the Yearbook of Immigration Statistics, while Unemployment data and Real Wage data are collected from the BLS at the national level, and the BEA at the state level. Wages are measured in constant 1984 dollars and are reported hourly at the national level and yearly at the state level.

**Table 2: Augmented Dickey-Fuller Test for Unit Roots**

<b>Nationwide</b>						
Variable	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value		
Variables Measured in Levels						
Immigration	-2.126	-3.648	-2.958	-2.612		
Unemployment Rate	-1.993	-3.648	-2.958	-2.612		
Real Wage	-0.976	-3.648	-2.958	-2.612		
First Differenced Variables						
Immigration	-5.762	-3.655	-2.961	-2.613		
Unemployment Rate	-4.769	-3.655	-2.961	-2.613		
Real Wage	-3.504	-3.655	-2.961	-2.613		
<b>State-Level</b>						
Variable	California	Texas	New York	Florida	Illinois	5% Critical Value
Variables Measured in Levels						
Immigration	-2.100	-2.508	-2.035	-2.543	-2.170	-2.989
Unemployment Rate	-2.004	-1.896	-2.510	-1.993	-1.499	-2.989
Real Wage	-0.502	-0.688	-0.316	0.221	-0.029	-2.989
First Differenced Variables						
Immigration	-3.902	-5.039	-4.383	-6.145	-4.761	-2.992
Unemployment Rate	-3.047	-4.194	-3.299	-3.243	-4.156	-2.992
Real Wage	-3.047	-3.561	-3.272	-2.882	-3.064	-2.992





**Figure 1: Impulse Response Function for the United States**

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

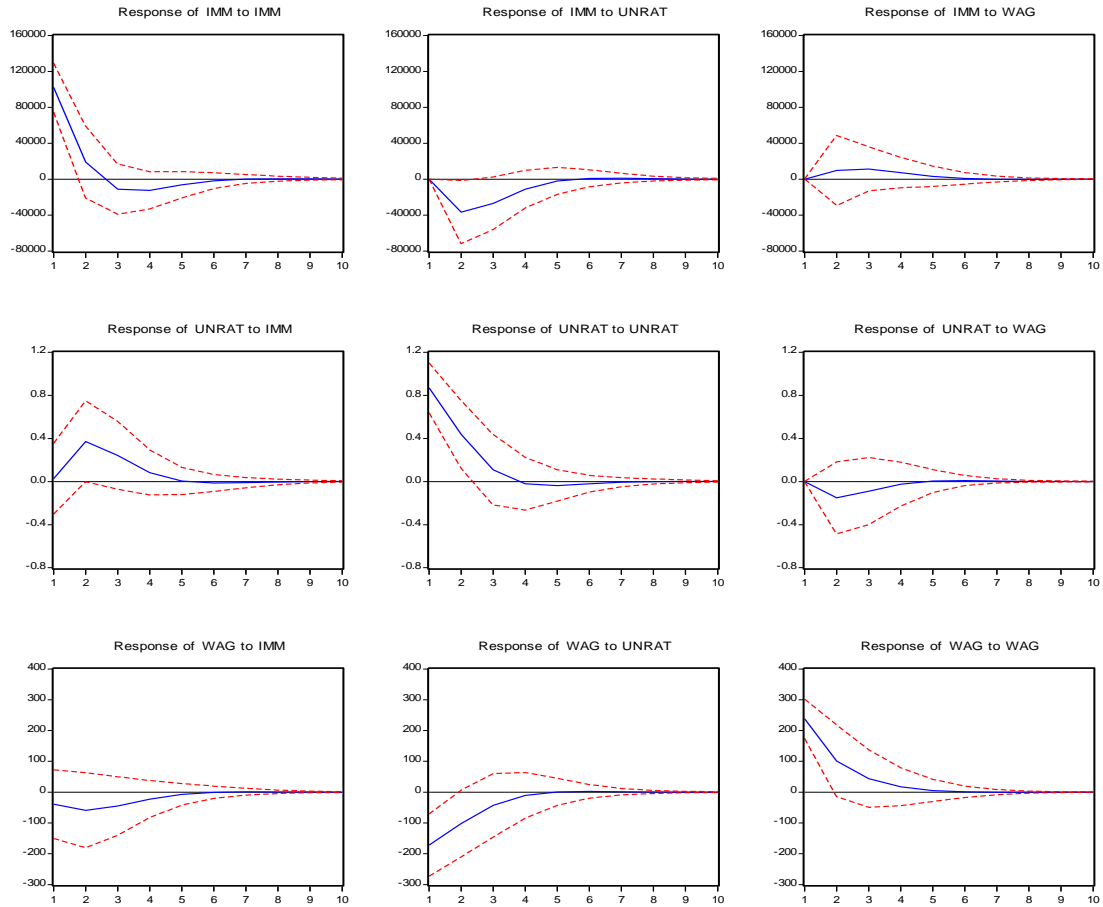


Figure 2: Impulse Response Function for California

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

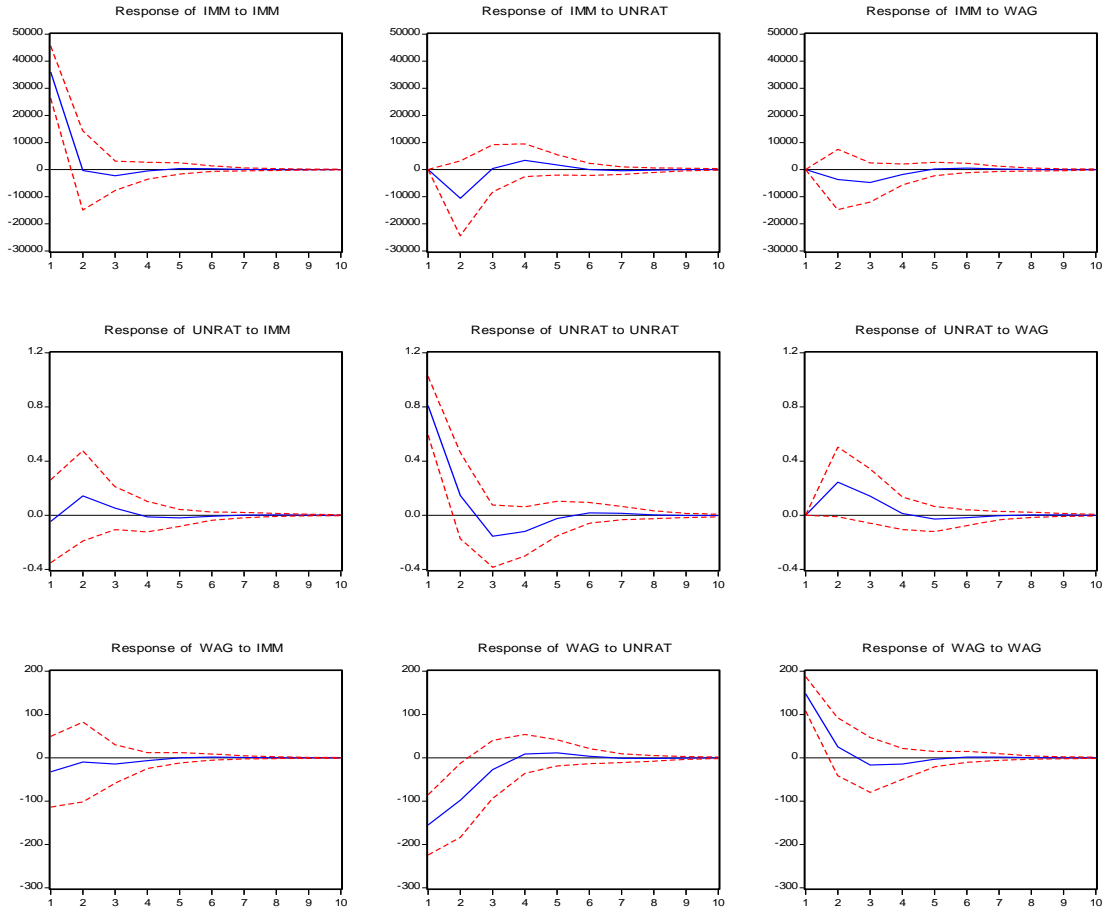


Figure 3: Impulse Response Function for Texas

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

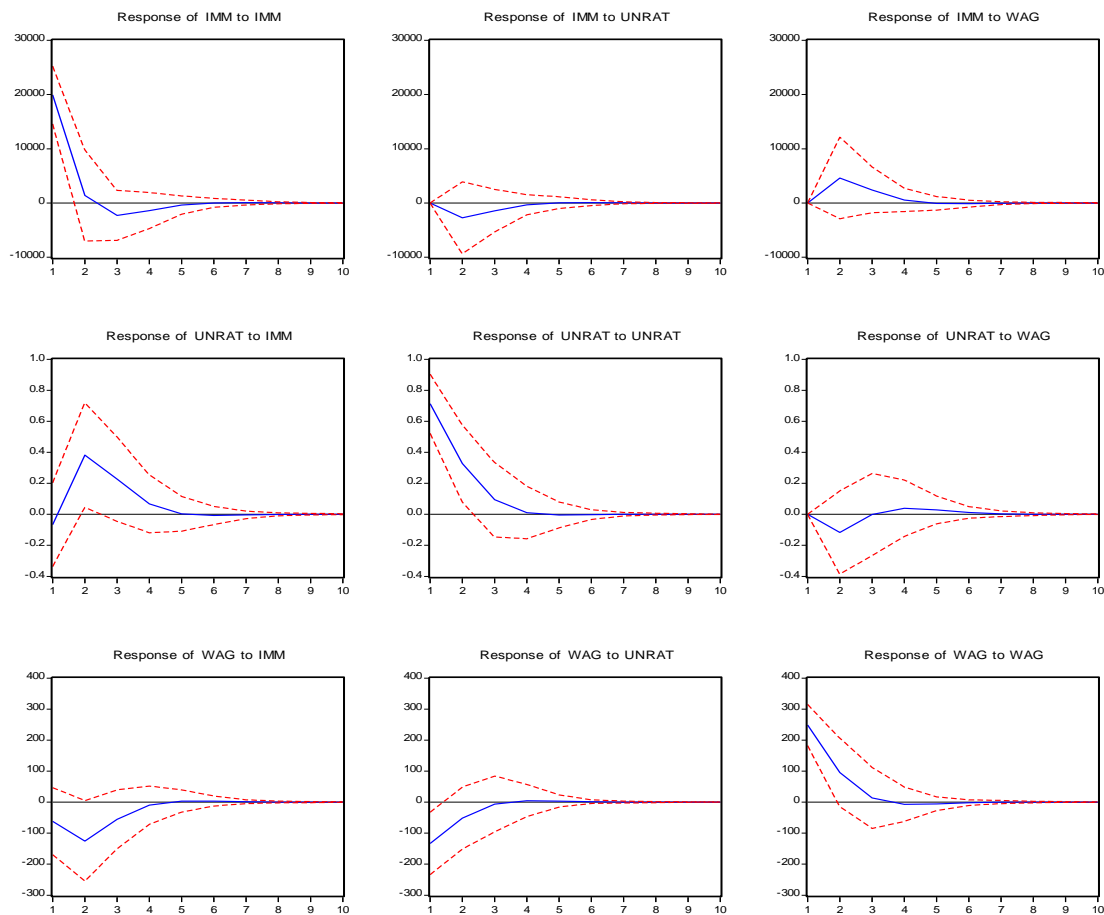


Figure 4: Impulse Response Function for New York

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

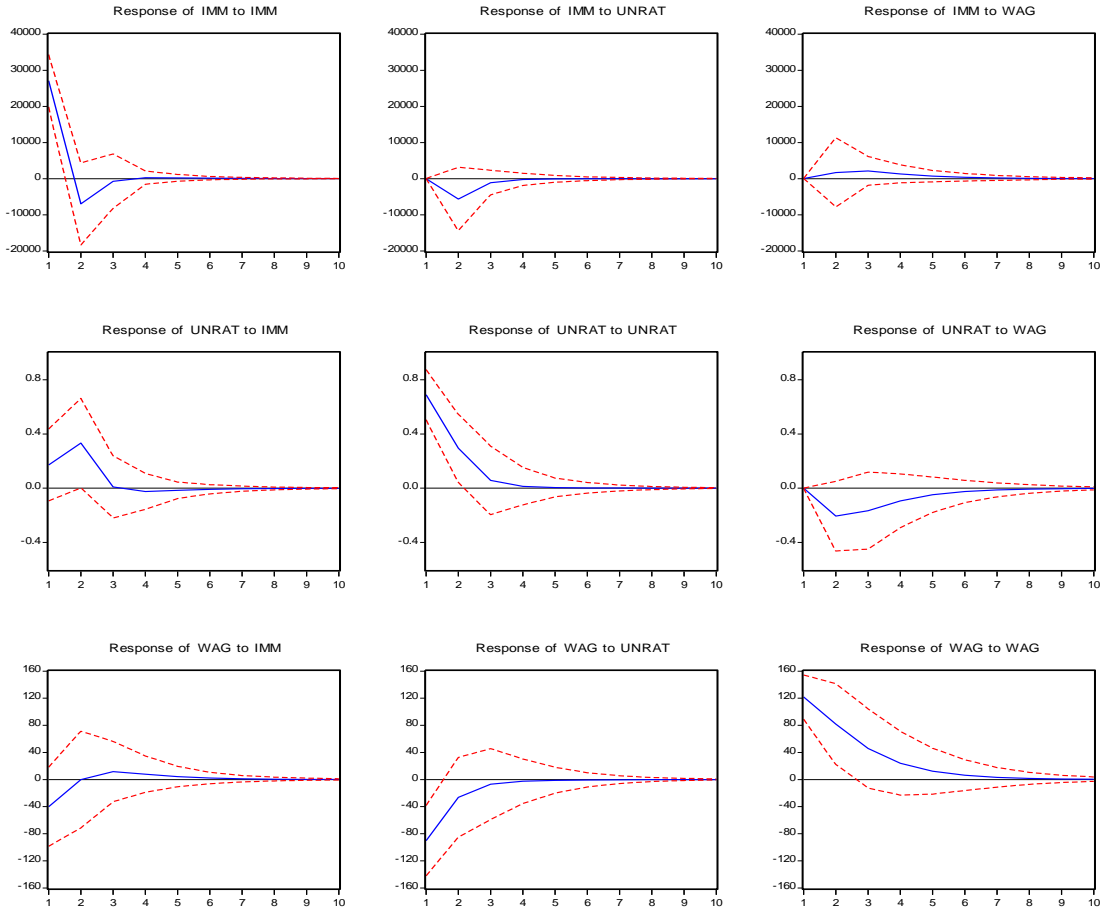


Figure 5: Impulse Response Function for Florida

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

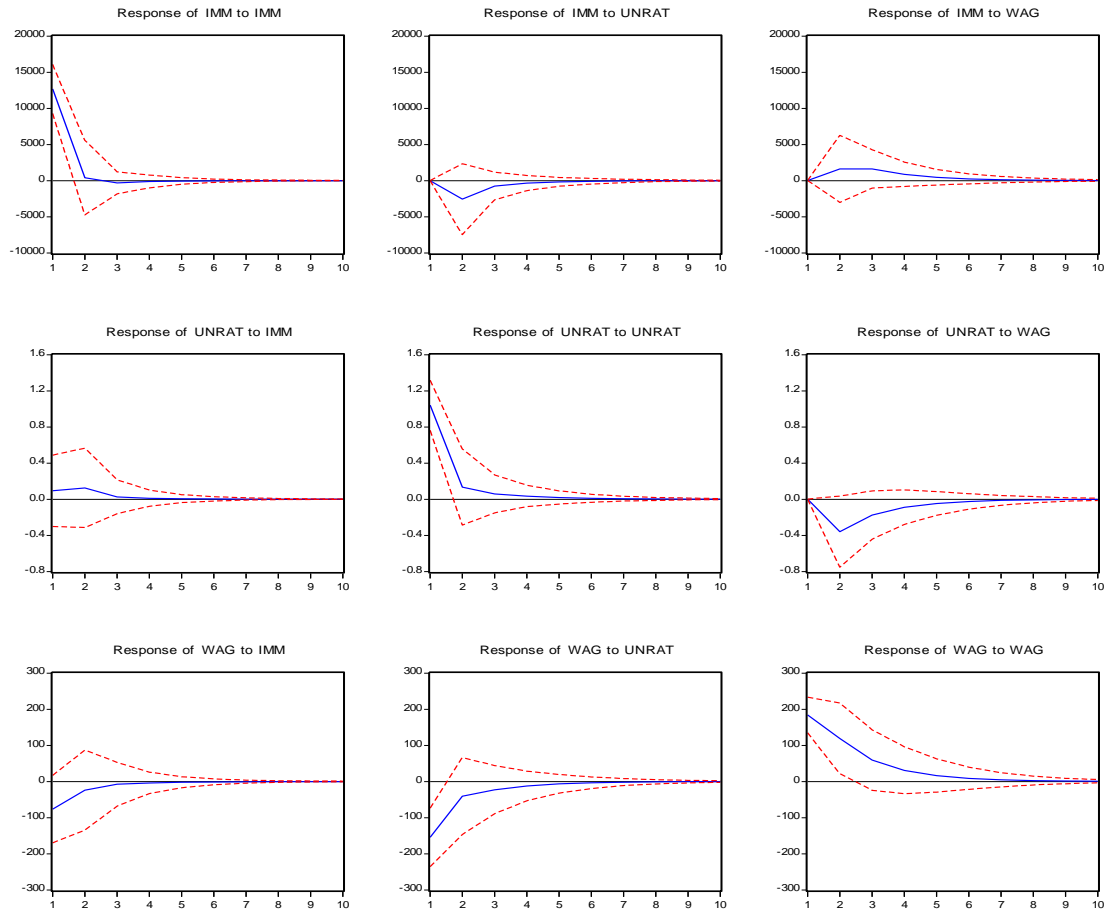


Figure 6: Impulse Response Function for Illinois